# Identifying intervention content to support reductions in parental provision of unhealthy foods to their three to seven-year-old children

by

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# ABBREVIATIONS

| | |
|---|---|
| ABS | Australian Bureau of Statistics |
| APEASE | Affordability, Practicability, Effectiveness and Cost-effectiveness, Acceptability, Side-effects / Safety and Equity |
| AUD | Australian Dollars |
| b | Unstandardised Coefficient |
| BCT | Behaviour Change Technique |
| CFI | Comparative Fit Index |
| COM-B | Capability Opportunity Motivation and Behaviour |
| df | Degrees of Freedom |
| DGI-CA | Dietary Guidelines Index for Children and Adolescents |
| EI | Energy Intake |
| HAPA | Health Action Process Approach |
| IQR | Interquartile Range |
| kJ | Kilojoules |
| OR | Odds Ratio |
| PFAQ | Parental Food Attitude Questionnaire |
| RMSEA | Root Mean Squared Error of Approximation |
| SD | Standard Deviation |
| SE | Standard Error |
| SRMR | Standardised Root Mean-square Residual |
| SSB | Sugar-Sweetened Beverages |
| TDF | Theoretical Domains Framework |
| TLI | Tucker Lewis Index |
| wk | Weekday |
| wkend | Weekend Day |
| $X^2$ | Chi-Squared |
| yo | Years Old |
| β | Standardised Coefficient |
| 95%CI | 95% Confidence Interval |

# GLOSSARY

| | |
|---|---|
| ***Alternatives*** | A discrete choice experiment term for options containing specific levels of attributes. For example, a snack option. |
| ***Attributes*** | A discrete choice experiment term for characteristics (i.e. factor) of an alternative. For example, cost of snack. |
| ***Attribute levels*** | A discrete choice experiment term for the different levels of the attribute. For example, cheaper and more expensive would be two attribute levels of the attribute ‘cost of snack’. |
| ***Behaviour Change Techniques*** | The smallest, reproducible components (referred to as the ‘active ingredients’) of an intervention to bring about behaviour change. |
| ***Capability*** | An individual’s ability to perform a behaviour, this includes physical capability (e.g. physical skills) and psychological capability (e.g. knowledge and skills). |
| ***Choice task*** | A discrete choice experiment term for one choice question presented to individuals to choose between alternatives with varying attribute levels. |
| ***Intervention content*** | A collective group of intervention strategies detailing the behaviour change components (including behaviour change techniques) and general concepts—i.e. what the strategy would look like. Intervention content does not to refer to specific text or key messages that would be used to implement such a strategy. |
| ***Motivation*** | The brain processes that energise and direct behaviour. An individual’s drive to perform a behaviour that can include reflective motivation (e.g. conscious decision-making, evaluations, intention) and automatic motivation (e.g. impulse, emotions, habit). |
| ***Opportunity*** | Factors in the physical and social environment that lie outside the individual that make a behaviour possible or prompt it. This includes the physical opportunity (e.g. resources) and social opportunity (e.g. social supports, norms). |
| ***Parent provision*** | Term used to refer to a range of behaviours relating to food provision including planning, purchasing, preparation and direct provision. |
| ***Unhealthy foods*** | Term given by the World Health Organisation to a group of foods and beverages higher in saturated fats, added sugars and / or sodium (or alcohol) than healthy foods, and often high in energy. In Australia these items are termed discretionary choices, and for this thesis the definition is being operationalised as per the Australian Dietary Guidelines. |
| ***Utility*** | A discrete choice experiment term for the level of happiness or satisfaction that an alternative yields to an individual. Utility is a latent, unobserved quantity which is estimated from the choices observed. |
| ***Utility weight*** | A discrete choice experiment term for the measure of utility. Another term for regression coefficient. |

Definitions adapted from Hensher et al.[1], Lancsar and Louviere[2], Michie et al.[3], World Health Organisation[4], National Health and Medical Research Council[5].

# THESIS SUMMARY


Australian children's unhealthy food intake is excessive, with three to seven-year-olds currently consuming up to eight times the dietary guideline recommendations. Unhealthy food intake is influenced by numerous factors across the socio-ecological framework. Parents are an ideal target population to create meaningful reductions in children's unhealthy food intake. Interventions to date have not reversed the trend in children’s excess unhealthy food consumption. New interventions are needed using a rigorous approach to intervention design to enhance intervention effectiveness. This thesis aimed to design theoretically grounded, evidence-informed intervention content to support parents to reduce unhealthy food provision to their three to seven-year-old children. Intervention design followed best-practice processes using the Behaviour Change Wheel, including performing a behavioural analysis based on the Capability, Opportunity, Motivation and Behaviour (COM-B) model.

Four studies were undertaken to address the overall thesis aim. The first three studies sought to generate new knowledge to fill gaps in the current evidence base. The final study directly addressed the overall thesis aim through best-practice intervention design. Study 1 (Chapter 3) used a cross-sectional design to measure parent-reported motivational constructs, analysed by structural equation modelling, to understand parents’ reflective motivation. Study 2 (Chapter 4) used a discrete choice experiment to understand the relative importance of physical and social opportunity on parents’ snack provision decision-making. Study 3 (Chapter 5) involved undertaking a systematic review and deconstructing parent-focussed interventions into their behaviour change components to identify novel approaches to behaviour change. Study 4 (Chapter 6) followed the Behaviour Change Wheel process to identify intervention content options.

Findings from parents self-reported motivational constructs in Study 1 (n=495), identified self-efficacy, intention and planning were the constructs of most importance. Study 2, the discrete choice experiment with parents (n=225), found home food availability, child resistance and support from co-parents were of greatest relative importance in parents’ snack provision to their children. The systematic review, Study 3, found interventions to date have resulted in small to moderate reductions in children’s unhealthy food intake. Deconstructing interventions revealed there is untapped potential in several behaviour change components to design theoretically informed parent-focussed interventions to reduce unhealthy foods. In Study 4, theoretically grounded, evidence-informed intervention strategies were designed to be implemented across socio-ecological levels and prioritised to target purchasing of unhealthy sweet and savoury snack foods for the home. Intervention content seeks to address the gaps identified in the behavioural analysis to increase aspects of parents’ psychological capability, physical and social opportunity, and reflective and automatic motivation.

This thesis contributes new knowledge to address children's unhealthy food intake, as well as novel methodological applications of behaviour change theory and discrete choice experiments to the field of behavioural nutrition. This PhD project provides a comprehensive approach to designing intervention content. Resulting intervention content provides a suite of intervention strategies that could be implemented in multiple environmental settings to support parents to reduce unhealthy food provision, whilst avoiding widening socio-economic inequalities. Future research can test outputs from this thesis in interventions to create meaningful reductions in young children's unhealthy food intake.

# DECLARATION

I certify that this thesis does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any university; and to the best of my knowledge and belief does not contain any material previously published or written by another person except where due reference is made in the text.

Brittany J Johnson 12 December 2019

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My supervisory panel consisted of Associate Professor Rebecca Golley (primary supervisor) at Flinders University, Dr Gilly Hendrie at Commonwealth Scientific and Industrial Research Organisation, Dr Dorota Zarnowiecki at Flinders University and Dr Elisabeth Huynh at Australian National University. Key achievements during my candidature are summarised in Appendix 1.

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# OVERVIEW OF THESIS STRUCTURE AND KEY CONTRIBUTIONS TO KNOWLEDGE

This thesis is structured as seven chapters, including four discrete studies—two original research studies, a systematic review of the literature, and a needs assessment informed intervention design study. Publications arising from this thesis are presented in Appendix 2. Each chapter includes a preface box prior to the chapter introduction to navigate the reader to the purpose of the chapter and reference use of publications resulting from this PhD project. The end of each study chapter (i.e. chapters three to six) includes a summary of chapter findings box to reinforce the key outcomes that relate to future chapters and the general discussion presented in chapter seven.

**Chapter 1** provides context to the PhD project, including a broad overview of the literature regarding children's consumption of unhealthy foods (those higher in saturated fat, added sugars and / or sodium). The chapter critiques the evidence regarding predictors of parents' provision of unhealthy foods and existing interventions supporting parents to reduce unhealthy food provision. It outlines the thesis aims and rationale for the research.

**Chapter 2** presents the theoretical frameworks that guided this program of research—the Behaviour Change Wheel, Capability, Opportunity, Motivation and Behaviour (COM-B) model, and Health Action Process Approach model.

The next two chapters report two original research studies. **Chapter 3** describes Study 1, which gathered parent self-rated motivational constructs using a cross-sectional online survey to, describe parents' current reflective motivation towards reducing unhealthy food provision, and identify the most important motivational constructs to prioritise in intervention design. A component of this chapter has been published in *Nutrients.* **Chapter 4** describes Study 2, which explored parents' opportunity through a discrete choice experiment to determine the relative importance of physical resources and social supports on parents' snack provision decision-making, including analyses comparing choice in social and non-social contexts, between subgroups of families.

**Chapter 5** contains an analysis and review of past parent-focussed interventions that included at least one strategy to reduce unhealthy foods. Interventions were deconstructed to their behaviour change components using the Behaviour Change Wheel, specifically to the sources of behaviour (COM-B elements), intervention functions, Behaviour Change Techniques and policy categories. This chapter has been published in *Obesity Reviews.*

**Chapter 6** presents the behavioural analysis and design of intervention content to reduce parental provision of unhealthy foods to their children. This chapter synthesises findings from preceding three chapters, as well as broader published literature of current progress towards reducing children's unhealthy foods intake across the socio-ecological framework. In addition, the Behaviour Change Wheel was used to guide selection and design of intervention content.

**Chapter 7** provides an overall discussion of this PhD project. Key findings of the four studies are reinforced, before consolidated findings are discussed in the context of the broader literature. The overarching strengths and limitations are discussed, and implications and future directions for research outlined, leading to the conclusion of this overall PhD project.

This program of research makes several original contributions to knowledge in the fields of nutrition, behaviour change intervention design, and in discrete choice experiment methods. Key contributions include use of advanced quantitative methods to gain insight into important motivational constructs and opportunity factors influencing parents' provision of unhealthy foods. Use of the Health Action Process Approach model, in Study 1, contributes new knowledge to the nutrition field, which has traditionally lacked theoretical guidance in understanding parental motivation. Use of this model also contributes to the fields of psychology and health behaviour change regarding novel applications of the model itself, using parent motivations to predict child outcomes.

Use of discrete choice experiment methods in the nutrition discipline is in its infancy. The current application of this advanced method, in Study 2, provides the first evidence in parent food provision decision-making, mitigating the influence of social desirability bias. In addition, embedding a cross-over element whereby parents completed two discrete choice experiments—social and non-social context—with the same attributes and experimental design has not yet been done in discrete choice experiment designs in any field. Hence, this project is the first to contrast two choice contexts and provides guidance for future applications of this novel method.

This thesis provided the first application of the Behaviour Change Wheel process to design an intervention targeting a reduction in unhealthy food purchasing in any age group. Moreover, this program used best practice approaches to coding behaviour change content of past parent-focussed interventions, extending beyond coding behaviour change techniques, generating new knowledge by synthesising behaviour change components to inform future intervention design. The current project adds to the evidence base and provides an example of thorough application of the framework, in a prospective application including systematic generation of intervention content, which can be used as exemplars for future nutrition intervention design and evaluation.

# 1. LITERATURE REVIEW

This chapter provides context to the PhD project including a broad overview of the literature including children' unhealthy food intake patterns, consequences of overconsumption and socio-ecological influences on children's intake. It also outlines and critiques existing evidence regarding the predictors of parents' unhealthy food provision and interventions that have sought to change parents' provision of unhealthy foods.

This background highlights the gaps in the literature and provides justification for this growing area of research. The end of the chapter introduces the overall research aim and objectives for this PhD project.

## 1.1. Children's overconsumption of unhealthy foods

### 1.1.1. Australian children's intake of unhealthy foods

The Australian Dietary Guidelines define 'discretionary choices' as those that are not necessary to provide the nutrients the body needs, characterised by higher saturated fat, added sugars and/or sodium, or alcohol, than foods that fall into the five food groups (healthy choices)[6](Appendix 3). For this thesis discretionary choices will be referred to as unhealthy foods as per the World Health Organisation terminology that is foods high in saturated fats, trans-fatty acids, free sugars or salt (i.e. energy-dense, nutrient-poor foods), regardless of their level of processing or how they are consumed[4]. Unhealthy foods capture a wide range of different foods and beverages such as cakes, biscuits, chocolate, sweetened beverages, processed meats, potato crisps, flavoured crackers, hot chips, takeaway foods (e.g. burgers, pizza). Whilst recommendations for unhealthy foods differ based on age, gender, height and activity levels, for all Australians they are recommended to be limited to only 'sometimes and in small amounts'[6]. For example, the recommendations for unhealthy foods for children aged zero to eight years is less than half a serve (i.e. 300kJ) per day, unless they are taller or more active in which 0—2 serves maximum per day[5]. The most recent nationally representative survey conducted in 2011—12, reported 98.6% of children and adolescents consumed unhealthy foods on the recalled day[7]. Unhealthy foods were found to contribute 39% of children's total energy intake (3080kJ)[7], compared to the recommendation of no more than approximately 15% of total energy[5]. Unhealthy foods also contributed to key nutrients of concern, namely 49% of total saturated fat, 52% of total sugars, 87% of added sugars and 51% of total sodium[7]. Children's intake of unhealthy foods is currently well above recommendations.

***Types of unhealthy foods commonly consumed***

Unhealthy foods are a diverse group of foods clustered together based on nutrients to moderate. Our previous secondary analyses of children and adolescents (2—18yo) in the latest national nutrition survey (2011—12) revealed commonly consumed subgroups of unhealthy foods and key contributors to total energy, saturated fat, added sugars and sodium intake[7]. Three subgroups of unhealthy foods were reportedly consumed the day prior to the survey by at least a quarter of children and adolescents, namely, sweet biscuits (31%), potato crisps and similar snacks (27%) and sugar-sweetened soft drinks (25%)[7]. Cakes, muffins and slices; sweet biscuits; potato crisps and similar snacks; processed meats; and sugar-sweetened beverages were all found to be within the top three to five food subgroup contributors to per capita energy and related nutrient intake[7]. In addition, when examining intakes per consumers of each subgroup, takeaway foods; cakes, muffins and slices; meat pies and other savoury pastries; processed meat; and sugar-sweetened beverages were key contributors to energy, saturated fat and sodium, or added sugars intake[7]. Reductions are needed in commonly consumed unhealthy foods such as cakes, biscuits and savoury snacks to reduce children's overall unhealthy food intake.

***Children's unhealthy food intake has persisted over time***

Children's intake of unhealthy foods has remained high for some time. National nutrition survey data over the past 25 years has consistently shown Australian children overconsume unhealthy foods[7-9]. In 1995, unhealthy foods contributed an average of 41% of two to 18-year-olds total energy intake[9]. According to the 1995 survey, 99.8% of responding children consumed unhealthy foods on the dietary recall day[9]. These foods and beverages were also found to contribute 47% of total saturated fat and 54% of total sugars consumed; sodium was not reported[9]. Overall unhealthy foods were consumed at two to four times the recommended serves[9]. The 2007 national children's survey (2—16yo, excluded 17—18yo) found 99.7% of children consumed at least one serve of unhealthy foods, with total unhealthy foods contributing to 35% of total energy intake[8]. All age groups had a slight decrease in energy from unhealthy foods by approximately 600kJ, or one serve according to the dietary guidelines, between 1995 (3645kJ) and 2007 (3049kJ)[8]. Comparing the two most recent surveys (2007 vs 2011-12), reveals the energy from unhealthy foods has remained stable but the proportion of total energy from unhealthy foods has increased[7, 8]. Despite slight reductions in unhealthy foods over time intakes continued to remain well above recommendations in 2012.

There are methodological differences in national nutrition surveys over this time frame that need to be considered. The 2007 survey did not include 17 to 18-year-olds, who were included in the 1995 and 2011—12 survey. Seventeen to 18-year-olds often report higher intakes, which might contribute to the differences in average serves observed over time[7]. When comparing consistent age groups from 1995[9] to 2011—12[7], there was lower absolute energy from unhealthy foods of approximately 600kJ, and lower percent of total energy of 2.5% from unhealthy foods, in the

2011—12 sample, with similar contribution to total saturated fat and sugars. The absolute energy from unhealthy foods aligned with overall energy intake and lower energy reported in 2011—12 of 7998kJ, compared with 8621kJ in 1995. However, within this time a list identifying unhealthy foods was produced by the Australian Bureau of Statistics[10], therefore some of the difference may also be as a result of changes in certain items being considered as unhealthy foods. Regardless of the absolute value, based on trends in the latest available national data children are likely to continue to somewhat overconsume unhealthy foods. The ongoing excessive intake, which contributes a large percentage of total energy, highlights that children's unhealthy foods intake remain a key area of research. It is clear this is a long-standing problem for majority of children, but are there certain sub-populations of children within Australia more at risk?

***Consideration for certain sub-populations: Child age group***

Examining children's unhealthy foods intake across age groups may reveal key periods for preventative efforts. Our previous secondary analyses of the national nutrition survey (2011—12) explored children who consumed unhealthy foods intake by age group[7]. Analyses revealed absolute energy from unhealthy foods increases with age from 1858kJ (approx. 30% of total energy intake) in two to three-year-olds up to 4016kJ (approx. 40% of total energy intake) in 14 to 16-year-olds.(Figure 1.1)[7]. The unhealthy food intake by age group equates to approximately 3.1 serves in two to three-year-olds versus 6.7 serves in 14 to 16-year-olds. Similar patterns are seen in the contribution of unhealthy foods to children's intake of saturated fat, added sugars and sodium[7], which is expected given the increased amount of unhealthy foods consumed by age. Consistent increases in unhealthy foods across childhood, highlight an opportunity for interventions early in childhood to provide anticipatory guidance[11], whilst eating habits are developing, before overconsumption habits are established.

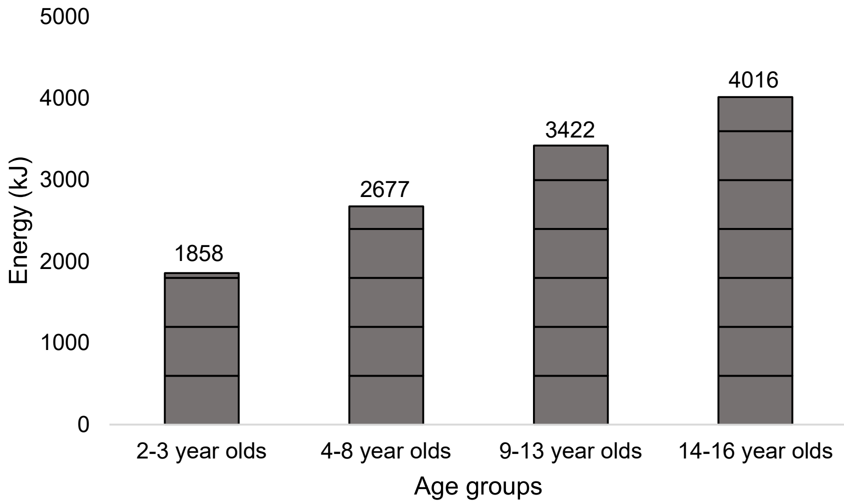



Figure 1.1: Absolute energy from unhealthy foods in Australian children[1]

[1] Data source[7]. Note: data presented are an aggregate of males and females therefore standard error is not presented. Each column block, from the x axis up, equates to a serve of unhealthy foods (600kJ).

***Consideration for certain sub-populations: Socio-economic position***

Examining children's unhealthy foods intake across the socio-economic gradient can further identify important sub-populations. It is particularly important to consider the specific needs of families from lower socio-economic backgrounds as indicators such as education and income are associated with diet quality and weight status[12-15]. Unhealthy foods intake is somewhat socio-economically patterned, although has been seen to differ based on age, gender and socio-economic indicator[13, 15-17]. In a study of young children, regardless of socio-economic position less than 10% of children met unhealthy foods guidelines[13]. Children of higher socio-economic position were however closer to the guideline recommendations in younger age groups (SES difference: 9 months: $\beta$ = -0.35, 95%CI -0.54 to -1.7, $p \leq 0.001$; 1.5 years: $\beta$ = -0.32, 95%CI -0.53 to -1.2, $p \leq 0.01$; 3.5 years: $\beta$ = -0.40, 95%CI -0.67 to -1.4, $p \leq 0.01$) but not at five years of age[13]. Zarnowiecki and colleagues[18] reported in nine to 13-year-old children, Socio-Economic Indexes For Areas was a predictor of girls unhealthy beverage intake ($\beta$ = -0.04) and boys unhealthy food intake ($\beta$ = 0.14), but not of boys unhealthy beverage or girls unhealthy food intakes. Whilst differences were noted in socio-economic predictors of boys and girl's unhealthy beverage and food intake, indicators of lower socio-economic position were generally associated with greater unhealthy beverage intake[18]. Similarly, a study examining socio-economic gradient of unhealthy food and beverage intake revealed differences by child age, gender and socio-economic indicator [16]. Again, in general the socio-economic gradient appears stronger for unhealthy beverages than for unhealthy foods; with unhealthy beverage intake inversely associated with carer education levels in two to 16-year-old boys (primary carer 2-8yo: b = -3, 95%CI -5.9 to -0.2; 9-16yo: b = -10.2, 95%CI -15.1 to -5.3) and girls (secondary carer 2-8yo: b = -3.5, 95%CI -6.3 to -0.8; 9-16yo b = -5.6, 95%CI -10.5 to -0.7) compared with only education levels associated with two to eight-year-old boys unhealthy snacks intake (secondary carer: b = -0.7 95%CI -1.1 to -0.2)[16]. Unhealthy food intake appears to be less socio-economically patterned than unhealthy beverages and other aspects of diet quality, yet, to avoid widening inequalities researchers should consider dietary influences on children of lower socio-economic position.

### 1.1.2. Children's intake of unhealthy foods globally

A key challenge in comparing children's intakes internationally and between studies is the variety of terms (e.g. non-core, ultra-processed), definitions and types of foods captured as unhealthy foods[19, 20]. Definitions of 'unhealthy foods' and food items captured under these definitions differ slightly from country to country (Appendix 3). Variations in terminology, definitions and methodology make direct comparisons between countries difficult. Regardless of the exact food items included, the general characteristics of unhealthy foods remain consistent—higher in nutrients to moderate, than other food groups, and often with the absence of beneficial nutrients.

This issue of unhealthy foods is not limited to Australia, with children across countries internationally exceeding the respective recommendations. National survey data from the United States, United Kingdom and Canada reveal children and adolescents exceed recommendations for energy and associated nutrients from unhealthy foods. In the United States over 91% of children and adolescents exceed unhealthy food recommendations, with up to 99.9% of two to eight-year-olds exceeding these recommendations (NHANES 2001/04)[21]. Sugar-sweetened beverages intake has been examined more recently (NHANES 2011/14), with 63% of children and adolescents (2—19yo) reporting consumption of at least one sugar-sweetened beverage on a given day, contributing on average 7% of total energy intake[22]. Within the United Kingdom (National Diet and Nutrition Survey 2012/13 – 2013/14), children and adolescents (1.5—18yo) intake of saturated fat ranged from 13% to 15%, compared with recommendations of less than 10%[23]. The latest of the United Kingdom rolling survey reported only one to 13% of children and adolescents had intakes of free sugars equal to or less than the 5% of total energy intake recommended[24]. Finally, in Canada, 2004 national survey data revealed ultra-processed foods (e.g. sugar-sweetened beverages, fast food dishes, salty snacks; considered unhealthy foods) contributed 48% of total energy intake in Canadians aged two years and over[25]. These examples from high income countries consistently highlight children's current overconsumption of unhealthy foods.

Overconsumption of unhealthy foods is not isolated to high income countries, with increasing intakes of unhealthy foods in children and adolescents from low- and middle-income countries. A review of six to 19-year-olds, from 42 low- and middle-income countries, reported increasing consumption of unhealthy snacks and beverages, particularly in urban areas[26]. In Mexico, 2012 national survey data, reported unhealthy foods and beverages contributed 26% of total energy intake in children and adults aged five years and over, exceeding recommendations for unhealthy foods by 6% and sugar-sweetened beverages by 7%[27]. The same survey identified the majority (58—85%) of the population consumed added sugars above the recommended 10% of total energy, noting unhealthy foods were the main contributor to added sugars intake[28]. More than 80% of children and 75% of adolescents also consumed saturated fats above recommendations (10% of total energy)[28]. Furthermore, two thirds of children in Mexico as young as 12 to 23 months were reported to consumed sugar-sweetened beverages[28]. Within Brazil, 2008—09 national survey data revealed ultra-processed foods contributed 30% of total energy consumed by those aged ten years and over[29]. These findings in low- and middle-income countries reinforce the widespread issue of overconsumption of unhealthy foods. Despite differing terminology and definitions reported intakes of unhealthy foods and characterising nutrients are above recommendations for children and adolescents in many parts of the world.

### 1.1.3. Consequences of excess intake of unhealthy foods

There are numerous negative consequences of excessive intake of unhealthy foods. Consequences include compromised growth, health and wellbeing, and increased risk of diet-related conditions and chronic disease. The Australian Dietary Guidelines aim to minimise these consequences by moderating unhealthy food intake[6]. Specifically, consequences relate to overall nutrition, chronic disease prevention, growth and development.

***Overall nutrition***

Overall nutrition and dietary guideline adherence can be assessed by measures of diet quality. Diet quality can be defined in terms of diet adequacy of healthy foods and nutrients, and moderation of unhealthy foods and nutrients[30]. Indices such as the Dietary Guidelines Index for Children and Adolescents provide a single measure of dietary intake compared to the Australian Dietary Guidelines[31, 32]. Dietary guidelines, and the related indices, include food groups that are linked back to the nutrients they have in common[33]. This allows the translation of nutrient reference values to practical recommendations, but also translates nutrients of risk as foods to limit, such as saturated fat, added sugars, sodium[33]. The adequacy component of diet quality includes beneficial or preventative components, such as fruit, vegetables, wholegrains, lean meats and reduced fat dairy products, protective against non-communicable conditions[5]. Whereas the moderation component of diet quality includes detrimental or risk elements, such as unhealthy foods high in saturated fat, added sugars and sodium that should be limited[5]. Hence, overconsumption of unhealthy foods has negative impacts on children's diet quality. It has been suggested unhealthy foods may also displace healthy food intake[5, 34], therefore impacting on diet quality twofold.

Within Australia, children's adherence to the dietary guidelines, or diet quality, is less than desirable. Analysis of national survey data using the dietary guideline index mentioned above, found four to 16-year-old children (n=3416) had a mean Dietary Guidelines Index for Children and Adolescents score of 53.6 (SD 0.4) out of 100[31]. This indicates low dietary guideline adherence[31]. In 2014—15, only 5% of Australian children aged two to 18-years-old (n=4170, population weighted to n=4,947,515) met the recommended serves for both fruit and vegetables[35]. Another Australian study using national nutrition survey data (n=789) comprehensively examined four to eight-year-old children's adherence to dietary recommendations, finding only one child met all recommendations for healthy foods and no children met the unhealthy food recommendations[36]. Children's current poor diet quality needs to be addressed, to reduce the risks of unfavourable dietary habits and non-communicable diseases within childhood. Intervening to reduce unhealthy food intake is expected to improve diet quality, by not only limiting unhealthy foods, but also creating the space to increase children's healthy food intake.

### *Chronic disease risks*

Consequences associated with chronic disease risks of unhealthy food intake can be direct or indirect. Direct consequences include dental caries, increasing risk of obesity and chronic conditions[5, 37]. Indirect consequences, through displacement of healthy foods, further increase the risk of chronic conditions (e.g. some cancers) and risk of nutrient deficiencies[5, 38]. Intakes that diverge from dietary guideline recommendations are a key contributor to chronic diseases, such as cardiovascular disease, diabetes and some cancers[39]. Such chronic diseases are the largest cause of disease and disability in Australia[39]. Globally, non-communicable diseases were estimated to account for 41 million deaths in 2016, of which 44% were caused by cardiovascular disease[40]. Australian data show, 7.3% of the total disease burden and 13% of all deaths were attributed to dietary risks, such as low vegetable intake, high processed meat, sugar-sweetened beverage and sodium intake[39]. Diet and disease risks are also a concern for the child and adolescent population. Research has shown a lasting impact of children's dietary habits and associated risks tracking into adolescence and then adulthood[40, 41]. In addition, many previously adult disease states are now presenting in childhood, such as type 2 diabetes, hypertension, high cholesterol levels and non-alcoholic fatty liver, including presentations in preschool aged children[42-44]. Reducing unhealthy foods to within recommendations can have long term health benefits in reducing chronic disease risk.

### ***Growth***

Excessive unhealthy foods intake has consequences on children's growth. Unhealthy foods are often higher in energy and consumed in addition to foods from healthy food groups. Overconsumption of unhealthy foods, hence energy intake in excess of requirements, combined with a lack of physical activity, has contributed to the high rates of population overweight and obesity[45]. The World Health Organisation estimated that globally, in 2016, 39% of adults had overweight and 13% had obesity[46]. In Australia, overweight and obesity is now affecting 63% of adults and 27% of children and adolescents (5—17yo; 2015)[47]. Global rates of childhood overweight and obesity, including low income countries, are also high with 18% of five to 19-year-olds being classified as with overweight or obesity[40]. Children with obesity are almost five times more likely to have obesity as adults, highlighting the need for prevention and importance of early life dietary habits[40, 41, 48]. Reducing unhealthy foods intake could be considered as one obesity prevention strategy. The recent World Health Organisation commission report to ending childhood obesity reinforced the need to address children and adolescent's dietary intake globally[4]. One of the key recommendations in the report being to *"implement comprehensive programs that promote intake of healthy foods and reduce the intake of unhealthy foods and sugar-sweetened beverages by children and adolescents"*[4] (Recommendation 1, p 17). Moderating unhealthy food intake in line with dietary guidelines recommendations can help to prevent development of overweight and obesity and support healthy growth throughout life.

### ***Development***

Excessive unhealthy food intake can have consequences on children's development. Specifically, relating to the development of food preferences and habits, but also academic performance. It has long been understood that children's taste preferences develop early in life, with dietary preferences established by five years of age[49, 50]. Once embedded, preferences and habits are more difficult to change, often persisting over time[51]. Children are born with a genetic predisposition to prefer sweet foods and learn preference for salty foods, which are key characteristics of unhealthy foods[50, 52]. Hence, if children are exposed to unhealthy foods in childhood, they are likely to develop and maintain unfavourable eating habits[53].

Early experiences are not only important for developing favourable preferences and habits, but learning experiences are also critical from an early age. High intakes of unhealthy foods are associated with lower academic performance in primary school aged children[54-57]. A large study of over 4500 grade five students in Canada, reported students in the second and third tertile of diet quality index moderation score—lower unhealthy food intake—were 15% and 20% less likely to fail their literacy assessment, than students with the lowest tertile[54]. A recent review of dietary intake and academic achievement in college students identified only seven studies in the area[58]. The one study included in the review that examined unhealthy food intake, reported regular consumption of unhealthy foods was associated with students being less likely to attend exams[59]. Limiting unhealthy foods from an early age support the development of favourable eating preferences and habits, as well as academic performance.

### 1.1.4. Summary of children's intake of unhealthy foods

Excessive intake of unhealthy foods remains a problem in majority of Australian children, and with this bring numerous consequences—overall nutrition, chronic disease risk, growth and development. Early childhood appears a key opportunity to alter the development of unhealthy food habits. Additional work is needed to standardise definitions and classifications of unhealthy foods to allow comparison of children's intakes internationally. Even within Australia there are often controversies in classification of unhealthy foods, with examples provided within the dietary guidelines and the Australia Bureau of Statistics Discretionary Food List providing some consistency[10]. There is currently a working group under the National Health and Medical Research Council to define unhealthy foods within the Australian context that may assist in future research[60]. Regardless of differing definitions, it is clear children overconsume unhealthy foods, and efforts need to focus on reducing children's intake in line with recommendations early in childhood.

## 1.2. Contextual factors influencing children's consumption of unhealthy foods

Children overconsume unhealthy foods, with numerous associated consequences. To address this problem, we need to better understand children's unhealthy food intake. Understanding how contextual factors including weekly routines, eating occasions, and social context influence children's unhealthy food intake can help to design practical interventions addressing these considerations.

### 1.2.1. Weekly routines and day of week influences on unhealthy foods

Day of week, particularly weekends or school holidays versus weekdays or school days, is associated with different unhealthy food consumption patterns. Researchers have suggested the formal structures related to school or weekdays provide consistency, are less autonomous and segmented with adult supervision[61]. Whereas weekend and school holiday days provide the opposite. Generally, weekends and school holidays are less structured, may involve socialising with extended family or friends, more autonomous, perhaps with less supervision and potential for greater access to less healthful choices in the home or community environment, compared with the school setting[61]. A review of eight studies based in the United States found children had poorer dietary intake on weekend days[61]. Analyses of the 2007 national survey of Australian children's (n=2696, 6—16yo) intake by school day found children had significantly greater mean intake of unhealthy foods on non-school days (6—11yo: 580g/d; 12—16yo: 882g/d), compared with school days (6—11yo: 438g/d, $p<0.001$; 12—16yo: 679g/d, $p<0.001$)[62]. Consistent patterns using the latest national nutrition survey were found when investigating children and adolescents (n=2362, 2—17yo) intake on weekend versus weekday[63]. A difference of approximately one serve in unhealthy foods was identified (weekday mean 4.53 serves, SE 0.1, weekend 5.50, SE 0.1; $p<0.001$), 374kJ total energy (weekday mean 7603kJ, SE 80, weekend 7978kJ, SE 113; $p=0.007$), and lower diet quality (-3.56 total diet score out of 100, $p<0.001$) on weekend days compared to weekdays[63]. Collectively findings highlight excessive unhealthy food intake on all days of week, but with slightly greater intakes of unhealthy foods on weekend days to warrant further investigation.

### 1.2.2. Eating occasions influence on unhealthy foods

The type of eating occasion can also result in different food consumption patterns. For example, main meal versus snack eating occasions. Snacks, snack foods and snacking have all been given varying definitions in the literature[64]. Hess and colleagues[64] suggest considering snacks as food and beverage items consumed between meals. Many snack foods consumed tend to be classified as unhealthy foods, for example salty snacks, candy, desserts and sweetened beverages[65]. Snack occasions, or between main meal eating occasions, appear to be of increasing importance based on observational data in the United States[65] and Australia[66]. Research in American children (2—18yo) reported an increased frequency in snacking behaviour from 1977 to 2006, with snacks contributing over 27% of their total energy intake in 2006[65]. Within Australia, comparisons of children's (2—16yo) weekday snacking behaviour between three national nutrition surveys from 1995 to 2011-12 reported higher snacking behaviour in the most recent survey[66]. The 2011—12 data found all snacks contributed 31% (SE 0.4%) of total energy; almost half (48%, SE 0.7%) of which was coming from unhealthy foods[66]. Another study using the latest national nutrition survey examined unhealthy food serves by eating occasion[67]. Authors reported that on average 52% of children's (2—18yo) unhealthy food serves across the day are consumed in snack occasions[67]. Both the nutrient profile of common snacks and their increasing frequency suggest 'snack occasions' may be an important eating occasion to reduce overall unhealthy food intake.

### 1.2.3. Social context and unhealthy foods

The social context of an eating occasion, such as who else is present or whether it is an everyday, social or celebratory occasion, may impact on the types of foods and amounts children consume. Occasions can be conceptualised on a spectrum of significant meaning, from everyday type occasions at the lower end to celebratory occasions at the higher end, with social occasions being placed somewhere in the middle (Figure 1.2). For the purposes of this thesis, 'social occasions' refers to occasions that include other people outside the child's immediate family. The degree of importance or significance placed on social occasions may differ between families, based on belief systems and frequency of these occasions. Little research is available exploring the types of social occasions and their influence on diet in childhood, with only one review and three additional studies identified in the literature. However, from the available data it can be hypothesised that social occasions may influence the types of foods children and adolescents consume. The review describing parental motivations from qualitative studies in the United Kingdom and United States reported occasions, such as having guests or at Christmas, as times when parents were more flexible in food provision[68]. An additional qualitative exploration of Australian parents' revealed parents perceived the social context as influencing their provision of unhealthy foods[69]. Parents expressed leniency around food provision with friends was generally acceptable[69]. Although parents reported there were some challenging social situations, for example when parents considered provision of certain foods by other parents inappropriate[69]. The remaining studies in the area relate to child and adolescents' perspectives on social influences and unhealthy foods. The qualitative study with ten to 11-year-old Danish children revealed differences in the influence of social context between children with healthier or less healthy diets[70]. Reporting meals and snacks were often shared social events and unhealthy foods were a marker of a special social occasion, in children with healthier eating habits[70]. Lastly, a questionnaire of Chinese adolescents found unhealthy foods were often associated with socialising, hosting visitors, eating out and parties[71]. Whilst social occasions appear to play a role in food provision and intake, more research is needed to understand the influence of social occasions on children's intake of unhealthy foods, particularly within the Australian context.

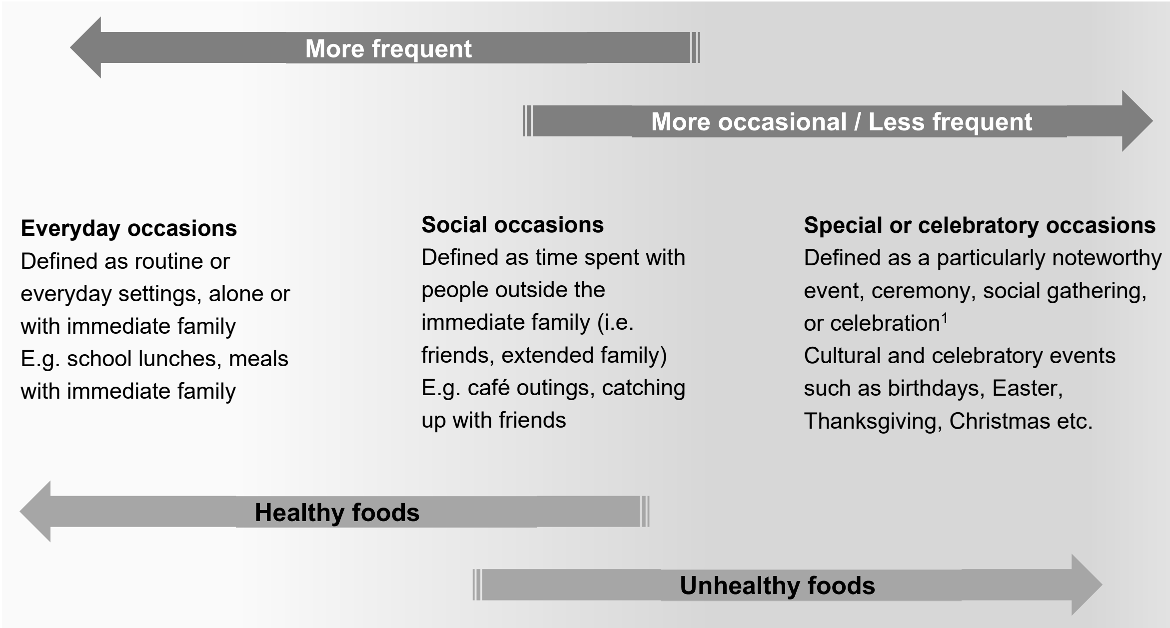



Figure 1.2: Hypothesised spectrum of occasions in childhood and associated types of food

[1] Oxford University Press[72]

### 1.2.4. Gaps in contextual influences on children's intake of unhealthy foods

Whilst there is some evidence to suggest research into children's unhealthy food intake should focus on weekend days, snack eating occasions and social contexts, the literature is lacking. More research into the aforementioned areas is needed to gain a deeper understanding of children's unhealthy food consumption, and more importantly in younger age groups gaining a deeper understanding of parents' provision. There is also limited research available regarding social contexts within Australian populations, particularly focussing on parents of young children. Understanding more about unhealthy foods will help to design targeted strategies for interventions to subsequently reduce intake, prevent displacement of healthy foods and reduce unhealthy food related consequences.

## 1.3. Socio-ecological influences on children's intake of unhealthy foods

There are numerous influences on children's unhealthy food intake[73, 74]. One approach is to consider these within and across each setting by the socio-ecological model[75-77]. There are many different terms available to group environmental influences. Figure 1.3 shows the terms used for this project, with the government and society setting the outer most circle, then moving inwards the food supply, community setting, with the home setting the most immediate to the individual child at the centre. It should be noted Figure 1.3 simplifies the complex, systemic and interdependent interactions between influences within and across levels of the socio-ecological model. For example, health services (community) may influence parents (home), who together with policy and guidelines (government and society) influence child care (community). Consumption of unhealthy foods a complex behaviour that can be influenced by, and take place in, many of these settings. It has been suggested that interventions need to consider change in the broader environment, to increase opportunities for individual behaviour change to help bridge the gap often seen between intention and behaviour[78]. It is important to consider how public health nutrition initiatives can support each of these levels to create supportive environments, but also to empower individuals within the current environment[75].

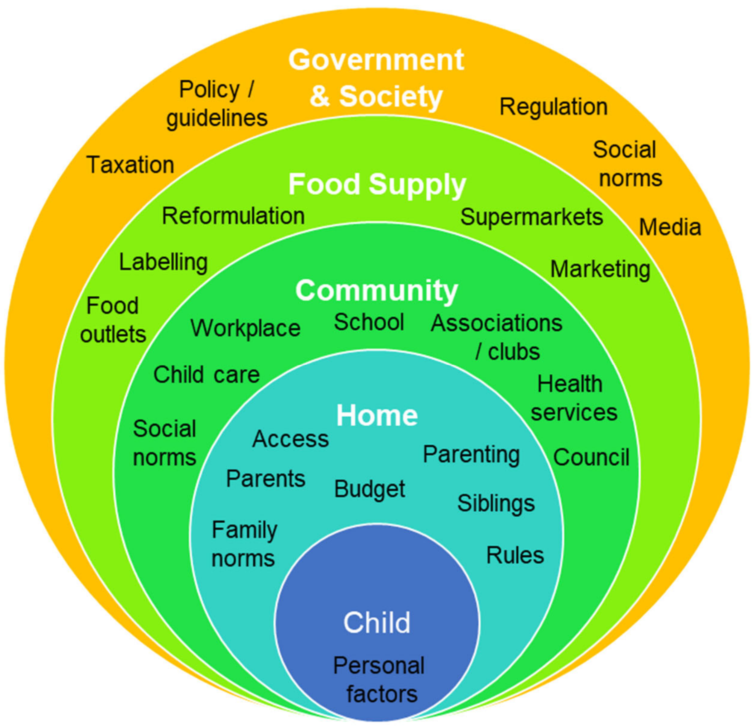



Figure 1.3: Socio-ecological model of influences on children's dietary intake

Adapted from Dahlgren and Whitehead[76]

### 1.3.1. Government and society influences

The integration of unhealthy foods into everyday life is, in part, a result of the broader environment that influences children's intake. Today unhealthy foods are abundantly available, widely advertised and embedded in celebrations and social activities. Influences in the physical environment as a result of government policies are varied. Examples include food item pricings and government sales taxes and levies, legislation of nutrition information labelling, and regulation of food advertising or marketing targeted towards children[73]. Legislation of nutrition labelling include requirements for individual food products, but also energy declarations in the quick service food sector[79, 80]. Food advertising has received considerable attention as an influence on children's intake[69, 81-83]. A multi-country study, including Australia, found 53—87% of all food advertisements related to unhealthy foods[84]. A meta-analysis examining the impact of unhealthy food advertisements, found significantly greater energy (mean difference +127kJ, 95%CI 12 to 242) and quantity intake (mean difference 4.8g, 95%CI 0.8 to 8.8) when children and adolescents were exposed to unhealthy food advertisements[85]. Government policies can shape the physical food environment resulting in a wide range of influences on children's unhealthy food intake.

Social norms also influence children's intake, for example the norm that unhealthy foods are accepted as a part of everyday life. Social norms are defined as *"common standards within a social group regarding socially acceptable or appropriate behaviour in particular social situations"*[86](para. 1). Unfavourable social norms reinforce unhealthy behaviours and can create additional challenges for individuals and interventions trying to change behaviour. Australian parents in qualitative research have expressed the belief that unhealthy foods can be included frequently as part of a balanced diet[69]. Despite these foods being referred to as 'sometimes' foods in the dietary guidelines and by parents themselves[69]. In a recent qualitative study in Ireland, parents and caregivers highlighted the increasing frequency of unhealthy food provision[87]. For example, *"Sweets are bought as part of the weekly shop now." "Just become more normal. Whereas they used to be a bit more of a treat."*[87](p 119). There are also broad social norms associated with unhealthy foods, such as linking unhealthy foods to different cultural celebrations and occasions[69, 88]. For example, birthday celebrations where 'birthday cake' is expected, or Easter celebrations focussed on chocolate eggs, or Christmas that includes a magnitude of unhealthy foods regardless of the differences in family or cultural traditions[88]. Such social norms influence children's understanding of unhealthy foods. Current society creates a challenge for reducing unhealthy foods that needs to be acknowledged in efforts to reduce unhealthy food consumption.

### 1.3.2. Food supply influences

There are both positive and negative food supply influences that relate to the physical availability and the promotion of unhealthy foods within supermarkets. The availability of certain food products in supermarkets and other food outlets impact what can be purchased. The Healthy Food Partnership initiative in Australia is working to improve healthier choices in the food supply[89]. The partnership is a collaboration between government, health professionals and food industry, to focus on voluntary product nutrient labelling and reformulation of processed products, including many unhealthy foods[89]. Hence, is seeking to support families to in making informed choices and improving the nutritional profile of processed foods. Other characteristics of food product labelling can however encourage children's preference for unhealthy foods, such as using children's characters on food packages[90]. There are also many ways supermarkets can also influence food choice. Supermarkets can influence unhealthy food purchasing and therefore intake, through price changes, rewards, advertising or in-store signage, in-store product tastings, changes to products stocked or item placement[91]. In addition, the location and density of fast food outlets within the geographic area can impact on children's intake of such foods[92]. The food supply can influence children's unhealthy food intake by impacting the foods that can be, and are, purchased for children's consumption.

### 1.3.3. Community setting influences

There are various settings and services that fall within the community setting, including associations, workplaces, health services, education and care settings. Clubs and community organisations or associations can influence unhealthy food intake via the availability of unhealthy food options in sporting clubs and at community events, or fundraising initiatives based on unhealthy foods, for example chocolates[93]. Commonly sporting and community events, whist supporting other health promoting behaviours such as physical activity or social connections, tend to involve unhealthy foods[93]. Workplaces are not directly relevant to children, but the working hours and flexible work practices may influence parents' food purchasing habits and preparation time available for family meals[94]. Health services provide an opportunity to promote consistent messages about diet and model healthy food environments, yet this is not always the case with numerous barriers to implementing healthy food policies noted[95].

Education settings however are of most relevance to children. Education settings include formal preschool and primary school environments, as well as child care centres. The transition from home or child care to preschool and primary school is a time of change and disruption, that brings additional influences and challenges to children's intake[96]. Within the child care sector in Australia and the school setting in many other countries, meal provision from the setting has an influence on what children have the opportunity to eat[97]. Largely, within schools in Australia, parents pack lunches from home, therefore the school setting influences what foods are provided by nutrition policies, or availability within school canteens[97]. The eating environment across child care, preschool and primary school years are times when children begin to be exposed to peer influences. Peer influences may encourage or discourage children's consumption of certain foods based on the peers eating habits[98]. The education sector may also include fundraising activities and school events promoting unhealthy foods. Within the education setting children's exposure to food and nutrition in the curriculum has the potential to influence children's eating habits, albeit indirectly through gains in knowledge. Education settings can also be an avenue for support and resources[99, 100], and collaboration between teachers, parents and children[101], to encourage development of favourable eating habits. The various community settings can have both positive and negative influences on children's unhealthy food intake and provides several areas to target preventative efforts.

### 1.3.4. Home setting influences

The home environment offers a broad range of influences on children's intake[102], which are the most proximal influences within the socio-ecological model[103, 104]. The home food environment has received much attention in the children's nutrition field[105, 106]. It is well recognised that parents are the 'agents of change' within the home setting[103, 107]. Parents are responsible for the home food availability, accessibility (i.e. children's independent access), meal structures, parent behaviours (e.g. role modelling) and family rules that can all influence children's unhealthy food intake[102]. For example, Schrempft and colleagues[102], investigated four year old's home food environment, classifying influences into lower- and higher-risk environments by capturing food availability, accessibility, parent modelling and parent feeding practices and rules. The study found a higher-risk food environment, including greater unhealthy food availability, was associated with consumption of more unhealthy snacks (OR 3.48, 95%CI 2.16—5.62) and sweetened drinks (3.49, 2.10—5.81)[102]. Another study, in older children (5—12yo) also found higher home food availability was significantly associated with higher intakes of unhealthy foods (salty snacks $\beta = 0.43$, $p<0.001$, confectionary $\beta = 0.37$, $p<0.001$, cakes $\beta = 0.38$, $p<0.001$, soft drinks $\beta = 0.36$, $p<0.001$)[104]. Hence, home food availability appears an important factor for unhealthy food intake within parents' control.

Meal routines are another influence, such as eating at home versus out of home. Yet, there are mixed findings regarding the impact of eating away from home and children's energy intake[108, 109]. Varying definitions of out of home meals including the school setting and whether data is presented as a proportion of total intake or of unhealthy food intake make it difficult to compare findings between studies. One study using the United Kingdom national survey data found four to 18-year-old children had higher energy intakes from unhealthy foods when foods were consumed outside of home or school (leisure places: 7.8-9.4% Energy Intake [EI] unhealthy vs 3.6—4.7% healthy foods; food outlets: 10.7—13.1% EI vs 4.7—8.8% EI; 'on the go': 7.4—7.6% EI vs 4.2—4.7%EI)[110]. Whereas, data from Australia, the United States and Portugal highlight the important role of the home with 65% to 71% of children's energy intake or meals consumed at or from the home[111-113].

Parents themselves present several influences on children's intake through their role modelling, parenting styles, and parent feeding practices that can impact unhealthy food intake[103, 114, 115]. There is a body of research examining associations between both parent feeding practices (e.g. monitoring, restriction, pressure to eat) and parenting styles and parent feeding styles (e.g. authoritarian, permissive, neglectful, authoritative) with child diet and weight related outcomes[116-118]. For example, cross-sectional research supports associations between greater restriction with higher preference for unhealthy foods, higher disinhibition and weight status[117, 119]. Pressure to eat, generally relating to healthy foods, has been found to be associated with lower weight status, again using cross-sectional study design[117]. Limited associations have been found between parental monitoring and weight outcomes[117]. Parenting styles and parent feeding styles, however, have shown mixed associations with children's intake and weight status, in cross-sectional research[117, 118]. That said, indulgent feeding style has been commonly associated with risk of obesity, and unhealthy foods often the types of foods children request[117]. Whereas an authoritative general parenting style has been found to be associated with higher fruit and vegetable intake and availability, and lower intake of sugar and fat[116]. There is evidence to suggest certain parenting styles and parent feeding practices may be important to consider in children's unhealthy food intake.

Parents' attitudes and beliefs may influence children's intake, as well as the development of children's own attitudes and beliefs towards unhealthy foods[120, 121]. For example, a parent belief that unhealthy foods should be a part everyday life, resulting in everyday provision of unhealthy foods, may then lead to children adopting this belief throughout life. Parental role modelling of healthy food consumption has been associated with both healthy and unhealthy food behaviours[103]. Young children are highly responsive and observant of parents, siblings and other carers' food behaviours[98, 122]. As with parent modelling of healthy foods to encourage children to eat these foods, the same can occur as a result of parents' unhealthy food intake, whereby children also want to eat unhealthy foods[123]. Reducing parent intake of unhealthy foods is one potential approach. Parents' diet quality has also been found to be correlated with children's diet quality[124]. Thus, there are several parent-related potential mechanisms of action for reducing children's unhealthy food intake, including modifying food environments, shared meals and parental role modelling[124].

Finally, there are then children's individual characteristics, including their tastes and preferences, nutrition knowledge, attitudes and beliefs that can influence their unhealthy food intake[125]. Children's beliefs and attitudes towards unhealthy foods have been explored in qualitative research, including a recent study of Australian 11 to 12-year-olds[126]. This study reported children indicated unhealthy foods should be consumed in moderation to maintain a balanced diet, but were more acceptable in social situations such as weekends[126]. Nutrition knowledge has been suggested to play a role in adolescent's food choice as they develop more autonomy, with associations noted between seventh and eighth grade adolescent's nutrition knowledge and food choices[127]. In younger children, without that autonomy, the influence of nutrition knowledge and preferences on unhealthy food intake may be moderated by home food availability or indirectly impact intake through their requests for unhealthy foods.

In summary, considering influences across the socio-ecological framework, the home setting and parents provide the most proximal influences for young children. This project therefore focussed on parents' provision of unhealthy foods to their young children. It is acknowledged that all environments offer a wide range of influences to consider when trying to reduce children's unhealthy food intake. However, as parents are primarily responsible for young children's food provision, parents were the prioritised change agents, rather than young children themselves.

## 1.4. Predictors of parents' provision of unhealthy foods to children

Parents are key influencers to shifting children's intake of unhealthy foods. Direct links between parent dietary behaviours and their children's intake, reflecting their share food environments, attitudes, beliefs and food provision, put parents in an ideal position to implement change, especially given the majority of young children's intake occurs in the home[110-113]. Parents are the primary gatekeepers of children's food access within the home, but also commonly within education settings in Australia[97, 128].

Similar to the variety of influences on children's intake, there are also numerous predictors of parents' provision of unhealthy foods to their children. Behaviours do not occur isolation, but rather as part of a complex system[3]. In addition to parents' individual characteristics, there are broader environmental influences within the socio-ecological model to consider. Predictors of parental food provision can therefore be broadly considered as individual predictors such as knowledge, skills and intention (i.e. internal processes), and environmental influences such as factors in the physical and social environment. For the purposes of this thesis, parental food provision refers to a range of behaviours relating to food provision including planning, purchasing, preparation and direct provision. While it is anticipated that parent behaviours such as modelling and parent feeding practices would be less important if unhealthy foods are not available within the home, all provision behaviours are being considered for the time being given the widespread prevalence of unhealthy foods. Although there has been research examining associations between parent-related factors such as home food availability and parent feeding practices with children's intake[105, 106, 129], there are gaps in understanding the internal thought and decision-making processes that mediate these associations.

### 1.4.1. Individual predictors of parents' provision of unhealthy foods

Individual predictors of parents' provision of unhealthy foods relate to numerous internal factors, such as knowledge, skills, attitudes, beliefs (e.g. self-efficacy), values, decision-making (e.g. outcome expectancies) and intention. Nutrition knowledge and skills are an important foundation to guide food provision[130]. For example, parents need to know what foods are appropriate for children, and have the skills to purchase, prepare, provide and promote these foods. Historically, nutrition research has taken an educational approach, assuming that for people to eat well, knowledge alone would stimulate behaviour change[131]. However, whilst nutrition knowledge may play a pivotal but small role in developing healthy eating habits[130], it is not solely sufficient to change food behaviour[131]. An Australian qualitative study reported parents were able to easily identify common unhealthy foods, such as chips, ice cream, lollies, cakes, sweet and savoury biscuits, takeaway foods and sugar-sweetened beverages[69]. This finding suggests parents already possess a certain level of unhealthy food knowledge. However, parents had difficulty identifying other types of unhealthy foods, such as muesli bars, rice crackers and some flavoured dairy snacks[69]. Another study of Australian parents (n=1202; 2—16yo) reported parents do not perceive knowing what foods to provide as a barrier to providing a healthy diet[132]. These studies suggest parents have a good general knowledge about unhealthy foods and do not perceive this as a barrier to their food provision, yet there is still something preventing parents from providing a healthy diet. Lack of motivation—including conscious reflections or automatic motivation drives—or external influences such as lack of physical resources or social supports may be contributing to excessive provision of unhealthy foods. More recent advances in nutrition education theory support this notion by highlighting the importance of other factors such as self-efficacy and how the physical and social environment influence food choices[131].

There is limited research regarding parents' attitudes and beliefs towards unhealthy foods, including self-efficacy. Few studies examining parents' self-efficacy have focussed on unhealthy food intake[133-137]. Lower levels of self-efficacy have generally been associated with higher child unhealthy food intake and habits[133-136]. Qualitative studies have reported parents' beliefs towards unhealthy foods, describing these foods as 'treats', with the belief that it is okay for children to consume unhealthy foods on a regular basis provided they also consume healthy foods or are physically active[69, 88, 138]. For example, a parent in the study by Petrunoff and colleagues[69] stated "*something little as a treat isn't a problem, … as long as I know that my children are getting good nutritious meals then in between those meals I don't mind them having extra things*"(p 6). A large quantitative study found parents' of eight to 14-year-olds (n=1302) attitudes generally favoured unhealthy foods and soft drinks, with these foods being considered as convenient and enjoyable[139]. Yet, the same study found parents also displayed negative attitudes with these foods and beverages perceived as unhealthy items[139]. In comparison, another large study of Australian parents of two to 16-year-olds (n=1202) reported more than half of parents disagree that 'it's okay for children to have treat foods everyday' (32% net agreement)[132]. Parents' attitudes towards unhealthy foods appear mixed, with studies identifying some parents are okay with providing unhealthy foods on a regular basis, whilst others have negative attitudes towards unhealthy foods being frequently provided. The mixed findings may reflect social desirability or cognitive dissonance, but also highlight more research is needed to understand how parents' attitudes and beliefs impact unhealthy food provision.

Parents' attitudes, beliefs, values, decision-making and intention can also be collectively considered as factors that influence motivation to provide certain foods. Few studies have explicitly assessed the impact of parents' motivation, or lack thereof, to provide a healthy diet on children's dietary intake. Most studies, primarily conducted in the United States, have focussed on examining the influence of motivational constructs on intention (Table 1.2). Hence, the existing evidence lacks exploration of comprehensive theoretical frameworks that extend beyond intention to behaviour. Whilst motivation is important for behaviour change, intention does not reliably predict behaviour[78]. Only one study by Van Allen and colleagues[140], using a small sample (n=42) in an obesity management intervention, explored the influence of a change in parental motivation on children's dietary intake. The study reported significant associations between increased parent motivation and decreased consumption of sugar-sweetened beverages ($\beta = -0.32$, $p \leq 0.05$) and sweets ($\beta = -0.33$, $p \leq 0.05$), but not salty snacks ($\beta = -0.28$, ns), and increased consumption of artificially sweetened beverages ($\beta = 0.37$, $p \leq 0.01$)[140]. A study using a larger sample, conducted structural equation modelling to examine associations with constructs in the Information-Motivation-Behavioral skills model, but only assessed children's sugar-sweetened beverages intake[141]. The study found motivation was not a significant predictor, but that the behavioural skills construct was inversely associated with children's sugar-sweetened beverage intake ($\beta = -0.27$, $p<0.001$)[141]. Other studies have examined motivational constructs on parental intention to limit sugar-sweetened beverages[142] or parent food monitoring behaviours[143], rather than children's unhealthy food intake.

Lastly, two studies have examined parents' motivation in more general terms. A study by Russell and colleagues[144] examined general food choice motives of Australian parents (n=371) of two to five-years-old snack provision and their association with children's food preferences. The study found health, nutrition and taste were key parent-rated motivators, yet were not significantly associated with children's unhealthy food preferences[144]. Lastly, Gunnarsdottir and colleagues[145] highlighted the importance of parental motivation in retaining Icelandic families in an obesity management intervention to enhance weight-related outcomes. Though this study did not assess changes in parental motivation throughout the intervention[145]. There are currently no obesity prevention interventions that have examined parental changes in motivation, and no studies that have comprehensively examined motivational factors on all unhealthy foods, rather than just sugar-sweetened beverages. The previous findings exploring motivational constructs justify the importance of motivation but are limited, leaving several gaps in our understanding of parental motivation towards limiting unhealthy foods.

Table 1.2: Summary of the key evidence examining constructs of parental motivation on their intention towards reducing provision of unhealthy foods and children's dietary intake

| **Reference Country** | **Study population** | **Aim and Theory** | **Analysis and Key results** | **Key limitations** |
|---|---|---|---|---|
| Andrews et al.[143]<br><br>United States | n=201 mothers of 2—5 year olds | Parent motivation on intention to limit unhealthy foods and 'tracking' behaviour (i.e. monitoring how often child eats unhealthy foods)<br><br>Theory of Planned Behavior | Path analysis<br><br>Associations between parent motivation constructs and intention to limit unhealthy foods:<br>Attitude (β = 0.43)<br>Subjective norm (β = 0.33)<br>Perceived behavioural control (β = 0.25)<br><br>Associations between parent motivation and tracking behaviour<br>Intention to behaviour (β = 0.29)<br>Perceived behavioural control to behaviour (β = 0.12)<br><br>*Significance not reported* | No measure of parent provision or children's intake |
| Tipton[142]<br><br>United States | n=165 caregivers of non-Hispanic Black 2—5 year olds | Parent motivation on intention to provide SSB<br><br>Theory of Planned Behavior | Multiple linear regression analysis<br><br>Associations between parent motivation constructs and intention to serve SSB:<br>Attitude (β = 0.44, $p$<0.001)<br>Subjective norm (β = 0.32, $p$<0.001)<br>Perceived behavioural control (β = 0.18, $p$≤0.05) | No measure parent provision or children's intake<br><br>Did not capture all unhealthy foods (beverages only) |
| Goodell et al.[141]<br><br>United States | n=196 parents of 1—5 year olds<br><br>Low socio-economic position | Parent motivation on children's intake of SSB<br><br>Information-Motivation-Behavioral skills model | Structural equation modelling<br><br>Associations between parent motivation and child SSB intake:<br>Information ↓ SSB intake (β = -0.24, $p$<0.001)<br>Motivation - SSB intake (β = 0.09, ns)<br>Behavioral skills ↓ SSB intake (β = -0.27, $p$<0.001) | Did not capture all unhealthy foods (beverages only) |
| Van Allen et al.[140]<br><br>United States | n=42 parents of 2—5 year olds<br><br>Children with obesity | Parent motivation on children's intake of several food items<br><br>Nil theory, secondary analysis of an intervention | Hierarchical multiple regressions<br><br>Associations between increased parent motivation and children's intake:<br>↓ sugar-sweetened beverages (β = -0.32, $p$≤0.05)<br>↓ sweets (β = -0.33, $p$≤0.05)<br>↑ artificially sweetened beverages (β = 0.37, $p$≤0.01)<br>- salty snacks (β = -0.28, ns) | Small sample<br><br>Did not include children of a healthy weight<br><br>Did not capture all unhealthy foods (certain subgroups only) |

Abbreviations: ↑ : increased; ↓ : decreased; - : no change; β: standardised regression coefficient; SSB: sugar-sweetened beverages

### 1.4.2. Summary of gaps in individual predictors of parents' provision

Whilst there is evidence to suggest parents have the general knowledge and skills to reduce unhealthy foods, little research has been undertaken to comprehensively understand parents' motivation. Few studies have examined the associations between parental motivational constructs and parents' provision or children's unhealthy food intake. Hence, they do not provide a complete understanding of motivation to implement successful behaviour change. Previous studies have not described parents' motivation in detail, nor have they identified key motivational constructs to prioritise intervention efforts. Only one study has used structural equation modelling with a simplified model of motivation[141]—highlighting research thus far has lacked advanced quantitative methods with strong theoretical foundations that allow deep exploration into parent motivation. Such methods can be used to identify important constructs to support change in parents' unhealthy food provision, noting the complexities in undertaking rigorous quantitative approaches including potential measurement and social desirability bias. More specifically, there is a lack of comprehensive quantitative research into parental motivation in the Australian population. In addition, evidence of in importance of self-efficacy, a motivational construct, in relation to food provision in general, further supports the rationale to explore motivation towards provision of unhealthy foods. Research is needed to better understand the motivational constructs influencing parents' provision of unhealthy foods.

### 1.4.3. Environmental predictors of parents' provision of unhealthy foods

Environmental or external predictors of parents' provision relate to the influences in the physical and social environment. Many of the food supply, government and society influences on children's intake are also predictors of parents' provision of unhealthy foods (Section 1.3.1 and 1.3.2). For example, the types of food items available for parents to purchase in the supermarket and how these are promoted. Predictors in the physical environment primarily relate to the physical resources' parents are exposed to, or can draw on, such as food availability, budget and time. Similar to the social influences on children's intake, the social norms and interactions with family members and friends may influence parents' unhealthy food provision. The existing nutrition literature often refers to environmental predictors as barriers or enablers to food provision. Table 1.3 provides a summary of the key evidence regarding physical resources and social influences on parents' unhealthy food provision.

Table 1.3: Summary of the key evidence regarding physical resources and social influences on parents' unhealthy food provision

| **Reference Country** | **Study population** | **Study details** | **Key results related to environmental factors** | **Key limitations** |
|---|---|---|---|---|
| Petrunoff et al.[69]<br><br>Australia | n=88 parents of 3—5 year olds<br><br>Parents of low SES (n=44) vs high SES (n=44)<br><br>Total 13 focus groups | Design: Qualitative focus groups<br><br>Aim: To investigate parents' understanding and approaches to providing unhealthy foods to their preschool children and any variation between parents of low and high SES<br><br>Analysis: Framework and thematic analysis | Key influences were:<br>• the child (preferences and requests)<br>• food-related parenting practices (reward, covert control, avoiding restriction)<br>• health considerations (nutritional value)<br>• food costs and convenience<br>• external factors (media, peers/siblings)<br>• child care factors (helpful, 'rules')<br>• social influences/occasions (fathers, grandparents negative role modelling, leniency with social occasions)<br><br>Parents of low SES were more likely to raise immediate concerns (risk perception) – dental and behaviour of high sugar food/beverages.<br><br>Parents of high SES discussed positive and negative influences of friends, and social occasions. | Primarily mothers who were married |
| Nepper and Chai[146]<br><br>USA | n=25 parents of 6—12 year olds<br><br>Parents of healthy weight children (n=14) vs parents of children with overweight/ obesity (n=11) | Design: Qualitative collective case study, semi-structured interviews<br><br>Aim: To explore parents' barriers and strategies in promoting healthy eating in the home, and to compare these between parents of healthy weight children and with overweight/obesity<br><br>Analysis: Exploratory and inductive data analysis | Key influences across groups were:<br>• parents are busy and strapped for time<br>• cost is a barrier in providing healthy food, but parents are resourceful<br>• children ask for junk food regularly, but parents have strategies to manage<br>• picky eaters are a challenge, but parents know they have to overcome this barrier<br>• early exposure to unhealthy eating influences children's food choices but strategies can help<br><br>Additional influence for parents of children with overweight/obesity: lack of support from their spouses/partners for healthy eating in the home | Primarily mothers with high education level<br><br>Did not focus directly on unhealthy foods |

Abbreviations: β: standardised regression coefficient; SES: socio-economic status; SSB: sugar-sweetened beverages

Table 1.3: Summary of the key evidence regarding physical resources and social influences on parents' unhealthy food provision (cont.)

| Reference Country | Study population | Study details | Key results related to environmental factors | Key limitations |
|---|---|---|---|---|
| Hoare et al.[147]<br><br>Australia | n=32 mothers of infants 6—12 months old<br><br>Mixed socio-demographics | Design: Qualitative semi-structured interviews<br><br>Aim: To explore the determinants of parental choices concerning beverage consumption<br><br>Analysis: Inductive thematic content analysis | Key influences were:<br>• health (high sugar, behavioural issues)<br>• child age<br>• child preferences and temperament of the child (nagging/requests)<br>• family (grandparent)<br>• social settings (e.g. parties, away from home) | Did not include fathers<br><br>Did not focus on all unhealthy foods (beverages only) |
| Peters et al.[138]<br><br>Australia | n=20 parents of 2—5 year olds<br><br>Healthy diet group (n=10) vs unhealthy diet group (n=10)<br><br>*Number of focus groups not reported* | Design: Qualitative semi-structured focus groups<br><br>Aim: To explore parent feeding strategies and beliefs, contrasting and comparing responses from parents of children identified as having healthy and unhealthy diets<br><br>Analysis: Open coding method of thematic analysis | Key barriers to healthy eating across groups were:<br>• time<br>• cost<br>• extended family and friends<br>• lack of organisation<br>• marketing<br>• fundraising drives<br><br>Some parents mentioned SSB only at parties. Partner involvement differed: conflicting/unsupportive in the unhealthy diet group, and supportive in healthy diet group.<br><br>Parents in the healthy diet group considered child's physical activity in provision of unhealthy foods. | Primarily mothers with high education level from high SES areas<br><br>Highly motivated to provide healthy and nutritious options<br><br>Did not focus directly on unhealthy foods<br><br>Participant groupings based on serves of fruit and vegetables not comprehensive measure of diet |
| Martin-Biggers et al.[148]<br><br>USA | n= 139 parents of 2—5 year olds<br><br>Total 43 focus groups randomly assigned 2 health behaviours. SSB: 8 groups (n=22 parents) | Design: Qualitative focus groups (and quantitative survey of parents own behaviours)<br><br>Aim: To examine parents' cognition, barriers, supports and modelling of seven obesogenic behaviours<br><br>Analysis: Standard content analysis | Specific barriers to limiting SSB:<br>• availability<br>• cost<br>• other priorities<br>• child resistance<br>• nutrition knowledge<br>• special occasions<br>• advertising<br>• convenience | Primarily parents with high education level *(gender not reported)*<br><br>Did not focus on all unhealthy foods (beverages only)<br><br>Sugar-sweetened beverages were one of seven behaviours examined |

Table 1.3: Summary of the key evidence regarding physical resources and social influences on parents' unhealthy food provision (cont.)

| Reference Country | Study population | Study details | Key results related to environmental factors | Key limitations |
|---|---|---|---|---|
| Smit et al.[149]<br><br>South Africa | Questionnaire: n=476 mothers of 7—15 year olds<br><br>Subsample completed focus groups: 6 groups, total n=37 mothers of 7—15 year olds<br><br>Random sampling of schools by SES, opt in by mothers. | <u>Design:</u> Quantitative questionnaire and qualitative focus groups<br><br><u>Aim:</u> To determine the factors that influence mothers' food choices and barriers to purchasing healthy foods<br><br><u>Analysis:</u> Descriptive statistics, chi-square and Kruskal-Wallis test; Thematic content analysis | Key influences across groups were:<br>• cost (60%), nutritional value (37%) and time constraints (29%)<br><br>In mothers of lower SES: cost was more important (low SES: 71.8% vs high SES 50.4%, $p<0.05$).<br><br>In mothers of higher SES the following were more important:<br>nutritional value (low SES: 29.2% vs high SES 44.1%, $p<0.05$)<br>time constraints (low SES: 18.3% vs high SES 41.7%, $p<0.05$)<br>child preferences (low SES: 14.8% vs high SES 33.1%, $p<0.05$)<br><br>Key barriers to healthy food purchasing from the focus groups were:<br>• mixed media messages (e.g. marketing strategies)<br>• the school environments (e.g. foods available to purchase, teachers)<br>• supermarket layouts (e.g. food item positioning and visibility) | Did not include fathers |
| Pettigrew et al.[139]<br><br>Australia | n=1302 parents of 8—14 year olds<br><br>50% of sample were fathers | <u>Design:</u> Quantitative – panel questionnaire<br><br><u>Aim:</u> To assess the factors influencing parents' attitudes to unhealthy foods and beverages<br><br><u>Analysis:</u> Multiple regression analyses | Factors associated with parents' attitude to unhealthy foods:<br>Child pestering ($\beta = 0.17$, $p<0.001$)<br>Social norms ($\beta = 0.13$, $p<0.001$)<br><br>Factors associated with parents' attitude to soft drinks:<br>Child pestering ($\beta = 0.16$, $p<0.001$)<br>Social norms ($\beta = 0.11$, $p<0.001$) | Limited number of factors measured |
| Slater et al.[132]<br><br>Australia | n=1202 parents of 2—16 year olds<br><br>Broadly representative of Australian population | <u>Design:</u> Quantitative questionnaire<br><br><u>Aim:</u> To identify parents' concerns and attitudes towards children's diets, activity habits, weight status<br><br><u>Analysis:</u> Descriptive statistics | Key factors perceived as making a healthy diet very or a little difficult to achieve for their child were:<br>• child resistance (89%), the availability of healthy food (72%), a busy lifestyle (67%) and the influence of food advertising (63%) | Primarily mothers who were married. Data were weighted to adjust for overrepresentation of high education levels.<br><br>Did not focus directly on unhealthy foods |

Aspects of physical resources in the context of healthy food provision have been explored, but few studies have examined these aspects in relation to unhealthy foods[69, 148]. Factors such as cost, time and convenience (time/effort) have been reported as barriers for increasing healthy food provision[132, 138, 146, 149, 150] and reducing unhealthy food provision[69, 148]. For example, in a qualitative study, one parent stated the following regarding lack of time: "*Not enough time to cook. I am busy and don't feel like cooking, so I will go buy fast food*"[146](p 159). Cost is also a commonly raised barrier to providing a healthy diet[69, 146], yet an analysis of the average cost of the current (unhealthy) diet in Australia found it to be one to 12% higher than the cost for families of a diet meeting the dietary guidelines[151]. Additionally, the amount spent on unhealthy foods contributed between 53—64% of their food budget[151]. Food availability appears a less reported influence by parents in qualitative research[69, 148]. However, the association between home food environment, including food availability, and children's intake is a commonly explored relationship by researchers in observational studies[102, 104]. For example, limiting food availability has been highlighted as a strategy parents use to reduce provision of sugar-sweetened beverages[147, 148] and unhealthy foods[138]. Thus, cost, time, convenience and food availability appear to play a role in parents (un)healthy food provision.

Social influences have also been identified as barriers to food provision by previous nutrition research. Barriers related to children themselves, such as child resistance, requests and preferences, have been reported by parents as common challenges in providing (un)healthy foods to their child[69, 81, 132, 146-148, 152]. Nepper and Chai[146] reported parents often gave in to children's requests for unhealthy foods out of frustration or wanting to please their children, for example "*The easy way out is to just buy it*"(p 161). Current research regarding social supports has mostly been derived from a small number of qualitative studies[68, 138, 146, 153]. In this research parents have voiced challenges with grandparents or partners undermining their provision of healthy foods[68, 138, 146, 153]. One qualitative study into parents' unhealthy food provision by Petrunoff and colleagues[69] revealed several important influences of food provision such as child requests and preferences, peers / siblings, child care, fathers and grandparents, as well as social occasions. Two qualitative studies have also reported the influence of friends as either helpful or a barrier to healthy food provision[69, 138]. Thus, child resistance, partners, grandparents and friends are all factors that warrant further consideration in understanding social influences on parents' provision of unhealthy foods.

To truly understand predictors of parents' provision, there is a need to understand *how* these environmental factors influence the decision-making processes that underlie parents' food provision. Food choice is complex. It has been estimated that each day individuals make approximately 220 decisions or choices about eating, many of which are unconscious or habitual[154]. Parents' are not only making decisions about what to eat themselves, but also about what they provide to their children. Few studies have explored the influence of environmental factors in parents' food choice decision-making processes. One qualitative study reported that although unhealthy food provision decision-making processes were not directly described by parents (of 3—5yo), they were addressed in the way parents balanced competing influences[69]. For example, parents in the study discussed trying to balance healthy and unhealthy foods across the day or week and managing time and convenience when deciding whether to provide unhealthy foods[69]. Another study of Australian mothers explored several factors influencing parents' food choice decisions for infants (4—15mths)[155]. Key environmental factors parents reported as influencing their provision choice included cost, availability of foods, preparation time and social connections[155]. Qualitative studies are however limited to describing common themes from parent-reported influences and are not able to determine the relative importance of such influences.

A study of Australian mothers of two to five-year olds (n=371) focussed on unhealthy foods choice motives (i.e. factors considered in decision-making), using a questionnaire to measure several different motives including environmental influences[144]. Five factors related to environmental influences and were found to be somewhat important in parents snack food provision decision-making[144]. Specifically, in descending order of contribution to decision-making, factors included child wants / requests, convenient to prepare, price, convenient to buy and other's preferences[144]. Other studies, using the similar versions of the questionnaire, with European families of older children (10—13yo, n=564—1095) also found whilst not the most important factors convenience and price were still somewhat important based on parent-ratings[156, 157]. Yet, convenience and time were not associated with children's unhealthy food intake[156, 157]. Two of the aforementioned studies provide some insights to the relative importance of factors by examining the amount of variance each influence accounted for in exploratory factor analyses, as part of preliminary analyses undertaken[144, 156]. However, these studies were reliant on parent-report with items rated individually, rather than rated against each other, as is often the case in real life food provision decision-making. Hence, there are currently no studies available that have explicitly examined environmental factors in parents' decision-making processes towards unhealthy food provision. Additional inquiry into the importance or influence of commonly raised environmental influences on parents' food provision decision-making is required.

#### 1.4.4. Summary of gaps in environmental predictors of parents' provision

Whilst there are a number of studies highlighting physical and social environmental factors on healthy food provision, there is limited research relating to unhealthy food provision. The available evidence is primarily from small studies of qualitative design, although strengthened by their in depth exploration and probing, cannot be generalised beyond the participants[147]. The existing quantitative studies have not yet investigated all areas of physical resources and social influences. Hence, comprehensive data particularly on social influences is not available, nor is the comparisons between environmental predictors within the same parent sample. Whilst current approaches are not able to determine the relative importance of environmental predictors of parents' provision, they do provide a list of multiple factors that are likely important in parents decision-making. Much of this research has been in Australian populations so does provide some information about these environmental factors. Regardless of design, the existing literature is highly dependent on parent report or rating therefore subject to social desirability bias. Thus, evidence is lacking the assessment of the relative importance or prioritisation of environmental predictors. Meaning little is known about which factors are of most importance and how these factors together influence parents' food provision decision-making. Advanced methodological designs are capable of answering such questions, whilst limiting social desirability bias and thereby could address gaps in the literature.

## 1.5. Existing interventions supporting parents to reduce unhealthy food provision

### 1.5.1. Focus on unhealthy food provision and intervention effectiveness

Few interventions or initiatives have directly focussed on reducing parental provision of unhealthy foods[158]. Our previous systematic review identified only ten interventions directly targeting reductions in four to eight-year old children's intake of unhealthy foods, in any setting in the socio-ecological model[73]. In general, there has been a focus of interventions on increasing healthy foods. It may be that intervention designers are anticipating a 'spill over' effect, whereby unhealthy food intake will decrease as a result of encouraging healthy food intake. But studies have often lacked comprehensive measures of unhealthy foods required to show this[159]. It is unclear why increasing healthy foods has been the focus of interventions and initiatives to date. Perhaps this behaviour is perceived as easier to change and more acceptable to parents by focussing on a positive 'increase' message or is simply the first step selected to improving diet. Limited progress in reducing children's unhealthy food intake signals the need for an alternative approach. Such as where reducing unhealthy foods is directly targeted, with potential spill over to increasing children's intake of healthy foods[73]. Interventions are needed to directly target reductions in parents' provision of unhealthy foods to their young children.

Of the existing literature identified within our past review, only three studies focussing on parents' provision of unhealthy foods were based in the home context[73]. The three interventions included in the prior review all included strategies to change the home food availability and found favourable results[160-162], yet only one study reported a significant reduction in unhealthy foods[160]. Dickin and colleagues[160] implemented a 21 month intervention, providing parent nutrition education through the Expanded Food and Nutrition Education program for low income families in the United States. Significant decreases in mean scores for frequency of children's soda intake (frequency on a 5-

point scale, units not reported; mean change 0.343, SE 0.087, $p<0.001$), and availability of fast food (mean change 0.469, SE 0.085, $p<0.001$) and unhealthy food snacks (mean change 0.490, SE 0.085, $p<0.001$) were reported from pre-post comparisons[160]. This study however lacked an independent control group and only assessed change in frequency not the amount of unhealthy foods consumed. Two other home-focussed interventions were randomised controlled trials within Australia, and did not find significant improvements in children's unhealthy foods intake[73]. Hence, a gap exists in effective interventions to support empowering parents to reduce unhealthy provision within the home in the current environment.

There have been several interventions targeting reductions in children's intake of sugar-sweetened beverages. A recent meta-analysis examining the effectiveness of interventions to reduce intake of sugar-sweetened beverages across the lifespan, found on average the 23 interventions lead to a moderate decrease in children's sugar-sweetened beverage intake of 76mL d-1 (95%CI -105 to -46, $p<0.01$)[163]. Other reviews of parent-focussed interventions broadly targeting children's dietary intake have included studies with a strategy to reduce unhealthy foods as one approach[158, 164, 165]. Such previous reviews have reported mixed improvements in children's dietary behaviours. In the recent review by Schlechter and colleagues[158] exploring parent involvement in interventions to improve children's diet, found only a third of studies (13 of 40) resulted in significant improvements in children's dietary behaviours. Whilst, dietary behaviours included reducing fast foods, sugar-sweetened beverages, fat, sugar or sodium intake, the majority of studies primarily targeted increasing fruit and vegetable intake.

Similar reviews by Golley and colleagues[164] and Kader and colleagues[165] reported the results of interventions included in their reviews in more detail. Hence, results of the studies that measured changes in children's unhealthy food items or associated nutrients could be easily identified and compared. The review by Golley and colleagues[164] of interventions involving parents (of children 1—18yo) found only two of the ten interventions that measured changes in children's fat intake reported a significant reduction. Furthermore, mixed patterns in effectiveness were reported depending on unhealthy food items measured in the interventions[164]. The two included studies measuring sugar-sweetened beverages reported improvements, whilst the two measuring high fat foods were not effective at reducing children's intake[164]. Finally, the review by Kader and colleagues[165] identified 25 studies targeting children's dietary intake, with 15 of these measuring changes in unhealthy food items or associated nutrient intake—fat or sugar. Majority of these studies (12 of 15) reported small significant improvements in children's intake[165]. Key limitations of these past reviews include they did not directly evaluate parents' provision of unhealthy foods, and often focussed instead on evaluating the influence or degree of parent involvement or other elements of intervention delivery. Of the available evidence, interventions to date specifically targeting parents' provision of unhealthy foods have been of mixed and modest effectiveness. There is a need to directly examine the effectiveness of parent-focussed intervention to reduce children's unhealthy food intake. As well as, exploring how current interventions seek to shift parents' food provision, which may provide opportunities to enhance intervention effectiveness.

To design effective interventions, it is important to gain an in-depth understanding of how interventions are changing behaviour, or in the case of ineffective interventions how they are not changing behaviour. Exploration into how current interventions attempt to change parents' provision of unhealthy foods is possible with standardised taxonomies of behaviour change content. For example, the Behaviour Change Technique taxonomy that provides a consistent language to describe the smallest behaviour change components in an intervention[166]. Researchers have described this approach as 'deconstructing' interventions[167]. Such methods have been used in previous reviews of interventions focussed on child obesity prevention or management[164, 168, 169] and increasing parents' vegetable provision[170]. Reviews published prior to 2015 have used a previous version of the Behaviour Change Technique taxonomy[171], limited to one third of the techniques captured in the latest version (BCTTv1)[166]. Only one review has examined the Behaviour Change Techniques in interventions to reduce children's sugar-sweetened beverages intake, yet this review used the previous version of the taxonomy, did not report the techniques used per intervention, nor capture unhealthy foods beyond sugar-sweetened beverages[163]. A key gap remains in understanding the behaviour change content of current parent-focussed interventions to reduce children's unhealthy food intake, which can then lead to enhanced intervention design.

### 1.5.2. Improving parent-focussed intervention effectiveness

There have been numerous calls to improve the quality of behaviour change interventions, such as those to change parents' food provision[172-175]. Advances in guidelines to improve transparent reporting, also serve as checklists in the design of interventions to strengthen their quality[176]. The content and delivery of interventions is ideally guided by theory and consultation with target populations, such as parents. However, intervention deign is often based on researchers' knowledge and experience[174]. A key limitation of this approach is the lack of theory and evidence-guided intervention development. Investment in deeply understanding the problem and behaviour change process is required to enhance intervention effectiveness[174]. Behaviour change literature has noted the importance of theory in underpinning intervention design to effectively change behaviour[3, 177-179], though this has been challenged[180]. It is often difficult to assess the degree of theory integration in intervention design versus, for example, a concept of a theory informing part of the intervention development. Use of psychology based theoretical frameworks provides a logical structure  for researchers to consider all relevant influences on the behaviour of interest, without unquestioned assumptions[3]. Researchers have also suggested more studies are needed to test interventions guided by frameworks such as the socio-ecological model, which prompts consideration of the environmental influences on behaviour change, in this case parents' provision[175]. To improve the quality of interventions, researchers need to develop interventions centred on theoretically informed understanding of what needs to change, by considering drivers and inhibitors of behaviour change.

Guidelines and frameworks have been developed to support the design of interventions that incorporate theory of behaviour change, such as guidelines by the United Kingdom Medical Research Council[181], and frameworks such as the RE-AIM framework[182], Intervention Mapping[183], and the Behaviour Change Wheel[174]. Such intervention design frameworks are generalizable across the health field and have been widely cited. The first of these frameworks is the RE-AIM framework by Belza and colleagues[182]. The framework is an acronym to guide program evaluation decision-making on: Reach, Effectiveness (positive and negative outcomes), Adoption (at a settings level), Implementation, and Maintenance (long term benefits and sustainability)[182]. This framework was initially proposed to guide intervention reporting but is now applied to strengthen the planning process for the adoption of sustainable and effective programs and highlights the importance of external validity. Although posing several important areas for consideration the framework is focussed on the practicalities of how to implement the intervention, with limited emphasis on the development of intervention content. The second is Bartholomew and colleagues[183] 'Intervention Mapping'. The Intervention Mapping framework includes five steps covering generation of program objective matrices (step one) to evaluation plan (step five). Each step is composed of a number of tasks. This framework has a strong focus on conducting a needs assessment drawing on multiple methodologies, integrating multiple theories and consideration of the broader environmental causes[183]. This framework however lacks an overarching model of behaviour, instead focussing on theoretical determinants, and is somewhat superseded by the Behaviour Change Wheel. The Behaviour Change Wheel framework developed by Michie and colleagues[174] is a new process to systematically consider behaviour change intervention design. This framework was developed following a critical review and synthesis of 19 existing frameworks, including the Intervention Mapping framework. The Behaviour Change Wheel framework provides a systematic method to guide step-by-step intervention design. Approaches to enhancing intervention effectiveness include understanding the behaviour change content of existing interventions and designing new interventions to incorporate behaviour change theory using the above-mentioned frameworks.

### 1.5.3. Summary of gaps in interventions to reduce parents' provision of unhealthy foods

In summary, there is a paucity of interventions directly targeting parents' unhealthy food provision. The limited number of existing parent-focussed interventions have varied in effectiveness or only achieved reductions in certain unhealthy food subgroups, such as sugar-sweetened beverages.

Thorough intervention design drawing on behaviour change theory may enhance effectiveness of interventions in this space. Yet, is difficult to determine the use of theory in existing interventions and the approaches of how such interventions aim to change behaviour. To address this gap, researchers need to gain in depth knowledge of the behaviour change content of the latest existing interventions. Hence, to understand behaviour change content an updated systematic search and assessment of behaviour change interventions focussed on parent provision of unhealthy foods is also required. Learning from existing interventions and applying best-practice intervention design approaches are needed to increase the likelihood of meaningfully reducing parents' provision of unhealthy foods to their children.

## 1.6. Summary of the research gaps

To recap, there has been few interventions with limited impact on reducing parents' provision of unhealthy foods. Specifically, there has been a lack of direct focus on unhealthy foods in parent-focussed intervention research. The research to date has been somewhat effective, yet has not achieved meaningful reductions in young children's intake of unhealthy foods. The limited effectiveness could be as a result of several factors. Firstly, lack of consideration that parents' make decisions and perform behaviours within the broader environmental context. Therefore, researchers need to consider both the socio-ecological model and individual behaviour change theory when designing interventions. Furthermore, poor understanding of the predictors of parental provision—specific to unhealthy foods and behaviour change—may be impacting researchers' ability to design interventions drawing on such theoretical understanding. For example, application of models to understand predictors of behaviour change not just current behaviour or intention. Whilst there is a growing body of research into the predictors of parents' food provision, there is still limited research specifically related to limiting unhealthy food provision, including motivational and environmental influences guiding parents' unhealthy food provision. Additional insight is needed to comprehensively understand motivational drivers and environmental influences on parents' food provision decision-making, using advanced methodological designs to not just fill these gaps but advance the nutrition field. Addressing the gaps in the lack of understanding of how existing interventions attempt to change parents' provision behaviour (e.g. behaviour change content) will provide further insight for future intervention design. Finally, the limited effectiveness of existing interventions may stem from inadequate use or application of behaviour change theory. There is a need to focus on behaviour change explicitly and utilise best-practice intervention design frameworks, incorporating behaviour change theory, such as the Behaviour Change Wheel[3]. By addressing the gaps in the existing body of literature focussed on parents' provision of unhealthy foods, researchers will be equipped with theoretical understanding and evidence required to design interventions with the best chance of success.

## 1.7. Thesis aims

This PhD project sought to address the aforementioned gaps in relation to parent unhealthy food provision and intervention design. The purpose of this project was to generate new knowledge in understanding predictors of parents' unhealthy food provision from within the home. The home setting refers to foods and beverages provided within the home and from the home, such as a lunchbox or picnic. The term provision is used to refer to a range of behaviours relating to food provision including planning, purchasing, preparation, and direct provision. Furthermore, the purpose of this project was also to apply knowledge generated and best-practice intervention design to produce content for an intervention to support parents to reduce provision of unhealthy foods. Intervention content is used to refer collectively to a group of intervention strategies or proposed packages of strategies. For this thesis intervention content does not include the specific resources or material wording to deliver an intervention. Instead it refers to the suite of potential intervention strategies, detailing the behaviour change components, which would be appropriate to take to stakeholders to assess the feasibility prior to refining and testing an intervention.

From behaviour change theory it is understood that creating lasting changes in complex repeated behaviours, such as dietary behaviours, requires habit formation[184]. In the case of children's excessive unhealthy food intake this also requires habits for this current less desired behaviour to be broken or unlearned[184]. The transition period from home or child care to preschool and junior primary years (i.e. three to seven years of age) is a time when new routines are being formed making it an ideal time to swap and create favourable habits[185]. This age group focus also corresponds to a period where children's unhealthy food consumption increases[7], thus could be an opportune time to intervene to halt such increases. Hence, this PhD project focussed on parents of three to seven-year-olds. The age group covers a five-year period that may be broad in terms of physical, social and cognitive development. The age group selected still provides initial understanding of targeting parental provision of unhealthy foods during the transition period and can inform future investigations toward narrower age groups.

<u>Overall Thesis Aim:</u> To design theoretically grounded, evidence-informed intervention content to support parents to reduce unhealthy food provision to their three to seven-year-olds.

The overall thesis aim was achieved by addressing three overarching objectives:

1. To better understand motivational and environmental predictors of parental provision of unhealthy foods to their children (Chapter 3: Study 1 and Chapter 4: Study 2)
2. To examine behaviour change content of interventions to reduce parents' unhealthy food provision to inform intervention design (Chapter 5: Study 3)
3. To identify behavioural supports and corresponding intervention content to focus future interventions to reduce parents' unhealthy food provision to their children (Chapter 6: Study 4)

# 2. THEORETICAL FRAMEWORKS

This chapter provides detailed explanations of the theoretical frameworks that guide this PhD project. As introduced in Chapter 1 this project considered the socio-ecological model (Figure 1.1 in Chapter 1) as an overarching model to consider parent food provision in the broader environmental context in which food provision behaviours occur.

In addition, there were three specific behavioural frameworks utilised, namely the Behaviour Change Wheel, the Capability, Opportunity, Motivation and Behaviour (COM-B) model and the Health Action Process Approach (HAPA) model. An overview of the frameworks and examples of the use or application of these frameworks are provided. The socio-ecological model and HAPA model are examples of where this project was theoretically based. Whereas, the Behaviour Change Wheel and COM-B model are examples of systematic application of theory and the existing evidence base.

## 2.1. The Behaviour Change Wheel

The Behaviour Change Wheel is a framework for best-practice intervention design[174]. The framework stemmed from a review by Michie and colleagues[174] of existing frameworks to cover three key areas; namely, comprehensiveness, coherence, and a clear link to an overarching model of behaviour. Comprehensiveness was defined as a framework having the ability to "*apply to every intervention that has been or could be developed*"[174](p 3 of 11). In reviewing, and then developing the new framework, a key focus for Michie and colleagues was to identify intervention categories that would be usable by intervention designers and policy makers[174]. Intervention categories were considered as both intervention functions and policy categories. Intervention functions are the approaches used to change behaviour[174]. Policy categories are the policy levers to support an intervention[174]. The review found no framework met the comprehensiveness criteria, that is they did not include all intervention categories[174]. The review did find three frameworks met the coherence criteria and seven frameworks were linked to the overarching model of behaviour[174]. A lack of a suitable existing framework justified the development of the Behaviour Change Wheel (Figure 2.1).

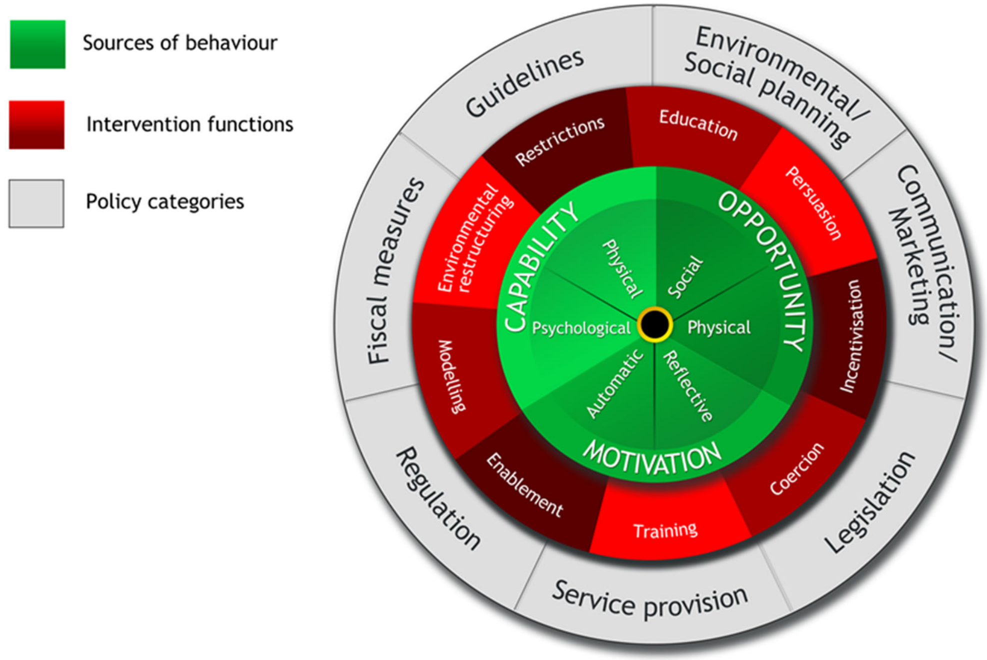



Figure 2.1: The Behaviour Change Wheel

Reproduced from Michie et al.[174], by CC BY

The Behaviour Change Wheel includes the Capability, Opportunity, Motivation and Behaviour (COM-B) model as the overarching model of behaviour (Figure 2.1, inner circle) linked to the nine intervention functions (mid-circle) and seven policy categories (outer circle) identified from the collated frameworks in the review[174]. It is considered a non-linear model and represents the best available theory to guide evidence-informed intervention development for any behaviour change target[3]. Along with the visual wheel, the framework has a corresponding process that guides researchers to consider the behaviour of interest, conduct a behavioural analysis, and select appropriate intervention functions, policy categories, Behaviour Change Techniques (BCTs) and delivery mode[174]. A key strength of the process is the behavioural analysis to understand the behaviour to be changed, and clear system for designing intervention content based on the behavioural analysis[174]. The behavioural analysis is centred on the COM-B model, suggesting the sources of behaviour: capability, opportunity and motivation, are all needed for a behaviour to occur[174]. The Theoretical Domains Framework can be used to provide deeper insight in the behavioural analysis. The Theoretical Domains Framework is a compilation of common theoretical domains, developed to simplify and integrate numerous behaviour change theories[186]. Researchers can integrate discipline specific theoretical frameworks to understand one or more of the sources of behaviour. Given the advantages researchers across a range of disciplines have begun to adopt this framework to address health and other behaviour change.

The Behaviour Change Wheel process has been used to develop evidence-informed health interventions[187-190], as well as to evaluate previous interventions to determine design strengths and limitations[191, 192]. Although there is growing use of the Behaviour Change Wheel, or components of the Behaviour Change Wheel, in a range of fields, few studies have used the framework in the context of nutrition[193]. Current nutrition studies have used the framework to improve dietary intake of infants[194-197], children[198-201] or adults'[202-204]. At the time of submitting this thesis eleven nutrition related studies had been published using the Behaviour Change Wheel. Only around two-thirds of the nutrition related studies have comprehensively used the Behaviour Change Wheel framework (e.g. COM-B, intervention functions, BCTs), with the remaining studies using the COM-B model in isolation[198, 199, 202].

Of the studies using multiple aspects of the Behaviour Change Wheel framework four targeted parent behaviours in relation to children's nutrition; specifically, breastfeeding[195], infant feeding[197], reducing unhealthy foods in the lunchbox (3—6yo)[201] and appropriate portion sizes for child weight management (5—11yo)[200]. Parent-focussed interventions designed using the framework, incorporated three to six intervention functions, namely education, training, enablement, modelling, environmental restructuring, persuasion or incentivisation, and approximately 20 unique BCTs. Three of the past interventions used mobile apps as the preferred mode of delivery[197, 200, 201]. To date, one of the four interventions have reported initial evaluation findings[196]. Using a quasi-experimental design, Russell and colleagues[196] reported no difference in infant's unhealthy food exposure (frequency score: mean difference −0.06, 95%CI −0.15 to 0.03, $p$=0.19; variety score: 0.03, −0.34 to 0.41, $p$=0.87) or parental feeding practices (awareness of hunger and satiety cues: −0.20, −0.54 to 0.14, $p$=0.26) between the control group and the mobile app intervention group. However, unhealthy foods strategies were only one component of the intervention. In addition, the study focussed on parents' capability and motivation and did not include strategies to change opportunity. As outcome assessment of interventions that were developed using the Behaviour Change Wheel framework continue to emerge the effectiveness of this framework in changing complex behaviours can be evaluated.

Currently a key gap remains where only one study, data collection period 2018 to 2019, has used the comprehensive Behaviour Change Wheel framework to design an intervention targeting reductions in children's unhealthy food intake[201]. The Behaviour Change Wheel process was selected and utilised to ensure the current project intervention content was designed based on theory and informed by evidence. Figure 2.2 provides an overview of the study design flow of the components within this PhD project, based on the Behaviour Change Wheel process[3]. The application of the Behaviour Change Wheel in this project provides a novel contribution to the behaviour change literature, as well as highlighting the use this new framework in reducing unhealthy food provision literature.

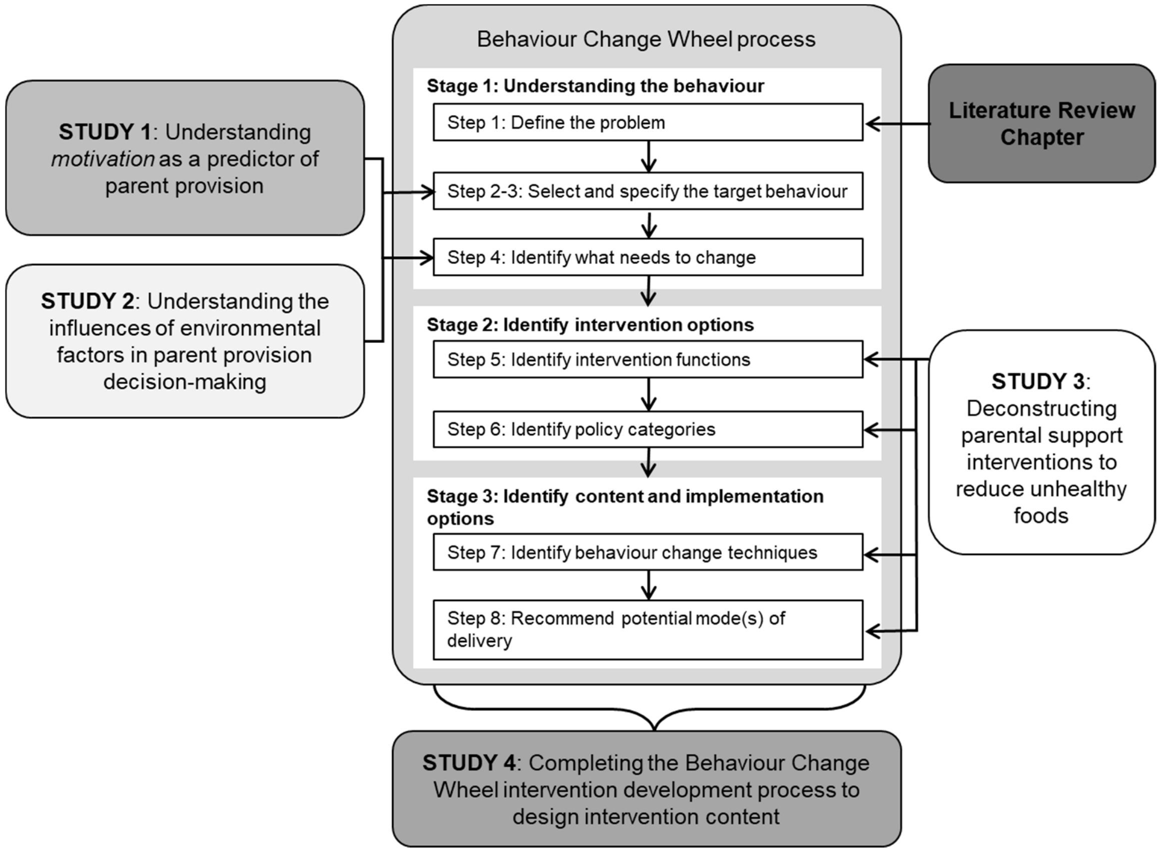



Figure 2.2: Thesis study design flow

Content adapted from Michie et al.[3]
Studies 1, 2 and 3 generated new knowledge to feed into the Behaviour Change Wheel process, completed as Study 4.

## 2.2. Capability, Opportunity, Motivation and Behaviour model

The COM-B model, is the inner circle of the Behaviour Change Wheel[174]. The COM-B model provides a generic model to predict and explain behaviour and behaviour change (Figure 2.3). The COM-B model is centred on the concept that for any behaviour to occur one needs the capability (knowledge and skills), opportunity (resources and supports), and the motivation (intention, impulses, habits)[174]. The arrows within the model highlight that performing the behaviour itself can enhance capability, opportunity and motivation. In addition, having the capability or opportunity can directly influence motivation, but not the reverse; for example, simply being motivated cannot directly increase skills. However, motivation can indirectly impact capability and opportunity, but only through performing the behaviour itself. An key advantage of the COM-B model over other psychological models is the inclusion of the opportunity element, which allows us to place behaviour in an environmental context (e.g. physical food environment, social norms)[174]. Theoretical frameworks commonly used to understand health and eating behaviour are heavily focussed on socio-cognitive factors, such as reflective motivation and psychological capability. Examples of such models are the Theory of Planned Behavior, Health Belief Model, and social cognitive theory[205-207]. The incorporation of the opportunity element in the COM-B model captures a range of factors external to an individual that influence behaviour, such as physical resources and social supports afforded by the environment that may help or hinder behaviour change[174].

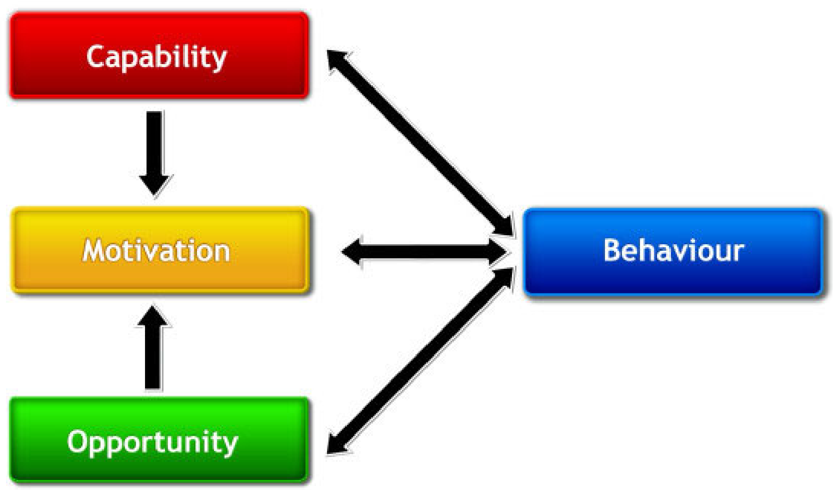



Figure 2.3: Capability, Opportunity, Motivation and Behaviour (COM-B) model

Reproduced from Michie et al.[174], by CC BY

Capability can be divided into *physical capability*, which includes having the physical ability to perform a behaviour, and the *psychological capability*, which includes the knowledge and skills of how to perform a behaviour[3]. Examples of physical capability in the context of this project, include having the ability to go food shopping or the knife skills to prepare a snack. Psychological capability encapsulates having the required knowledge and mental skills and stamina to reduce unhealthy food provision. It is often stated that parents know what foods are healthy versus unhealthy (capability), yet there is something preventing parents from providing a healthy diet. These barriers could be a lack of motivation (i.e. conscious reflections or automatic motivation drives) or opportunity (i.e. physical resources or social supports). This PhD project investigated components of parental motivation and opportunity to understand the potential barriers and levers needed to change parents' provision of unhealthy foods.

Motivation is defined broadly as *"all those brain processes that energise and direct behaviour"*[174](p 4). As previously mentioned, motivation can be enhanced by increasing parents' capability (knowledge, skills) and opportunity (physical resources, social supports), as well as through performing the behaviour itself[3]. When it comes to changing a behaviour, even if one has the capability and opportunity to perform the new behaviour, if one does not have the motivation, behaviour change will not occur[174]. Motivation can be divided into *reflective motivation,* which encapsulates conscious purposeful motivation, and *automatic motivation,* which includes reactive motivation driven by emotions and habits[174]. Automatic motivation is used when performing a behaviour out of habit, often prompted by the external environment[3]. For example, seeing a fast food outlet or smelling hot chips when hungry leading to purchasing these foods for the family. Automatic motivation acts without conscious thought—what researchers strive to make a desired behaviour become yet cannot often be directly changed through an intervention. There are strategies that can be put in place to restructure the environment to prompt the automatic desired behaviour or focus can be placed on reflective motivation, and through repeatedly performing the behaviour it would develop into a habit[3].

Opportunity is defined by Michie and colleagues[174] as *"all the factors that lie outside the individual that make the behaviour possible or prompt it"*[(p 4)]. Consideration of the opportunity element is consistent with the socio-ecological model of behaviour and allows for behaviours to be considered in the environments in which they occur[174]. Environmental prompts can reinforce current behaviour by triggering habits[174]. For example, having unhealthy foods in the pantry can prompt providing them to children. Opportunity can be divided into *physical opportunity*, which includes the physical resources available, and the social opportunity, which includes the social norms and support from friends and family. It is crucial to understand the influence of opportunity factors, such as the physical resources and social supports to develop appropriate interventions to support parents to change provision.

## 2.3. Health Action Process Approach model

While the COM-B model provides a basis to understanding behaviour and levers of behaviour change, specific theoretical frameworks can be used in combination to provide more detailed theoretical guidance[3]. Several models have been developed to specifically understand reflective motivation, broadly referred to as models that aim to capture intention towards a behaviour. The Health Action Process Approach (HAPA) model was selected as a more advanced model to provide additional guidance to understand parents' reflective motivation. The HAPA model has been proposed to not just capture intention, but to consider stages of self-efficacy and implementation intentions (i.e. planning) to support initiation and maintenance of positive health behaviours[208, 209]. Essentially this model includes several constructs theorised as important in the thought processes motivating and leading to behaviour, such as parental unhealthy food provision.

In the Behaviour Change Wheel process, the Theoretical Domains Framework elaborates on the COM-B model with several domains relating to reflective motivation[3]. Experts have previously mapped constructs from various frameworks to their corresponding domain within the Theoretical Domains Framework[186]. Constructs within the HAPA model were cross-checked (by BJJ) against the Theoretical Domains Framework mapping to ensure constructs related to reflective motivation. Therefore, supporting the suitability of the HAPA model to provide the detailed theoretical guidance into reflective motivation for Study 1 (Chapter 3). Constructs in the HAPA model mapped to the domains of goals, beliefs about consequences, beliefs about capabilities (i.e. self-efficacy) and intentions. It is important to highlight that though there may be different interpretations, authors of the COM-B model describe belief and perception of capabilities as part of reflective motivation, rather than psychological capability which captures having the mental stamina (University College London, Centre for Behaviour Change Summer School 2017). Of note, two constructs in the HAPA model, namely action planning and coping planning, can be considered under both the 'behavioural regulation' domain as part of psychological capability, as well as 'goals' under reflective motivation. Action and coping planning in the HAPA context are considered equivalent to implementation intentions, hence more strongly align with the 'goals' domain[208, 209]. There is overlap between reflective motivation and psychological capability—that is having the motivation but also the psychological stamina (capability), in developing implementation intentions or 'if-then' plans[210]. For the purposes of this PhD project action and coping planning are conceptualised as motivational constructs contributing to reflective motivation.

The HAPA model consists of two phases: the motivational phase and the volitional phase[208] (Figure 2.4). In the current context, the motivational phase includes parents' risk perception associated with their current provision of unhealthy foods, outcome expectancies (pros and cons) of reducing provision and confidence to start reducing provision (action self-efficacy), all leading to parents' intention to limit the provision of unhealthy foods. The volitional phase includes having plans to reduce provision in ideal circumstances (action planning) and in the face of barriers (coping planning), as well as confidence in the face of barriers (maintenance self-efficacy), and confidence to re-limit provision of unhealthy foods after a lapse (recovery self-efficacy), all of which lead to the action—the behaviour of limiting provision of unhealthy foods. The HAPA model provides a framework to gain insight into the determinants of behaviour change rather than of the current unfavourable behaviour.

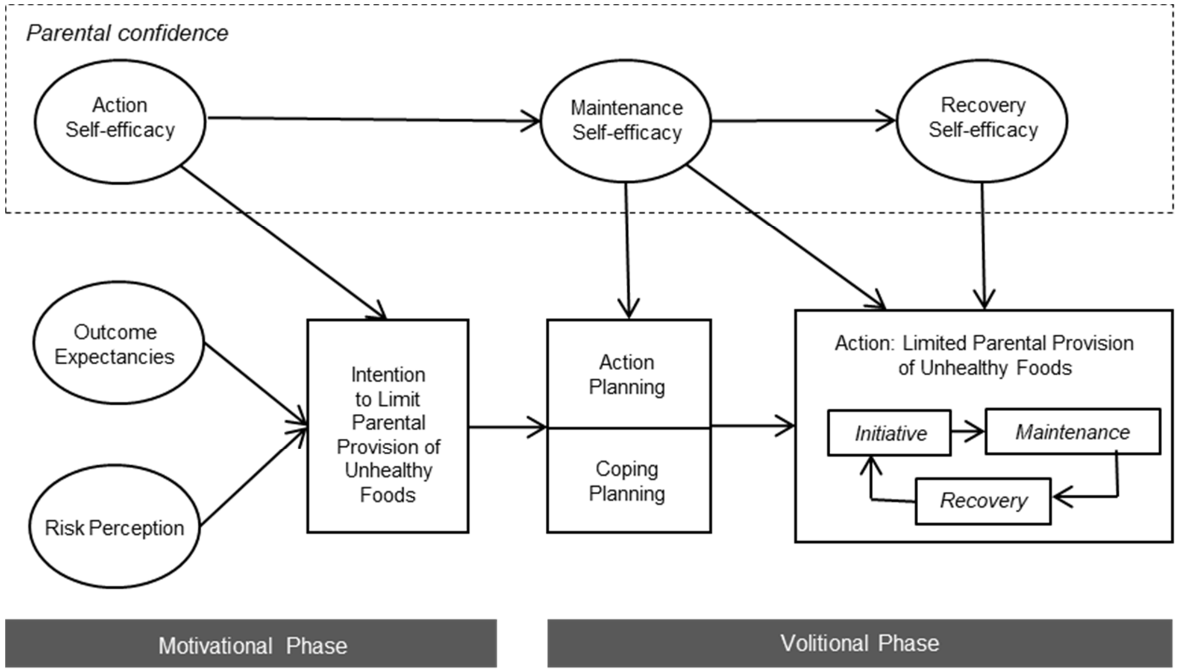



Figure 2.4: Health Action Process Approach model for limiting provision of unhealthy foods

Adapted from Schwarzer[208] (Modeling Health Behavior Change: How to Predict and Modify the Adoption and Maintenance of Health Behaviors, Applied Psychology, Vol.57, p.1—29), by permission of John Wiley and Sons

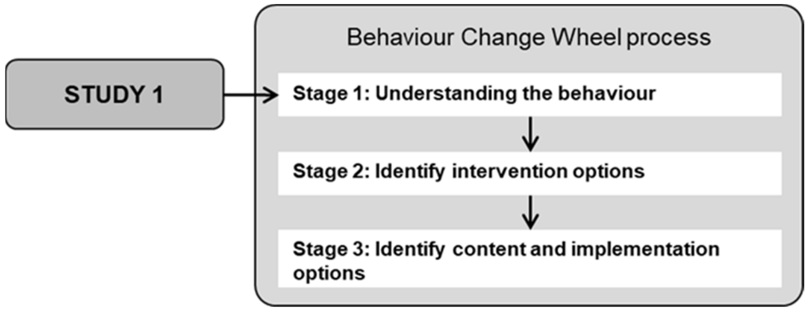
The HAPA model has been described as an extension of the Theory of Planned Behaviour—used in numerous childhood and adolescence dietary studies[142, 143, 211-213]. The Theory of Planned Behaviour fails to extend post-intention; often resulting in an 'intention-behaviour gap' where there is a disconnect between intention and behaviour, especially in habitual and complex behaviours[78, 208, 214]. Whereas, the HAPA model addresses factors leading to intention (motivational phase) and factors leading to the target behaviour of parental provision of unhealthy foods (volitional phase)[208]. Brug and colleagues[78] discussed the importance of the inclusion of a volitional phase within theoretical frameworks, particularly inclusion of implementation intentions (planning) and more challenging contexts to help bridge the intention-behaviour gap. The HAPA model captures important motivational constructs to comprehensively understand parents' motivation leading to behaviour. Thus, the HAPA model provides a framework to comprehensively understand parents' reflective motivation, that is thought to bridge the gap between intention and behaviour.

The HAPA model has predicted changes in several health-related behaviours including diet[209, 215, 216], physical activity[209, 217, 218], and dental hygiene[209] in adults, and smoking cessation in adolescents[219]. However, researchers have not yet investigated the ability of the HAPA model to predict children's health behaviours. The exception being our preliminary investigations of parental provision of unhealthy foods[220]. Our past work examined the ability of HAPA constructs to predict parental intention (motivational phase) and children's unhealthy food intake (volitional phase) using multiple linear regression analyses[220]. Pilot analyses revealed action self-efficacy (β = 0.32,

$p<0.001$) and absolute risk perception for child ($\beta = 0.19$, $p=0.03$) were significant predictors of parents' intention to limit unhealthy foods[220]. Maintenance self-efficacy ($\beta = -0.30$, $p=0.016$) was found to be a significant predictor of children's intake of unhealthy foods[220]. The small sample size of our prior work (n=162)[220] prevented exploration of the HAPA model using structural equation modelling to assess the suitability of the HAPA model in its structural form, hence this is an area that needs to be addressed. Though the HAPA model has shown promising results in predicting various health behaviours in adult populations, examination of the HAPA model in children's health behaviours are needed, including relating to parents' provision of unhealthy foods.

In summary, the social-ecological model, Behaviour Change Wheel framework, COM-B model and the HAPA model provided detailed theoretical guidance for this PhD project. Each framework provided a unique contribution to this project in a cohesive manner to ensure the resulting intervention content was theoretically grounded. Using this combination of theoretical frameworks has allowed for consideration of both broader environmental influences and individual influences of parents' unhealthy food provision. The following chapters will revisit the relevant theoretical frameworks that underpinned each piece of research presented in this thesis.

# 3. UNDERSTANDING MOTIVATION: PREDICTORS OF PARENTS’ PROVISION OF UNHEALTHY FOODS




This chapter addresses the motivational aspect of the overall thesis objective 1: to better understand *motivational* and environmental predictors of parental provision of unhealthy foods to their children.

This chapter is focussed on understanding the motivation, including gaining a broad descriptive understanding of parents’ motivation based on the Health Action Process Approach model. Structural equation modelling was performed, based on the Health Action Process Approach model, to test the suitability of the model in capturing parents’ motivation, and to gain insight into the most important motivational predictors of parents’ provision of unhealthy foods. Findings from this chapter provide new knowledge to inform the behavioural analysis completed in Chapter 6 (Study 4).

The structural equation modelling component of this study has been published in *Nutrients,* a quartile one journal, ranked 16th of 124 in *Nutrition and Dietetics* by SCImago Journal Rankings. This chapter was used to prepare the publication, hence there is direct overlap in content and phrasing. Please see Appendix 2 for formatted published version.

The following quotes express examples of parents’ motivation towards unhealthy foods to set the scene for readers of this chapter:

> *“She has been having carrot sticks, celery sticks, tomatoes, a French onion dip for her veg, a packet of crisps, a piece of fruit and a piece of cake or something sweet. I do not deny her this since she eats so healthy otherwise.”*[120](p 204)

> *“Well, I think it’s alright, isn’t it, to have…some ‘‘naughty bits’’. It would be a bit boring otherwise… a bit dreary.”*[221](p 93)

> *“Something little as a treat isn’t a problem,… as long as I know that my children are getting good nutritious meals then in between those meals I don’t mind them having extra things”*[69](p 6)

## 3.1. Introduction

### 3.1.1. Understanding motivation

Motivation can lead directly to performing a behaviour, in the presence of capability and opportunity. When it comes to starting a new behaviour, even if we have the capability and opportunity to perform the new behaviour, if we do not have the motivation, behaviour change is unlikely to not occur[3]. Motivation can be described as reflective motivation, including conscious planning and evaluations; or automatic motivation, including habitual processes, desires, and emotion responses[3]. The balance of reflective motivation to automatic motivation in habit formation suggests that reflective motivation is more important in the early stages of starting a new behaviour, which requires greater conscious decision-making effort[3]. Parents' reflective motivation is an important aspect in initiating behaviour change to reduce unhealthy food provision to their children.

Reflective motivation includes the intentions and plans we make and beliefs we hold[222]—essentially all the thought processes that lead to performing a behaviour. By considering all of these thought processes researchers can extend their understanding of motivation beyond the factors that predict intention, to gain a more comprehensive understanding of how motivation influences provision. There are several constructs including self-efficacy, beliefs, outcome expectancies, intentions, goals, action and coping planning, identity and optimism that are associated with reflective motivation; referred to hereafter as motivational constructs[3]. There is a gap in the literature reporting these motivational constructs in relation to parents' provision of unhealthy foods to their children.

As previously mentioned in Chapter 1 (Literature Review), few studies relating to young children's unhealthy food intake have comprehensively examined parental motivational constructs[140]. Studies have often been limited to exploring constructs such as self-efficacy alone[133-135], or reporting associations between motivational constructs and parental intention[142, 143] rather than provision or children's intake. Whilst past nutrition interventions have included strategies to increase parents' motivation[159], majority of studies have not examined parents' initial motivation, nor identified important constructs of motivation to prioritise intervention efforts. One study by Taylor and colleagues[223] examined associations between parental motivation and intervention outcomes. Although, authors found no difference between the weight management intervention group and control group at 24 months using a brief measure of parental motivation to change[223]. An inadequate understanding of parents' underlying motivational state may be impacting the effectiveness of intervention strategies seeking to create favourable parental motivation.

Existing studies exploring parental motivation towards unhealthy foods have rarely examined associations using advanced quantitative methodologies[141]. The lack of advanced methods has meant researchers have not had the quantitative evidence to determine the motivational constructs of greatest importance and hence prioritise intervention targets. Only one study has used structural equation modelling using a simplified model of motivation[141]. A key advantage of structural equation modelling is that it provides the ability to test theoretical models of motivation in their structural form and to measure motivation as latent constructs[224]. Research into parents' motivation is incomplete, with limited advanced quantitative research examining parental motivation towards unhealthy food provision and a lack of comprehensive framework use to gain insight into multiple motivational constructs, particularly those beyond intention.

### 3.1.2. Comprehensive theoretical approach to understanding motivation

The Health Action Process Approach (HAPA) model, introduced in Chapter 2 (Theoretical Frameworks), provides a theoretical framework to comprehensively understand constructs contributing to parents' reflective motivation[208]. To briefly recap, the HAPA model consists of two phases, the motivational phase that captures constructs leading to intention, and the volitional phase that includes post-intentional constructs of self-efficacy and planning leading to the behaviour itself[208]. The motivational phase of the model is akin to the Theory of Planned Behavior, commonly used in past nutrition and health research[142, 143, 205, 225, 226]. The Theory of Planned Behavior has been criticized for its poor ability to predict behaviour; creating what is referred to as the intention-behaviour gap[208, 225]. The HAPA model aims to bridge this gap by including the post-intentional constructs, including action and coping planning and maintenance and recovery self-efficacy. However, this requires further testing. Although the HAPA model has been used to understand motivation in adult populations in relation to behaviours including diet[209, 215, 216], physical activity[209, 217, 218], and dental hygiene[209], it has not yet used to investigate behaviours relating to children's health. While there is limited direct evidence relating to parental unhealthy food provision and each of the motivational constructs included in the HAPA model, there is broader research regarding the importance of self-efficacy and food provision[133-136]. As such the suitability of HAPA model to capture parental motivation towards child behaviour also requires investigation. This study seeks to explore many motivational constructs in the context of limiting parental provision of unhealthy foods for the first time.

### 3.1.3. Study aim and objectives

The aim of this study was to understand parents' reflective motivation towards limiting unhealthy food provision to their children. To address this aim there were three objectives:

Objective 1: To describe parents' reflective motivation towards limiting provision of unhealthy foods to their three to seven-year-old children.

Specific questions in relation to Objective 1 were:

*Are parents aware of the risks or benefits of the excessive or desired provision of unhealthy foods?*

*Do parents intend to reduce unhealthy food provision?*

*Do parents have the confidence to limit unhealthy food provision?*

*Do parents have plans to limit unhealthy food provision?*

Objective 2: To examine the suitability of the HAPA model to measure parental motivation towards limiting provision of unhealthy foods to their children.

Specific questions in relation to Objective 2 were:

*Can the HAPA model be applied to understand parents' reflective motivation for reducing provision of unhealthy foods?*

*Does the HAPA model help to bridge the intention-behaviour gap (i.e. how does the HAPA model compare to the Theory of Planned Behavior)?*

Objective 3: To understand the relationships between, and relative importance of, motivational constructs and parental intention and provision of unhealthy foods.

Specific questions in relation to Objective 3 were:

*Which motivational constructs are of most importance to reducing parental provision of unhealthy foods?*

## 3.2. Methods

### 3.2.1. Study design and ethics approval

An original research study was conducted using a cross-sectional design to measure motivational constructs influencing parents' provision of unhealthy foods. Prior to commencing the study parents were presented with a participant information sheet and consented to taking part through the online survey tool. Ethics approval was obtained from the University of South Australia Human Research Ethics Committee (number 0000033798). Ethics endorsement was received from CSIRO Health and Medical Human Research Low Risk Ethics Committee (number LR 2/2015). Amendments were approved for a second wave of data collection by the University of South Australia Human Research Ethics Committee (22nd December 2016) and CSIRO Health and Medical Human Research Low Risk Ethics Committee (16th February 2017). This chapter was prepared using the STROBE-nut reporting statement[227] (Appendix 4).

### 3.2.2. Participant sampling and recruitment

The study was conducted online and included families within all states and territories in Australia. Recruitment of participants took part in two waves. Wave one in April to August 2015 (existing data from a previous project) and wave two in March to July 2017 (new data collection). The second wave was required to obtain a larger sample sufficient to perform structural equation modelling. Participants were recruited via online advertisements, including paid Facebook advertisements, parenting magazines / forums, and relevant Facebook page promotions. Paper flyers and snowball recruitment strategies whereby participants refer others in their social network were also used. The sample collected in 2015 has been described elsewhere[220]; in brief the sample was predominately female, married or living as married, with a high education level, working part-time or away from the workforce, and residing primarily in South Australia. Therefore, recruitment strategies in used in this study (2017 data collection) aimed to produce a combined sample that better reflected the National demographic profile of parents[228]. Specifically, recruitment strategies were targeted towards parents living in states other than South Australia and attempted to encourage parents in lower socio-economic circumstances to take part (e.g. posts on targeted geographical Facebook forums). However, given the likelihood of females to respond to nutrition surveys it was expected there would not be an even gender split, with the final sample likely to primarily represent mothers.

Parents of children aged three to seven years of age, living in Australia, fluent in written English were eligible for the study. Parents were excluded if their child was not within the specified age range (<3.0 or ≥ 8.0 years) at the time of the study, or if their child had a medical condition requiring a special diet inconsistent with the Australian Dietary Guidelines (e.g. cystic fibrosis). The special diet needed to preclude them from following the dietary guidelines to be excluded. For example, if a child was reported to have a cow's milk protein allergy the dietary guidelines would still be appropriate as non-dairy alternatives would be encouraged to meet the recommended serves of 'milk, yoghurt, cheese'[6]. Parents self-selected to participate in the study, with the start of the online survey including eligibility screening items.

Minor differences occurred between the two recruitment waves. The previous recruitment wave was limited to parents of children aged four to seven years, yet, was expanded to include three-year-old children in the current recruitment wave. The age range was expanded to better capture the transition to preschool period, as children may be three or four years of age when commencing preschool. An incentive was offered, during the first wave, with a chance to win one of ten double movie passes. The same incentive was not offered in the current study as it was not thought this increased recruitment as a quarter of participants opted out of the incentive draw, and the budget was instead prioritised to paid advertising.

### 3.2.3. Variables

***Outcome: Parental provision of unhealthy foods***

Children's mean daily serves of unhealthy foods was the primary outcome used as a proxy measure of parent provision of unhealthy foods. Children's intake of unhealthy foods was deemed a suitable proxy measure for parental provision because of the bidirectional nature with child factors and the associations between home food availability and children's food intake [104, 229]. For the purposes of this chapter parental provision refer to direct provision, i.e. the types, amounts and frequency of foods provided to children. Food and beverage items were considered unhealthy foods as per the Australian Dietary Guidelines[6].

***Predictors: Motivational constructs***

Predictor variables were motivational constructs within the HAPA model—both motivational and volitional phases. Constructs included: risk perception, positive and negative outcome expectancies, action self-efficacy, intention, maintenance self-efficacy, action planning, coping planning and recovery self-efficacy[208].

***Socio-demographics***

A number of variables were collected to allow comparison between recruitment waves and the Australian population to determine generalisability of the current results. Comprehensive parent socio-demographics were collected, including gender, age, education level, employment status, household income, weight status, number of children living at home, state of residency, socio-economic position, marital status (single or dual parent household) and nutrition knowledge. Child socio-demographic information was collected for age, gender, education setting attendance, weight status, and diet quality. Children's diet quality was captured to compare children in the study with other childhood nutrition studies.

### 3.2.4. Measurement tools

***Outcomes: Parental provision of unhealthy foods***

Parents' provision via proxy of children's intake of unhealthy foods, was measured by the unhealthy foods subset of the Short Food Survey[230]. In the Short Food Survey, unhealthy foods are classified as such based on the Australian Dietary Guidelines, therefore consistent with the definition used in this thesis. The unhealthy food subset has been found to have appropriate relative validity (correlation coefficient 0.44, $p<0.01$) and reliability (correlation coefficient 0.87, $p<0.01$) compared to 24 hour food recall, in children aged four to 11 years old[230]. The questionnaire has been described in detail elsewhere[230]; in brief the Short Food Survey included 20 detailed items about unhealthy foods. For example, ‘How often does your child usually eat savoury pastries?’ with the response options of ‘each day’, ‘each week’, ‘each month’ or ‘doesn’t eat savoury pastries’; followed by ‘How many times does your child usually eat savoury pastries?’ with a free text field for parents to enter the quantity. The questionnaire assumes that each unhealthy food consumed was equivalent to one serve of unhealthy foods (600kJ). Frequency of unhealthy foods were converted to overall mean daily serves of children’s unhealthy foods.

***Predictors: Motivational constructs***

Predictor variables were collected using the Parental Food Attitude Questionnaire[220]. Note that although the questionnaire name states ‘attitudes’, the constructs measures are those in the HAPA model. The Parental Food Attitude Questionnaire has been found to have good face and content validity, as evident by minimal changes to the questionnaire wording following parent pre-test and assessment by a panel of experts in the area of children’s nutrition and psychology[220]. The initial validation tests performed also supported appropriate construct validity with predominately high factor loadings (motivational phase 0.43—0.89; volitional phase 0.53—0.85) and high internal consistency (Cronbach’s alpha motivational phase 0.77—0.88; volitional phase 0.85—0.92)[220]. The Parental Food Attitude Questionnaire has 57-items that measure 14 motivational constructs of the HAPA framework (motivational and volitional phases) specifically towards parental provision of unhealthy foods (Appendix 5). In brief, the questionnaire asks parents to rate how strongly they agree to disagree with a given statement about risk, or how confident they are with each given situation, or how true a given statement is for them. For example, the item addressing maintenance self-efficacy reads ‘Some situations can make it hard to maintain certain behaviours. How confident are you, that you could limit providing unhealthy foods to your child from within the home, even if… a) your child is requesting/ demanding/ fussing/ pestering for unhealthy foods; b) your child is resistant to limiting unhealthy foods; c) you are tired, etc.’ Responses to this item ranged from 1) not at all confident to 4) extremely confident. To minimise any potential influence of parents’ interpretation of unhealthy foods or negative framing from the term unhealthy foods, the questionnaire provides a detailed introduction to the types of foods and drinks of interest and refers to these as ‘extras’. For example, ‘*Extras’ foods and drinks can be referred to as sometimes foods or treats/junk food. When we talk about ‘extras’ we are including: Soft drink (regular, diet/low joule), fruit drinks, sweetened flavoured water, energy drinks, sports drinks; Pies, pastries, sausage rolls; Ice cream, chocolate, lollies; etc.*’ (Appendix 5).

***Socio-demographics***

Socio-demographic items were adapted or replicated from previous nutrition surveys [17, 231] and the Australian Government Census[232] (Appendix 5). Parent self-reported weight and height were used to calculate body mass index (BMI; $kg/m^2$) and classify weight status as underweight (BMI <18.5), healthy weight (18.5—24.9), overweight (25—29.9) or obesity (≥ 30)[233]. Parent reported child weight and height were converted to BMI z-scores by the least mean squares method, which adjusts for age and gender, using an add-in to Microsoft Excel[234]. To add confidence to the parent reported child weight and height parents were also asked to indicate whether their child's weight and/or height had been measured in past six months. Parents were also informed they would need to report their child's weight and height prior to commencing the online survey. Children's BMI z-scores were then classified into weight status categories using the International Obesity Task Force definitions[235, 236]. Categorising weight and height measures into weight status reduces the influence of inaccurate self-reported measures[237, 238]. Research in Australian children has found no significant difference in weight status when comparing gold standard researcher measured weight and height with parent reported[237, 238].

Child diet quality was calculated from the Short Food Survey using the Dietary Guideline Index for Children and Adolescents (DGI-CA)[31, 32, 230]. The Short Food Survey consisted of 15 questions about healthy foods, as well as the items regarding unhealthy foods. A SPSS syntax file was obtained from the authors of the Short Food Survey and DGI-CA to calculate DGI-CA scores. The syntax was used to calculate serves of each food group from the Short Food Survey and to combine this information along with diet variety measures to calculate the DGI-CA component and total scores. This index provides a total diet score of 0 to 100, as a measure of compliance with the Australian Dietary Guidelines, with a higher score suggesting greater guideline compliance, compared with a lower score indicating lower compliance[31, 32, 230]. The validity of the DGI-CA has been examined by comparing nutrient intake across quintiles of DGI-CA score—finding higher DGI-CA scores were associated with higher intake of nutrients including fibre, folate, calcium, iron, zinc and vitamin A, and lower intake of saturated fat, added sugars and sodium (Q1 to Q5 $p$-trend <0.0001)[31].

Socio-economic position was classified using the Socio-Economic Indexes For Areas (SEIFA) of relative advantage and disadvantage[239] by matching parent reported postcode. Socio-Economic Indexes For Areas scores were collapsed into tertiles of low (588—953), medium (954—1018) and high (1019—1191) relative to the Australian profile[239]. Parent nutrition knowledge was assessed using four validated questions from the modified General Nutrition Knowledge Questionnaire, and an additional item addressing unhealthy food recommendations[231]. Initial validation of the questionnaire in an Australian population found the 'dietary recommendations' component of the questionnaire—used in the current study—had good concurrent validity with the nutrition-educated sample scoring higher than the community sample with a mean difference of 1.24 ($p$<0.001) and moderate internal reliability (Cronbach's alpha 0.53)[231]. A nutrition knowledge score out of 14 was generated by summing correct responses from the five items, with a higher score indicating greater nutrition knowledge.

### 3.2.5. Data collection procedure and bias

All data were parent reported through an online survey (SurveyMonkey®). The survey took approximately 30—40 minutes to complete. An estimate time was provided to parents prior to commencing the survey. To keep data collection anonymous, the online survey delivery method did not include a function for parents to save their responses and continue at a later point. To improve the user experience and support parents through the survey prompts were provided at multiple stages regarding their progress and importance of their responses. Prompts reminding parents of the anonymous nature of the survey were included to encourage honest responses to reduce social desirability bias. The order of the questionnaire was designed to also reduce the impacts of social desirability bias, such as first collecting whole of diet food frequency items to mask the focus on unhealthy food consumption and aimed to reduce over- or under-reporting. Explanatory statements were included prior to the Parental Food Attitude Questionnaire to highlight the current social norms and challenges parents face providing a healthy diet. Self-selection bias as a result of recruitment method, was likely to have contributed to a sample more interested in nutrition and health which may limit the generalisability of results to the general Australian parent population. However, given the widespread overconsumption of unhealthy foods and depth of the questioning the study still provides valuable initial insights into parents' reflective motivation.

### 3.2.6. Sample size

The primary analysis method of this chapter was structural equation modelling, hence guided the sample size calculation. Structural equation modelling includes *"a wide range of multivariate methods aimed at examining the underlying relationships, or structure, among variables in a model"*[240](p 76), such as the HAPA model. As the chance of error increases with the complexity of the model being tested in structural equation modelling (i.e. number of relationships being explored), sample size is commonly calculated by the N:q rule, where q is the number of variables in the model[241]. A N:q ratio of 15 to 20 participants per variable is an accepted sample size guide[241, 242]. The estimated sample size required for this study was 225 to 300, assuming 15 variables, i.e. HAPA constructs within the initial questionnaire. This sample size was also appropriate to assess the construct validity of the Parental Food Attitude Questionnaire (PFAQ) using confirmatory factor analysis.

## 3.3. Data analysis

Two analysis approaches were used to address the study objectives. For Objective 1, descriptive statistics were used to describe parents' reflective motivation levels. For Objective 2 and 3, structural equation modelling was used to test the suitability of the HAPA model, and identify the relative importance of motivational constructs, respectively. Structural equation modelling is a method of analysis which combines factor analysis and multiple regression processes[224]. Structural equation modelling can be considered as *confirmatory* when used to test if a theoretical model is supported by the data, or *exploratory* when used to develop a model from the data[224]. This study primarily used a confirmatory approach to test the suitability of the HAPA model. Structural equation modelling was preceded by exploratory factor analysis to familiarise with the data, and confirmatory factor analysis. Confirmatory factor analysis was used to test the theorised relationships between the measured variables (PFAQ items) and corresponding latent constructs, known as the measurement stage of the structure equation modelling process[224, 241]. Multiple regression analyses would have been an appropriate method to explore the strength and direction of relationships between motivational predictors and children's intake of unhealthy foods (outcome variable)[224, 243]. Structural equation modelling overcomes several limitations of multiple regression analysis. For example, the use of latent (unobserved) variables, separating out the measurement error associated with each observed variable, and has the ability to test the complexities of the HAPA model in its structural format, including mediating variables[224]. Mediating variables are those that mediate the relationship between an independent variable and the dependent variable. For example, within the HAPA model planning is a mediating variable of the relationship between intention and children's unhealthy food intake. Each of the analysis processes are described in detail below.

### 3.3.1. Data preparation

Data were exported to Microsoft Excel (2013, Microsoft Corporation, Redmond, WA, USA) where string items were numerically coded for stage one of data cleaning. Parental Food Attitude Questionnaire items were reverse scored and additional variables computed (Table 3.1 and 3.2). Data were imported into IBM SPSS Statistics (Version 25; SPSS Inc., Chicago, IL, USA) for further data cleaning. New variables were computed for weight status categories, SEIFA tertiles, mean daily serves of unhealthy foods and diet quality scores (DGI-CA total diet score). Ineligible participants were removed. Data were checked for input errors and extreme implausible values recoded as missing data, for example, child height of 0cm or 200cm. Data were screened for normality as many of the selected analyses were parametric tests, hence assume data is normally distributed, including structural equation modelling[241, 244]. Normality was checked by examining skewness, kurtosis, normal Q-Q plots and histograms[244]. Ordinal Likert scale items were treated as continuous variables in exploratory factor analyses, confirmatory factor analyses and structural equation modelling analyses[245, 246].

Table 3.1: Socio-demographic data cleaning and new variable generation

| Variable | Type | Coding |
|---|---|---|
| Participant identification | Nominal | All participants were assigned an ID prior to cleaning data and removing ineligible records |
| Recruitment period | Nominal | This variable was used to test differences between recruitment periods<br>0 = 2015, 1 = 2017 |
| Completer status | Nominal | Used to filter only completers for main analyses<br>0 = completer (completing entire survey), 1 = partial completer (completed PFAQ but not all demographic variables), 2 = non-completer (did not complete PFAQ items) |
| Parent gender | Nominal | 0 = female, 1 = male |
| Parent age | Scale | Response given in years |
| State of residency | Nominal | 1 = Australian Capital Territory, 2 = Northern Territory, 3 = Queensland, 4 = South Australia, 5 = Tasmania, 6 = Victoria, 7 = Western Australia, 8 = New South Wales |
| Number of children living at home | Nominal | 1 = 1 child, 2 = 2 children, 3 = 3 children, 4 = 4 children, 5 = more than 4 children |
| Child age in years | Scale | Calculated from date of birth, adjusted to complete years.<br>Used to determine ineligible respondents |
| Child gender | Nominal | 0 = female, 1 = male |
| Relationship of participant to child | Nominal | Other response option was used to determine ineligible respondents<br>1 = mother, 2 = father, 3 = caregiver, 4 = other |
| Medically indicated special diet | Nominal | Types of special diets were used to determine ineligible respondents<br>1 = no, 2 = yes (details of diet provided) |
| Education setting | Nominal | 1 = child care, 2 = family day care, 3 = kindergarten, 4 = primary school, 5 = n/a |
| Child weight status | Ordinal | BMI z-score excel using LMSgrowth excel add-in<br>Categorised as:<br>1 = underweight <18.5, 2 = healthy weight ≥18.5 to 24.9, 3 = overweight ≥25.0 to 29.9, 4 = obesity ≥30.0 |
| Parental confidence in reported height | Ordinal | Variable used as a descriptive indicator of suitability of self-reported weight status measures<br>Likert scale: 1 = not at all confident, 2 = somewhat confident, 3 = confident, 4 = extremely confident |
| Parental confidence in reported weight | Ordinal | Variable used as a descriptive indicator of suitability of self-reported weight status measures<br>Likert scale: 1 = not at all confident, 2 = somewhat confident, 3 = confident, 4 = extremely confident |
| Weighed/measured in past 6mths | Nominal | Variable used as a descriptive indicator of suitability of self-reported weight status measures<br>1 = yes, 2 = no |
| Marital status | Nominal | Variable was also dummy coded to married/living as married or other<br>1 = single/never married, 2 = married, 3 = living as married, 4 = separated/ divorced, 5 = widowed |
| Parent education | Ordinal | 1 = didn't go to school, 2 = primary school, 3 = some high school, 4 = completed high school, 5 = tech or trade qualification (including TAFE), 6 = tertiary degree (e.g. university), 7 = post graduate degree |
| Parent employment | Nominal | Categorised employment into employed (part or full time) and not employed<br>1 = employed full time, 2 = employed part time, 3 = unemployed, 4 = full time home maker, 5 = retired, 6 = student, 7 = disabled or too ill to work, 8 = volunteering / unpaid work |
| Household income | Ordinal | 1 = less than \$20,800, 2 = \$20,800 to \$36,399, 3 = \$36,400 to \$51,999, 4 = \$52,000 to \$77,999, 5 = \$78,000 to \$103,999, 6 = \$104,000 to \$114,399, 7 = \$144,400 and over, -1 = I'd prefer not to answer (missing data) |

Abbreviations: ABS: Australian Bureau of Statistics; BMI: body mass index; ID: identification; PFAQ: Parental Food Attitude Questionnaire

Table 3.1: Socio-demographic data cleaning and new variable generation (cont.)

| Variable | Type | Coding |
|---|---|---|
| SEIFA | Ordinal | Postcode was matched to SEIFA. Grouped into tertiles: low 588—953, medium 954—1018, high 1019—1191 SEIFA |
| Urban/rural status | Nominal | Postcode was matched to ABS Postcode to Remoteness Area spreadsheet<br>1 = major cities, 2 = rural and regional |
| Parent weight status category | Ordinal | BMI was calculated using weight (kg) / height ($m^2$)<br>Categorised as:<br>1 = underweight <18.5, 2 = healthy weight ≥18.5 to 24.9, 3 = overweight ≥25.0 to 29.9, 4 = obesity ≥30.0 |
| Parental general nutrition knowledge | Scale | Calculated total nutrition knowledge score using scoring criteria guide<br>Total score out of 14 (1 = low score, 14 = high score) |
| **Short Food Survey key variables** | | |
| DGI-CA total child diet quality score | Scale | DGI-CA total diet quality score /100 (100 = 100% compliance with the dietary guidelines) |
| Mean serves of unhealthy foods | Scale | Used as a proxy for parent provision of unhealthy foods<br>Daily mean serves (1 serve = 600kJ) |

Abbreviations: DGI-CA: Dietary Guideline Index for Children and Adolescents; SEIFA: Socio-Economic Indexes for Areas

Table 3.2: Parental Food Attitude Questionnaire variable coding

| Construct | Item | Type | Response option coding |
|---|---|---|---|
| Risk perception – absolute risk | comparison with dietary guidelines | Ordinal[1] | 1 = higher, 2 = slightly higher, 3 = same, 4 = slightly lower, 5 = lower, -1 = I don't know guidelines (missing data) |
| | child's activity levels | Ordinal | 1 = higher, 2 = slightly higher, 3 = same, 4 = slightly lower, 5 = lower |
| | child's overall diet | Ordinal | |
| | other children the same age | Ordinal | |
| | other children the same size | Ordinal | |
| Risk perception – general severity assessment | being overweight | Ordinal | 1 = not at all serious, 2 = somewhat serious, 3 = moderately serious, 4 = serious, 5 = very serious |
| | tooth decay | Ordinal | |
| | behavioural issues | Ordinal | |
| | too much energy and associated nutrients | Ordinal | |
| Risk perception – absolute risk for my child | becoming overweight | Ordinal | 1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, 5 = strongly agree |
| | developing tooth decay | Ordinal | |
| | having behavioural issues | Ordinal | |
| | eating too much energy and associated nutrients | Ordinal | |
| Positive outcome expectancies | 'good' parent | Ordinal | 1 = not at all true, 2 = somewhat true, 3 = mostly true, 4 = exactly true |
| | be healthy | Ordinal | |
| | save money on food shopping | Ordinal | |
| | healthy eating habits | Ordinal | |
| | eat more fruit and vegetables | Ordinal | |
| | environmentally-friendly | Ordinal | |
| Negative outcome expectancies[2] | throw a tantrum or pester | Ordinal | 1 = exactly true, 2 = mostly true, 3 = somewhat true, 4 = not at all true |
| | spend more time | Ordinal | |
| | adjust my own intake of unhealthy foods | Ordinal | |
| | miss out on treats | Ordinal | |
| | affect family time | Ordinal | |
| | restricting enjoyment of food | Ordinal | |
| | overeat unhealthy foods when available | Ordinal | |
| | miss out on eating what their friends eat | Ordinal | |
| Action self-efficacy | Action self-efficacy | Ordinal | 1 = not at all confident, 2 = somewhat confident, 3 = moderately confident, 4 = extremely confident |
| Intention | Intention | Ordinal | 1 = don't intend at all, 2 = somewhat intend, 3 = moderately intend, 4 = strongly intend |

[1] Ordinal responses were treated as scale for factor analysis and structural equation modelling.
[2] Note negative outcome expectancies were reverse scored.

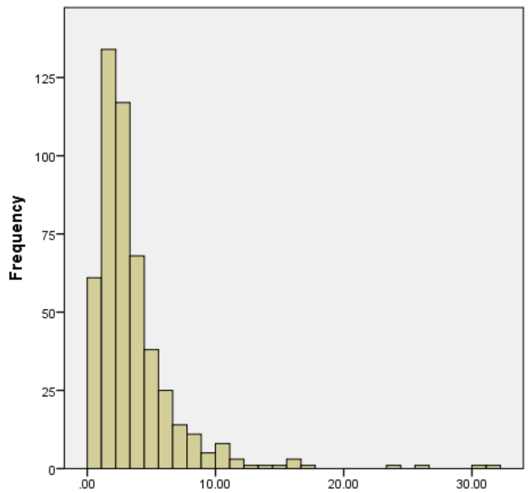
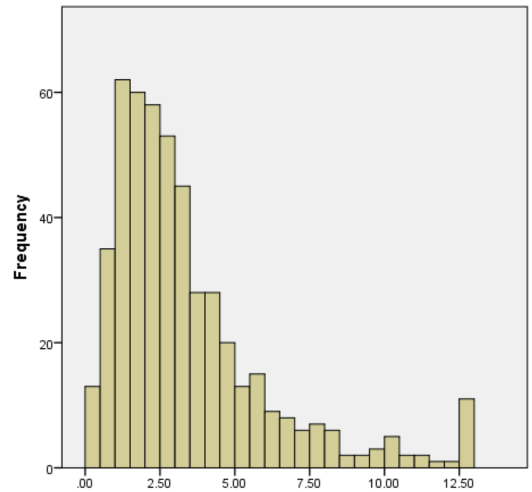
Table 3.2: Parental Food Attitude Questionnaire variable coding (cont.)

| Construct | Item | Type | Response option coding |
|---|---|---|---|
| Maintenance self-efficacy | child is pestering for unhealthy foods | Ordinal[1] | 1 = not at all confident, 2 = somewhat confident, 3 = moderately confident, 4 = extremely confident |
| | child resistant to limiting unhealthy foods | Ordinal | |
| | you are tired | Ordinal | |
| | having a very busy day | Ordinal | |
| | partner is undermining you | Ordinal | |
| | financial pressures | Ordinal | |
| | school/child care holidays | Ordinal | |
| | consume unhealthy foods around child | Ordinal | |
| | takes a long time to make habit | Ordinal | |
| | food marketing on television | Ordinal | |
| | parents/relatives continue to bring unhealthy foods | Ordinal | |
| | having family time | Ordinal | |
| | child has strong liking for unhealthy foods | Ordinal | |
| Action planning | weekdays | Ordinal | 1 = not at all true, 2 = somewhat true, 3 = mostly true, 4 = exactly true |
| | weekend | Ordinal | |
| | packing lunchbox | Ordinal | |
| | buying takeaway meals and snacks | Ordinal | |
| | home with visitors | Ordinal | |
| | celebrating a special occasion | Ordinal | |
| | people bring food to my home | Ordinal | |
| Coping planning | child asks for unhealthy foods | Ordinal | 1 = not at all true, 2 = somewhat true, 3 = mostly true, 4 = exactly true |
| | certain situations | Ordinal | |
| | friends undermine my plans | Ordinal | |
| | relatives undermine my plans | Ordinal | |
| | set-backs when unhealthy foods have been provided | Ordinal | |
| Recovery self-efficacy | small relapse (2 days) | Ordinal | 1 = not at all confident, 2 = somewhat confident, 3 = moderately confident, 4 = extremely confident |
| | moderate relapse (2—6 weeks) | Ordinal | |
| | large relapse (weeks—months) | Ordinal | |

[1] Ordinal responses were treated as scale for factor analysis and structural equation modelling

The final sample consisted of parents who had completed the survey (completers) from both recruitment waves. Normality tests were performed on the final combined sample. Extreme outliers were identified through box-whisker plots, and by reviewing histograms for data points sitting alone. Extreme outliers identified in children's mean serves of unhealthy foods were censored to one unit above the closest plausible response within two standard deviations of the mean (Table 3.3)[245, 247].

Table 3.3: Extreme outlier management in mean serves of unhealthy foods variable

| Prior to censoring outliers | After censoring outliers |
|---|---|
|  |  |
| Mean 3.58 (SD 3.48)[1]<br>Median 2.66<br>Min 0.00 to Max 32.14<br>Skewness 3.86 (SE 0.11)<br>Kurtosis 22.48 (SE 0.22) | Mean 3.41 (SD 2.62)<br>Median 2.66<br>Min 0.00 to Max 12.53<br>Skewness 1.67 (SE 0.11)<br>Kurtosis 2.79 (SE 0.22) |

[1] Initial output revealed a mean of 3.58 (SD 3.48), therefore +3SD from the mean was 14.02. Participants with mean serves above this value are censored to one value above the last participant <14.02 (mean serves 12.52).

After censoring outliers mean serves of unhealthy foods (key outcome variable) remained skewed. To maintain a continuous outcome variable, the option to transform the scale outcome measure was selected. For robustness other measures such as an indicator of meeting or exceeding the Australian Dietary Guidelines recommendations (≤2 serves: mean 1.3, SD 0.5; >2 serves: mean 4.5, SD 2.6) and a categorical variable of tertiles of unhealthy foods were also considered (low: mean 1.3, SD 0.5; moderate: mean 2.7, SD 0.4; high: mean 6.3, SD 2.6). Two methods of transformation were tested, namely square root and log, with both resulting in the median serves of unhealthy foods 1.6 (range 3.5; skewness 0.7, SE 0.1; kurtosis 0.5, SE 0.2). All models were performed using the untransformed (skewed) scale outcome variable and then repeated with the transformed outcome variable. Key findings are presented using transformed mean unhealthy food serves.

Structural equation modelling requires no missing data points. Final data preparation included inputting missing data for items with structured missing data (risk perception sub-item *'I don't know the dietary guidelines'*; household income '*I'd prefer not to answer*') or where implausible responses were removed. Other missing data were imputed using the full information maximum likelihood missing data function in SPSS, which uses individual response patterns to assign an appropriate value for the missing data point. Approximately 30% of respondents had one or more missing data points. The most common missing variables were household income, a risk perception sub-item, and parent or child weight status—due to missing weight, height or both. Only six respondents (of 495, 1.2%) were missing more than two data points (Table 3.4). Descriptive statistics were repeated with the final sample prior to inputting missing data. As Little's Missing Completely at Random test was significant ($p$=0.21) a sensitivity analysis was performed on the sub-sample of participants with no missing data, to examine the final confirmatory structural equation model without inputting missing data points.

Table 3.4: Frequency of missing data points per participant within the final sample (n=495)

| Number of missing responses | Frequency (%) |
|---|---|
| 0 | 339 (68.5) |
| 1 | 133 (26.9) |
| 2 | 17 (3.4) |
| 3 | 5 (1.0) |
| 5 | 1 (0.2) |

### 3.3.2. Statistical analysis

Descriptive statistics were performed with continuous data presented as mean (SD) or median (IQR, for skewed data), and percentage (count) for categorical variables. Statistical significance was considered at $p<0.05$. Sample differences were examined between completer status (completer: all responses; partial-completer: <75% of survey [end of the PFAQ]; non-completer: <50% [end of short food survey]), recruitment waves (2015 vs 2017), and reported special diet using chi-square test, one-way ANOVA or Kruskal-Wallis. As there were no meaningful differences between the recruitment waves it was deemed appropriate to combine samples to make up the final sample.

Parental Food Attitude Questionnaire responses were described by frequencies, expressed as counts (percentage). Constructs for risk perception were rated on a five-point scale. For *Risk perception 1 (absolute risk)* and *Risk perception 2 (general severity assessment)* item ratings of three to five were considered favourable. Whereas *Risk perception 3 (absolute risk for my child)* item ratings of four or five were considered favourable with a rating of three signifying neither agree nor disagree. All remaining reflective motivational constructs were rated on a four-point scale, with ratings of three or four considered favourable towards limiting unhealthy foods. Sensitivity analyses were performed by reviewing parental motivation ratings for a subgroup of parents residing in the low socio-economic areas (i.e. low SEIFA tertile) and comparing patterns of parental ratings with whole sample findings.

#### ***Exploratory Factor Analysis***

Exploratory factory analysis informed the measured variables to be tested per latent construct. Analyses were performed in IBM SPSS (Version 25; SPSS Inc., Chicago, IL, USA). Exploratory factory analyses reduces the individual items by collapsing to factors composed of similar items[248]. Hence, exploratory factory analysis was used to check the Parental Food Attitude Questionnaire sub-items load with the theorised corresponding reflective motivation latent construct. Data suitability for exploratory factor analyses was confirmed using the following cut offs[249]: 1) inter-item correlations of >0.3, to assess there were sufficient inter-item correlations; 2) Kaiser-Meyer-Olkin measure of sampling adequacy >0.90, indicating sufficient sample of participants; and 3) significant Bartlett's test of Sphericity ($p$<0.05), assessing whether the sample correlation matrix differs significantly from the identity matrix, rejecting the null hypothesis that variables are uncorrelated.

Analyses were performed using principal axis factoring extraction with direct oblimin rotation with Kaiser normalisation as there was a slight skewness of the items[245]. The number of factors to retain was based on standardised processes of: Eigenvalues >1.0, between 50—60% of the variance explained by the factors, examination of the scree plot by counting the number of factors above the scree, and theoretical interpretation of the factor structure[249]. Communalities were also examined to determine the suitability of individual items, with communalities <0.3 indicating the item has little in common with the proposed factors[249]. Following selection of factors to retain forced seven and nine factor solutions were performed, with factor scores <0.3 supressed and factor scores of >0.4 considered meaningful[249]. Pattern matrices were examined considering the theoretical interpretation. Inter-item reliability was examined by Cronbach's alpha (>0.7 acceptable) and change in Cronbach's alpha value if an item were to be removed. Both the seven and nine factor solutions were taken forward to confirmatory factor analysis following the removal of three items based on consistently low communalities, and separation of two single measured items.

#### ***Confirmatory Factor Analysis***

Confirmatory factor analysis is used to assess whether theoretical constructs are supported by the data and accounts for multi-dimensional factors with two or more factor constructs[241]. This method was used to confirm a theoretical latent construct and formed the first step of structural equation modelling to ensure the measurement side of the model was an appropriate fit before combining latent constructs in the theoretical model. Both confirmatory factor analysis and structural equation modelling were performed using IBM SPSS AMOS Graphics (Version 25; SPSS Inc., Chicago, IL, USA). One factor models—per latent construct—were first performed for each factor as per the seven and nine exploratory factor analyses factor solutions. Once appropriate model fit and resulting final factor composition was found grouping measured items per latent construct, the one factor models were combined to form the HAPA motivational and volitional phases.

Confirmatory factor analysis was performed using the following procedure to examine item suitability, or otherwise, and model fit[243]. This procedure was repeated for each one factor model.

1. Model conceptualisation

   Items were grouped into one factor models based on exploratory factor analysis structure outputs to measure the related theoretical construct. When an item cross-loaded with another factor the model was repeated including the additional cross-loading items. Theoretical guidance was also followed throughout confirmatory factor analyses, whereby any data driven removal or addition was always checked against theoretical appropriateness before a decision was made.

2. Path diagram construction and model specification

   One factor models per motivational construct were drawn in AMOS Graphics with the corresponding error terms for each Parental Food Attitude Questionnaire item. Within each model the latent construct was assigned the reference variable with a fixed value of 1.

3. Model identification

   Each one factor model was checked to ensure it met the over-identified criteria with positive degrees of freedom. When required, two factors were examined together to meet this criterion, such as including a final factor model with an under-identified model to be tested.

4. Parameter estimation

   Maximum likelihood estimation method was used in all confirmatory factor analyses. Outputs were examined to determine the feasibility of parameter estimates and to ensure there were no unreasonable estimates. For example, correlations >1.0, negative variances, or covariance or correlation matrices that were not positive definite, were used as an alert to an error in the model. Standardised errors were examined to check they were not excessively large or small. As there is no established cut off, patterns were examined between items in a model. Statistical significance of parameter estimates were reviewed to ensure the critical ratio was > +/- 1.96. The critical ratio test checks if the estimate is statistically different to zero.

5. Model of fit assessment

   There are a number of model of fit statistics available each with limitations, therefore it is recommended a few statistics should be used to determine model fit[241]. Selected fit statistics are outlined in Table 3.5 and corresponding cut offs from the literature[224, 243, 250]. Suitability of model fit was determined by a combination of tests close to the suggested cut offs and by examining change in model fit between re-specification model manipulations.

Table 3.5: Model of fit statistics and assessment cut offs[1]

| Test | Assessment cut off | Relevant notes |
|---|---|---|
| Chi-squared ($X^2$)<br>Global fit assessment<br>Reported as $X^2$, df, p value | Non-statistically significant<br>p>0.05 | Provides the difference between the unrestricted and restricted sample covariance matrix.<br>Tends to be inflated with large sample sizes or skewed data. |
| Root Mean Squared Error of Approximation (RMSEA) | Value equal or less than 0.05 (up to 0.08)<br>PCLOSE >0.05 | Can examine 90% CI range to add confidence<br>Takes into account the error of approximation in the population<br>PCLOSE tests the closeness of fit |
| Tucker Lewis Index (TLI) | Value close to 0.95 | Assesses relative fit and ranges from 0 to 1 |
| Comparative Fit Index (CFI) | Value close to 0.95 | Assesses normed fit, compares the hypothesized model with the independence mode and ranges from 0 to 1 |
| Standardised Root Mean-square Residual (SRMR) | Value less than 0.6 | Average value across all standardised residuals and ranges from 0 to 1 |

[1] Content adapted from Byrne[243], Hu and Bentler[250], and Schumacker and Lomax[224]

6. Model re-specification

   Model re-specification is a process of small manipulations to the model to improve the model fit within the theoretical bounds. Following each manipulation by removal of an item or addition of covariance the model fit was re-examined. This cycle of manipulation and model assessment was repeated with the smallest number of manipulations from the theorised model. A model can be manipulated in a number of ways. The following approach was used:

   a. Reviewed unstandardised regression weights: > +/- 1.96 and *p*<0.05. Items were removed one at a time if they were inconsistent with the unstandardised regression weight cut offs.

   b. Reviewed standardised residual covariances: > +/- 1.96. A large value suggests the association between the two items is not sufficiently captured by the model, highlighting there may be two constructs present.

   c. Reviewed squared multiple correlations: Items with the lowest value, therefore smallest variance explained, were removed. A squared multiple correlation of <0.3 is considered a poor measure, 0.3—0.5 weak but appropriate measure, and >0.5 reflects the factor well.

   d. Reviewed modification indices: The highest covariance that made theoretical sense was added, as judged by modification indices and positive parameter change. Adding a covariance was essentially splitting the factor into two constructs. If splitting a factor was support by model fit assessment the items were re-drawn to differentiate the two constructs.

Once deemed a suitable fit within theoretical confines there were no additional adjustments to the model. For models where items were split into two or more constructs an additional test for discriminant validity was performed to ensure the items were truly measuring different constructs[245]. To examine discriminant validity the covariance between the two factors (latent constructs) was constrained to one and the chi-square test compared between the freely estimated and constrained models. A significantly worsened chi-square test in the constrained model supports separating items to multiple factors[245]. All one factor construct models were combined to form one measurement model per HAPA phase—motivational and volitional phases—and model fit statistics repeated.

***Structural Equation Modelling***

Structural equation modelling involves two stages: 1) the measurement stage that involves confirmatory factor analysis—as was completed in the previous section; and 2) the structural stage where the relationship between variables are examined and the theorised models tested[243]. The structural stage analyses were undertaken through a similar process to confirmatory factor analysis, with additional processes to prepare composite variables for inclusion complex models and the inclusion of the structural paths.

Second order confirmatory factor analysis and structural equation modelling

*Model conceptualisation*

As per confirmatory factor analyses the first step involved model conceptualisation. The motivational constructs from confirmatory factor analysis were structured as per the HAPA framework motivational and volitional phases (Figure 3.1). In the theorised model children's mean serves of unhealthy foods was the outcome variable. The complete HAPA model was built in a stepwise approach, first modelling the second order latent constructs, before combining the latent variables and measured items from both the motivational and volitional phases. Results are presented for the second order latent constructs and for the HAPA model. It was hypothesised the data would support the HAPA model as depicted in Figure 3.1.

Exploratory structural equation models were performed testing an alternative theoretical model and following data driven approaches. The alternative theoretical model was used to examine the intention-behaviour gap, by considering a model similar to the Theory of Planned Behaviour[205]. All volitional phase constructs were removed from the model, resulting in a direct path from intention to intake, to allow comparisons with the complete HAPA model outputs. The data driven approaches included adding paths as per modification indices or removing non-significant paths, to produce alternative models similar to the theorised HAPA model. Model suitability was determined by assessing if the data-driven model made theoretical sense or if it supported the original HAPA model.

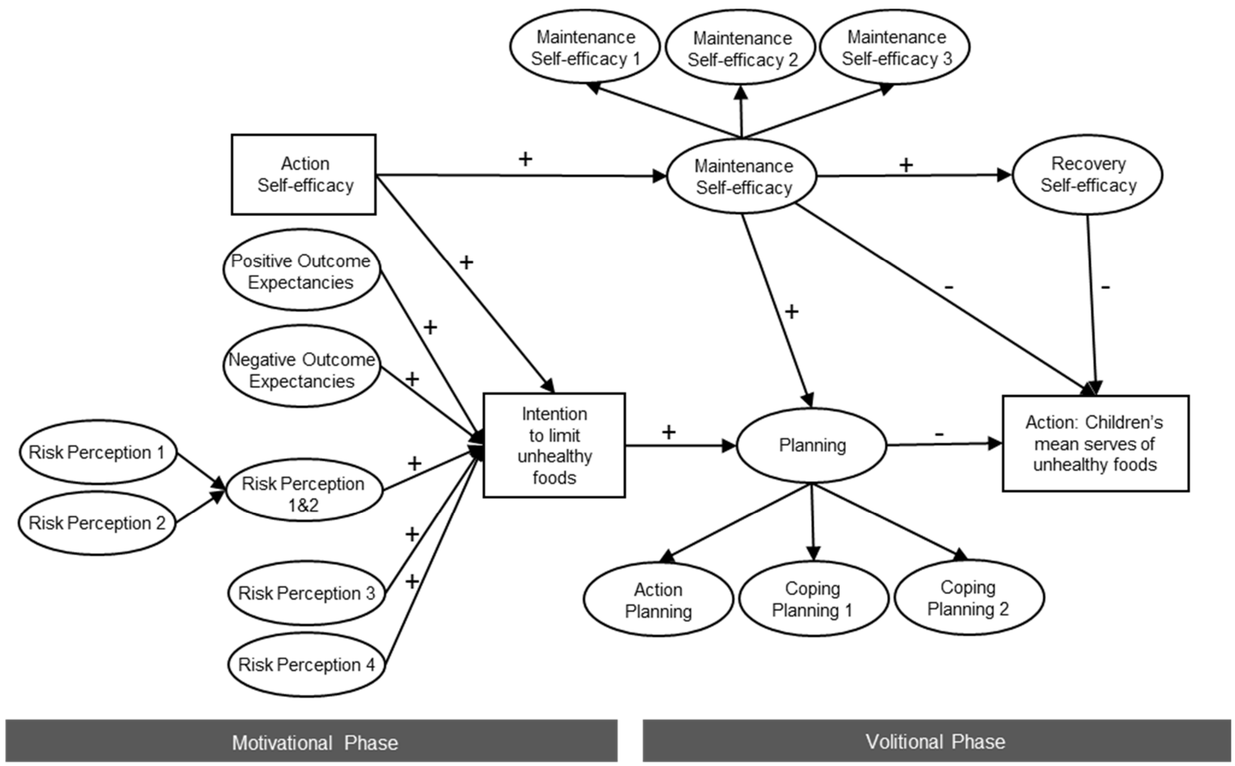



Figure 3.1: Theorised Health Action Process Approach model to examine using structural equation modelling

Adapted from Schwarzer[208].
Rectangles represent measured constructs; ellipses represent latent constructs; + represents hypothesised positive relationship; – represents a negative relationship between variables.

Prior to performing the structural equation analyses, several processes were undertaken to prepare the data for incorporating into the complex model. Processes included the creation of composite variables for motivational constructs, examining the correlations within motivational constructs, and between structural equation model inputs and the outcome variables. Each of these processes are detailed in the following sections.

*Creating composite motivational constructs*

Composite variables were created for each motivational construct to allow for sufficient sample size to test the complex model[251]. To determine the most suitable method for creating these composites one factor models were used in assessing if a construct was parallel or congeneric and model of fit compared[245]. Parallel constructs are where all factor loadings were constrained to equal, whereas congeneric constructs are where factor loadings could be freely estimated and differ in value[245]. All one factor models except for *Maintenance self-efficacy 2* and *3* were found to be congeneric (i.e. unequal factor loadings) (Appendix 6). Therefore, weighted composites were created using rescaled factor score weights, and descriptive statistics performed to understand the data and identify construct standard deviations for use in parameter value calculations (Appendix 6). Construct reliability was calculated using Cronbach's alpha, which assumes a factor is parallel, therefore likely underestimation; and coefficient H, which does not assume the item is parallel, calculated from the standardised regression weights. A Microsoft Excel parameter calculator was used to determine the factor loading (standard deviation * √ coefficient H) and error variance (standard deviation$^2$ * [1 – coefficient H]) for each construct using the construct standard deviation and coefficient H reliability value (Appendix 6)[245]. A summary of all predictor variables included in the structural equation modelling is provided in Appendix 6.

*Examining correlations between structural equation modelling variables*

Pearson's correlations were performed to examine the associations between motivational constructs and children's serves of unhealthy foods (Table 3.6). The strongest correlations were observed between *Risk perception 1* and *2* ($r$ = .64, $p$=0.001), *Maintenance self-efficacy 1, 2* and *3* ($r$ = .63—.69, $p$=0.001), and *Coping planning 1* and *2* ($r$ = .67, $p$=0.001). These strong correlations along with the theoretical framework structure suggest second order latent constructs for risk perception, maintenance self-efficacy and planning. Models were examined for each potential higher order construct, namely risk perception including all four composite constructs, maintenance self-efficacy including all three composite constructs, and planning containing action planning and the two coping planning composite constructs. Model fit was examined along with squared multiple correlations and factor score weights to check for similar weights greater than 0.5. Resulting second order latent variables were included in the final models.

Table 3.6: Pearson's correlations between structural equation modelling variables

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Mean unhealthy food serves[1] | 1 | | | | | | | | | | | | | | |
| 2. Risk perception 1 | -.22$^{**}$ | 1 | | | | | | | | | | | | | |
| 3. Risk perception 2 | -.13$^{**}$ | **.64**$^{**}$ | 1 | | | | | | | | | | | | |
| 4. Risk perception 3 | -.06 | .10$^{*}$ | .10$^{*}$ | 1 | | | | | | | | | | | |
| 5. Risk perception 4 | -.19$^{**}$ | .14$^{**}$ | .16$^{**}$ | .22$^{**}$ | 1 | | | | | | | | | | |
| 6. Positive outcome expectancies | -.18$^{**}$ | .17$^{**}$ | .22$^{**}$ | .25$^{**}$ | .35$^{**}$ | 1 | | | | | | | | | |
| 7. Negative outcome expectancies | -.16$^{**}$ | .26$^{**}$ | .18$^{**}$ | .05 | .09$^{*}$ | .05 | 1 | | | | | | | | |
| 8. Action self-efficacy | -.32$^{**}$ | .40$^{**}$ | .43$^{**}$ | .15$^{**}$ | .25$^{**}$ | .29$^{**}$ | .35$^{**}$ | 1 | | | | | | | |
| 9. Intention | -.23$^{**}$ | .29$^{**}$ | .35$^{**}$ | .18$^{**}$ | .32$^{**}$ | .34$^{**}$ | .17$^{**}$ | .47$^{**}$ | 1 | | | | | | |
| 10. Maintenance self-efficacy 1 | -.23$^{**}$ | .38$^{**}$ | .35$^{**}$ | .07 | .13$^{**}$ | .15$^{**}$ | .36$^{**}$ | **.55**$^{**}$ | .32$^{**}$ | 1 | | | | | |
| 11. Maintenance self-efficacy 2 | -.20$^{**}$ | .32$^{**}$ | .35$^{**}$ | .11$^{*}$ | .12$^{**}$ | .15$^{**}$ | .32$^{**}$ | **.55**$^{**}$ | .29$^{**}$ | **.69**$^{**}$ | 1 | | | | |
| 12. Maintenance self-efficacy 3 | -.16$^{**}$ | .32$^{**}$ | .35$^{**}$ | .10$^{*}$ | .09$^{*}$ | .14$^{**}$ | .31$^{**}$ | .49$^{**}$ | .28$^{**}$ | **.66**$^{**}$ | **.63**$^{**}$ | 1 | | | |
| 13. Action planning | -.26$^{**}$ | .39$^{**}$ | .38$^{**}$ | .20$^{**}$ | .22$^{**}$ | .26$^{**}$ | .29$^{**}$ | **.55**$^{**}$ | .41$^{**}$ | **.50**$^{**}$ | **.53**$^{**}$ | .45$^{**}$ | 1 | | |
| 14. Coping planning 1 | -.11$^{*}$ | .25$^{**}$ | .18$^{**}$ | .08 | .05 | .07 | .25$^{**}$ | .34$^{**}$ | .20$^{**}$ | .45$^{**}$ | .38$^{**}$ | .39$^{**}$ | .40$^{**}$ | 1 | |
| 15. Coping planning 2 | -.13$^{**}$ | .32$^{**}$ | .26$^{**}$ | .15$^{**}$ | .12$^{**}$ | .20$^{**}$ | .32$^{**}$ | .48$^{**}$ | .31$^{**}$ | **.56**$^{**}$ | **.53**$^{**}$ | **.50**$^{**}$ | **.56**$^{**}$ | **.67**$^{**}$ | 1 |
| 16. Recovery self-efficacy | -.20$^{**}$ | .29$^{**}$ | .32$^{**}$ | .06 | .11$^{*}$ | .15$^{**}$ | .31$^{**}$ | **.50**$^{**}$ | .24$^{**}$ | **.50**$^{**}$ | **.56**$^{**}$ | .48$^{**}$ | .49$^{**}$ | .34$^{**}$ | .49$^{**}$ |

[1] Transformed children's mean serves of unhealthy foods

$^{*}$ Correlation is significant at the 0.05 level (2-tailed); $^{**}$ Correlation is significant at the 0.01 level (2-tailed)

**Bold** text indicates a large correlation >.5[244]

*Path diagram construction and model specification*

The theorised model was drawn in IBM SPSS AMOS Graphics, as per Figure 3.1 including the second order constructs, with the composite factor loadings and error variances added for each latent motivational construct. All composites were treated as continuous scores for the construct of interest. All exogenous variables within the model were correlated as per the general assumption of structural equation modelling, and all mediating variables were given a residual term[245]. A covariance was added between the residual terms of the latent variables *Coping planning 1* and *2* to indicate the sub-domain of coping planning within the higher order planning construct.

*Model identification*

The model was checked as per in confirmatory factor analysis to ensure it met the criteria for over-identification with positive degrees of freedom, by using p(p+1)/2 and counting the number of model data points and number of parameters to be estimated including regression coefficients, measurement error variances, and residual error terms.

*Parameter estimation*

Structural equation models were estimated using maximum likelihood estimation method. Several analyses were selected including: standardised estimates, squared multiple correlations, sample moments, implied moments, residual moments, modification indices, and indirect, direct and total effects. Once estimates had been calculated outputs were examined to determine the feasibility of parameter estimates by checking parameters showed the sign and size consistent with the theory, and to ensure there were no unreasonable estimates. Statistical significance of parameter estimates were reviewed, with a p value greater than 0.05 indicating the path was not significant at the five percent level of significance in the current data sample. Bootstrap procedure, of 500 samples, for bias-corrected confidence intervals was used to obtain significance of overall indirect effects from within the model. Though it should be noted these estimates may be inaccurate with smaller sample sizes[241].

*Model of fit assessment*

Model of fit assessment was examined using the same model of fit statistics as in the confirmatory factor analysis stage. The selected model of fit statistics have been outlined in Table 3.5. Suitability of model fit was again determined by a combination close to the suggested cut offs and by examining change in model fit between re-specification manipulations.

## 3.4. Results

### 3.4.1. Participant characteristics and intake of unhealthy foods

Seven-hundred and sixty-six parents commenced the online survey, with a 67% completion rate, resulting in 495 parents completing to the entire questionnaire—considered completers (Figure 3.2). There were no significant differences in the demographic characteristics, including parent and child age and gender, between completer, partial-completers and non-completers (data not presented). Twenty-eight participants were excluded due to ineligible child age (below 3.0yo: n=17; above 7.9yo: n=4), respondent was not the study child's parent (n=1), or medically indicated special diet precluding the Australian Dietary Guidelines (n=6). This exceeded the initial estimated sample size requirements.

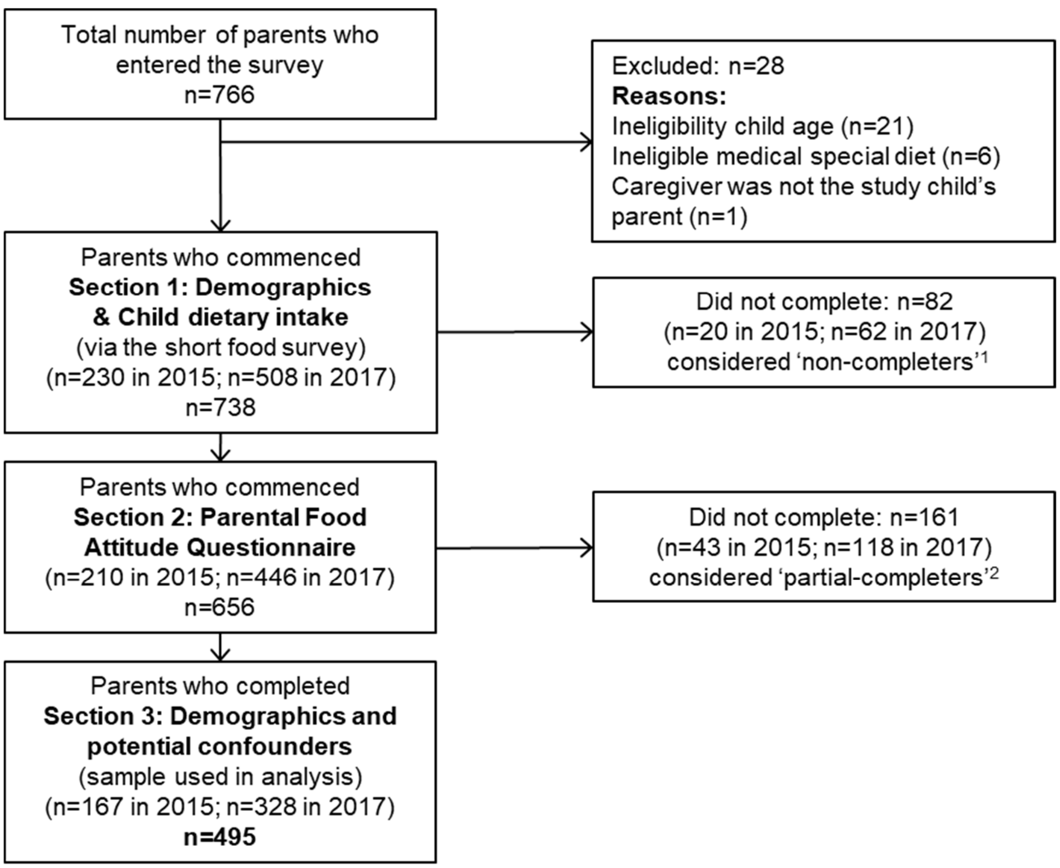



Figure 3.2: Flow of parent completion of the online survey

[1] Non-completers were excluded from all analyses.
[2] Partial-completers, completed more than 50% of the survey

In addition to medical special diets precluding the Australian Dietary Guidelines, several other special diets were reported. For example, dairy avoidance or nut allergies. Whilst dietary guidelines are still applicable to these children, comparisons were conducted between children in the final sample reporting no special diet and children who were eligible but reported special diets (n=41). There were no significant differences between these groups in any socio-demographic characteristics or outcome variable, giving confidence in their inclusion in the final sample data analyses (data not presented).

Socio-demographics were examined between recruitment waves revealing slight differences in parent and child characteristics primarily aligned with a change in child eligibility to include three-year-old children in 2017 (Table 3.7a and b). Specifically, differences were seen for child age with a significantly younger sample in 2017 than 2015 (2015: 5.6 [SD 1.1] vs 2017: 5.1 [SD 1.3], $p<0.001$). Consistent with this education setting was also significantly different ($p<0.001$) where more reported child care attendance (2015: 18.6% vs 2017: 23.5%) rather than primary school attendance in 2017. There were also significant differences not directly explained by the adjustment of eligibility in 2017, namely higher parent employment (employed part or full time 2015: 62.9% vs 2017: 71.6%, $p=0.029$), higher parent nutrition knowledge score (2015: mean 8.5 [SD 2.5] vs 2017: 9.0 [SD 2.4], $p=0.032$), more parents residing in non-metropolitan areas (2015: 19.2% vs 2017: 30.8%, $p=0.008$) and lower child serves of unhealthy foods (2015: median 2.80 [IQR 3.06] vs 2017: 2.64 [IQR 2.56], $p=0.025$) in the 2017 sample. The difference in nutrition knowledge and child serves of unhealthy foods could have been a true change in population over this time span, but more likely due to recruitment avenues, such as promotion of the study through nutrition focussed Facebook pages in 2017. Given the minimal number and small magnitude of the differences it was deemed appropriate to combine the two samples for analyses.

The final sample consisted of primarily mothers, with a mean age of 36.8 (SD 5.3) years, majority partnered, with higher education levels and higher household income, than the Australian population[228, 252]. There was a mixture of socio-economic position, yet the lowest tertile of socio-economic position was under represented. Children's intake of unhealthy foods was a median of 2.66 (IQR 2.69) serves. Children had a mean age of 5.3 (SD 1.6) years, with approximately half female (53%), and a mean total diet score of 70.82 (SD 10.07) suggesting approximately 70% compliance with the dietary guidelines. For full socio-demographic details see Table 3.7a and b.

Table 3.7a: Descriptive characteristics of parents (completers) 2015 and 2017

| Characteristic | Combined (n=495) | 2015 (n=167) | 2017 (n=328) | Test of difference[1] |
|---|---|---|---|---|
| Age, years (mean, SD) | 36.8 (5.3) | 37.2 (5.1) | 36.6 (5.4) | 0.142 |
| Gender (%, count) | | | | 0.400 |
| Male | 5.1 (25) | 7.8 (13) | 3.7 (12) | |
| Female | 94.9 (470) | 92.2 (154) | 96.3 (316) | |
| BMI[2] (mean, SD) | 26.0 (5.5) | 25.3 (4.8) | 26.3 (5.7) | |
| Weight status (%, count) | | | | 0.257 |
| Underweight | 1.3 (6) | 2.5 (4) | 0.6 (2) | |
| Healthy weight | 52.7 (252) | 55.6 (89) | 51.3 (163) | |
| Overweight | 28.0 (134) | 25.0 (40) | 29.6 (94) | |
| Obesity | 18.0 (86) | 16.9 (27) | 18.6 (59) | |
| Number of children living at home (<18 years old) (%, count) | | | | 0.260 |
| 1 | 16.4 (81) | 12.6 (21) | 18.3 (60) | |
| 2 | 54.9 (272) | 58.1 (97) | 53.4 (175) | |
| 3 | 22.2 (110) | 24.6 (41) | 21.0 (69) | |
| 4 or more | 6.4 (32) | 4.8 (8) | 7.4 (24) | |
| Relationship to child (%, count) | | | | **0.029** |
| Mother | 93.5 (463) | 89.8 (150) | 95.4 (313) | |
| Father | 5.1 (25) | 7.2 (12) | 4.0 (13) | |
| Caregiver or other | 1.4 (7) | 3.0 (5) | 0.6 (2) | |
| Marital status (%, count) | | | | 0.888 |
| Married / Living as married | 90.3 (447) | 89.8 (150) | 90.5 (297) | |
| Single / Separated | 9.7 (48) | 10.2 (17) | 9.5 (31) | |
| SEIFA[3] Index of Advantage and Disadvantage (%, count) | | | | 0.760 |
| Low | 19.2 (95) | 21.0 (35) | 18.3 (60) | |
| Medium | 33.4 (165) | 33.5 (56) | 33.3 (109) | |
| High | 47.4 (234) | 45.5 (76) | 48.3 (158) | |
| Education level (%, count) | | | | 0.058 |
| High school completion or below | 7.6 (38) | 12.0 (20) | 5.4 (18) | |
| Tech or trade qualification | 18.6 (92) | 20.4 (34) | 17.7 (58) | |
| Tertiary degree or higher | 73.7 (365) | 67.6 (113) | 76.8 (252) | |
| Employment status (%, count) | | | | **0.037** |
| Employed | 68.7 (340) | 62.9 (105) | 71.6 (235) | |
| Not in the workforce[4] | 31.3 (155) | 37.1 (62) | 28.4 (93) | |
| Household income[5] (%, count) | | | | 0.491 |
| Less than $52,000 | 14.4 (64) | 15.8 (24) | 13.6 (40) | |
| $52,000 to $103,999 | 33.4 (149) | 34.9 (53) | 32.7 (96) | |
| $104,000 and over | 52.3 (233) | 49.4 (75) | 53.7 (158) | |
| Residential area (%, count) | | | | **0.008** |
| Metropolitan | 73.1 (362) | 80.8 (135) | 69.2 (227) | |
| Non-metropolitan | 26.9 (133) | 19.2 (32) | 30.8 (101) | |
| General nutrition knowledge (/14) | | | | **0.032** |
| Score (mean, SD) | 8.9 (2.4) | 8.5 (2.5) | 9.0 (2.4) | |
| *Range observed* | 0—14 | 0—13 | 1—14 | |
| State of residency (%, count) | | | | |
| South Australia | 38.4 (190) | 73.7 (123) | 20.4 (67) | |
| Victoria | 20.2 (100) | 13.2 (22) | 23.8 (78) | |
| New South Wales | 14.1 (70) | 2.4 (4) | 20.1 (66) | |
| Queensland | 13.5 (67) | 6.6 (11) | 17.1 (56) | |
| Western Australia | 5.9 (29) | 1.2 (2) | 8.2 (27) | |
| Australian Capital Territory | 3.4 (17) | 1.8 (3) | 4.3 (14) | |
| Tasmania | 2.8 (14) | 0.6 (1) | 4.0 (13) | |
| Northern Territory | 1.6 (8) | 0.6 (1) | 2.1 (7) | |

Abbreviations: BMI: body mass index; SEIFA: Socio-Economic Indexes for Areas; SD: standard deviation
[1] Chi-square, one-way ANOVA or Kruskal-Wallis based on data.
[2] Missing anthropometric responses for parent (2015 n=7, 2017 n=10, combined n=17).

[3] SEIFA scores were divided into tertiles low (588—953), medium (954—1018) and high (1019—1191) as per Australian Bureau of Statistics [228].
[4] Not in the workforce includes full time homemaker, student, volunteer work.
[5] Missing income responses (2015 n=15, 2017 n=34, combined n=49) 'I'd prefer not to answer'.

Table 3.7b: Descriptive characteristics of children (completers) 2015 and 2017

| Characteristic | Combined (n=495) | 2015 (n=167) | 2017 (n=328) | Test of difference[1] |
|---|---|---|---|---|
| Age, years (mean, SD) | 5.3 (1.3) | 5.6 (1.1) | 5.1 (1.3) | **<0.001** |
| Gender (%, count) | | | | 1.000 |
| Male | 47.5 (235) | 46.7 (78) | 47.9 (157) | |
| Female | 52.5 (260) | 53.3 (89) | 52.1 (171) | |
| BMI z-score[2] (mean, SD) | -0.15 (1.97) | 0.03 (1.81) | -0.25 (2.05) | |
| Weight status (%, count) | | | | 0.585 |
| Underweight | 22.8 (107) | 21.3 (34) | 23.5 (73) | |
| Healthy weight | 57.4 (270) | 55.0 (88) | 58.7 (182) | |
| Overweight | 12.1 (57) | 13.8 (22) | 11.3 (35) | |
| Obesity | 7.7 (36) | 10.0 (16) | 6.5 (20) | |
| Education setting attendance (%, count) | | | | **<0.001** |
| Child care centre | 22.9 (122) | 17.1 (31) | 25.9 (91) | |
| Family day care | 1.9 (10) | 0 (0) | 2.9 (10) | |
| Kindergarten | 21.1 (112) | 23.8 (43) | 20.0 (69) | |
| Primary school | 50.4 (268) | 58.6 (106) | 46.2 (162) | |
| n/a | 3.8 (20) | 0.6 (1) | 5.4 (19) | |
| Dietary intake | | | | |
| Median (IQR) mean serves of unhealthy foods per day | 2.7 (2.7) | 2.8 (3.1) | 2.6 (2.6) | **0.025** |
| DGI-CA total diet quality score[3] (mean, SD) | 70.8 (10.1) | 71.4 (10.3) | 70.5 (10.0) | 0.830 |
| Special diet (eligible for inclusion) (%, count) | | | | 0.250 |
| Yes | 8.3 (41) | 6.0 (10) | 9.5 (31) | |
| No | 91.7 (454) | 94.0 (157) | 90.5 (297) | |

Abbreviations: BMI: body mass index; DGI-CA: Dietary Guideline Index for Children and Adolescents; SD: standard deviation
[1] Chi-square, one-way ANOVA or Kruskal-Wallis based on data
[2] Missing anthropometric responses for child (2015 n=7, 2017 n=18, combined n=25); BMI z-score standardises BMI by age and gender. Parent confidence in reported height (49.5% (n=245) confident or extremely confident; 11.5% (n=57) not at all confident) and weight (61.4% (n=304) confident or extremely confident; 9.3% (n=46) not at all confident)
[3] DGI-CA maximum score 100, higher score indicates higher diet quality.

### 3.4.2. Objective 1: Describing parents' reflective motivation for reducing unhealthy food provision

Parental rating of motivational constructs (n=57 items) were obtained for the final (n=495) sample. The motivational phase (Table 3.8a) had overall more favourable ratings, than for the volitional phase (Table 3.8b). Ratings are presented as frequency and percentage, with ratings that related to higher provision of unhealthy foods considered unfavourable (i.e. 1—2). Ratings towards limiting provision of unhealthy foods considered favourable (i.e. 3—4 or 5). For risk perception items that included a five-point scale the middle rating (i.e. 3) was grouped as favourable. In these items a middle rating indicated provision that was, for example, in line with the dietary guidelines or children's activity levels, or indicated moderately serious concern for risks such as becoming overweight. Sensitivity analyses were performed by reviewing parental ratings for a subgroup of parents (n=95; 19% of sample) residing in the low socio-economic areas. Patterns of low socio-economic position parental ratings (Appendix 6) were primarily consistent with the overall sample, hence results for the whole sample (n=495) are presented here.

The first risk perception sub-item, asking parents to rate their child's intake of unhealthy foods compared to the Australian Dietary Guidelines recommendations (n=401), received a range of responses with majority of parents rating their child's consumption as slightly higher or the same as the guidelines. Generally, most parents rated very high awareness of risk (75 to 91% rating 3—5 out of 5), with the exception of perception to reduce their child's risk of '*behavioural issues*' (65%) and '*eating too much energy and associated nutrients*' (50%). There was a mixture of favoured (three sub-items) ratings for perceived positive outcomes of limiting unhealthy foods, and items not seen as a benefit to changing provision (three sub-items). The outcome expectancy relating to '*saving money*' by changing provision received more even ratings, indicating parents have differing views on the cost of unhealthy foods. Majority of negative outcomes were rated favourably, suggesting parents did not perceive them as barriers to changing provision (81—92%, rating 3—4 out of 4); with exceptions being '*spend more time*' (56%) and '*adjusting own intake*' (48%) rated relatively evenly between being seen as a barrier or not to reducing unhealthy foods. Action self-efficacy ranged from somewhat to extremely confident with a relatively even mix of parental ratings (somewhat 34%, moderately 25%, extremely 34% confident). Approximately half of parents reported moderately or strongly intention to change provision (53%).

In the volitional phase, maintenance self-efficacy ratings varied depending on the provision context. Consistently lower ratings were observed for contexts where parents also consume unhealthy foods around their child (42%), or relatives bringing unhealthy foods to their home (39%); compared with generally higher ratings of confidence in child pestering contexts (74% to 77%). In action planning, more parents rated having strategies for weekdays (77%) and lunchboxes (86%), and less for contexts with visitors (52%), special occasions (34%) and when others bring food to their home (33%). Coping planning was similar, with majority of parents rating they didn't have plans for when friends (55%) or family (65%) undermined their own plans. A greater percent of parents rated they had plans for immediate family contexts (54% to 74%). Parents' primarily rated the three sub-items of recovery self-efficacy as moderately or extremely confident (73% to 80%).

In summary, parents appeared to be aware of the risks of unhealthy foods, favourable outcome expectancies, that is they see more positives than negatives of limiting provision. Yet, there was a range of confidence levels (action self-efficacy) and only half of parents intended to change their provision. Even though the majority (66%) of children's intake of unhealthy foods were above the maximum recommended serves. Parents' confidence in the face of barriers (maintenance self-efficacy) and plans (action and coping planning) were lower when involving friends or relatives, or social and special occasions.

Table 3.8a: Parent ratings of HAPA motivational phase questionnaire items

| Item | Response frequency (%)[1] | | | | |
|---|---|---|---|---|---|
| | Unfavourable response[2] | | Favourable response[3] | | |
| | 1 | 2 | 3 | 4 | 5 |
| **Absolute risk perception^** | | | | | |
| child's activity levels | 10 (2.0) | 60 (12.1) | **249 (50.3)** | 85 (17.2) | 91 (18.4) |
| child's overall diet | 14 (2.8) | 89 (18.0) | **192 (38.8)** | 98 (19.8) | 102 (20.6) |
| other children the same age | 8 (1.6) | 43 (8.7) | 115 (23.2) | 154 (31.1) | **175 (35.4)** |
| other children the same size | 9 (1.8) | 34 (6.9) | **169 (34.1)** | 146 (29.5) | 137 (27.7) |
| *comparison with dietary guidelines[4]* | *44 (11.0)* | ***150 (37.4)*** | *101 (25.2)* | *54 (13.5)* | *52 (13.0)* |
| **General severity assessment** | | | | | |
| being overweight | 32 (6.5) | 68 (13.7) | 112 (22.6) | **210 (42.4)** | 73 (14.7) |
| tooth decay | 16 (3.2) | 28 (5.7) | 97 (19.6) | **321 (64.8)** | 33 (6.7) |
| behavioural issues | 20 (4.0) | 43 (8.7) | 127 (25.7) | **270 (54.5)** | 35 (7.1) |
| too much energy and associated nutrients | 17 (3.4) | 43 (8.7) | 102 (20.6) | **273 (55.2)** | 60 (12.1) |
| **Absolute risk perception for my child^** | | | | | |
| becoming overweight | 10 (2.0) | 32 (6.5) | 80 (16.2) | **224 (45.3)** | 149 (30.1) |
| developing tooth decay | 8 (1.6) | 13 (2.6) | 35 (7.1) | **252 (50.9)** | 187 (37.8) |
| *having behavioural issues* | *13 (2.6)* | *51 (10.3)* | *108 (21.8)* | ***207 (41.8)*** | *116 (23.4)* |
| *eating too much energy and associated nutrients* | *8 (1.6)* | *19 (3.8)* | *220 (44.4)* | ***248 (50.1)*** | *0 (0)* |
| | **Unfavourable response** | | **Favourable response** | | |
| | **1** | **2** | **3** | **4** | |
| **Positive outcome expectancies** | | | | | |
| be healthy | 17 (3.4) | 95 (19.2) | **213 (43.0)** | 170 (34.3) | |
| healthy eating habits | 9 (1.8) | 99 (20.0) | **242 (48.9)** | 145 (29.3) | |
| eat more fruit and vegetables | 49 (9.9) | 122 (24.6) | **174 (35.2)** | 150 (30.3) | |
| environmentally-friendly | 187 (37.8) | **199 (40.2)** | 81 (16.4) | 28 (5.7) | |
| *'good' parent* | *50 (10.1)* | ***214 (43.2)*** | *172 (34.7)* | *59 (11.9)* | |
| *save money on food shopping* | *112 (22.6)* | ***145 (29.3)*** | *134 (27.1)* | *104 (21.0)* | |
| **Negative outcome expectancies^** | | | | | |
| throw a tantrum or pester | 40 (8.1) | 51 (10.3) | **222 (44.8)** | 182 (36.8) | |
| miss out on having treats | 8 (1.6) | 38 (7.7) | 176 (35.6) | **273 (55.2)** | |
| affect family time | 12 (2.4) | 30 (6.1) | 173 (34.9) | **280 (56.6)** | |
| overeat unhealthy foods when available | 28 (5.7) | 65 (13.1) | **207 (41.8)** | 195 (39.4) | |
| miss out on eating what their friends eat | 15 (3.0) | 55 (11.1) | 211 (42.6) | **214 (43.2)** | |
| *spend more time* | *85 (17.2)* | *132 (26.7)* | ***161 (32.5)*** | *117 (23.6)* | |
| *adjust my own intake of unhealthy foods* | *118 (23.8)* | *138 (27.9)* | ***140 (28.3)*** | *99 (20.0)* | |
| *restricting enjoyment of food* | *32 (6.5)* | *63 (12.7)* | ***211 (42.6)*** | *189 (38.2)* | |
| **Action self-efficacy** | 32 (6.5) | **169 (34.1)** | 125 (25.3) | **169 (34.1)** | |
| **Intention** | 77 (15.6) | **154 (31.1)** | 135 (27.3) | 129 (26.1) | |

[1] For ease of interpretation responses are presented based on item scoring, with relevant items (^) reverse scored. Results are presented as percentage of parents responding (n=495). **Bold** text indicates the highest frequency response. *Grey italics* text indicates items removed in confirmatory factor analysis.
[2] Unfavourable response related to higher provision of unhealthy foods.
[3] Favourable response towards limiting unhealthy foods.
[4] Missing n=94 responses (I don't know the guidelines).

Table 3.8b: Parent ratings of HAPA volitional phase questionnaire items

| Item | Response frequency (%)[1] | | | |
|---|---|---|---|---|
| | Unfavourable response[2] | | Favourable response[3] | |
| | 1 | 2 | 3 | 4 |
| **Maintenance self-efficacy** | | | | |
| child is pestering for unhealthy foods | 21 (4.2) | 94 (19.0) | 166 (33.5) | **214 (43.2)** |
| child is resistant to limiting unhealthy foods | 19 (3.8) | 93 (18.8) | 172 (34.7) | **211 (42.6)** |
| you are tired | 72 (14.5) | 141 (28.5) | **189 (38.2)** | 93 (18.8) |
| having a very busy day | 70 (14.1) | 150 (30.3) | **184 (37.2)** | 91 (18.4) |
| partner is undermining you | 94 (19.0) | 138 (27.9) | **141 (28.5)** | 122 (24.6) |
| financial pressures | 43 (8.7) | 97 (19.6) | 173 (34.9) | **182 (36.8)** |
| school/child care holidays | 45 (9.1) | 140 (28.3) | **186 (37.6)** | 124 (25.1) |
| takes a long time to make it habit | 32 (6.5) | 156 (31.5) | **179 (36.2)** | 128 (25.9) |
| food marketing on television | 33 (6.7) | 96 (19.4) | 134 (27.1) | **232 (46.9)** |
| family time | 63 (12.7) | **183 (37.0)** | 161 (32.5) | 88 (17.8) |
| *consume unhealthy foods around your child* | ***146 (29.5)*** | *141 (28.5)* | *118 (23.8)* | *90 (18.2)* |
| *parents/relatives continue to bring unhealthy foods* | *120 (24.2)* | ***181 (36.6)*** | *122 (24.6)* | *72 (14.5)* |
| *child has a strong likely for unhealthy foods* | *37 (7.5)* | *131 (26.5)* | ***185 (37.4)*** | *142 (28.7)* |
| **Action planning usual routine** | | | | |
| weekdays | 24 (4.8) | 91 (18.4) | 174 (35.2) | **206 (41.6)** |
| weekend days | 34 (6.9) | 133 (26.9) | **176 (35.6)** | 152 (30.7) |
| packing lunchbox | 18 (3.6) | 52 (10.5) | 137 (27.7) | **288 (58.2)** |
| takeaway meals and snacks | 54 (10.9) | 119 (24.0) | **185 (37.4)** | 137 (27.7) |
| *visitors* | *62 (12.5)* | *176 (35.6)* | ***178 (36.0)*** | *79 (16.0)* |
| *celebrating a special occasion* | *132 (26.7)* | ***193 (39.0)*** | *122 (24.6)* | *48 (9.7)* |
| *people bring food to my home* | *133 (26.9)* | ***201 (40.6)*** | *115 (23.2)* | *46 (9.3)* |
| **Coping planning** | | | | |
| certain situations | 44 (8.9) | 135 (27.3) | **204 (41.2)** | 112 (22.6) |
| friends undermine my plans | 97 (19.6) | **175 (35.4)** | 156 (31.5) | 67 (13.5) |
| relatives undermine my plans | 118 (23.8) | **206 (41.6)** | 125 (25.3) | 46 (9.3) |
| set-backs when unhealthy foods have been provided | 62 (12.5) | 165 (33.3) | **182 (36.8)** | 86 (17.4) |
| *my child asks for unhealthy foods* | *25 (5.1)* | *102 (20.6)* | *166 (33.5)* | ***202 (40.8)*** |
| **Recovery self-efficacy** | | | | |
| small relapse (2 days) | 10 (2.0) | 87 (17.6) | 152 (30.7) | **246 (49.7)** |
| moderate relapse (2—6 weeks) | 16 (3.2) | 88 (17.8) | 189 (38.2) | **202 (40.8)** |
| large relapse (weeks—months) | 23 (4.6) | 109 (22.0) | 172 (34.7) | **191 (38.6)** |

[1] For ease of interpretation responses are presented based on item scoring, nil items reverse scored. Results are presented as percentage of parents responding (n=495). **Bold** text indicates the highest frequency response. *Grey italics* text indicates items removed in confirmatory factor analysis.
[2] Unfavourable response related to higher provision of unhealthy foods.
[3] Favourable response towards limiting unhealthy foods.

### 3.4.3. Objective 2: Examining the suitability of the HAPA model to measure parental motivation towards limiting provision of unhealthy foods

***Exploratory factor analysis***

Exploratory factor analyses were performed on the Parental Food Attitude Questionnaire items (n=57) on the final sample (n=495). Data were considered suitable with: a range of correlation coefficients but with numerous greater than 0.30; Kaiser-Meyer-Olkin value of 0.924 (≥0.9 marvellous value) signifying adequacy of relationships amongst variables; and significant ($p$<0.001) Bartlett's Test of Sphericity suggesting the sample correlation matrix differed significantly from the identity matrix. Reviewing initial communalities prompted the removal of three *items 'risk perception: eating too much energy (calories), saturated fat, added sugars and salt'* (0.16), *‘outcome expectancy: I’ll be seen as a good parent for doing what’s best for my child’s health’* (0.28), and *‘outcome expectancy: I’ll save money on food shopping’* (0.26), all with communalities <0.3 suggesting the items had little in common with the other items.

Reviewing the scree plot revealed initial breaks at three and five factors but these only accounted for 40.5% and 48.3% of the variance, respectively (Appendix 6). There were additional breaks with seven and nine factors above the scree; with eigenvalues above 1.0, accounting for 55.1% and 59.8% of the variance, respectively, that were taken forward. Analyses were run with and without the inclusion of the three items with low communalities and the two single item questions to confirm their proposed exclusion from the analyses. Due to their initial communalities the two single items—action self-efficacy 0.583 and intention 0.450—were not removed but instead considered single measurement items for these two constructs.

A forced seven factor solution was first performed on the remaining 52 items which accounted for 57.9% of the variance with eigenvalues of 1.87 to 14.82 (Appendix 6). Examining the pattern matrix revealed a solution interpretable within the theoretical framework. The seven factors could be explained as 1) absolute risk perception, 2) risk perception severity, 3) positive outcomes (positive outcome expectancies and risk perception for child), 4) negative outcomes (negative outcome expectancies), 5) weekday planning (action planning items), 6) planning (action and coping planning), and 7) self-efficacy (combining maintenance and recovery self-efficacy items) (Appendix 6).

A forced nine factor solution was repeated on the same 52 items which accounted for 62.8% of the variance with eigenvalues of 14.82 to 1.23. The resulting pattern matrix strongly aligned with the proposed HAPA theoretical framework. The nine factors were: 1) absolute risk perception, 2) risk perception severity, 3) risk perception for child, 4) positive outcome expectancies, 5) negative outcome expectancies, 6) action planning, 7) coping planning, 8) maintenance self-efficacy, and 9) recovery self-efficacy (Table 3.9).

Internal consistency assessed by Cronbach’s alpha was used to examine the cross-loading items and to check for additional items to remove. Within the seven factor solution, addition of a cross loading item or removal of an item did not dramatically alter the Cronbach’s alpha value. In the nine factor solution, removal of one negatively loading sub-item *‘outcome expectancy: I will also need to change my own intake of unhealthy foods’* was suggested by a Cronbach’s alpha of 0.346 with the item, compared with 0.717 if the item were removed from the positive outcome expectancies factor. There were no other substantial changes to Cronbach’s alpha by including cross-loading items or suggestions for removal. The final seven factor solution included 52 items to the next stage of confirmatory factor analysis, as was the nine factor solution removing the outcome expectancies sub-item including 51 items.

Table 3.9: Nine factor solution pattern matrix[1] for parents' motivational constructs

| Construct | Factor loadings | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4[2] | 5 | 6 | 7 | 8 | 9 |
| **Risk perception (absolute)** | | | | | | | | | |
| comparison with dietary guidelines | **.657** | | | .124 | | .173 | | | .155 |
| child's activity levels | **.771** | | | | | | | | |
| child's overall diet | **.813** | | | | | | | | |
| other children the same age | **.812** | | | | | | .121 | .150 | |
| other children the same size | **.836** | | | | | | | | |
| **Risk perception (general severity)** | | | | | | | | | |
| being overweight | | **-.745** | | | | | | | |
| tooth decay | | **-.776** | | | | | | | |
| behavioural issues | | **-.795** | | | | | | | |
| too much energy and associated nutrients | | **-.765** | | .113 | | | | | |
| **Risk perception (for child)** | | | | | | | | | |
| becoming overweight | | | **-.705** | .111 | | | | | |
| developing tooth decay | | | **-.836** | | | | | | |
| having behavioural issues | .128 | | **-.562** | | | | | -.108 | .115 |
| **Positive outcome expectancies** | | | | | | | | | |
| be healthy | | | -.139 | **.534** | | | | | |
| healthy eating habits | | | | **.745** | | | | | |
| eat more fruit and vegetables | | | | **.734** | .100 | | | | |
| environmentally-friendly | | | -.110 | **.323** | -.192 | | | | |
| **Negative outcome expectancies** | | | | | | | | | |
| throw a tantrum or pester | .196 | | | | **.411** | .166 | | | -.178 |
| spend more time | | | .106 | -.183 | **.359** | | .128 | .147 | |
| miss out on having treats | | | | | **.502** | .109 | | | |
| affect family time | .106 | | | .130 | **.444** | .129 | .107 | | |
| restricting enjoyment of food | | | | | **.610** | | | | |
| overeat unhealthy foods when available | | | | | **.542** | | | | |
| miss out on eating what their friends eat | | | | | **.720** | | | | .109 |
| **Maintenance self-efficacy** | | | | | | | | | |
| child is pestering for unhealthy foods | | | | | | **.575** | .136 | | -.327 |
| child is resistant to limiting unhealthy foods | | | | | | **.636** | .103 | | -.333 |
| you are tired | | | | | | **.733** | | | |
| having a very busy day | | | | | | **.702** | | | |
| partner is undermining you | | | .106 | | | **.550** | | -.129 | |
| financial pressures | | | | | | **.740** | | .145 | |
| school/child care holidays | | | | | | **.633** | | | |
| consume unhealthy foods around your child | | | .123 | | | **.576** | | | .143 |
| takes a long time to make it habit | | | | | | **.629** | | | |
| food marketing on television | | | -.106 | -.123 | | **.628** | | | -.114 |
| parents/relatives continue to bring unhealthy foods | | | | | | **.452** | | -.357 | .240 |
| family time | | | | | | **.596** | | -.126 | .206 |
| child has a strong likely for unhealthy foods | | | | | | **.689** | | | |
| **Action planning** | | | | | | | | | |
| weekdays | | | -.102 | | | | **.646** | | -.220 |
| weekend days | .100 | | | | | | **.592** | -.121 | -.143 |
| packing lunchbox | | | | | | | **.741** | .128 | |
| takeaway meals and snacks | | | | | | | **.678** | | |
| visitors | | | | | | | **.602** | -.312 | .159 |
| celebrating a special occasion | | | | | | .110 | **.431** | -.355 | .264 |

[1] Extracted by Principal Axis Factoring, rotated by Oblimin with Kaiser Normalization (converged in 19 iterations), factor loadings <0.1 supressed; cumulative variance 62.8%.
[2] Item *'negative outcome expectancies: adjust my own intake of unhealthy foods'* initially loaded on to Factor 4 (factor loading of -.332) was removed following inspection of the Cronbach's alpha .346 (when included).

Table 3.9: Nine factor solution pattern matrix[1] for parents' motivational constructs (cont.)

| Construct | Factor loadings | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4[2] | 5 | 6 | 7 | 8 | 9 |
| **Action planning** | | | | | | | | | |
| people bring food to my home | | | | | | .159 | .373 | **-.438** | .246 |
| **Coping planning** | | | | | | | | | |
| certain situations | | | | | | .178 | .270 | **-.400** | -.196 |
| friends undermine my plans | | | | | | | | **-.779** | -.137 |
| relatives undermine my plans | | | | | | | | **-.809** | |
| set-backs when unhealthy foods have been provided | | | | | | .128 | .168 | **-.575** | -.220 |
| **Coping planning** | | | | | | | | | |
| my child asks for unhealthy foods | | | | | | .128 | .289 | -.294 | **-.430** |
| **Recovery self-efficacy** | | | | | | | | | |
| small relapse (2 days) | | | | | | .280 | .132 | | **-.524** |
| moderate relapse (2—6 weeks) | .119 | | | | | .189 | | -.187 | **-.579** |
| large relapse (weeks—months) | .118 | | | | | .228 | | -.186 | **-.455** |
| Eigenvalue | 2.70 | 1.87 | 1.34 | 4.38 | 2.17 | 14.8 | 1.92 | 2.24 | 1.23 |
| % variance explained | 5.19 | 3.59 | 2.58 | 8.43 | 4.17 | 28.5 | 3.70 | 4.30 | 2.37 |
| Cronbach's alpha | .884 | .849 | .767 | .717 | .730 | .926 | .870 | .877 | .864 |

[1] Extracted by Principal Axis Factoring, rotated by Oblimin with Kaiser Normalization (converged in 19 iterations), factor loadings <0.1 supressed; cumulative variance 62.8%.
[2] Item *'negative outcome expectancies: adjust my own intake of unhealthy foods'* initially loaded on to Factor 4 (factor loading of -.332) was removed following inspection of the Cronbach's alpha .346 (when included).

### *Confirmatory Factor Analysis*

Confirmatory factor analysis one factor models were run for the seven and nine factor solutions identified in the exploratory factor analysis. Cross-loading items in exploratory factor analyses were examined in confirmatory factor analysis by testing the items in both constructs to confirm their corresponding construct. Single factor items for action self-efficacy and intention were excluded from one factor models, instead treated as single measured constructs to be combined in the structural equation modelling of the HAPA theoretical framework. The HAPA framework provided theoretical guidance when interpreting confirmatory factor analysis outputs. This guidance led to a measurement model well aligned with the HAPA constructs supported by the data.

Comparisons were made between the resulting structures from the seven factor solution and nine factor solution. Overall the two measurement models were near identical in latent constructs with 12 constructs consisting of 34 items and 3 single measured items in seven factor solution (data not presented) and 13 constructs consisting of 40 items and 2 single measured items in nine factor solution (Appendix 6). Key differences in the seven versus nine factor solutions, were the removal of the latent construct for action planning, with the related items reduced to a single measured item of *'action planning: at home on weekdays'*. As the two measurement models were similar both were considered appropriate to use in structural equation modelling. However, given the interpretation of the maintenance self-efficacy construct, the nine factor solution was selected. Results of the nine factor solution one factor models are presented in Table 3.10a and 3.10b.

Table 3.10a: Final one factor model confirmatory factor analysis standardised regression weights for motivational phase latent constructs

| **Latent variable**<br>**Items** | **Factor loading**[1] | | **Model fit** |
|---|---|---|---|
| | **β** | **Unstandardised coefficient (SE)** | |
| *Risk perception 1 – absolute risk* | | | $X^2$ 0.552, df 1, *p*=0.458 |
| child's activity levels | .793 | 0.779 (0.044) | TLI 1.002 |
| child's overall diet | .878 | 0.952 (0.044) | CFI 1.000 |
| *Risk perception 2 – absolute risk* | | | RMSEA 0.000, PCLOSE 0.676 |
| other children the same age | .888 | 0.918 (0.039) | SRMR 0.0026 |
| other children the same size | .916 | 0.912 (0.037) | |
| *Risk perception 3 – severity assessment* | | | $X^2$ 10.194, df 2, *p*=0.006 |
| being overweight | .749 | 0.823 (0.045) | TLI 0.971 |
| tooth decay | .753 | 0.614 (0.033) | CFI 0.990 |
| behavioural issues | .789 | 0.709 (0.036) | RMSEA 0.091, PCLOSE 0.081 |
| too much energy and associated nutrients | .794 | 0.733 (0.037) | SRMR 0.0179 |
| *Risk perception 4[2] – risk for child* | | | $X^2$ 30.066, df 8, *p*<0.001 |
| becoming overweight | .927 | 0.879 (0.093) | TLI 0.964 |
| developing tooth decay | .687 | 0.556 (0.063) | CFI 0.981 |
| | | | RMSEA 0.075, PCLOSE 0.066 |
| | | | SRMR 0.0216 |
| *Positive outcome expectancies* | | | $X^2$ 2.563, df 2, *p*=0.278 |
| be healthy | .649 | 0.530 (0.038) | TLI 0.996 |
| healthy eating habits | .736 | 0.552 (0.034) | CFI 0.999 |
| eat more fruit and vegetables | .764 | 0.735 (0.044) | RMSEA 0.024, PCLOSE 0.623 |
| environmentally-friendly | .380 | 0.331 (0.043) | SRMR 0.0146 |
| *Negative outcome expectancies* | | | $X^2$ 16.639, df 5, *p*=0.005 |
| throw a tantrum or pester | .569 | 0.504 (0.044) | TLI 0.940 |
| miss out on having treats | .582 | 0.410 (0.035) | CFI 0.970 |
| affect family time | .564 | 0.404 (0.036) | RMSEA 0.069, PCLOSE 0.167 |
| overeat unhealthy foods when available | .565 | 0.482 (0.043) | SRMR 0.0311 |
| miss out on eating what their friends eat | .602 | 0.465 (0.038) | |

Abbreviations: β: standardised regression coefficient; CFI: Comparative Fit Index; $X^2$: chi-squared; df: degrees of freedom; RMSEA: Root Mean Squared Error of Approximation; PCLOSE: the p-value for testing the null hypothesis than RMSEA is <0.05; SE: standard error; SRMR: Standardised Root Mean-square Residual; TLI: Tucker Lewis Index

[1] All regression weights were statistically significant with p<0.001

[2] Note *Risk perception 4* model was run in combination with *Risk perception 3* to meet required degrees of freedom.

Table 3.10b: Final one factor model confirmatory factor analysis standardised regression weights for volitional phase latent constructs

| **Latent variable**<br>**Items** | **Factor loading[1]** | | **Model fit** |
|---|---|---|---|
| | **β** | **Unstandardised coefficient (SE)** | |
| *Maintenance self-efficacy 1* | | | $X^2$ 78.920, df 34, *p*<0.001 |
| partner is undermining you | .697 | 0.733 (0.043) | TLI 0.983 |
| financial pressures | .792 | 0.752 (0.037) | CFI 0.987 |
| school/child care holidays | .750 | 0.689 (0.037) | RMSEA 0.052, PCLOSE 0.402 |
| takes a long time to make it habit | .749 | 0.666 (0.036) | SRMR 0.0322 |
| food marketing on television | .659 | 0.626 (0.040) | |
| family time | .609 | 0.562 (0.039) | |
| *Maintenance self-efficacy 2* | | | |
| child is pestering for unhealthy foods | .936 | 0.822 (0.031) | |
| child is resistant to limiting unhealthy foods | .949 | 0.819 (0.030) | |
| *Maintenance self-efficacy 3* | | | |
| you are tired | .944 | 0.902 (0.033) | |
| having a very busy day | .921 | 0.874 (0.033) | |
| *Action planning* | | | $X^2$ 35.104, df 2, *p*<0.001 |
| weekdays | .914 | 0.805 (0.033) | TLI 0.896 |
| weekend days | .845 | 0.775 (0.035) | CFI 0.965 |
| packing lunchbox | .696 | 0.570 (0.034) | RMSEA 0.183, PCLOSE |
| takeaway meals and snacks | .612 | 0.587 (0.041) | <0.001 SRMR 0.0361 |
| *Coping planning 1* | | | $X^2$ 1.195, df 1, *p*=0.274 |
| friends undermine my plans | .924 | 0.877 (0.036) | TLI 0.999 |
| relatives undermine my plans | .813 | 0.738 (0.036) | CFI 1.000 |
| *Coping planning 2* | | | RMSEA 0.020, PCLOSE 0.521<br>SRMR 0.0050 |
| certain situations | .768 | 0.689 (0.037) | |
| set-backs when unhealthy foods have been provided | .863 | 0.791 (0.037) | |
| *Recovery self-efficacy[2]* | | | $X^2$ 230.753, df 64, *p*<0.001 |
| small relapse (2 days) | .793 | 0.661 (0.032) | TLI 0.956 |
| moderate relapse (2—6 weeks) | .927 | 0.785 (0.030) | CFI 0.964 |
| large relapse (weeks—months) | .846 | 0.763 (0.034) | RMSEA 0.073, PCLOSE<br><0.001<br>SRMR 0.0573 |

Abbreviations: β: standardised regression coefficient; CFI: Comparative Fit Index; $X^2$: chi-squared; df: degrees of freedom; RMSEA: Root Mean Squared Error of Approximation; PCLOSE: the p-value for testing the null hypothesis than RMSEA is <0.05; SE: standard error; SRMR: Standardised Root Mean-square Residual; TLI: Tucker Lewis Index
[1] All regression weights were statistically significant with *p*<0.001
[2] Note *Recovery self-efficacy* model was run in combination with *Maintenance self-efficacy* constructs to meet required degrees of freedom.

The final motivational phase measurement model had appropriate model fit ($X^2$ = 255.218, df = 137, *p*<0.001; CFI = 0.965; TLI = 0.956; RMSEA = 0.042, PCLOSE = 0.956; SRMR = 0.0473) and consisted of two single measured items (action self-efficacy and intention) and six constructs: four measuring risk perception (absolute risk perception 1: two items; absolute risk perception 2: two items; risk perception severity assessment: four items; risk perception for child: two items), one positive outcome expectancies (four items) and one negative outcome expectancies (five items). The final volitional phase measurement model had appropriate model fit ($X^2$ = 409.045, df = 168, *p*<0.001; CFI = 0.967; TLI = 0.959; RMSEA = 0.054, PCLOSE = 0.162; SRMR = 0.0421) and consisted of seven constructs: three measuring maintenance self-efficacy (maintenance self-efficacy child factors: two items; maintenance self-efficacy parent factors: two items; maintenance self-efficacy additional barriers: six items), one action planning (four items regarding everyday context), two coping planning (coping planning parent factors: two items; coping planning friends and family: two items) and one recovery self-efficacy (three item). Eleven items were removed during confirmatory factor analysis: two risk perception, three outcome expectancies, three maintenance self-efficacy, three action planning and one coping planning.

### ***Structural Equation Modelling***

Second order confirmatory factor analysis

Higher order latent constructs were proposed and tested for risk perception, maintenance self-efficacy and planning based on the theoretical framework and correlations between latent variables (Table 3.11). The risk perception second order construct was initially tested with the four risk perception variables, yet findings supported the inclusion of only *Risk perception 1* and *2*, both measures of absolute risk perception (Figure 3.3). *Risk perception 3 - severity assessment* and *4 - risk for child* had low squared multiple correlations of 0.02 and 0.05, respectively, as well as substantially lower factor loadings of 0.15 (risk perception 3) and 0.22 (risk perception 4), compared with *Risk perception 1* (0.85) and *2* (0.87). These two variables were retained in the model but as direct predictors of intention, rather than forming part of the higher order construct. Maintenance self-efficacy latent variables all had similarly large factor loadings (0.80—0.92) supporting a higher order construct (Figure 3.4). Planning variables also had large standardised factor loadings (0.61—1.07), initially with *Coping planning 2* with a factor loading greater than one. The underlying theoretical distinction between action and coping planning, supported by the high correlation (.672) between *Coping planning 1* and *2*, resulted in a covariance added between coping planning constructs and the final loadings for the three planning constructs were between 0.60 and 0.84 (Figure 3.5).

Table 3.11: Second order confirmatory factor analysis final outputs[1]

| Higher order construct<br>First order constructs | Factor loading | |
|---|---|---|
| | β | Unstandardised coefficient (SE) |
| Risk perception | | |
| Risk perception 1 – absolute risk | .894 | 0.893 (0.054) |
| Risk perception 2 – absolute risk | .820 | 0.819 (0.052) |
| Maintenance self-efficacy | | |
| Maintenance self-efficacy 1 | .912 | 0.911 (0.041) |
| Maintenance self-efficacy 2 | .845 | 0.844 (0.040) |
| Maintenance self-efficacy 3 | .797 | 0.796 (0.041) |
| Planning | | |
| Action planning | .783 | 0.782 (0.046) |
| Coping planning 1 | .600 | 0.599 (0.050) |
| Coping planning 2 | .837 | 0.835 (0.048) |

Abbreviations: β: standardised regression coefficient; SE: standard error
[1] All three final models were run in combination to meet required degrees of freedom. Model fit: $X^2$ = 31.522, df = 16, *p*=0.012; CFI = 0.991; TLI = 0.985; RMSEA = 0.044, PCLOSE = 0.629; SRMR = 0.0255.

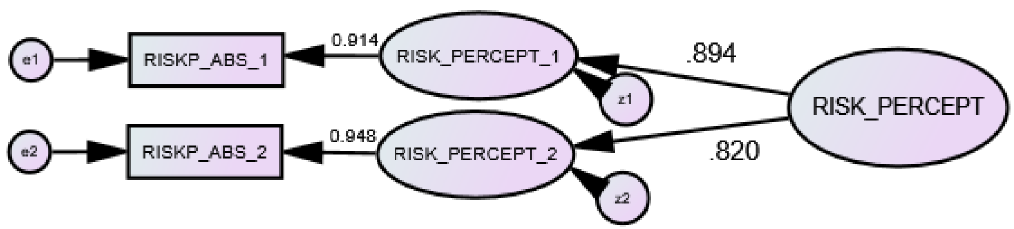



Figure 3.3: Risk perception second order factor for input into the structural equation model

e: error term; z: residual term. Values presented are standardised regression coefficients

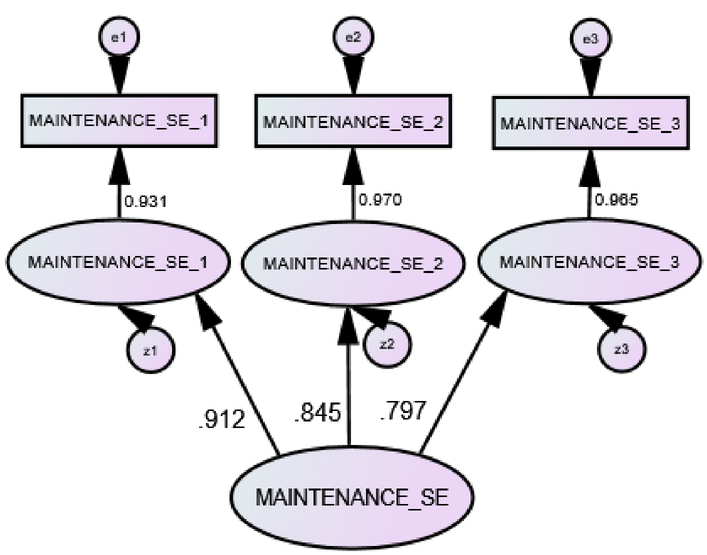



Figure 3.4: Maintenance self-efficacy second order factor for input into the structural equation model

e: error term; z: residual term. Values presented are standardised regression coefficients

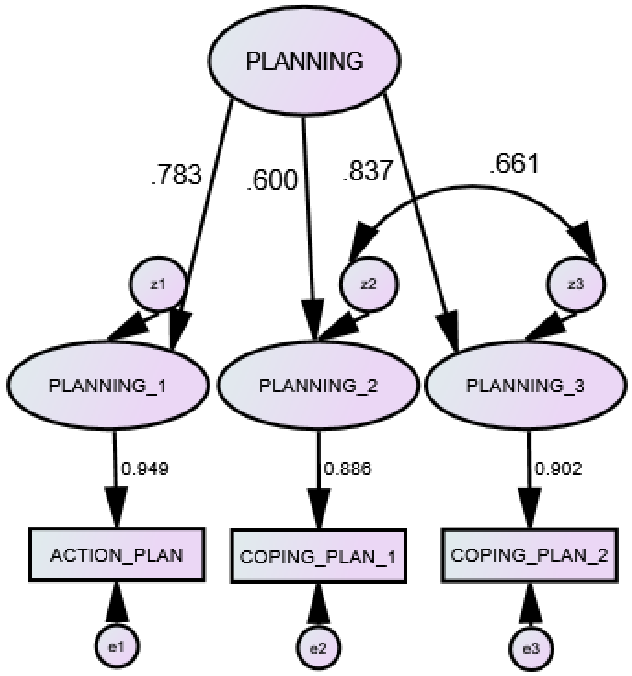



Figure 3.5: Planning second order factor for input into the structural equation model

e: error term; z: residual term. Values presented are standardised regression coefficients

Exploratory and confirmatory structural equation modelling

An alternative theoretical model was tested to explore the intention-behaviour gap. Figure 3.6 shows the model somewhat comparable to the Theory of Planned Behaviour, composed of the HAPA motivational phase and children's mean serves of unhealthy foods, hence removing maintenance and recovery self-efficacy and planning constructs. The model of fit statistics were appropriate ($X^2$ = 55.294, df = 12, $p$<0.001; TLI = 0.847; CFI = 0.949; RMSEA = 0.085, PCLOSE = 0.005; SRMR = 0.0496) and saw a significant inverse direct association between parental intention and children's intake of unhealthy foods (β = -0.234, b = -0.147, $p$<0.001). The alternative theoretical model accounted for 5.5% of the variance of unhealthy food serves (Appendix 6).

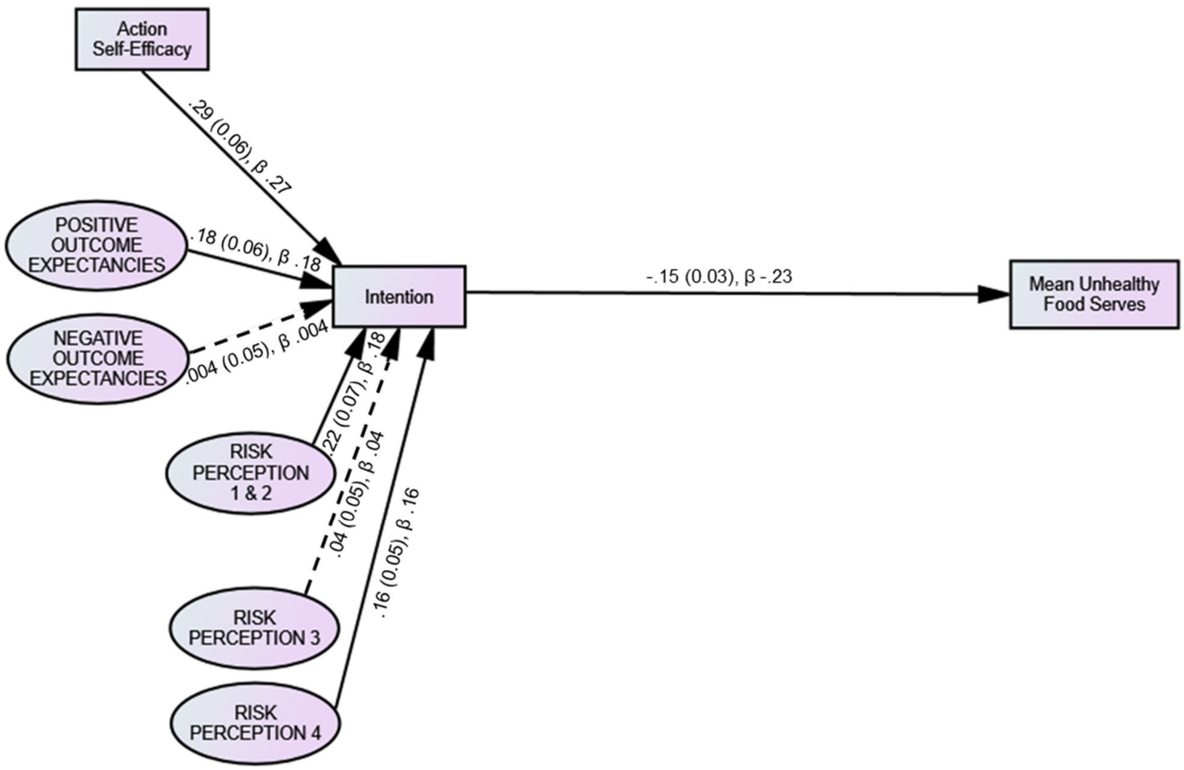



Figure 3.6: Exploratory structural equation modelling testing the predictive ability of intention to action regression coefficients

Model of fit: $X^2$ = 55.294, df = 12, *p*<0.001; TLI = 0.847; CFI = 0.949; RMSEA = 0.085, PCLOSE = 0.005; SRMR = 0.0496. Model explains 5.5% of the variance in mean unhealthy food serves. Path coefficients are presented as: unstandardised regression coefficient (standard error), standardised regression coefficient; rectangles represent measured constructs; ellipses represent latent constructs; solid line indicates statistically significant relationship (*p*<0.05); dashed line indicates non-significant relationship

*Testing the Health Action Process Approach model*

All first and second order latent constructs and measured variables were combined to form one model of reflective motivation replicating the HAPA model (Figure 3.7). The model consisted of 15 HAPA variables and three second order variables. Hence, the final sample available of n=495 well exceeded the required a sample size of 270 to 360 based on the N:q rule. The model consisted of congeneric composites items and transformed mean unhealthy food serves as the outcome variable. The model contained 59 variables, 16 of which were observed and 43 unobserved variables. The model was over-identified with 83 degrees of freedom. Model of fit statistics supported an adequate fitting model. Chi-square was elevated and significant (210.03, df = 83, *p*<0.001), as expected for large samples and complex models[245]. Tucker Lewis Index was near to an ideal fit at 0.94 (≥0.95 target), and CFI was ideal at 0.96 (≥0.95 target). Root Mean Square Error of Approximation was acceptable at 0.056 (ideal ≤0.05, generally acceptable at <0.08) with a related p value (PCLOSE) of 0.153 (≥0.05 signifies fit), and SRMR was appropriate at 0.06 (≤0.06 target). The six motivational phase constructs accounted for 32.8% of the variance in parental intention to limit children's intake of unhealthy foods. The overall HAPA model was found to explain 9.2% of the variance in children's mean serves of unhealthy foods (proxy measure for parental provision). Compared to the alternative model similar to the Theory of Planned Behavior (Figure 3.6), the HAPA model including the volitional phase constructs accounted for a greater amount of variance, specifically an additional 3.7%. Inclusion of the volitional phase constructs was seen to begin to bridge the intention-behaviour gap, but only moderately.

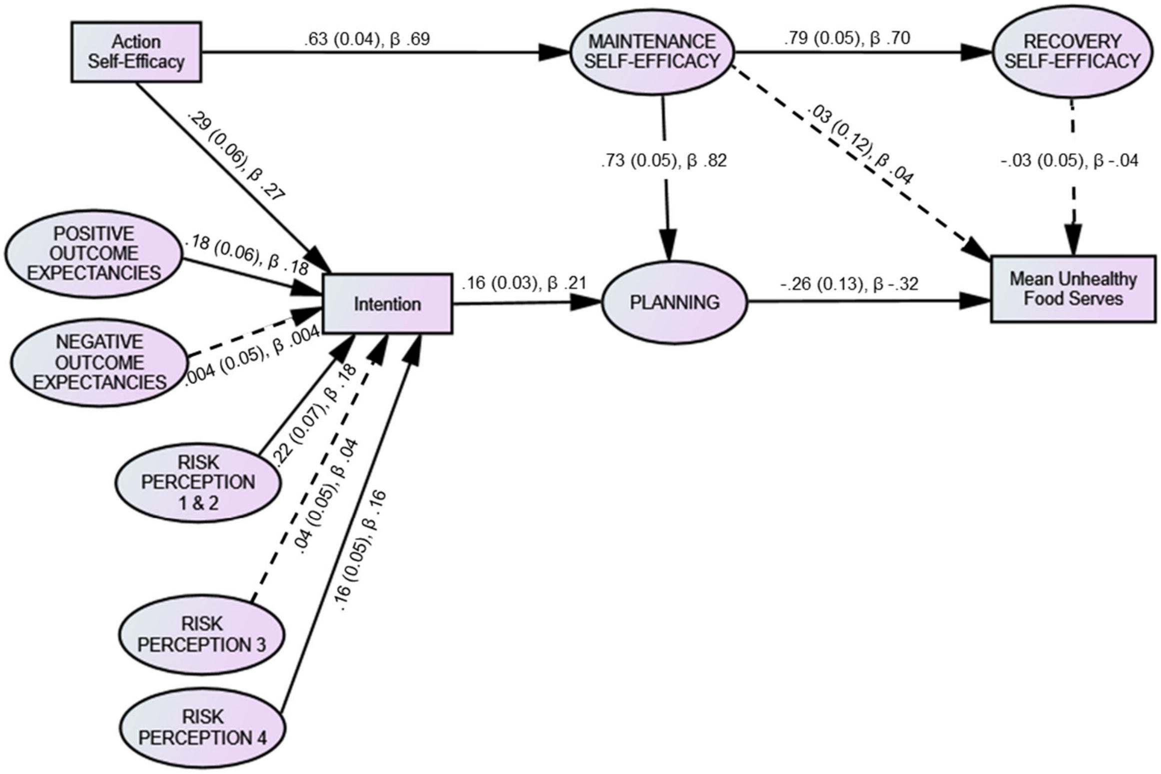



Figure 3.7: Final confirmatory structural equation modelling of the Health Action Process Approach model with regression coefficients

Model of fit: $X^2$ = 210.033, df = 83, $p$<0.001; CFI = 0.956; TLI = 0.936; RMSEA = 0.056, PCLOSE = 0.153; SRMR = 0.0601. Model explains 9.2% of the variance in mean unhealthy food serves. Path coefficients are presented as: unstandardised regression coefficient (standard error), standardised regression coefficient; rectangles represent measured constructs; ellipses represent latent constructs; solid line indicates statistically significant relationship ($p$<0.05); dashed line indicates non-significant relationship

*Data driven alternative model*

Reviewing the standardised residual covariances and modification indices revealed additional paths that could be added to improve the theorised HAPA model (Appendix 6). Specifically, paths from both *Negative outcome expectancies* and *Absolute risk perception 1&2* to *Maintenance self-efficacy*. Testing this model found both paths to be statistically significant (negative outcome expectancies β = 0.240, b = 0.212, $p$<0.05; risk perception 1&2 β = 0.229, b = 0.238, $p$<0.05).

Although the model had appropriate model of fit, this data driven approach did not make theoretical sense. This alternative model implied having a higher level of awareness of the negative consequences and perception of child's unhealthy food intake would both lead to greater confidence in the face of barriers. A second data driven alternative model was explored where *Negative outcome expectancies*, *Risk perception 3 – severity assessment* and *Recovery self-efficacy* constructs were removed as they all had only non-significant paths with near zero regression coefficients in the confirmatory HAPA model. Removing these constructs dramatically worsened the model of fit, with no fit statistic within the acceptable limits ($X^2$ = 860.136, df = 68, $p$<0.001; TLI = 0.590; CFI = 0.694; RMSEA = 0.154, PCLOSE <0.001; SRMR = 0.1057). Therefore, alternative models provided support for the original theorised HAPA model.

### 3.4.4. Objective 3: Understanding the relationships and relative importance of motivational constructs and parental intention and provision of unhealthy foods

*Maintenance self-efficacy* to *Planning* was the strongest relationship in the model with a standardised regression coefficient (β) of 0.816 (unstandardised: b = 0.730, $p$<0.001) (Figure 3.7). This implied higher maintenance self-efficacy (confidence to maintain limited provision in the face of barriers) are associated with higher levels of plans or strategies to manage both usual routine and more challenging circumstances (e.g. when visitors are present). There were also strong positive associations between parental confidence constructs. Amongst the motivational phase predictors, *Action self-efficacy* was the strongest predictor of *Intention* (β = 0.269, b = 0.289, $p$<0.001), followed by *Positive outcome expectancies* (β = 0.177, b = 0.182, $p$<0.001) and *Absolute risk perception 1&2* (β = 0.176, b = 0.215, $p$=0.001). *Intention* had a small positive association with *Planning* (β = 0.209, b = 0.160, $p$<0.001). *Planning*, in turn, was inversely associated with serves of unhealthy foods (β = -0.315, b = -0.259, $p$=0.044), implying a higher level of planning was associated with lower serves of unhealthy foods. The majority of paths within the model were significant with the exception of both *Negative outcome expectancies* and *Risk perception 3 – severity assessment* to *Intention* in the motivational phase, and both *Maintenance self-efficacy* and *Recovery self-efficacy* to children's serves of unhealthy foods in the volitional phase.

Majority of overall indirect effects within the model were small, with the largest significant pathway being from *Action self-efficacy* through *Maintenance self-efficacy* to *Recovery self-efficacy* (β = 0.477, b = 0.496, $p$=0.004). *Absolute risk perception 1&2* (β = 0.037, b = 0.035, $p$=0.002), *Risk perception 4 – for child* (β = 0.032, b = 0.026, $p$=0.002) and *Positive outcome expectancies* (β = 0.037, b = 0.029, $p$=0.002) all had significant indirect effects on *Planning*, through *Intention*. Whereas, *Negative outcome expectancies* (β = 0.001, b = 0.001, $p$=0.916) and *Risk perception 3 – severity assessment* (β = 0.007, b = 0.006, $p$=0.390) did not. *Action self-efficacy* (β = 0.615, b = 0.505, $p$=0.006) had a significant indirect effect on *Planning*, through *Intention* and/or *Maintenance self-efficacy*. *Action self-efficacy* was also indirectly inversely associated with children's serves of unhealthy foods (β = -0.184, b = -0.124, *p*=0.004), through *Intention* or *Maintenance self-efficacy* and *Planning*. No other motivational phase construct had a significant indirect relationship with children's serves of unhealthy foods. See Appendix 6 for complete model outputs.

Sensitivity analyses were performed on a sub-sample (n=339) excluding all respondents with any missing data (n=156). Model of fit statistics ($X^2$ = 160.233, df = 83, *p*<0.001; CFI = 0.962; TLI = 0.945; RMSEA = 0.052, PCLOSE = 0.355; SRMR = 0.0606) supported the overall appropriateness of the HAPA model to measure parents' motivational constructs. The model accounted for 11.0% of the variance in children's serves of unhealthy foods, with primarily similar regression coefficients (Appendix 6). The greatest paths were as per the primary structural equation model, specifically *Maintenance self-efficacy* to *Planning* (β = 0.858, b = 0.723, *p*<0.001), and between constructs of self-efficacy (β = 0.719, b = 0.669, *p*<0.001; β = 0.728, b = 0.803, *p*<0.001). Non-significant paths were as per the primary models, as well as additional non-significant paths for *Absolute risk perception 1&2* and *Risk perception 4 – for child* to *Intention* (β = 0.111, b = 0.138, *p*=0.105, and β = 0.096, b = 0.099, *p*=0.070, respectively), and *Planning* to children's unhealthy food serves (β = -0.308, b = -0.266, *p*=0.215). Lack of significance of these paths may have been an impact of the smaller sample size.

## 3.5. Discussion

This chapter provides insight into motivational constructs contributing to parents' unhealthy food provision using a theory-based approach. Specifically, this study sought to assess parents' reflective motivation and test a theoretical model to measure motivational constructs. Additionally, this study aimed to understand the relationship between, and relative importance of, motivational constructs and children's intake of unhealthy foods, as a proxy for provision. Broadly, parent ratings revealed relatively high awareness of risk and primarily favourable outcome expectancies to support reducing unhealthy foods. However, there were mixed responses regarding action self-efficacy and only half of parents intended to change their provision behaviour. Moving beyond intention, parents' self-efficacy and plans were consistently lower in more challenging situations, including those relating to friends and relatives, compared with more routine contexts involving immediate family members. Analyses of parent-reported data supported the Health Action Process Approach (HAPA) model as a suitable framework to explain parents' reflective motivation by capturing several motivational constructs. Parental action and maintenance self-efficacy—confidence to limit unhealthy food provision in ideal conditions, and to maintain confidence in the face of barriers, respectively—were found to play a key role in explaining parental intention and children's unhealthy food intake. Whereas, recovery self-efficacy and negative outcome expectancies were not significant predictors of children's unhealthy food intake. This indicates they may play less of a role in unhealthy food provision or be areas where the model or measurements could be improved. Exploratory analyses of an alternative theoretical model highlighted the additional benefits the HAPA model presents over the Theory of Planned Behaviour. Yet, the overall variance of children's unhealthy food intake explained reinforces there may be other important aspects of parental provision or children's intake of unhealthy foods not captured by reflective motivation alone. Greater understanding of reflective motivation can improve researchers' ability to develop interventions to enhance parents' reflective motivation to support behaviour change.

### 3.5.1. Objective 1: Describing parents' reflective motivation for reducing unhealthy food provision

***Motivational phase constructs***

Results indicate certain motivational phase constructs that need to be enhanced to support successful attempts in changing parents' behaviour. There appears to be a disconnect between risk perception, outcome expectancies and intention, whereby parents generally reported higher risk perception and favourable outcome expectancies, yet variable intention. The varied intention to change behaviour may be influenced by the mixed ratings of action self-efficacy. A lack of confidence (self-efficacy) might explain why even with a high level of risk awareness and a favourable decision balance (outcome expectancies) parents may not intend to reduce their unhealthy food provision.

Parental self-efficacy is a commonly discussed topic in the food provision literature[133-137]. Findings generally support an inverse relationship between parental self-efficacy and children's unhealthy food intake[134-136]. Self-efficacy levels have been associated with intake of unhealthy foods. For example, Taveras and colleagues[135] reported an association between lower parental self-efficacy and higher child unhealthy food intake (fast food $\beta$ = -0.730, 95%CI -1.150 to -0.300; SSB $\beta$ = -0.040, 95%CI -0.080 to -0.002). Past research into healthy lifestyle behaviours, also support inverse associations between parents' self-efficacy and one-year-old children's intake of unhealthy foods (cordial $r = -0.26$, $p<0.05$; cake $r = -0.34$, $p<0.01$)[134]. Further, the evidence of this inverse relationship appears to differ by child age. Campbell and colleagues[134] found lower levels of self-efficacy in parents of five-year-olds, versus one-year-olds, likely reflecting older children's increase in independence and existing bad habits posing additional barriers. Whereas, another Australian study of parents of three and a half year-olds, found no longitudinal association between parental self-efficacy and children's diet quality[137]. Though, self-efficacy was measured when children were nine months old, hence may not have been representative of parents' current self-efficacy[137]. Findings from such studies signal the need to consider parents' self-efficacy specific to children's age, and supports the tailoring of interventions based on child age.

Additionally, self-efficacy appears to be related to parents own intake of unhealthy foods. Arsenault and colleagues[133], investigated parents intake, child intake and self-efficacy for limiting unhealthy food provision (fast food, SSB). The study found significant associations between parents own fast food intake and self-efficacy, but not for sugar-sweetened beverages[133]. The same study found greater association between limited child intake of unhealthy foods and high parent self-efficacy (fast food OR 4.51, 95%CI 2.91-6.98; SSB OR 3.40, 95%CI 0.98-11.8), compared with limited parent intake of unhealthy foods and high self-efficacy (fast food OR 1.18, 95%CI 0.75-1.86; SSB OR 1.20, 95%CI 0.83-1.73)[133]. The current finding confirms parental self-efficacy is an ideal intervention target, with past research suggesting greater need to support parents of older pre-school children, and those where parents themselves and / or their child have higher intakes of unhealthy foods.

The current study findings suggest it may be important to examine the accuracy of parents' ability to rate children's intake of unhealthy foods against the dietary guidelines. Children's intake of unhealthy foods was found to exceed current dietary guideline recommendations by two to three serves[5], yet parents on average rated children's intake of unhealthy foods as in line with the dietary guidelines (initial absolute risk perception item). Although social desirability bias may have influenced parent-reported ratings, 11% and 37% of parents reported children's unhealthy food intake was higher or slightly higher than recommendations, respectively. If a discrepancy is present where a parent perceives their child's intake as appropriate when it exceeds recommendations, the parent may exhibit a favourable risk perception, outcome expectancies and action self-efficacy but still not intend to reduce provision. Research to date has only begun to explore this concept regarding children's intake. The first study in the area, in American parents, was presented at the American Society for Nutrition conference in June 2019[253]. Authors reported similar discrepancies where more than 40% of parents perceived their child ate healthy, when their child's diet was within the lower two quartiles of diet quality[253].

There are parallels with research noting parents' inability to accurately identify their child as overweight or at risk of overweight or obesity[254-258]. In one study, predictors of parents' perception of children's weight status was explored and found no associations with concern about obesity (risk perception) or parent self-efficacy, but did find associations with parents' health literacy[258]. Other research focusing on adult's own intake have noted discrepancy between self-rated fruit and vegetable intake or diet quality and more objective measures, but not specifically with dietary guidelines[259, 260]. As findings cannot be extrapolated to parents' perception of children's intake of unhealthy foods this requires further investigation including in Australian parents. Mis-matched perception is a key example where strategies to increase parents' understanding of the dietary guidelines recommendations and approaches to monitor and evaluate children's intake (psychological capability), could directly increase parents' reflective motivation.

***Volitional phase constructs***

Examination of the volitional phase constructs also revealed certain constructs to be targeted by intervention strategies. Intervention strategies are required to support parents in more challenging situations including those outside of routine or involving friends and relatives. Parents commonly rated having self-efficacy or plans for items relating to their child and more routine everyday type behaviours, such as packing the lunchbox. This finding may be supported by school and child care nutrition policies[261, 262] and public health initiatives[263, 264] to encourage healthy lunches in Australia. Parents' rated items regarding weekend and school holiday settings, as having less strategies to reduce unhealthy foods, than weekdays; suggesting periods with less routine may result in lower strategies to limit unhealthy foods. Other research has found associations with weekend periods and higher energy intake in children[265-267]. It may also be that weekends and school holidays are times that more commonly involve friends and relatives or expanded social environments, where there are additional social pressures or other barriers to healthy food provision. Intervention strategies focussed on shifting social norms, as well as strategies to expand the range of convenient healthier food options could both assist parents in limiting provision of unhealthy foods in these more challenging situations.

There was a lower percentage of parents with coping plans, compared with action plans, and when referring to contexts involving friends and relatives. Both coping planning and maintenance self-efficacy are constructs that include additional barriers that can inhibit parents' ability to limit unhealthy food provision. These additional barriers create more challenging situations where parents require a higher level of resilience, compared with less challenging situations. For example, being tired or having a busy day, as well as times where friends and relatives can influence children's unhealthy food intake or where parents perceive additional social pressures. Qualitative studies have noted social influences such as friends and relatives, in particular grandparents, as barriers to healthy food provision or limiting unhealthy foods[69, 138, 147]. For example, Petrunoff and colleagues[69] reported social situations as challenging times if they included food items parents considered as inappropriate, but also a time for some leniency regarding food provision. There appears to be context specific factors influencing parents self-rating of volitional phase constructs.

### 3.5.2. Objective 2: Examining the suitability of the HAPA model to measure parental motivation towards limiting provision of unhealthy foods

The HAPA model was proposed as a framework to explain parents' reflective motivation. The model fit statistics of the current analysis supports the HAPA model as being suitable to understand parents' reflective motivation towards limiting unhealthy foods. This is the first study to test the HAPA model relating to a provision behaviour and found the model accounted for 9.2% of the variance in children's unhealthy food serves. This variance is lower than for other studies using the HAPA model for similar complex behaviours such as increasing physical activity (15-18%)[217, 218] and healthy dietary intake (33%)[215], but when investigating adults own physical activity or intake. A recent study explored adolescents sugar-sweetened beverage intake using an extended version of the HAPA model, finding 14% of the variance was accounted for, yet also not comparable given the additional constructs included[268].

Though there are no studies looking at comparable predictors and children's unhealthy food intake, cautious comparisons can be made with other models examining other aspects of children's nutrition. For example, a study by Ong and colleagues[269] found aspects of the home food environment accounted for 9.3% of the variance in slightly older children's healthy diet score. Looking at pre-schoolers unhealthy food and beverage intake McGowan and colleagues[114] found a more comprehensive model, including parental and child factors and the home food environment, accounted for 21% of the variance in unhealthy sweets and snacks intake and 33% of the variance in unhealthy beverage intake. Similarly, Kroller and colleagues[270] observed 34% of the variance in children's (1—10yo) unhealthy food intake was accounted for by child and parent factors including parent feeding strategies. The range of constructs measured in previous studies and the variance explained in children's intake highlight the complexities of the target behaviour, including factors outside of parents' reflective motivation.

Examining the constructs leading to parental intention, the early motivational phase constructs were found to account for 33% of the variance in intention to limit unhealthy food provision. The motivational phase can be considered similar to the constructs in the Theory of Planned Behaviour[205], which is a theory that has been widely cited in past child nutrition literature. Although, many previous studies used the theory to guide development but not evaluation, and others lacked thorough reporting, such as amount of variance explained by the model[143, 212] or were limited to multiple regression analyses that do not separate the measurement error from the variance explained[142, 213]. A study by Tiption[142], examining caregivers' intention to serve sugar-sweetened beverages, found the Theory of Planned Behaviour constructs accounted for 47.9% of the variance in multiple regression analyses. Again, using the same analyses but in an adolescent population, the model accounted for 32% of the variance in parents' intention to limit sugary beverage intake[213]. A meta-analysis of studies in any population using the Theory of Planned Behaviour reported the model accounted for on average 21% of the variance in intention to perform dietary behaviours[225]. Both the higher and lower variance explained in the aforementioned studies compared with the current study, may relate to the different age groups and measures of dietary intake included in analyses. Nonetheless, previous research supports the similarities in the motivational phase of the HAPA model and the Theory of Planned Behaviour[142, 213, 225]. The HAPA model provides detailed theoretical guidance to understand motivational constructs, but also needs to be combined with an understanding of parents' capability and opportunity to gain greater insight into children's intake of unhealthy foods.

***Closing the intention-behaviour gap***

For a new behaviour to occur intention is needed. Having formed strong intentions does not always result in behaviour, creating the intention-behaviour gap[78, 208, 214]. Whilst the COM-B model comprehensively captures other important sources of behaviour such as capability and opportunity, the HAPA model provides some additional guidance regarding motivation to start to bridge this gap. Exploratory structural equation modelling was used to assess how well the HAPA model bridges the intention-behaviour gap. A modified version of the HAPA model was run where the volitional constructs of self-efficacy and planning were removed. The remaining model included the motivational phase constructs and was akin to the Theory of Planned Behaviour, which accounted for 5.5% of the variance in children's intake of unhealthy foods. Compared with results of the complete HAPA model, the volitional constructs accounted for an additional 3.7% of the variance in unhealthy foods intake. Although current results show the HAPA model is helping to bridge the intention-behaviour gap, there is still 90% of the behaviour not explained by these models of motivation. Further investigation, using a more complex model including all components of the COM-B model, for reducing parental provision of unhealthy foods, may help to continue to close the gap between holding intention and performing behaviour.

### 3.5.3. Objective 3: Understanding the relationships and relative importance of motivational constructs and parental intention and provision of unhealthy foods

To develop targeted interventions, motivational constructs need to be prioritised to focus intervention strategies. Structural equation modelling provided the ability to identify the relative importance of the HAPA constructs to inform such intervention design. Self-efficacy constructs were highlighted as key with each pathway between the three types of self-efficacy within the HAPA model showing significant and large regression weights ($\beta = 0.69$, $b = 0.63$, $p<0.001$ and $\beta = 0.70$, $b = 0.79$, $p<0.001$). Action self-efficacy was shown to be the largest predictor of intention in the model. This makes action self-efficacy an ideal intervention target for parents not yet intending to change their provision. Maintenance self-efficacy was the predictor with the strongest relationship ($\beta = 0.82$, $b = 0.73$, $p<0.001$) in the HAPA model, with higher maintenance self-efficacy associated with higher levels of planning. Self-efficacy constructs were associated with limiting parental provision through the constructs of intention and planning, rather than directly between maintenance or recovery self-efficacy and parent provision. This may have been related to the lack of distribution in parent ratings compared with action self-efficacy in the current sample.

The importance of self-efficacy has also been seen in other health-related behaviours using the HAPA model in structural equation modelling. Studies in adults have seen self-efficacy constructs as the largest significant predictors of intention and/or behaviour in dietary change[209, 215] and physical activity[217, 218]. Self-efficacy, specifically in ideal conditions (action self-efficacy) and in the face of barriers (maintenance self-efficacy), is the most important aspect of parental motivation for reducing unhealthy food provision and subsequent children's intake; hence should form an initial intervention target.

Secondary intervention targets include intention and planning (i.e. implementation intentions). There was a small ($\beta$ = 0.21, b = 0.16, $p<0.001$) but significant relationship between intention and planning, where a higher intention was associated with a higher rating for planning (action and coping). This may have been influenced by the need to conceptualise intention to reduce unhealthy foods prior to detailing how and when the intended behaviour could be performed. Planning both in ideal conditions (action planning) and in the face of barriers (coping planning) also present considerations for intervention design, given the significant inverse relationship ($\beta$ = -0.32, b = -0.26, $p$=0.044) between having these plans and children's intake of unhealthy foods. Coping planning in particular has been raised as important when addressing complex behaviours[218], such as limiting provision of unhealthy foods.

In other HAPA research of physical activity in adults, intention to planning was found to be the second most important relationship, after self-efficacy constructs[217, 218]. One study investigating dietary behaviour in adults, also found both the path from intention to planning and then planning to behaviour to have the second largest regression coefficients, again following self-efficacy[209]. In designing intervention content, it is important to think about parents' current state of reflective motivation as a baseline. For example, if a parent already poses a high level of self-efficacy, this should not be the focus of their supports but instead these secondary targets of enhancing intention and forming plans would be more appropriate. Findings highlight a novel way to tailor interventions to parents' individual needs; in terms of self-efficacy, intention or planning, or a combination approach to delivering intervention strategies.

***Opportunities to improve of the measurement of reflective motivation***

There are ongoing opportunities to simplify frameworks and to improve or refine questionnaire measures to inform, tailor and measure motivation in intervention research. The current study results highlight several constructs within the HAPA model that may not be as important for parental provision of unhealthy foods or where the measurement of parental attributes could be improved to better capture and model such constructs. It may be that these constructs were not identified in the current sample of parents but may be seen in potentially less motivated more representative samples of the general parent population, such as parents in lower socio-economic circumstances. Nonetheless, constructs that were found to have non-significant paths in the model were *Negative outcome expectancies* and *Risk perception 3 – severity assessment* (general severity of consequences not specific to child), and *Recovery self-efficacy*, as well as one of the paths from *Maintenance self-efficacy* directly to children's unhealthy food intake.

Both *Negative outcome expectancies* and *Risk perception 3 – severity assessment* were negatively- or loss-framed messages. Schwarzer[208] acknowledged that past investigations using a negative outcome expectancies construct did not enhance the amount of variance in intention, beyond what was captured by positive outcome expectancies. These findings also align with those of a meta-analysis by Gallegher and Updegraff[271] suggesting people respond better to gain-framed messages, compared with loss-framed, in a preventative health context. Hence, are more motivated by the benefits of changing a behaviour. However, there are inconsistent findings in the literature regarding nutrition and health messaging[272, 273]. *Risk perception 4 – for child* was based on consequences of unhealthy foods but worded in a positive frame that by reducing unhealthy foods parents can reduce their child's chances of, for example, developing obesity. Parent ratings for *Negative outcome expectancies* (81—92%) and *Risk perception 3 – severity assessment* (80—91%) were also primarily highly favourable (all except for 2 sub-items were above 80%). The skewed distribution of parent ratings may have influenced the non-significant relationship observed. The value of negative outcome expectancies in parent food provision is unclear.

Recovery self-efficacy ratings were inconsistent with constructs of action and maintenance self-efficacy. Results suggested that on average 20% of parents had a higher level of confidence to again limit unhealthy foods after a period where unhealthy foods were provided, than of their confidence to begin limiting unhealthy foods in ideal conditions. It could be that parents were rating their hypothetical self-efficacy, imagining how confident they might feel in this situation when they would have already performed the behaviour, and thinking that it would be easier to re-limit than to initially limit unhealthy foods. Given children' current high intake of unhealthy foods, many parents may not have experienced a reduced provision context. Schwarzer[208] proposes for an individual to accurately rate their recovery self-efficacy they need to have lived experience in the situation. It may be that recovery self-efficacy is not a useful construct when trying to initiate behaviour change, but rather a construct that comes more strongly into play when looking at establishing habits and dealing with set-backs. This was the case in a study by Barg et al.[218] examining motivation to increasing physical activity levels, where researchers didn't include recovery self-efficacy stating it would not be relevant as many of the sample were inactive. The wording of the recovery self-efficacy items may also have influenced the contradicting finding with other self-efficacy ratings. The construct of recovery self-efficacy may not be important to measure in relation to parental unhealthy food provision within the context of children's current unhealthy food intake.

### 3.5.4. Study strengths and limitations

There are several strengths of the current chapter. Firstly, my study is the largest to collect quantitative information about parents' reflective motivation towards reducing unhealthy foods using a validated questionnaire. Although given the self-selection recruitment method, the sample was not representative of the Australian population limiting the generalisability of these findings to parents in general. Yet, this study still provides insights into parental motivation in a subsample of the Australian parent population. Another key strength was the comprehensive approach taken to understand parents' motivational constructs, strongly underpinned by theory. The current study involved novel exploration of the HAPA framework in the parent provision context. However, the model requires cross-validation, by testing in another sample, to enhance confidence in the findings. Exploration of the HAPA framework not only provides opportunities for future nutrition research to utilise this model, but also to use this framework in other health fields to expand understanding of participants' motivation. Collection of a large sample of parents to be sufficiently powered to test the HAPA model using structural equation modelling and was the first study to do so. The use of structural equation modelling allowed the model to be tested in its structural form, as well as determining the mediating pathways within the HAPA model, such as the pathway from intention to unhealthy food intake through planning. It was one of few studies to examine parental motivation or provision of unhealthy foods using this analysis approach.

There are also several limitations to be considered. The cross-sectional nature of the study did not allow for measurement of parents' provision of unhealthy foods in the timeframe of their rated intention to limit provision and was reliant on self-reported motivation. The primary purpose was to gain an understanding of reflective motivation involved in current provision, however this design does not allow causality to be conferred. It is possible that the absolute level of stresses that parents were experiencing at the time of completing the questionnaire may have influenced their ratings, rather than self-efficacy itself. Response bias was mentioned above with the skewed demographic characteristics of the sample, which was primarily partnered mothers with higher household income than the national average. Hence, it did not adequately represent fathers or single parents. In addition, participants potentially have a greater interest in nutrition given the self-selection nature of the recruitment strategy, all limiting the external validity of the findings. While no significant differences in demographic characteristics between completers and non-completers were identified, limited demographics were collected at the beginning of the survey, hence it was not possible to compare more broadly.

Children's diet quality was substantially higher than previous Australian samples[31] (current sample mean DGI-CA 70.8, SD 10.1; vs n=950, 4—7yo, 2x 24hr recall DGI-CA: mean 60.6, SE 0.5) suggesting the presence of sampling and / or social desirability bias. However, a range of children's unhealthy food intake (0 to 12.5; median 2.7, IQR 2.7) were observed. Observed unhealthy food intake were only slightly lower than that of the latest national nutrition survey (n=874, 3—7yo, 24hr recall serves of unhealthy foods: range 0—18.3, median 3.2, IQR 3.4)[274], suggesting the sample was largely representative of the target behaviour. Lastly, a proxy measure of children's intake was used to capture parents' provision rather than directly measuring parents' provision. All items were self-reported or parent-reported for child items, hence there is the potential for inaccurate reporting and social desirability bias.

The measurement tools themselves also present limitations, with the complexity of the items contained in the Parental Food Attitude Questionnaire, likely to place a cognitive burden on parents, particularly for those with lower education levels or with distractions present when completely the survey impacting on parents' concentration. The cognitive burden may need to be tested prior to using the questionnaire in a larger more diverse sample. It is important to understand unique motivations and self-efficacy to approach challenging situations of parents from low socio-economic backgrounds[15], which presents an avenue for future research. In addition, planning elements were considered as motivational constructs due to the overlap with implementation options, however they may not be interpreted in this way by parents. It is important to also note the potential for common method variance (i.e. variance attributed to the measurement method rather than the motivational construct)[275].

The Short Food Survey used to collect children's mean serves of unhealthy foods has the potential to overestimate intake through the assumption that each reported occasion of consuming unhealthy foods was a serve of unhealthy foods (600kJ) stated in the Australian Dietary Guidelines[5]. On the flipside there is potential for under-reporting of unhealthy foods due to social desirability bias. Unhealthy foods are often under reported more than other foods, and with portion size versus recommended serve sizes meaning these foods are often up to three times the standard serve[5, 276]. The overestimation in the questionnaire may have been balanced by underreporting. The anonymous nature of the online survey was also used to attenuate the potential risk of social desirability bias.

Lastly, although the tested model was comprehensive, there are likely other important factors that influence children's unhealthy food intake not captured by the structural equation models. For example, parenting styles[277] and parent feeding practices[119, 270], children's preferences and other child and parent demographics. In addition, aspects of parents' capability (i.e. knowledge and skills) and opportunity (i.e. physical resources and social supports) were not measured or represented in this model, given the focus on comprehensively examining motivation.

### 3.5.5. Implications for future research

***Understanding and targeting motivational constructs***

Both the motivational and volitional phases of the HAPA model include several constructs of interest for further exploratory research, as well as for intervention design. Within the motivational phase, results highlight avenues for further investigation and design of behavioural supports to increase parents' self-efficacy and appropriate recognition of children's intake in relation to dietary guideline recommendations, to form favourable intentions. There is scope for qualitative investigations to pursue an understanding of why parents currently perceive their capabilities quite poorly (i.e. low self-efficacy), and if there are certain contexts that impact on parents' self-efficacy. Further research is also required to explore the differing influences of weekends, school holidays and social occasions, including the role of friends and relatives in parents' food provision. Investigation of the frequency of social contexts will assist in understanding the impact they may be having on overall unhealthy food intake and whole of diet, to determine the priority of research in this area.

In terms of intervention design, it is important to consider tailoring intervention strategies to parents' current state of reflective motivation, which would involve assessing parents' motivation at baseline. Tools such as the Parental Food Attitude Questionnaire could be used to provide this baseline assessment for future interventions. Future interventions could be designed to direct behavioural supports towards increasing parental self-efficacy in ideal settings and more challenging context when parents' confidence may be reduced in the face of barriers. The Parental Food Attitude Questionnaire provides a tool to not only capture changes in parental motivation in these future interventions, but also in a practice setting to help tailor strategies in for example a one-on-one consultation.

A gap that remains following the current study is in determining if and what competing intentions parents may hold regarding food provision. For example, a recent review of qualitative studies, synthesized parents' motivations towards food provision into four key themes: promoting good health, building positive relationships, as well as practicalities and constraints, and emotional motivations[68]. The current study assumes parents are motivated by promoting good health, however these competing motivations require further exploration, and to examine whether they are consistent across subgroups of parents. There are several research avenues that can be pursued to continue to build a comprehensive understanding of motivational constructs that will assist in designing interventions to reduce children's unhealthy food intake.

***Health Action Process Approach model and Parental Food Attitude Questionnaire***

Repeating this study in a larger, more diverse sample would be beneficial for many reasons, including cross validation, additional exploration of indirect paths and examination by intention status. There is a need to cross-validate the HAPA structural equation model in more generalizable parent samples to give confidence in the current outputs, as well as examine baseline differences by demographics such as socio-economic position. Further studies should also consider assessments of the statistical significance of the indirect pathways in the HAPA model with the use of programs such as MPlus[278], to run the structural equation models. A key limitation of software used in the current analyses is the inability to compute the statistical significance of each indirect or mediated pathway, instead provides an estimated significance for the combined indirect paths per construct in the model[245].

In addition, to further improve the Parental Food Attitude Questionnaire, cognitive interviewing studies could be used to understand how parents are answering the items, particularly for maintenance (regarding visitors) and recovery self-efficacy constructs. While the content validity of the questionnaire was established[220], further investigations in terms of the reliability of the questionnaire can be explored. The approaches of cross-validation and cognitive analysis may also provide guidance into the non-significant paths between constructs in the model. The variation in parent rated action self-efficacy and intention also lend to exploration of the HAPA model by differing parental self-efficacy levels and by non-intenders, intenders and actioners. Such investigations could also provide valuable information to tailor intervention strategies based on parents' initial (baseline) self-efficacy levels and intention.

***Capability, Opportunity, Motivation and Behaviour model***

The lack of variance in children's unhealthy food intake accounted for by reflective motivation alone, signals the need to capture additional individual and environmental constructs in future models, such as elements of capability and opportunity. Future research could undertake structural equation modelling to test the COM-B model as a more complete model to understand parental provision of unhealthy foods. Considering behaviour in the context of the COM-B model, current study findings signal the need to investigate the role of social opportunity. Lower parent ratings of self-efficacy and plans relating to contexts with friends and relatives, suggest parents do not feel they are surrounded by social supports to encourage reduced provision of unhealthy foods. Whether such feelings are a true reflection of their social supports or of the current social norm to enjoy unhealthy foods in excessive amounts, requires further investigation. To summarise, there are numerous avenues for further research into parents' reflective motivation, as well as aspects of capability and opportunity that may influence parents' perceptions of these components (captured under their motivation).

## 3.6. Conclusion

Parents' reflective motivation to reduce unhealthy foods is one component needed to initiate a change in provision of unhealthy foods to their children. This chapter reveals parents' self-rated motivational constructs show areas of potential as key areas for intervention strategies. Analyses using the Health Action Process Approach model provides guidance to prioritise the key constructs to be targeted in future interventions. For example, self-efficacy to develop intention, and self-efficacy and planning for complex situations, such as friends, relatives, weekends and other non-routine circumstances, to support parents to act on their intentions. Results of the current study support the use of the Health Action Process Approach model to understand parents' reflective motivation towards reducing unhealthy foods. However, overall model variance signals there are still other important factors not accounted for by reflective motivation alone, such as constructs within capability or opportunity. Both lower parent self-efficacy and plans in complex situations, suggest prioritising research to further explore parents' social opportunity within the COM-B model.

## ***Chapter 3 findings at a glance***

*Are parents aware of the risks or benefits of the excessive or desired provision of unhealthy foods?*

Yes, primarily favourable parent ratings for risk perception and negative outcome expectancies, suggest parents are aware of the risks of excessive unhealthy food intake and do not see the negative consequences as barriers to changing provision. Mixed ratings were seen for positive outcome expectancies, suggesting that some of the positive consequences were not considered benefits to changing provision.

*Do parents intend to reduce unhealthy food provision?*

Approximately 50% of parents reported they moderately or strongly intended to reduce their provision of unhealthy foods within the next month.

*Do parents have the confidence to support limiting unhealthy food provision?*

Parents reported mixed levels of confidence (self-efficacy), with generally lower levels of confidence reported for more challenging non-routine contexts including those involving friends and relatives.

*Do parents have plans to limit unhealthy food provision?*

Yes, parents commonly reported having strategies to limit unhealthy foods in routine contexts such as packing the lunchbox. However, parents often reported they did not have strategies for situations when friends and relatives undermine their plans to limit unhealthy foods.

*Can the HAPA model be applied to understand parents' reflective motivation for reducing provision of unhealthy foods?*

Yes, structural equation modelling revealed suitable model fit for the HAPA model, with the model explaining 9.2% of the variance in children's unhealthy food intake.

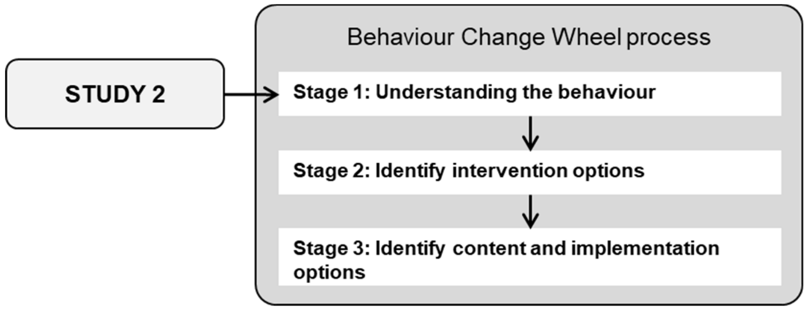
*Does the HAPA model help to bridge the intention-behaviour gap?*

Yes, the HAPA model volitional phase constructs accounted for an additional 3.7% of the variance in children's intake of unhealthy foods, when compared with an exploratory model similar to the Theory of Planned behaviour consisting of only motivational phase constructs.

*Which motivational constructs are of most importance to reducing parental provision of unhealthy foods?*

Action and maintenance self-efficacy were identified as the most important constructs for reducing unhealthy foods, followed by intention and planning.

# 4. UNDERSTANDING HOW PARENTS' FOOD PROVISION CHOICES ARE INFLUENCED BY OPPORTUNITY FACTORS




This chapter addresses the environmental aspect of the overall thesis objective 1: to better understand motivational and *environmental* predictors of parental provision of unhealthy foods to their children.

This chapter explores the influence of physical and social opportunity (environmental) factors in parents' food provision choices to their children. This was addressed using a discrete choice experiment designed to force parents to trade-off attributes to identify important factors influencing their provision choice. Use of discrete choice experiment methodology advances the nutrition field by avoiding a reliance on parent report methods that are subject to social desirability bias. To provide an in-depth analysis, this chapter investigates parent decision-making in social and non-social contexts, to explore whether opportunity influences differ by social occasions—an understudied area.

Findings from this chapter provide new knowledge to inform the behavioural analysis that is presented in Chapter 6 (Study 4).

**Glossary**
(adapted from Hensher et al.[1], Lancsar and Louviere[2])

| | |
|---|---|
| Alternatives | Options containing specific levels of attributes. For example, a snack option. |
| Attributes | Characteristics (i.e. factor) of an alternative. For example, cost of snack. |
| Attribute levels | The different levels of the attribute. For example, cheaper and more expensive would be two attribute levels of the attribute 'cost of snack'. |
| Choice task | One choice question presented to participants to choose between alternatives with varying attribute levels. |
| Utility | Level of happiness or satisfaction that an alternative yields to a participant. Utility is a latent, unobserved quantity that is estimated from the choices observed. |
| Utility weight | Measure of utility. Another term for regression coefficient. |

## 4.1. Introduction

### 4.1.1. Opportunity influences on food provision

Parents' food provision impacts what young children eat. There are numerous factors affecting what parents provide to their children, as discussed in Chapter 1 (Literature Review). In addition to motivation investigated in the previous chapter (Study 1), there are many external or environmental factors that can influence parents' food provision. To briefly recap, there is a body of qualitative research that has identified several environmental factors on unhealthy food provision. Specifically, studies have reported influences such as cost, time, convenience, food availability, child resistance, partners, grandparents and friends[69, 138, 146-148]. These external factors are considered under the opportunity element of the COM-B model. To restate, opportunity is defined as *"all the factors that lie outside the individual that make the behaviour possible or prompt it"*[174](p 4 of 11).

The opportunity element within the COM-B model is separated into physical opportunity and social opportunity components[3]. Physical opportunity is defined as the physical resources available, for example: time, money, access to and availability of foods, cooking and storage facilities[3]. Physical opportunity components can be considered by asking 'does one have all the necessary physical resources to action the behaviour in the current environmental context?'[3]. Social opportunity is defined as what is afforded by the social environment, such as the supports from friends and family and the social norms that can support or hinder a behaviour[3]. Norms that align with a favourable behaviour are a facilitator to behaviour change. For example, if a parent's social network discourages provision of unhealthy foods, children are less likely to be provided unhealthy foods. Depending on the specific external / environmental context where the behaviour occurs there may be differing levels of influence of physical or social opportunity on the behaviour. To understand the impact of external / environmental factors it is important to understand how physical and social opportunity influence parents' food provision decision-making processes.

### 4.1.2. Parental food provision in the context of food choice

Food choice is complex; even more so for parents who are not only making decisions about what to eat themselves, but also about what they provide to their children (Figure 4.1). As discussed in Chapter 1 (Literature Review) there is a paucity of evidence, where studies have rarely explored *how* opportunity (external/environmental factors) influence parents' food provision decision-making. To briefly recap, two qualitative studies of Australian parents of infants and preschool age children provide some indication of unhealthy food provision decision-making, including seeking dietary balance[69, 155]. Yet, these studies were limited to describing common themes from parent-reported influences and cannot determine the relative importance of such influences. Three studies using a modified version of the Food Choice Questionnaire, explored various motives of parents' food provision choices for their children[144, 156, 157]. Although these studies included some physical and social opportunity influences, they were not comprehensive often only including certain physical opportunity influences. In addition, they relied on parent-reported importance with items rated individually, rather than forcing parents to make compromises by rating factors against each other, to mimic real life provision decision-making. Whilst current approaches are not able to determine the relative importance of opportunity factors influencing parents' food provision decision-making, they can provide a list of multiple factors that are likely important for parents. Investigations require novel methodologies to understand the importance of opportunity factors in parents' unhealthy food provision, to build this research area and overcome limitations of past designs.

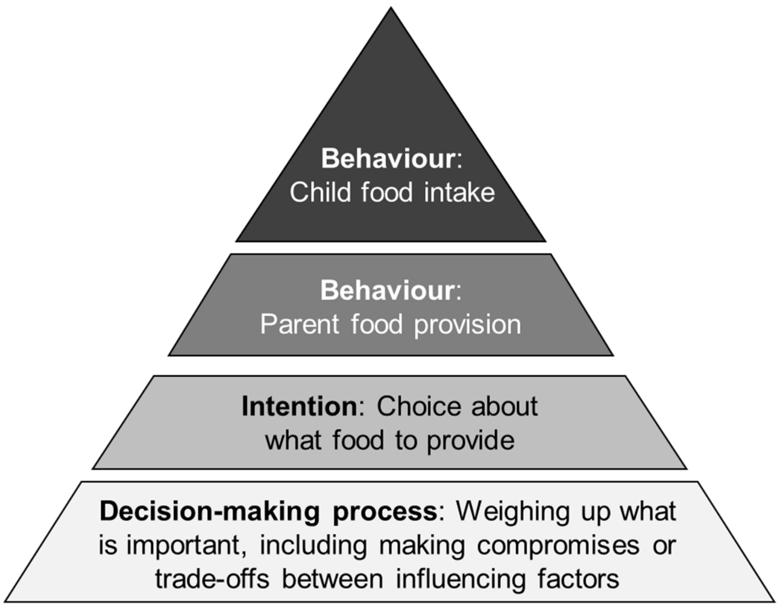



Figure 4.1: Hypothesised broad level processes involved in parent food provision behaviour

***Context, parent and child characteristics in parents' decision-making***

Various contextual factors, as well as parent and child characteristics may also impact parents' food provision decision-making. For example, parents' self-efficacy may mediate their food provision decision-making if their child has been resistant to healthy foods provided in the past. Contextual factors including weekly routines, eating occasions and social context were outlined in Chapter 1 (Literature Review). The limited available evidence suggests weekends, snack eating occasions and social contexts may be important to consider in children's unhealthy food consumption. In addition, findings from Chapter 3 (Study 1) revealed parents rated several motivational constructs lower in contexts involving visitors or extended family members, compared with contexts involving immediate family. Findings from Chapter 3 (Study 1) further support the need for more research to understand the role of social occasions on children's intake of unhealthy foods.

Parent and child characteristics may act as mediators or moderators between opportunity factors and parents' food choice. There are many characteristics that have been explored as influences in past child nutrition research, including but not limited to parents age, weight status, self-efficacy, socio-economic position, as well as children's gender, weight status, behaviour or temperament traits[88, 146, 279-281]. Of interest to this study are parenting self-efficacy, child temperament, socio-economic position and child weight status. Parenting self-efficacy that relates to how confident and satisfied a parent is in their parenting and in overcoming parenting problems, is thought to be important in parenting dietary and physical activity behaviour change[282-284]. Parenting self-efficacy may weigh in to parents' decision-making when involving other people, such as friends, extended family or co-parents. Similarly, a child's temperament—the way the individual child responds to the world around them—may influence how parents consider children's preferences or anticipated resistance when deciding which foods to provide[285]. Child temperament traits have been associated with weight status and certain feeding practices and styles (e.g. restrictive, permissive)[286, 287], hence may have a role in unhealthy food provision, yet requires investigation. Research also suggest that parents' food provision or feeding practices differ in parents of children with overweight or obesity and those of children in the healthy weight range[146, 288]. There is also evidence suggesting children from lower socio-economic backgrounds have poorer diet quality[31, 289], and higher unhealthy food intake, which has in turn been linked to higher weight status[15]. Qualitative research has reported differences in parent reported factors influencing unhealthy food provision when interviewing parents experiencing low versus high socio-economic circumstances[69]. Parenting self-efficacy and child temperament my act as mediators, whilst child weight status and family socio-economic position may act as moderators, of parents' food choice, hence warrant further investigation when examining parents' food provision decision-making.

### 4.1.3. Understanding food choice decision-making using discrete choice experiments

Discrete choice experiments provide an approach to understand complex factors influencing choice by mimicking real life decision-making, and attenuating social desirability bias[1]. This includes being forced to make compromises (trade-offs) when making decisions, not often possible with other study designs[290] (Figure 4.1). 'Attributes' is the term given to factors or characteristics that are weighed up in decision-making (e.g. cost, time). The discrete choice experiment study design, developed in marketing and applied economics[290], provides a novel approach to experimentally explore parental food provision decision-making. Whilst the use of discrete choice experiments has increased in health care research over the past 20 to 30 years[2], examples of the use of this study design in the nutrition field have only emerged in the published literature in the last five years (i.e. from ~2015).

Despite being a relatively new application of this study design, discrete choice experiments are becoming increasingly utilised in nutrition research, commonly relating to food labelling[291-297]. In the past four years, three discrete choice experiments have examined meal or snack attributes in adult populations[292, 294, 298]. These studies explored the importance of taste, healthiness, price, preparation time, travel time to shops, convenience, and nutritional characteristics (i.e. sugar, fat, salt, energy, fibre, natural) when choosing meals and snacks[292, 294, 298]. Five studies have explored parent or child preferences for: home food preparation and environment interventions[295], front of package labelling[291, 293, 296], and snack choice[299]. Virudachalam and colleagues[295] revealed three subgroups of parents (of 1—4yo), based on their preference for intervention content, clustered as: a healthy cooking group, a creative cooking group and a child resistance group[295]. Food product labelling has been investigated in children[293, 296], and adults[293, 297], and parents of five to 11-year-olds[291]. These studies have focussed on front of pack marketing aspects and nutrition information labelling. Finally, one study examined the influence of branding and price in eight to 11-year-old children's snack choice[299]. The study found product type was of most relative importance in driving children's snack choice, followed by brand and price[299]. However, the study by Hartmann and colleagues[299] was limited to the three attributes and does not contribute to the understanding of parents' snack provision choices, nor those of children under eight years of age. Parent snack provision is yet to be investigated through discrete choice experiment methods. The small but growing body of research supports this emerging method to investigate parent food choice decision-making.

#### 4.1.4. Overview of the discrete choice experiment approach

Discrete choice experiments elicit preferences to determine the importance of attributes (e.g. cost), or the value parents place on them in food choice decision-making[2]. They do this by estimating the contribution of each attribute to overall utility, through analysis of choice data[2]. This relies on the assumptions of random utility theory that the systematic part of utility can be determined by a sum of its parts (i.e. attributes)[2]. Therefore, the utility or preference parents place on cost for example when choosing snacks can be estimated. Utility weights are a key output obtained from discrete choice experiment analyses, and are a measure of utility[1]. Utility is a latent unobservable level of preference that an alternative yields to a parent[1]. Evaluation of preferences can be either revealed, which are the observations of the world as it is (e.g. observing the foods parents provided to their child and analysing the cost of those items etc), or stated preferences, that is what people say they would do, obtained from surveys such as discrete choice experiments (e.g. responses from hypothetical snack choice tasks)[290]. Stated preferences are elicited when wanting to predict future events / services or when it is not possible to observe revealed preferences, as is the case in parent snack provision[1, 290]. Stated preference data also allow for the separation of value or importance attached to attributes, to determine key attributes driving choice. Separation of the importance attached to attributes is not possible in revealed preference data as attribute values are correlated[290]. To identify important influences and the relative importance of attributes, stated preference data obtained through a discrete choice experiment are needed.

There are several benefits to discrete choice experiment methods. Analyses of data obtained from parents' trading off choices reveals the underlying importance of attributes, hence reducing the risks of social desirability bias[1]. Although still limited to hypothetical decisions, as parents are not physically providing foods to their child, the design offers a more comparable approach to real life decision-making than other methods such as qualitative designs. This method provides an alternative approach to gain insight into decision-making overcoming limitations of qualitative designs such as smaller samples which limit generalisability, increased social desirability bias and inability to assess the relative importance of influences on provision[294, 300]. A discrete choice experiment approach can identify important influences and relative importance of attributes to prioritise opportunity intervention targets.

#### 4.1.5. Study aim and objectives

The aim of this study was to explore the role of physical and social opportunity in parents' unhealthy food provision decision-making to their three to seven-year-old children using a discrete choice experiment. Specifically, this study focussed on snack provision on a weekend day, as such contexts have been highlighted as common times unhealthy foods are consumed (Literature Review). Physical opportunity is defined as the physical resources a parent has available, such as money (cost), time and availability of food options. Social opportunity is defined as what is afforded by the social environment, such as child resistance, or support from co-parent and friends. For this study food provision decision-making is defined as the processes of weighing up the various factors that can influence what parents choose to provide to their child, including making trade-offs or compromises between these factors. Contextual factors and individual characteristics investigated were social occasions, child temperament, parenting self-efficacy, socio-economic position and child weight status. While it is acknowledged that presence of any other person may be considered social in nature, for the purposes of this chapter social occasions are defined as occasions involving those outside of a child's immediate family (e.g. extended family, friends). The study aim was addressed through four objectives, detailed below.

<u>Objective 1:</u> To determine the relative importance of physical opportunity (cost, time, food availability) and social opportunity (child resistance, support from co-parents and friends) aspects when parents are choosing snacks to provide to their child.

Specific question in relation to Objective 1 was:

*Which attribute (cost, time, food availability, child resistance, support from co-parents and friends) is of greatest relative importance when parents are choosing snacks to provide to their child?*

Objective 2: To investigate how the importance of physical and social opportunity attributes differ in social versus non-social occasions.

Specific question in relation to Objective 2 was:

*Does the relative importance of physical and social opportunity attributes differ in social versus non-social occasions?*

Objective 3: To investigate whether child temperament, parenting self-efficacy or frequency of social occasions mediates the effect of opportunity attributes on parent choice.

Specific questions in relation to Objective 3 were:

*Does child temperament mediate the effect of child resistance on parents' snack choice?*

*Does parenting self-efficacy mediate the effect of support from co-parents and friends on parents' snack choice?*

*Does frequency of social occasions mediate the effect of food availability on parents' snack choice?*

Objective 4: To investigate how the importance of opportunity attributes is moderated by socio-economic position or child weight status.

Specific questions in relation to Objective 4 were:

*Does socio-economic position moderate the importance of opportunity attributes when parents are choosing snacks to provide to their child?*

*Does child weight status moderate the importance of opportunity attributes when parents are choosing snacks to provide to their child?*

## 4.2. Methods

### 4.2.1. Study design and ethics approval

This study used a discrete choice experiment design. Ethics approval was obtained from the Flinders University Social and Behavioural Research Ethics Committee July 2018 (project number 8043). The study was prospectively registered with the Australian New Zealand Clinical Trials Registry (ACTRN12618001173280). This chapter was prepared using the STROBE-nut statement checklist for reporting observational studies in nutritional epidemiology[227] and the ESTIMATE checklist for reporting discrete choice experiment analyses[301] (Appendix 4).

### 4.2.2. Participant sampling and recruitment

The sampling frame for this study was Australian parents. Parents were eligible to take part in the study if they were the primary food provider of a three to seven-year-old child, residing in Australia, and fluent in written English with internet access. Parents were ineligible if they were aged less than 18 years, or if their child was outside of the study age range (<3.0 or ≥8.0 years old).

Recruitment occurred from 25th July to 30th September 2018. Parents were recruited using non-probability sampling, where parents self-selected to take part in the study, through the social media platform Facebook. A study Facebook page was created and a paid Facebook advertising campaign ($300) ran throughout August 2018. Recruitment via Facebook was supplemented with recruitment via printed flyers, and traditional media (ABC Riverland radio; linked to a child nutrition media release through Flinders University), as well as through the BubHub online parenting website ‘Research Help’ forum. To reduce selection bias targeted study promotion was implemented between 27th August to 15th September where purposeful contact was made with parenting or playgroup Facebook pages in low socio-economic areas (SEIFA deciles 1—3, using the postal area to IRSAD)[302] to boost recruitment of families in lower socio-economic circumstances. An incentive of a chance to win one of ten $30 supermarket vouchers was offered to parents completing the study.

### 4.2.3. Development of the discrete choice experiment survey instrument

The discrete choice experiment involved development of an elicitation task and statistical modelling approach to understanding parents’ snack provision preferences. The survey instrument had six sections: screening items, quasi-revealed parental snack provision preferences, discrete choice experiment, usual snack provision, explanatory variables, and parent and child socio-demographic characteristics. The discrete choice experiment was the main component of the survey instrument and was designed to obtain an understanding of the key components of opportunity that influence parents' snack provision choices. A discrete choice experiment is described by the choice condition—decision-making context—in which the choice is made, and the choice tasks themselves. The choice tasks involve parents making choices among alternatives, which reflect varying attribute levels as determined by a statistical experimental design. The development, implementation, and analysis process for discrete choice experiments is outlined in Figure 4.2. This section details the development steps including: choice conditions, attributes and attribute levels, choice tasks, explanatory variables, experimental design and pilot testing.

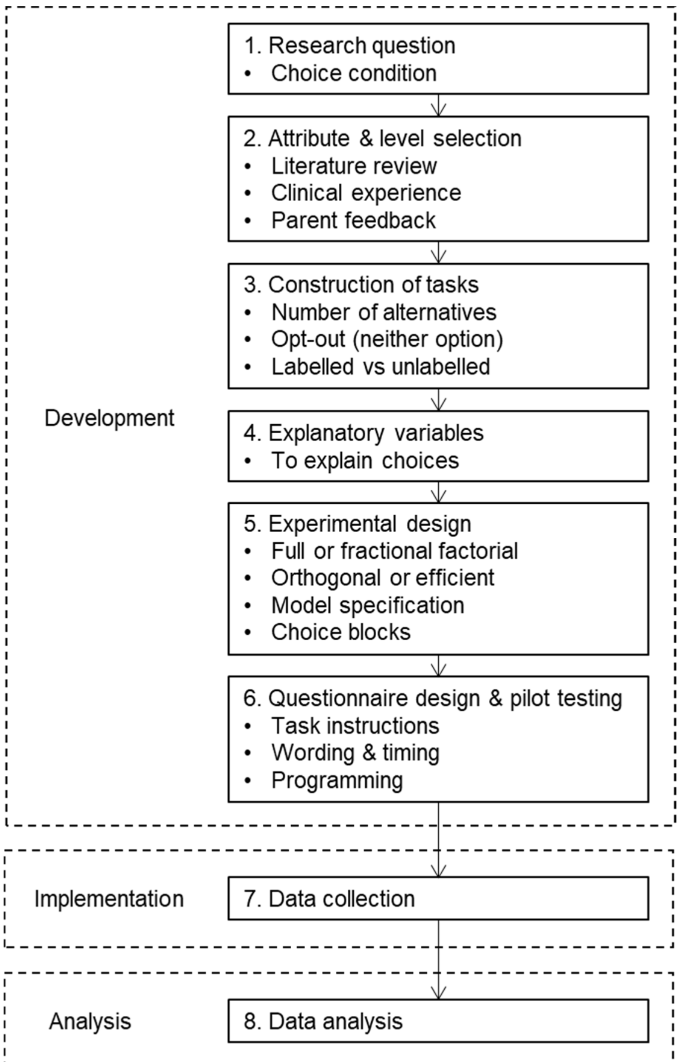



Figure 4.2: Overview of the discrete choice experiment methodology

Content adapted from Bridges et al.[303], Lancsar and Louviere[2]

***Choice conditions and choice task scenarios***

Two conditions were included in the discrete choice experiment: 1) a control condition where parents were asked to make decisions for snacks provided assuming that only immediate family were present (referred to as 'non-social' context), and 2) a manipulated condition which was a social context, where parents were asked to assumed they were making snack provision decisions as if family friends were going to be present ('social' context). The manipulated condition was informed by unpublished results from an additional item included in Study 1 (see Appendix 6) asking parents to report the types of social occasions their child had in the past week. Social occasions with family friends (e.g. parent friends with child/ren) such as catching up (64%) or eating out (38%) were the most frequently reported types of social occasions, followed by catching up (52%) or eating out (21%) with extended family (including grandparents), and child playdates (e.g. child and peer, nil additional adults; 52%). Hence, catching up with friends as a family was selected as the social context for the current study.

The non-social context was presented to parents in the choice task scenario as: *'Please imagine it is a typical Saturday morning and you are at home with your family. It is mid-morning and you are preparing a snack to give your child'*. The social context scenario read: *'Weekends are a common time to catch up with friends as a family. Please imagine you have a friend, their partner and child visiting/over to your home on a typical Saturday morning. It is mid-morning and you are preparing a snack to give your child'*.

***Attributes and attribute levels***

In a discrete choice experiment, attributes are the characteristics of an alternative. A list of potential attributes to include in the discrete choice experiment were developed from quantitative and qualitative literature on food provision. Specifically, components of both physical and social opportunity were considered (e.g. [69, 146, 148]). Potential physical opportunity attributes included: cost, time, convenience, availability, accessibility. Potential social opportunity attributes included: support or acceptance of child/ren, co-parents[1], extended family members including grandparents, or parents' friends. Attributes were prioritised based on the literature regarding commonly raised barriers or significant associations with child intake, and researcher clinical and practical experience. Unfeasible attributes were excluded, for example directly including snack availability was excluded as this was inherent within the choice task. To minimise parent response burden and task complexity[2], the number of attributes were limited to six, three capturing physical opportunity (cost, time to prepare, food availability), and three addressing social opportunity (child's response, support from co-parent and friends) (Table 4.1). Food availability was measured via proxy of type

[1] The term co-parent is used to capture the child's secondary food provider, whether they are the child's biological parent (e.g. partner or separated parent) or a step parent (e.g. new partner) or another caregiver.

of food attribute, as it was not possible to include availability directly because part of a choice task is that both alternatives are available. The type of food attribute also assisted parent interpretation of generic unlabelled alternatives (e.g. Snack A) in the choice task and provided information regarding provision of unhealthy foods in social versus non-social occasions. Time to prepare attribute reflected both time and convenience considerations for parents. Attribute levels were limited to two or three levels per attribute considering attribute balance and to minimise design complexity, parent response burden and task complexity[2]. Select of the attribute levels were informed by clinical and research experience.

Table 4.1: Discrete choice experiment attributes, attribute levels and corresponding evidence

| COM-B | Attribute | Attribute levels | Supporting evidence | | | |
|---|---|---|---|---|---|---|
| | | | Reference | Child age | Study design | Food focus |
| Physical opportunity | Cost of snack | Cheaper | Petrunoff et al. 2012[69] | 3—5 years | Qualitative | Unhealthy foods |
| | | More | Martin-Biggers et al. | 2—5 years | Qualitative | SSB, Healthy foods |
| | | expensive | 2015[148] | 2—5 years | Qualitative | All foods |
| | | | Peters et al. 2014[138] | 7—15 years | Quantitative | All foods |
| | | | Smit et al. 2017[149] | 6—12 years | Qualitative | All foods |
| | | | Nepper & Chai 2016[146] | | | |
| | Time to prepare | Instant | Petrunoff et al. 2012[69] | 3—5 years | Qualitative | Unhealthy foods |
| | | Quick | Horning et al. 2014[150] | 8—12 years | Quantitative | Unhealthy foods |
| | | More time | Martin-Biggers et al. | 2—5 years | Qualitative | SSB, Healthy foods |
| | | consuming | 2015[148] | 2—5 years | Qualitative | All foods |
| | | | Peters et al. 2014[138] | 7—15 years | Quantitative | All foods |
| | | | Smit et al. 2017[149] | 6—12 years | Qualitative | All foods |
| | | | Nepper & Chai 2016[146] | 2—16 years | Quantitative | Healthy foods |
| | | | Slater et al. 2009[132] | | | |
| | Type of food | Everyday | Petrunoff et al. 2012[69] | 3—5 years | Qualitative | Unhealthy foods |
| | *(proxy food* | foods | Martin-Biggers et al. | 2—5 years | Qualitative | SSB, Healthy foods |
| | *availability)* | Sometimes | 2015[148] | 7—15 years | Quantitative | All foods |
| | | foods | Smit et al. 2017[149] | 2—16 years | Quantitative | Healthy foods |
| | | | Slater et al. 2009[132] | | | |
| Social opportunity | Your child's | Accepting | Petrunoff et al. 2012[69] | 3—5 years | Qualitative | Unhealthy foods |
| | likely response | Resistant | Hoare et al. 2014[147] | 0.5—1 years | Qualitative | SSB |
| | | | Pettigrew et al. 2017[152] | 8—14 years | Quantitative | Unhealthy foods, SSB |
| | | | Martin-Biggers et al. | 2—5 years | Qualitative | SSB, Healthy foods |
| | | | 2015[148] | 6—12 years | Qualitative | All foods |
| | | | Nepper & Chai 2016[146] | 2—9 years | Quantitative | All foods |
| | | | Huang et al. 2016[81] | 2—16 years | Quantitative | Healthy foods |
| | | | Slater et al. 2009[132] | | | |
| | Significant | Supportive | Petrunoff et al. 2012[69] | 3—5 years | Qualitative | Unhealthy foods |
| | family members | Unsupportive | Lora et al. 2017[153] | 2—5 years | Qualitative | All foods |
| | (Co-parent) | | Peters et al. 2014[138] | 2—5 years | Qualitative | All foods |
| | | | Nepper & Chai 2016[146] | 6—12 years | Qualitative | All foods |
| | Family friends | Supportive | Petrunoff et al. 2012[69] | 3—5 years | Qualitative | Unhealthy foods |
| | | Unsupportive | Peters et al. 2014[138] | 2—5 years | Qualitative | All foods |

Abbreviations: COM-B: Capability, Opportunity, Motivation and Behaviour model; SSB: sugar-sweetened beverages

### ***Choice task***

An example choice task is shown in Figure 4.3. Parents were asked to consider two alternatives and select their most preferred option. Parents were presented with an explanation of the task and an example choice task prior to receiving their first choice task, to assist in completing the discrete choice experiment (Figure 4.3). Each choice task presented the scenario, underlining key text to differentiate the social or non-social context. Parents were asked to indicate which option they most preferred to provide to their child between Snack A or Snack B or the ‘neither’ opt-out option. An opt-out option was included to enhance the external validity given that in the real-world parents could also choose to provide neither snack alternative[304]. Attribute levels were displayed in a table in a text-only format[305]. Parents were able to see the number scenario between one and five they were completing to highlight to parents each choice task was different.

Thank you for your responses so far.

The following questions will show you a scenario, where you will need to select one of three options: Snack A, Snack B, or Neither. Choose the option that most closely matches what you would think about when choosing snacks to give the child you selected earlier in the survey (i.e. the child you have selected for this study).

- There are many things we think about when choosing what foods or drinks we give to our children. We have listed some common things which will vary in the options. When making your choice please consider only these things: **Cost of snack**, **Time to prepare**, **Your child's likely response**, **Significant family members**, **Family friends**, **Type of food**.
- We have explained what we mean by these things, please click on this link to open it in a new tab of your web browser so you can read it as needed throughout the survey.
- When answering the questions you will need to weigh up these things between Snack A and Snack B (see example question below).
- Although there are probably other things that might change what you choose to give your child, imagine these other things stay the same between options.

**Example of what the questions will look like:**

Please imagine it is a typical Saturday morning. It is mid-morning and you are preparing a snack to give to your child.

Please indicate which option you most prefer to provide to your child.
Assume they are all available options.

Scenario 1 out of 5

| | **Snack A** | **Snack B** |
|---|---|---|
| Cost of snack | Cheaper | More expensive |
| Time to prepare | More time consuming | Quick |
| Your child’s likely response | Accepting | Resistant |
| Significant family members (e.g. co-parent) | Unsupportive | Supportive |
| Family friends | Supportive | Unsupportive |
| Type of food | Sometimes foods | Everyday foods |

- ○ Snack A
- ○ Snack B
- ○ Neither

Ready to get started? Remember that your answers are **anonymous** so please answer honestly.
**There are no right or wrong answers**, just choose which option you would choose in the scenario.

Click the arrow to continue to the next screen.

Figure 4.3: Screenshot of the explanation and example of a choice task presented to parents in the online discrete choice experiment

### *Explanatory variables*

Three explanatory variables, child temperament, parenting self-efficacy and frequency of social occasions, were included. Explanatory variables were included in the analysis as interaction terms in the utility model specification to examine their mediating influence on the importance of parents' decision-making.

Child temperament was chosen as an explanatory variable as it was hypothesised to influence the derived utility or value parents placed on the attribute for child's likely response to the snack alternative. Child temperament is defined as *"constitutionally based, individual differences in reactivity and self-regulation"*[285](p 1395). Temperament consists of three traits extraversion / surgency, negative affectivity and effortful control[306]. How a child behaves and reacts to being offered foods they dislike (commonly healthier 'everyday' foods) was anticipated to impact on how much this attribute factors into parents' decision-making. Child temperament was measured via a three item scale including surgency / extraversion, negative affectivity, effortful control, rated on a five point Likert scale from '1) Extremely untrue of your child' to '5) Extremely true of your child'[306]. The brief temperament scale was developed by Sleddens and colleagues[306] from the three broad factors—surgency / extraversion, negative affectivity, effortful control—in the Child Behavior Questionnaire scale very short version (36 items)[307]. The brief three item scale, selected for use in this study, has been found to be moderately correlated (0.45 to 0.54, $p\leq0.001$) with the average scores of the corresponding factors in the 36-item very short version of the Child Behavior Questionnaire, and the surgency / extraversion factor is correlated (0.28, $p\leq0.001$) to child impulsivity, in children aged four to eight years[306].

Parenting self-efficacy was chosen as an explanatory variable as it was hypothesised to mediate the utility of support from co-parent and support from family friend attributes. General parenting self-efficacy consist of domains of efficacy and satisfaction of parenting[282]. A higher level of general parenting self-efficacy was hypothesised to result in parents deviating from alternatives that co-parents or family friends were supportive of. Parental self-efficacy was measured with the Parenting Sense of Competence ('Being a parent') scale where parents rated agreement for 16 items on a six-point Likert scale from '1) Strongly agree' to '6) Strongly disagree'[282]. The scale has been validated in a sample of mothers and fathers of children aged four to nine years[282]. Different approaches to producing subscales and total scores have been documented in the literature following initial validation of the scale in 1989, such as producing two or three subscales and presenting total scores as a sum or means[308-311]. A separate score was produced for efficacy containing seven items that were reverse scored, and satisfaction containing nine items, using the items included in the Johnston and Mash[282] version. The total score for efficacy could range from a minimum of seven to maximum of 42 and satisfaction from a minimum of nine to maximum of 54. Initial validation reported high internal consistency of the two sub-scales, with Cronbach's alpha of 0.75—0.76, as well as primarily significant inverse correlations between Parenting Sense of

Competence scores and internalizing (-0.21 to -0.26, $p<0.01$, efficacy -0.07, NS) and externalizing (-0.10 to -0.30, $p<0.05$) scores from the Child Behaviour Checklist[282].

Frequency of social occasions was anticipated to influence the weighting of type of food attribute. It was hypothesised that more frequent social occasions would be associated with lower unhealthy foods (sometimes foods) alternatives. Frequency of social occasions was measured by an item developed for this study. The item asked parents to report the number of times their child took part in each of the presented occasions, over the past week. Occasions included, for example, a play date, catching up with friends as a family, eating out with extended family. Occasions also included birthdays and other celebrations, which are considered celebratory occasions, to ensure parents didn't consider these in the social occasions. Responses for celebratory occasions were separated, and total frequency of social occasions over the past week calculated. See Appendix 5 for copies of the explanatory variable items.

***Experimental design***

Hypothetical combinations of levels of each attribute in the discrete choice experiment are designed by an experimental statistical approach to ensure attribute balance for the identification of statistically robust utility weights[290]. An experimental design can be viewed as a matrix of values that are used to determine what goes where in a discrete choice experiment measurement tool. The values that populate the matrix represent the attribute levels that are used in the choice task, whereas the columns and rows of the matrix represent the choice situations, attributes and alternatives of the experiment. For this study, one experimental design was developed so that all aspects of the experiment were the same for both the control and manipulated conditions to allow comparison of results. A fractional factorial design was selected over a full factorial design which would have consisted of 128 possible alternative combinations, based on one attribute with four levels and five attributes with two levels (2 x 4 x 2 x 2 x 2 x 2). Fractional factorial designs help to restrict the design to a practical number of alternatives, by systematically selecting a subset of the possible alternatives to maximise data for effects of interest in a more efficient manner[290]. A fractional factorial orthogonal main effects design was used to maximise the power of the design to detect significant relationships[1]. Orthogonal designs are based on the assumptions of attribute level balance and that attributes were not correlated[1]. This design was selected over an efficient design given the lack of prior estimates to input into an efficient design and to allow determination of the contribution of each attribute[1]. The design was prepared using NGene (ChoiceMetrics 2018, version 1.2.0), including five attributes with two levels and one attribute with four levels (middle level repeated) with 20 rows (i.e. unique choice tasks) and four blocks. An efficient design was also derived but failed to obtain acceptable attribute level balance, as examined by cross-tabs.

The final design included 20 hypothetical choice tasks (Table 4.2). Choice tasks in the final design were checked for dominant alternatives with a clearly preferable alternative and no-choice tasks where both alternatives present the same attribute levels. Two attribute levels were recoded to remove the no-choice task and reduce dominant alternatives. The 20 choice tasks were split into four blocks of five tasks per respondent per condition (i.e. total of 5 tasks x 2 conditions = 10 tasks per parent). Time to prepare attribute contained three levels, therefore one level (quick) was repeated for the design to contain only even level attributes to create balance. Attribute levels and corresponding names were revised in consultation with researchers with children within the age range.

Table 4.2: Final discrete choice experiment design with rotated coding to address unfeasible tasks[1]

| Choice Task | Alternative 1 | | | | | | Alternative 2 | | | | | | Block |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cost of snack | Time to prepare | Child response | Co-parent | Family friends | Type of food | Cost of snack | Time to prepare | Child response | Co-parent | Family friends | Type of food | |
| 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| 2 | 0 | 2 | 0 | 0 | 1 | 1 | 1 | 3 | 1 | 1 | 0 | 0 | 1 |
| 3 | 1 | 2 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 3 |
| 4 | 0 | 2 | 1 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 1 | 2 |
| 5 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 2 | 1 | 0 | 0 | 1 | 2 |
| 6 | 0 | 3 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 |
| 7 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 2 |
| 8 | 0 | 3 | 0 | 1 | 0 | 0 | 1 | 3 | 0 | 1 | 1 | 1 | 4 |
| 9 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 2 | 1 | 1 | 0 | 0 | 3 |
| 10 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 3 | 1 | 0 | 1 | 1 | 1 |
| 11 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 3 | 1 | 1 | 1 | 0 | 4 |
| 12 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 4 |
| 13 | 1 | 3 | 0 | 1 | 1 | 1 | 0 | 2 | 0 | 1 | 1 | 0 | 2 |
| 14 | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 2 |
| 15 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 3 | 0 | 0 | 0 | 1 | 3 |
| 16 | 0 | 2 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 4 |
| 17 | 1 | 3 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 3 |
| 18 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 4 |
| 19 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 |
| 20 | 1 | 2 | 1 | 0 | 1 | 0 | 1 | 2 | 0 | 0 | 1 | 0 | 3 |

[1] Choice task 1 was a no choice task, and choice task 19 was a dominant choice task; therefore, no trade-off between attributes. Attribute 4 in alternative 1 and attribute 5 in alternative 2 have been rotated, from initial design all 0=1 and 1=0. Cross tabs were checked to ensure attribute level balance.

Parents were randomised within the online survey to receive either the social (manipulated) or non-social (control) condition. Parents were then further randomised to one of four blocks within the condition, followed by a break activity, prior to being randomised to one of four blocks of the alternative condition (Appendix 7). For example, one parent may have received social block two of four, break activity, non-social block four of four; the next parent may have received non-social block three of four, break activity, social block one of four. The break activity, which was an image-based choice question on an unrelated topic, acted as a distraction before parents were presented with a different condition[312]. Within each choice task the order in which attributes were presented was also randomised. Randomisation of condition, task block and attribute order were used to mitigate the risks of order bias in parent responses. By completing both the social and non-social conditions parents acted as their own control.

The final discrete choice experiment design was pilot tested with a convenience sample of colleagues, nutrition students and family, with minor revisions incorporated. See Appendix 5 for a copy of the online discrete choice experiment and additional items.

#### 4.2.4. Socio-demographic variables

Data on parent and child socio-demographic items were collected to describe the participant sample and to aid interpretation of results. Parent and family characteristics included parent age, gender, weight status, education level, employment status, ancestry, family structure (number of parents and children) and socio-economic position. Child specific characteristics included age, gender and weight status.

Items were based on the Australian Census[313] where possible, or previous nutrition research studies[231, 314]. Parent self-reported weight and height were used to calculate body mass index (BMI; $kg/m^2$) and classify weight status as underweight (BMI <18.5), healthy weight (18.5—24.9), overweight (25—29.9) or obesity (≥ 30)[233]. Parent reported child weight and height was used to calculate BMI and was converted to BMI z-scores by the least mean squares method, which adjusts for age and gender, using an add-in to Microsoft Excel[234]. Children's BMI z-scores were then classified into weight status categories using the International Obesity Task Force definitions[235, 236]. Parent reported weight and height was deemed appropriate, due to agreement of categorised weight status with weight status from objectively measured weight and height[237, 238]. To add confidence to the parent reported child weight and height parents were also asked to indicate whether their child's weight and/or height had been measured in past six months. Parent reported postcode was used to classify socio-economic position using the Socio-Economic Indexes for Areas (SEIFA) Index of Relative Advantage and Disadvantage[302] score and decile, as well as state of residence.

Families socio-economic position and child weight status were used to examine differences in subgroups of parent-child dyads. Selection of these characteristics were based on prior literature. Research suggests children from lower socio-economic backgrounds have poorer diet quality[31, 289], and higher unhealthy food intake, which has in turn been linked also to higher weight status[15]. In addition, differences have been noted in parent reported factors influencing unhealthy food provision when interviewing parents of low versus high socio-economic position[69]. Cost was anticipated to be of greater importance of cost in the lower socio-economic group. Parent provision was hypothesised to differ for children with overweight or obesity, compared with parents' children with a healthy weight. One qualitative study has explored differences in barriers and strategies to promote healthy eating between parents of healthy weight children and parents of children with overweight or obesity (6—12yo)[146]. The previous study noted similar barriers between parent groups, but with a key difference being the lack of partner support in parents of children who were overweight, which was not raised in parents in the healthy weight group[146]. The current study sought to explore whether using a different method, findings would support this prior qualitative finding focussed on healthy eating or if other differences would emerge in parents' snack decision-making by child weight status.

#### 4.2.5. Quality assurance measures

Measures of parent perceived barriers to a healthy diet and current examples of snacks provided in social and non-social occasions provided quasi revealed preference data. As mentioned earlier revealed preference data is observed choice data. True revealed preference data regarding food provision was not possible as this would require covert observations in snack provision contexts in the home. Interpreting stated preference findings, choice analysis outputs, in the relation to revealed preference data helps to improve the external validity of the findings[304].

The item regarding perceived barriers to children eating a healthy diet was adapted to include additional social opportunity barriers, from a question by Slater and colleagues[132] with ten barriers in a sample of Australian mothers of two to 16-year-olds. The item asked parents to rate each barrier on a three-point Likert scale, as 'makes it very difficult', 'makes it a little difficult' or 'does not make it difficult at all' for their child to eat a healthy diet.  Barriers included were mapped to the COM-B model (see Table 4.6, in 'Results').

Current examples of snacks were assessed by two open text response items where parents reported common snacks provided to their child on a Saturday, with and without visitors. Each food and beverage item was coded as a healthy or unhealthy food using the Australian Bureau of Statistics 'Discretionary Foods Flag'[10]. The discretionary food flag classifies all individual food items as healthy or unhealthy that were included in the latest food composition database. The number of unhealthy foods was divided by the total number of food items to create a percentage of unhealthy foods variable for social and non-social occasions.

### 4.2.6. Data collection procedure and bias

The discrete choice experiment was administered through an online questionnaire using Qualtrics® (XM, SAP America Inc., Palo Alto, CA, USA). Parents were first presented with the study overview landing page, then the participant information sheet and informed consent statements. The first five items assessed eligibility and screened out parents who did not meet the inclusion criteria. Parents answered several items before the discrete choice experiment, such as examples of current snacks and perceived barriers. As well as, several items after the discrete choice experiment including usual snack attribute levels, explanatory variables and socio-demographic items (Appendix 5). It was estimated that it would take parents 20—30 minutes to complete the study. To ensure anonymity parents accessed the survey through an anonymous link and completed the study in one sitting. In addition, items regarding the prize draw occurred in a second survey collection linked to the end of the primary survey to protect anonymity.

There was a risk of hypothetical bias as parents were making choices in a hypothetical environment rather than provision decision-making in real life. Parents were instructed to imagine all other factors remained constant to limit the consideration of attributes not included in the discrete choice experiment. A glossary was provided for all attributes to mitigate the risk of parents interpreting attributes and levels differently (Figure 4.4). It was thought the anonymous natural of the online survey would limit the tendency of social desirability reporting common in the nutrition field.

**Parent Food Choice Study**

What do we mean by each of these things that will vary between the options?

**Snack**

A snack is any food or drink that could be provided at a snack eating occasion, which is the time between main meal eating occasions (e.g. breakfast, lunch, dinner). Sometimes these snack occasions are called other names depending on the time of day such as morning tea, recess, and supper.

**Cost of snack**

This refers to how much the snack costs, and can vary from **cheaper** to **more expensive**. When considering the cost think about what you would think of as a: cheap and expensive snack as a reference point.

**Time to prepare**

This refers to how long it will take to prepare the snack. This will vary from **instant** which would be almost instant or ready to eat (such as taken straight from the fridge or pantry), **quick** so a few minutes (such as chopping, toasting or plating), or **more time consuming** which would be around 5 minutes or more (such as cooking, preparing multiple components).

Figure 4.4: Screenshot excerpt of the glossary of attributes included in online discrete choice experiment

As previously alluded to the recruitment strategy implemented introduces selection bias, whereby parents interested in nutrition or research may be over represented. An incentive of a voucher draw was used to entice parents who may have been less likely to self-select to participate, however may not have been sufficient and was not promoted in advertisements. As well as, secondary recruitment strategy of purposeful sampling to reach parents in low socio-economic areas, often underrepresented when using non-random sampling.

### 4.2.7. Sample size

The sample size calculation was based on the primary analysis method. There are several general sample size guides, within the discrete choice experiment field[1, 303]. Lanscar and Louviere[2] suggest 20 participants per block; with four blocks in the current design this would be 80 participants per context. Another guide by Long[315] is at least 100 participants, as they discourage using maximum likelihood with samples less than 100. Finally, Johnson and Orme (2003; cited in de Bekker-Grob[316]) proposed a rule of thumb: $N > 500c / (t \times a)$. Where $t$ is the number of choice tasks (per participant; five), $a$ is the number of alternatives (two) and $c$ is the number of analysis cells (i.e. largest number of attribute levels; three); therefore, a minimum sample of (500 x 3) / (5 x 2) = 150 per context. As all participants completed both a block of social and non-social condition the required sample size was 150. To allow for selection of 'neither' option, where responses provide no information about attribute trade-off, over sampling is suggested. Based on prior research an estimate of 20% opt out was used to as an initial guide, requiring 30 extra participants. Therefore, a sample size of approximately 180 participants was set. This was consistent with all sample size estimation approaches.

## 4.3. Data analysis

### 4.3.1. Data preparation

Data were imported to Microsoft Excel (2013, Microsoft Corporation, Redmond, WA, USA) for initial data cleaning. Variables were created for child weight status, SEIFA score and decile, state of residence, and unhealthy foods percentage of usual snacks. Data were imported into IBM SPSS Statistics (Version 25; SPSS Inc., Chicago, IL, USA) for further data cleaning. New variables were computed for parent weight status and parenting self-efficacy. Ineligible participants were removed. Sample characteristics and usual snack data were checked for errors, outliers and normality using the same procedure as Chapter 3 (Study 1, see section 3.3.1.). Normality checks and screening for outliers revealed one outlier in the frequency of total social occasions, three extreme outliers for child BMI z-score and one outlier for parent BMI; however, BMI outliers were controlled for when categorising weight status. The online survey tool forced responses prior to continuation; therefore, completed records did not include missing responses. Descriptive statistics were performed on sample characteristics, explanatory variables and quality assurance measure variables. Data were checked for unfeasible choice responders. For example, completing the online survey in two minutes, as this is deemed insufficient time to make trade-offs between alternatives in the choice tasks.

Data were restructured to obtain stacked choice data with 15 cases per parent, with five choice tasks each with three alternatives, for each condition. Choice task attributes and levels were dummy coded, where a one indicated the attribute level was presented in the alternative and zero represented the reference level—the level that was not shown (Table 4.3). Choice data variables were checked for coding errors, and descriptive statistics of the choice data were completed in IBM SPSS Statistics. The frequency count of how often the 'neither' alternative was selected were checked by choice block, condition, and overall, as a measure of external validity. Selection of 'neither' alternative was checked per participant to ensure there were no respondents who opted out of all choice tasks to ensure trade-offs were made and identification of model parameters (i.e. 10 out of 10 neither selection). Marginal means were produced to provide preliminary results and anticipate multinominal logit model outputs as a quality assurance check for errors. Marginal means were calculated for each attribute level for both control and manipulated conditions, using the equation: frequency of choice selection presenting the attribute level divided by the availability attribute level—frequency of level presented. Choice data were exported as comma separated values files for use in Nlogit version 6 (Student version, Econometric Software Inc., 2016) for the main statistical analysis.

Table 4.3: Design attributes and levels, and reference levels for multinomial logit model analyses

| Attribute | Levels | Reference level |
|---|---|---|
| A1 Cost of snack | L0 Cheaper<br>L1 More expensive | L0 Cheaper |
| A2 Time to prepare | L0 Instant<br>L1 Quick *(note duplicate)*<br>L2 More time consuming | L0 Instant |
| A3 Your child's likely response | L0 Accepting<br>L1 Resistant | L0 Accepting |
| A4 Significant family members (e.g. co-parent) | L0 Supportive<br>L1 Unsupportive | L1 Unsupportive |
| A5 Family friends | L0 Supportive<br>L1 Unsupportive | L1 Unsupportive |
| A6 Type of foods | L0 Everyday foods<br>L1 Sometimes foods | L1 Sometimes foods |

### 4.3.2. Statistical analysis

***Multinominal logit model analyses***

Primary choice analyses were performed as multinomial logit models. Multinomial logit analyses are based on the assumptions of random utility theory. That is, the premise that respondents will choose the alternatives that will maximise their utility, including that people will trade-off between attributes (i.e. compensatory decisions)[1, 301, 317]. As utility is a latent construct, choices measured in the discrete choice experiment acted as indicators of utility[2]. As mentioned earlier, based on the assumption that the systematic part of utility is the sum of its parts, the utility weight can be determined for each component of utility (i.e. attribute)[2]. For the purposes of this chapter, the terms utility weight and coefficient are used interchangeably. Multinomial logit model analysis is a regression to linearly related to the probability of choosing one snack alternative with a certain profile, that is combination of attribute levels, over another[301]. Models were performed for non-social (control) and social (manipulated) conditions, as well as for subgroups of respondents, and for each condition including explanatory variables as interaction effects. Subgroup analyses accounted for some of the observed preference heterogeneity, which is differences in choice by socio-demographics. It was hypothesised that in social occasions food availability would not be important (i.e. non-significant) and for support from family friends to be the most important (and not be significant in non-social) influence in parents' snack decision-making.

In all models the constant was included as the utility for the 'neither' alternative. Reference levels were set as cheaper (cost), instant (time), child accepting, unsupportive co-parent, unsupportive family friend, and sometimes food (type of food) (Table 4.3), to interpret the first three attributes as disutility and the final three as utility. The utility function equation for the presented alternatives is specified in Equation 1, in which the reference alternative is 'neither'. A model was run including a dummy coded variable for condition order (i.e. social versus non-social presented first) to check for order effects on the uptake of the choice tasks. Models including explanatory variables—child temperament, parenting self-efficacy, frequency of social occasions—included the explanatory variables as both main effects and as interaction terms. Interaction terms were included by multiplying the explanatory variable with a design attribute, as hypothesised (e.g. child temperament trait x child's likely response attribute).

Scale has long been an issue in discrete choice models[318], as utility is a latent construct the magnitude of coefficients estimated in one context cannot be directly compared to those in another context, and only the relative importance can be strictly observed. Scale heterogeneity across conditions was explored by examining the slope of the utility weights by plotting one set of coefficients against another (e.g. control coefficients vs manipulated coefficients) as recommended by Swait and Louviere[318] [2]. The slope was determined by graphing coefficients as a scatterplot

[2] Due to software restrictions formal test of scale heterogeneity was not performed.

with a line of fit in Excel. If the slope is one or close to one then this is an indication there is no difference in the scale between the groups (i.e. conditions, or SEIFA or weight status groups) and utility weights between groups can be compared[318]. In the case of no scale differences, it is possible to also compare the coefficients from the model across the two conditions. Although not a formal test, individual attribute coefficients from the social (manipulated) condition were compared with the 95%CI of the non-social (control) coefficient estimates, when these values do not overlap it was assumed there may be a statistical difference[319].

***Equation 1***

Utility function:

$$\begin{aligned} V = \; & \beta 0 + \beta 1\, COST\ more\ expensive + \beta 2\, TIME\ quick + \beta 3\, TIME\ more\ time\ consuming \\ & + \beta 4\, CHILD\ resistant + \beta 5\, COPARENT\ supportive + \beta 6\, FRIEND\ supportive \\ & + \beta 7\, FOOD\ everyday\ foods \end{aligned}$$

***Choice model fit and presentation***

Model fit was first examined by comparison of the model log-likelihood with that of a constant only model (i.e. model without predictors) to determine whether the attributes were being considered by parents over and above a constant. A log-likelihood value closer to zero represented greater relative explanatory power[301]. The goodness of fit was examined by the likelihood ratio chi-square to ensure that including the attributes significantly improved the model fit, calculated by: -2 (log-likelihood of the constant only model – log-likelihood of the model). Models with a higher likelihood ratio chi-square were assumed to have a better fit[301]. Pseudo $R^2$, a measure of relative fit assessment, was calculated by Equation 2 (where LL represents log-likelihood); with a value of 0.2 to 0.4 considered good model fit (McFadden 1978 cited in Hauber[301]). Norm. Akaike Information Criterion (norm. AIC) was obtained from the model output, with a lower value indicating a better model[301].

***Equation 2***

$$Pseduo\ R^2 = 1 - \frac{LL\ of\ the\ full\ model}{LL\ of\ the\ constant\ only\ model}$$

To prioritise future intervention targets, attribute relative importance scores were calculated, using two methods (Appendix 7). The first method, as described by Hauber and colleagues[301] represents the difference in utility weights between the most preferred level and the least preferred level. This method provides an estimate of the relative importance of the attribute, taking into account multiple attribute levels, however in the current design majority of attributes contained two dummy coded levels therefore the importance scores are the same as the raw utility weights. Equation 3 is as follows, where β is the utility weight:

***Equation 3***

$$Preference\ range = \beta\ for\ most\ preferred\ level\ - \beta\ for\ the\ least\ preferred\ level$$

The second method, partial log-likelihood analysis, was selected from one of four methods for discrete choice experiments recommended by Lancsar and colleagues[320]. The partial log-likelihood analysis method requires an orthogonal design and is used to measure overall attribute effects relative to other attributes[320]. This method required running multiple versions of the multinomial logit model analyses, removing only one attribute (all levels) each time (i.e. adjusted model) to calculate the relative contribution of the attribute to the model log-likelihood. The relative importance of each attribute was determined by dividing the partial effect by the total partial effects, as per Equation 4, where LL is the log-likelihood:

***Equation 4***

$$Absolute\ partial\ effect = LL\ of\ the\ adjusted\ model - LL\ of\ the\ full\ model$$

$$Relative\ effect\ (\%) = \frac{partial\ effect}{sum\ of\ partial\ effects}\ \mathrm{x}\ 100$$

Outputs from both relative importance score methods were ranked in descending order to assign scores from one to six and compared between contexts. In addition, given that attribute levels were categorised, primarily only two categories, hence the same unit of measure, utility weights were able to be interpreted as effect sizes to determine the magnitude of influence of one attribute on parent snack decision-making, to another attribute. It should be noted that traditionally absolute utility weights cannot be directly compared given differences in measurement scales[301], this remains the case for explanatory variables. Choice data outputs are presented as utility weights (coefficient), 95% confidence intervals, p value, and relative importance scores. For the time to prepare attribute (three attribute levels), p value was calculated using the Wald test to account for the multiple attribute levels[1].

## 4.4. Results

### 4.4.1. Participant characteristics, explanatory variables and quality assurance measures

***Participant characteristics and explanatory variables***

Two-hundred and fifty-eight parents commenced the online survey, with 225 eligible parents completing the study (87% response rate) (Figure 4.5). All parents in the final sample (n=225) completed five choice tasks per condition, providing 1125 choice observations per condition for analyses. Randomisation was successful with 114 completing non-social context first and 111 completing the social context first. There was even representation of each of the choice task blocks, ranging from 53 to 61 participants per block. The mean survey duration was 22 minutes (SD 16 minutes), indicating sufficient time to consider choice trade-offs.

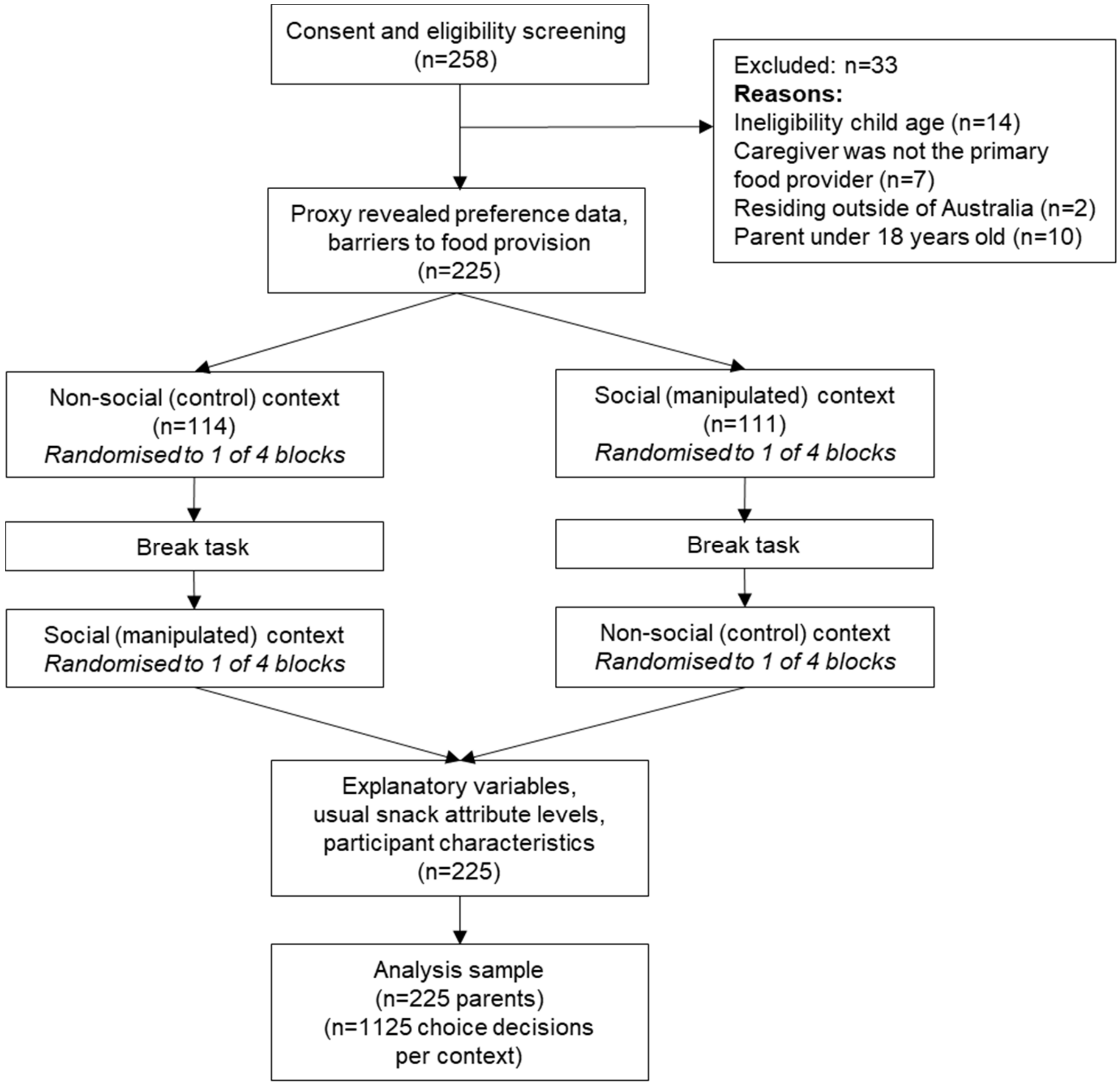



Figure 4.5: Flow chart of participants through the online survey and discrete choice experiment

Table 4.4 presents descriptive characteristics of the parent and child sample. The parent sample consisted of predominately mothers (99.6%), who were married or living as married (94.7%), with a child (13.8%) or children (80.9%). Socio-Economic Index For Areas quintiles were relatively evenly represented. Approximately half of the parent sample were employed part time (51.6%), and majority held a tertiary or postgraduate degree (72.5%). Children were aged between three and seven, with just over half of the sample classified within the healthy weight range (55.6%). Majority of parents (57.3%) rated the child temperament negative affectivity item as extremely untrue or slightly true of their child. Computed total frequency of social occasions in the past week ranged from zero to 28, with a median of five times per week (IQR 4).

Table 4.4: Descriptive characteristics of parents and children (n=225)

| Characteristic | Parent | Characteristic | Child |
|---|---|---|---|
| Age, years (mean, SD) | 35.3 (3.8) | Age, years (mean, SD) | 5.2 (1.3) |
| Gender (%, count) | | Gender (%, count) | |
| Male | 0.4 (1) | Male | 49.3 (111) |
| Female | 99.6 (224) | Female | 50.7 (114) |
| Weight status[1] (%, count) | | Weight status (%, count) | |
| Underweight | 1.8 (4) | Underweight | 13.9 (31) |
| Healthy weight | 39.6 (86) | Healthy weight | 55.6 (124) |
| Overweight | 33.2 (72) | Overweight | 15.2 (34) |
| Obesity | 25.3 (55) | Obesity | 15.2 (34) |
| Family structure (%, count) | | Weight and/or height measured in past 6 months (%, count) | 73.8 (166) |
| Couple with a child | 13.8 (31) | | |
| Couple with children | 80.9 (182) | | |
| One parent family with a child | 0.9 (2) | Frequency of social occasions in past week (median, IQR) | 5 (4) |
| One parent family with children | 1.8 (4) | | |
| Other family type | 2.7 (6) | | |
| SEIFA[2] Index of Relative Advantage and Disadvantage, quintiles (%, count) | | Frequency of select celebratory occasions in past week (median, IQR) | 0 (1) |
| 1 | 14.7 (33) | | |
| 2 | 14.7 (33) | | |
| 3 | 23.7 (53) | Child temperament, 5 point scale (mean, SD) | |
| 4 | 25.9 (58) | | |
| 5 | 21.0 (47) | Surgency/extraversion | 3.6 (1.2) |
| Parent education (%, count) | | Negative affectivity | 2.4 (1.1) |
| Completed high school or less | 6.7 (15) | Effortful control | 3.6 (1.2) |
| Tech or trade | 20.9 (47) | | |
| Tertiary degree | 35.6 (80) | | |
| Postgraduate degree | 36.9 (83) | | |
| Parent employment (%, count) | | | |
| Employed full time | 18.2 (41) | | |
| Employed part time | 51.6 (116) | | |
| Not working / homemaker | 30.2 (68) | | |
| State (%, count) | | | |
| SA | 38.8 (87) | | |
| QLD | 15.6 (35) | | |
| NSW | 14.7 (33) | | |
| VIC | 12.9 (19) | | |
| WA | 7.6 (17) | | |
| TAS | 5.8 (13) | | |
| ACT | 2.7 (6) | | |
| NT | 1.8 (4) | | |
| Ancestry[3] (%, count) | | | |
| Australian | 48.0 (108) | | |
| English | 45.8 (103) | | |
| Other | 25.3 (57) | | |
| Scottish | 14.2 (32) | | |
| Irish | 13.3 (30) | | |
| German | 6.2 (14) | | |
| Italian | 5.3 (12) | | |
| Chinese | 1.3 (3) | | |
| Parental self-efficacy[4] (mean, SD) | | | |
| Efficacy scale | 31.1 (5.1) | | |
| Satisfaction scale | 36.3 (7.4) | | |

[1] Missing anthropometric responses for parents (n=8) and for children (n=2)
[2] SEIFA, Socio-Economic Indexes for Areas. Missing SEIFA (n=1)
[3] Parents could select up to two ancestries.
[4] Parenting self-efficacy scores calculated from 6-point likert scale, possible range for efficacy scale is 7 to 42 and satisfaction 9 to 54.

***Barriers to provision***

Parent rating of barriers to healthy food provision (Table 4.5) was used to assess the suitability and construct validity of the discrete choice experiment design attributes. ‘Busy lifestyle’ (83% of parents) was identified as the biggest self-reported barrier, followed by ‘child resistance’ (76%). Four of the six opportunity attributes were ranked in the top seven (of 13) barriers, confirming the selection of the discrete choice experiment attributes. Food availability and friends support ranked outside of the top seven barriers.

Table 4.5: Percent of parent ratings of factors that make providing a healthy diet difficult[1]

| | Makes it a little or very difficult[2] | Does not make it difficult | Corresponding attribute | Corresponding source of behaviour |
|---|---|---|---|---|
| Busy lifestyle | 83.1 | 16.9 | ~Time | Physical Opportunity |
| Child resistance | 76.0 | 24.0 | Child's likely response | Social Opportunity |
| Grandparents undermining provision | 57.3 | 42.7 | | Social Opportunity |
| High cost of healthy food | 49.8 | 50.2 | Cost | Physical Opportunity |
| Effort required to provide healthy | 46.2 | 53.8 | ~Time | Physical Opportunity / Reflective Motivation |
| Influences of child's peers | 45.3 | 54.7 | | Social Opportunity |
| Co-parent undermining provision | 43.6 | 56.4 | Co-parent | Social Opportunity |
| Food advertising | 41.3 | 58.7 | | Physical Opportunity |
| Ability to set rules and stick to them | 32.4 | 67.6 | | Psychological Capability |
| Knowing how to get child to eat healthy foods | 31.1 | 68.9 | | Psychological Capability |
| Healthy food availability | 24.4 | 75.6 | ~Type of food | Physical Opportunity |
| Expectations from my friends about what to provide | 20.9 | 79.1 | Friends | Social Opportunity |
| Knowing what foods to provide / allow | 20.4 | 79.6 | | Psychological Capability |

[1] Item adapted from Slater and colleagues[132]
[2] Response options 1 and 2 combined.

***Usual snack provision (quasi revealed preference)***

Parents reported common snacks provided in both social and non-social occasions. This data were used as a proxy measure for revealed preference data regarding parents snack provision. Snack items were categorised as healthy or unhealthy based on the Australian Dietary Guidelines discretionary choices definition, and the proportion of unhealthy food snacks was calculated. In the non-social context the mean percentage of unhealthy food snacks was 29.0% (SD 23.2%), compared with 45.9% (SD 29.9%) in the social context. Parent reported usual snack attribute levels (Table 4.6) were used to understand the likely profile of the neither (opt-out) option. It can be assumed that the neither alternative is a snack profile that is cheaper, quick to prepare, the child is accepting of, co-parents and family friends are supportive of and are considered as everyday foods.

Table 4.6: Parent reported usual[1] snack attribute levels

| Attribute | Attribute levels | % (count) |
|---|---|---|
| Cost | **Cheaper** | **61.3 (138)** |
| | More expensive | 38.7 (87) |
| Time to prepare | Instant | 6.2 (14) |
| | **Quick** | **84.4 (190)** |
| | More time consuming | 9.3 (21) |
| Child's likely response | **Accepting** | **92.0 (207)** |
| | Resistant | 8.0 (18) |
| Co-parent support | **Supportive** | **96.9 (218)** |
| | Unsupportive | 3.1 (7) |
| Friends support | **Supportive** | **96.4 (217)** |
| | Unsupportive | 3.6 (8) |
| Type of foods | **Everyday foods** | **92.4 (208)** |
| *(proxy food availability)* | Sometimes foods | 7.6 (17) |

[1] Ratings were based on any context
**Bold** text signals higher frequency

### 4.4.2. Choice data descriptive results

The proportion of 'neither' choice selection was examined by choice block (ranged from 3 to 20% of all choices), condition (non-social context 9.4%, social context 10.9% of all choices), and overall (10.2% of all choices). Comparisons between the marginal means (Figure 4.6) and parent reported usual snack attribute level frequencies (Table 4.6) revealed the same patterns but with the differences between attribute levels attenuated in the marginal means, when compared to parent-report. For example, majority of parents' self-reported co-parents and friends were supportive of usual snacks (96.9% and 96.4%, respectively), whereas marginal means suggested co-parents and friends support aligned with parent provision approximately half the time (49—53%) in parents hypothetical snack provision choices. Marginal means for social and non-social conditions appeared very similar (Figure 4.6).

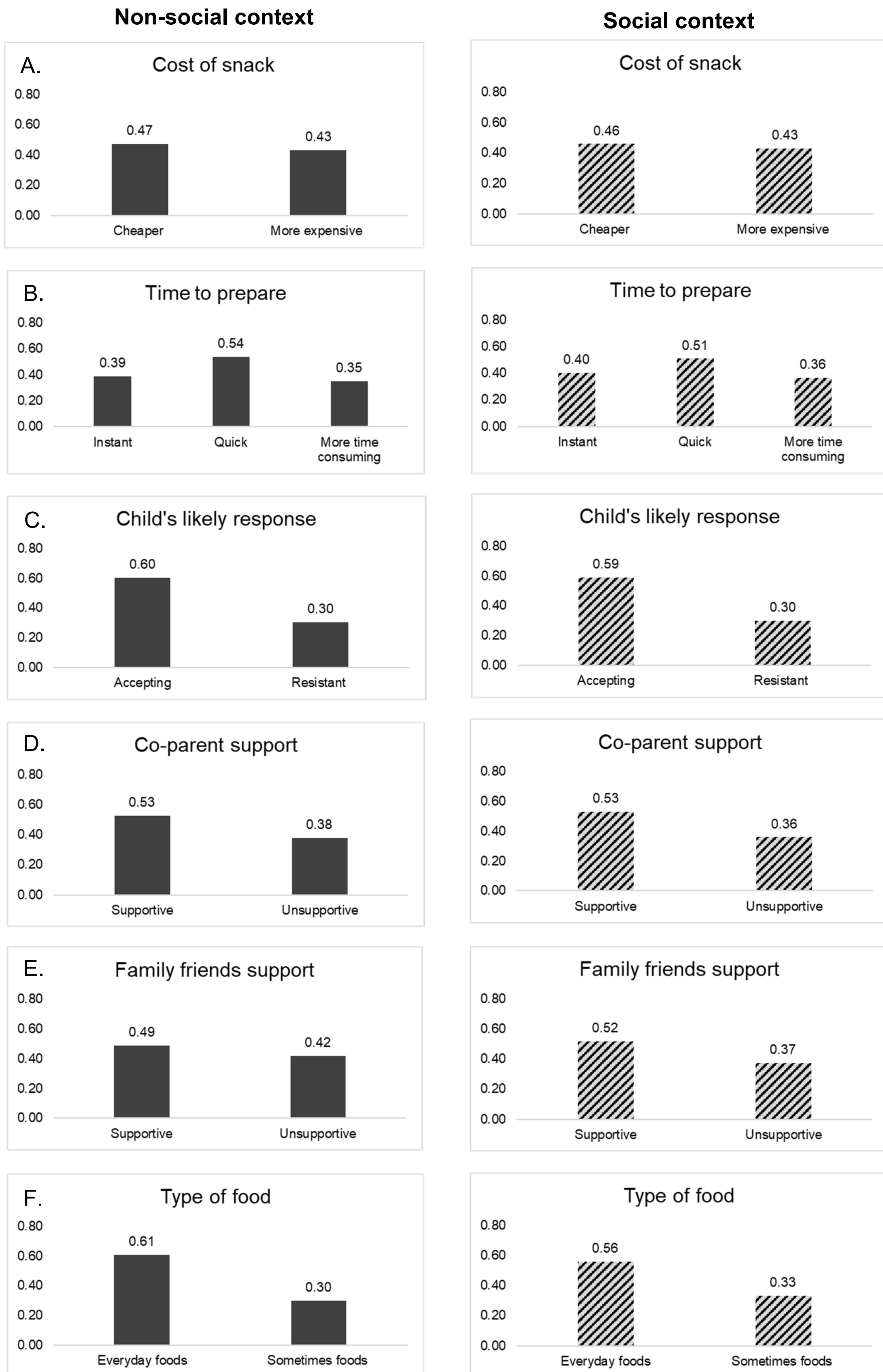



Figure 4.6: Marginal means for non-social and social condition attributes[1]

[1] Note: Marginal means do not have an index of certainty.

### 4.4.3. Multinominal logit model analyses results

***Objective 1 and 2: Understanding the relative importance of opportunity attributes and differences in social and non-social contexts***

Results of the multinominal logit model analysis are presented in (Table 4.7). The indicator for condition order was significant (non-social $\beta = -0.751$, $p<0.001$; social $\beta = -0.544$, $p<0.001$). This suggests there was an order effect on the overall uptake of the choice task, but there were no differences in attribute importance. Final multinomial logit models were controlled for condition order. Five of the six attributes were found to significantly influence parents' snack decision-making: cost, child resistance, co-parent support, friends support and type of food. Time to prepare attribute was not found to be significant. The negative direction of the coefficient (utility weights) indicate that parents preferred snack options that were lower in cost, time and resistance from child. Positive direction for type of food and support from co-parent and friends, indicate parents preferred snack options that were everyday foods and where co-parents and friends were supportive. Specifically, according to the utility weight differences (Equation 3), the type of food attribute was 20% more influential than the disutility for child resistance that was next most influential attribute. Support from co-parents has double the influence of support from friends in the non-social context. The influence of support from friends and cost were of similar size.

Analyses were repeated for the social occasions context. Coefficients could be directly compared between social and non-social occasions, as scale parameter was near one (0.952) (Figure 4.7). When comparing the 95% confidence intervals for social (experimental) coefficients with non-social coefficient, it was suggested there may be a difference in support from friends and type of food attributes and caution should be taken when comparing point estimates between conditions. However, there was no convincing statistical difference between the remaining attributes, so general comparisons have been made. Table 4.8 presents social occasions model outputs. The attributes significantly influencing parent snack decision-making were the same for non-social (control) and social (manipulated) occasions. Relative important scores indicated a similar importance for attributes in both non-social (top 3: type of food, child's likely response, co-parent support) and social (top 3: child's likely response, type of food, co-parent support) occasions. Examining the magnitude of influence in social the context, co-parent support was only 25% more influential than support from friends, compared to near double in non-social. Support from friends was more than double the influence of cost in social contexts. However, the difference in the influence of type of food and child resistance was smaller (~9% greater influence of child resistance), than for the non-social context.

Table 4.7: Multinomial logit model for parents' provision of snack decisions in non-social occasions[1]

| Attributes | Coefficient | 95%CI | P value | Relative importance score |
|---|---|---|---|---|
| **Cost** | | | | |
| Cheaper (reference level) | | | | 5 |
| More expensive | -0.333 | -0.586 to -0.081 | 0.010 | |
| **Time**[2] | | | | |
| Instant (reference level) | | | | 6 |
| Quick | 0.115 | -0.227 to 0.458 | 0.950 | |
| More time consuming | -0.096 | -0.428 to 0.236 | | |
| **Child's likely response** | | | | |
| Accepting (reference level) | | | | 2 |
| Resistant | -1.624 | -1.851 to -1.398 | <0.001 | |
| **Support from co-parent** | | | | |
| Supportive | 0.998 | 0.774 to 1.223 | <0.001 | 3 |
| Unsupportive (reference level) | | | | |
| **Support from friends** | | | | |
| Supportive | 0.448 | 0.220 to 0.675 | 0.0001 | 4 |
| Unsupportive (reference level) | | | | |
| **Type of food** | | | | |
| Everyday foods | 1.944 | 1.685 to 2.202 | <0.001 | 1 |
| Sometimes foods (reference level) | | | | |
| **Neither alternative** | -1.256 | -1.778 to -0.734 | <0.001 | |
| **Model fit statistics** | | | | |
| Log likelihood of model | -756.18 | | | |
| Log likelihood of model without predictors | -1204.62 | | | |
| Likelihood ratio $X^2$ | 896.88 | | | |
| Norm. AIC | 1.360 | | | |
| Pseudo $R^2$ | 0.372 | | | |

Abbreviations: AIC: Akaike information criterion; SE: standard error; $X^2$: chi-square; 95%CI: 95% confidence interval
[1] No. of respondents n=225, No. of observations n=1125. Adjusted for condition order effects.
[2] Wald test p value presented for time attribute (quick + more time consuming = 0)

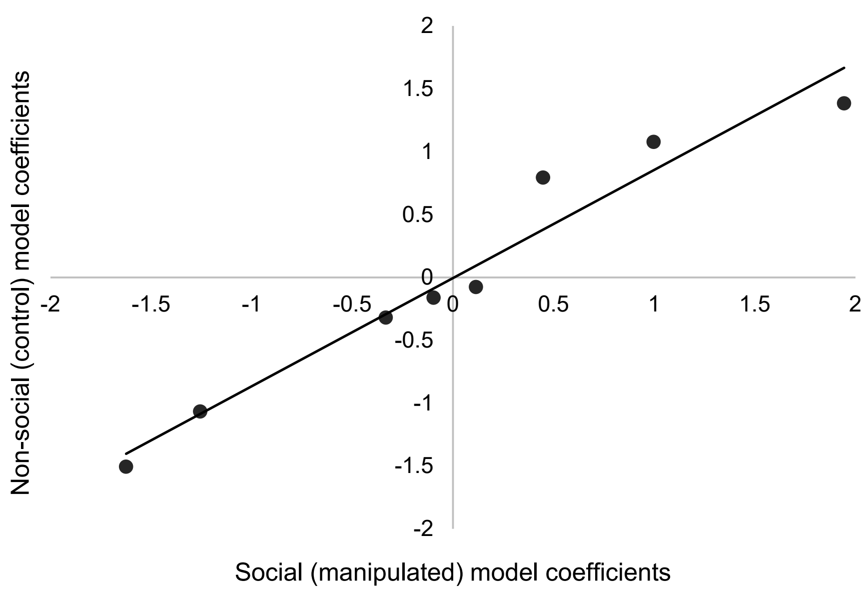



Figure 4.7: Plot of non-social versus social context model coefficients to assess scale parameter

Slope: y = 0.86x - 0.01; $R^2$ = 0.952

Table 4.8: Multinomial logit model for parents' provision of snack decisions in social occasions[1]

| **Attributes** | **Coefficient** | **95%CI** | **P value** | **Relative importance score** |
|---|---|---|---|---|
| **Cost** | | | | |
| Cheaper (reference level) | | | | 5 |
| More expensive | -0.320 | -0.552 to -0.087 | 0.007 | |
| **Time**[2] | | | | |
| Instant (reference level) | | | | |
| Quick | -0.077 | -0.402 to 0.248 | 0.423 | 6 |
| More time consuming | -0.162 | -0.491 to 0.166 | | |
| **Child's likely response** | | | | |
| Accepting (reference level) | | | | 1 |
| Resistant | -1.506 | -1.722 to -1.291 | <0.001 | |
| **Support from co-parent** | | | | |
| Supportive | 1.077 | 0.855 to 1.298 | <0.001 | 3 |
| Unsupportive (reference level) | | | | |
| **Support from friends** | | | | |
| Supportive | 0.794 | 0.575 to 1.014 | <0.001 | 4 |
| Unsupportive (reference level) | | | | |
| **Type of food** | | | | |
| Everyday foods | 1.384 | 1.154 to 1.614 | <0.001 | 2 |
| Sometimes foods (reference level) | | | | |
| **Neither alternative** | -1.066 | -1.556 to -0.575 | <0.001 | |
| **Model fit statistics** | | | | |
| Log likelihood of model | -827.29 | | | |
| Log likelihood of model without predictors | -1207.44 | | | |
| Likelihood ratio $X^2$ | 760.30 | | | |
| Norm. AIC | 1.487 | | | |
| Pseudo $R^2$ | 0.315 | | | |

Abbreviations: AIC: Akaike information criterion; SE: standard error; $X^2$: chi-square; 95%CI: 95% confidence interval
[1] No. of respondents n=225, No. of observations n=1125. Adjusted for condition order effects.
[2] Wald test p value presented for time attribute (quick + more time consuming = 0)

Importance scores for opportunity attributes were compared with parent-reported barriers to food provision (Figure 4.8). Child resistance was the only attribute which aligned with parent reported barriers and relative importance score in non-social context, both ranking child resistance as second most important. Cost and time were ranked highly from parent report (time: first and fifth; cost: fourth), however obtained the lowest relative importance scores within the discrete choice experiment. Type of food, which was a proxy for food availability, received the highest relative importance score in the non-social context yet ranked near the bottom (11 out of 13) by parent report.

| | |
|---|---|
| Ranking of parent reported opportunity barriers (attributes): | |
| 1. Busy lifestyle | (~time) |
| 2. Child resistance | (child's likely response) |
| 4. High cost of healthy food | (cost) |
| 5. Effort required to provide healthy food | (~time) |
| 7. Co-parent undermining provision | (co-parent support) |
| 11. Healthy food availability | (food availability - type of food) |
| 12. Expectations from my friends about what to provide | (friend support) |

Figure 4.8: Selected parent reported barriers to food provision matched to opportunity attributes

***Objective 3: Understanding the influence of child temperament, self-efficacy and frequency of social occasions on parents' food provision***

To further understand the role of physical and social opportunity several predicted mediators were examined by performing multinomial logit model analyses with the inclusion of explanatory variables as main effects and interacted with selected opportunity attributes. All parents provided responses for explanatory variables, therefore 1125 choice observations were again included in each model. First, whether child's temperament mediates the effect of child's likely response (attribute) on parent choice (Table 4.9). Examining the main effects suggested negative affectivity significantly influences parent decision-making in both contexts, and surgency / extraversion only in social contexts. However, when examining the interaction of child temperament with child's likely response there were no significant interaction effects.

Secondly, models were run to investigate whether parenting self-efficacy mediates the effect of support from co-parent or friends (attributes) on parent choice (Table 4.10). Models were run with interaction effects with both co-parent support and family friend together, and separately will no change in results interpretation; therefore, the combined models are presented. Main effects of parenting self-efficacy domains saw satisfaction was significant in non-social context decision-making but not for the social context, and efficacy was not a significant influence in either context. When parenting self-efficacy measures were interacted with both support from co-parents and friends, there was no significant influences on choice in either context.

Lastly, whether frequency of social occasions mediates the effect of type of food (attribute) on parent choice in social occasions was investigated. When examining the main effects of frequency of social occasions there was no significant influence on decision-making (Table 4.11). When frequency of social occasions was interacted with type of food there was a significant interaction effect, suggesting that with more frequent social occasions there was greater influence of everyday foods on decision-making. The same was not seen when frequency of social occasions measure was categorised, hence should be interpreted with caution.

Table 4.9: Multinomial logit model for parents' provision of snack decisions in non-social and social occasions with interactions between child temperament and child's likely response[1]

| | Non-social occasions | | | Social occasions | | |
|---|---|---|---|---|---|---|
| **Attributes** | **Coefficient** | **95%CI** | **P value** | **Coefficient** | **95%CI** | **P value** |
| **Cost** | | | | | | |
| Cheaper (reference level) | | | | | | |
| More expensive | -0.363 | -0.616 to -0.110 | 0.005 | -0.332 | -0.566 to -0.098 | 0.005 |
| **Time**[2] | | | | | | |
| Instant (reference level) | | | | | | |
| Quick | 0.059 | -0.285 to 0.403 | 0.801 | -0.110 | -0.436 to 0.216 | 0.341 |
| More time consuming | -0.137 | -0.471 to 0.198 | | -0.176 | -0.507 to 0.155 | |
| **Child's likely response** | | | | | | |
| Accepting (reference level) | | | | | | |
| Resistant | -1.733 | -2.164 to -1.301 | <0.001 | -1.314 | -1.713 to -0.915 | <0.001 |
| **Support from co-parent** | | | | | | |
| Supportive | 0.992 | 0.768 to 1.217 | <0.001 | 1.091 | 0.868 to 1.314 | <0.001 |
| Unsupportive (reference level) | | | | | | |
| **Support from friends** | | | | | | |
| Supportive | 0.438 | 0.208 to 0.663 | <0.001 | 0.786 | 0.566 to 1.005 | <0.001 |
| Unsupportive (reference level) | | | | | | |
| **Type of food** | | | | | | |
| Everyday foods | 1.928 | 1.670 to 2.186 | <0.001 | 1.393 | 1.162 to 1.625 | <0.001 |
| Sometimes foods (reference level) | | | | | | |
| **Child temperament**[3] **(low vs high)** | | | | | | |
| Surgency/extraversion | 0.331 | -0.156 to 0.819 | 0.183 | 0.476 | 0.0219 to 0.930 | 0.040 |
| Negative affectivity | 1.234 | 0.395 to 2.073 | 0.004 | 1.186 | 0.442 to 1.929 | 0.002 |
| Effortful control | -0.517 | -1.034 to 0.000 | 0.050 | -0.442 | -0.922 to 0.038 | 0.071 |
| **Child temperament and Child likely response** | | | | | | |
| Surgency/extraversion x Resistant | -0.195 | -0.619 to 0.229 | 0.367 | -0.099 | -0.512 to 0.314 | 0.639 |
| Negative affectivity x Resistant | -0.289 | -0.864 to 0.287 | 0.326 | -0.490 | -1.058 to 0.079 | 0.092 |
| Effortful control x Resistant | 0.403 | -0.041 to 0.847 | 0.075 | -0.102 | -0.517 to 0.313 | 0.630 |
| **Neither alternative** | -1.334 | -2.000 to -0.667 | <0.001 | -0.995 | -1.640 to -0.350 | 0.025 |
| **Model fit statistics** | | | | | | |
| Log likelihood of model | -747.48 | | | -816.69 | | |
| Log likelihood of model without predictors | -1204.62 | | | -1207.44 | | |
| Likelihood ratio $X^2$ | 914.28 | | | 781.50 | | |
| Norm. AIC | 1.356 | | | 1.479 | | |
| Pseudo $R^2$ | 0.380 | | | 0.324 | | |

Abbreviations: AIC: Akaike information criterion; $X^2$: chi-square; 95%CI: 95% confidence interval

[1] No. of respondents n=225, No. of observations n=1125. Adjusted for condition order effects.

[2] Wald test p value presented for time attribute (quick + more time consuming = 0)

[3] Surgency/extraversion: 0= 1—3, 1= 4—5; Negative affectivity: 0= 1—3, 1= 4—5; Effortful control: 0= 1—3, 1= 4—5

Table 4.10: Multinomial logit model for parents' provision of snack decisions in non-social and social occasions with interactions between parenting self-efficacy and support from co-parent and friends[1]

| | Non-social occasions | | | Social occasions | | |
|---|---|---|---|---|---|---|
| **Attributes** | **Coefficient** | **95%CI** | **P value** | **Coefficient** | **95%CI** | **P value** |
| **Cost** | | | | | | |
| Cheaper (reference level) | | | | | | |
| More expensive | -0.331 | -0.585 to -0.078 | 0.010 | -0.326 | -0.559 to -0.094 | 0.006 |
| **Time**[2] | | | | | | |
| Instant (reference level) | | | | | | |
| Quick | 0.125 | -0.220 to 0.470 | 0.905 | -0.087 | -0.412 to 0.238 | 0.398 |
| More time consuming | -0.088 | -0.422 to 0.246 | | -0.166 | -0.495 to 0.163 | |
| **Child's likely response** | | | | | | |
| Accepting (reference level) | | | | | | |
| Resistant | -1.633 | -1.862 to -1.405 | <0.001 | -1.510 | -1.726 to -1.294 | <0.001 |
| **Support from co-parent** | | | | | | |
| Supportive | -0.697 | -2.092 to 0.698 | 0.328 | 0.254 | -1.191 to 1.698 | 0.731 |
| Unsupportive (reference level) | | | | | | |
| **Support from friends** | | | | | | |
| Supportive | 0.627 | -0.759 to 2.012 | 0.375 | 1.077 | -0.275 to 2.429 | 0.119 |
| Unsupportive (reference level) | | | | | | |
| **Type of food** | | | | | | |
| Everyday foods | 1.955 | 1.695 to 2.215 | <0.001 | 1.388 | 1.157 to 1.619 | <0.001 |
| Sometimes foods (reference level) | | | | | | |
| **Parenting self-efficacy**[3] | | | | | | |
| Efficacy | -0.019 | -0.621 to 0.584 | 0.951 | -0.265 | -0.843 to 0.312 | 0.368 |
| Satisfaction | -0.475 | -0.893 to -0.057 | 0.026 | -0.302 | -0.683 to 0.080 | 0.122 |
| **Parenting self-efficacy and Co-parent support** | | | | | | |
| Efficacy x Supportive | 0.447 | -0.034 to 0.928 | 0.068 | 0.057 | -0.451 to 0.565 | 0.827 |
| Satisfaction x Supportive | 0.085 | -0.239 to 0.408 | 0.608 | 0.180 | -0.149 to 0.508 | 0.284 |
| **Parenting self-efficacy and Friends support** | | | | | | |
| Efficacy x Supportive | -0.097 | -0.593 to 0.399 | 0.703 | -0.116 | -0.577 to 0.346 | 0.623 |
| Satisfaction x Supportive | 0.030 | -0.312 to 0.371 | 0.865 | 0.022 | -0.295 to 0.338 | 0.894 |
| **Neither alternative** | -3.036 | -4.862 to -1.209 | 0.001 | -2.999 | -4.763 to -1.235 | <0.001 |
| **Model fit statistics** | | | | | | |
| Log likelihood of model | -749.52 | | | -823.17 | | |
| Log likelihood of model without predictors | -1204.62 | | | -1207.44 | | |
| Likelihood ratio $X^2$ | 910.20 | | | 768.54 | | |
| Norm. AIC | 1.359 | | | 1.490 | | |
| Pseudo $R^2$ | 0.378 | | | 0.318 | | |

Abbreviations: AIC: Akaike information criterion; $X^2$: chi-square; 95%CI: 95% confidence interval

[1] No. of respondents n=225, No. of observations n=1125. Adjusted for condition order effects.

[2] Wald test p value presented for time attribute (quick + more time consuming = 0)

[3] Efficacy scores 7—34 (scaled by /10); Satisfaction scores 9—54 (scaled by /10)

Table 4.11: Multinomial logit model for parents' provision of snack decisions in social occasions with interactions between frequency of social occasions and type of food[1]

| Attributes | Coefficient | 95%CI | P value |
|---|---|---|---|
| **Cost** | | | |
| Cheaper (reference level) | | | |
| More expensive | -0.324 | -0.557 to -0.092 | 0.006 |
| **Time**[2] | | | |
| Instant (reference level) | | | |
| Quick | -0.077 | -0.402 to 0.249 | 0.443 |
| More time consuming | -0.153 | -0.482 to 0.176 | |
| **Child's likely response** | | | |
| Accepting (reference level) | | | |
| Resistant | -1.506 | -1.721 to -1.290 | <0.001 |
| **Support from co-parent** | | | |
| Supportive | 1.085 | 0.863 to 1.307 | <0.001 |
| Unsupportive (reference level) | | | |
| **Support from friends** | | | |
| Supportive | 0.806 | 0.586 to 1.026 | <0.001 |
| Unsupportive (reference level) | | | |
| **Type of food** | | | |
| Everyday foods | 0.985 | 0.587 to 1.383 | <0.001 |
| Sometimes foods (reference level) | | | |
| **Frequency of social occasions**[3] | | | |
| Frequency of social occasions | -0.329 | -0.968 to 0.311 | 0.314 |
| **Frequency of social occasions and Type of food** | | | |
| Frequency of social occasions x Everyday foods | 0.715 | 0.118 to 1.311 | 0.019 |
| **Neither alternative** | -1.241 | -1.851 to -0.630 | <0.001 |
| **Model fit statistics** | | | |
| Log likelihood of model | -824.33 | | |
| Log likelihood of model without predictors | -1207.44 | | |
| Likelihood ratio $X^2$ | 766.22 | | |
| Norm. AIC | 1.485 | | |
| Pseudo $R^2$ | 0.317 | | |

Abbreviations: AIC: Akaike information criterion; SE: standard error; $X^2$: chi-square; 95%CI: 95% confidence interval
[1] No. of respondents n=225, No. of observations n=1125. Adjusted for condition order effects.
[2] Wald test p value presented for time attribute (quick + more time consuming = 0)
[3] Frequency of social occasions rescaled (/10)

***Objective 4: Understanding moderators of physical and social opportunity on parent choice***

The last objective split parent respondents into subgroups, based on certain characteristics, to investigate whether the effect of physical or social opportunity on food provision differed by parent or child characteristics. Subgroups were created for parents living in lower SEIFA areas (IRSAD deciles of 1 to 5; n=91) providing 455 choice observations and those living in higher SEIFA areas (IRSAD deciles of 6 to 10; n=133) providing 665 choice observations (Appendix 7). Subgroups were also created based on child weight status. There were 124 parents of children within the healthy weight range providing 620 choice observations, and 68 parents of children with overweight or obesity providing 340 choice observations. This analysis excluded parents of children classified as underweight. Multinominal logit model analyses were performed for each subgroup, as well as scatterplots produced to obtain the scale parameter for each subgroup and context. Scale parameters for SEIFA areas were 0.94 for non-social and 0.95 for social contexts.

Similarly, scale parameters for weight status subgroup models were 0.98 for non-social and 0.96 for social contexts. Hence as scale was near one, coefficients could be compared between subgroups and contexts.

Outputs for SEIFA area subgroups are presented in Table 4.12 and 4.13. Within parents living in lower SEIFA areas the relative importance of attributes were interpreted in a similar pattern as the whole sample with type of food and child's likely response the most important attributes, in non-social and social contexts, respectively. The key difference being that in social contexts cost was ranked as higher importance than support from friends. In the higher SEIFA group, attributes were also given the same relative importance scores, except the cost attribute was not a significant influence on parent decision-making in either context. Comparing lower and higher SEIFA subgroups, the cost attribute parameter weights were larger in the lower SEIFA group in both contexts than in the higher SEIFA group. This difference was at a magnitude of 1.4 times the importance of cost attribute in lower versus higher SEIFA group.

Table 4.12: Multinomial logit model for parents living in lower SEIFA areas provision of snack decisions in non-social and social occasions[1]

| | Non-social occasions | | | Social occasions | | |
|---|---|---|---|---|---|---|
| **Attributes** | **Coefficient** | **95% CI** | **P value** | **Coefficient** | **95%CI** | **P value** |
| **Cost** | | | | | | |
| Cheaper (reference level) | | | | | | |
| More expensive | -0.424 | -0.808 to -0.040 | 0.031 | -0.477 | -0.835 to -0.119 | 0.009 |
| **Time**[2] | | | | | | |
| Instant (reference level) | | | | | | |
| Quick | 0.251 | -0.276 to 0.797 | 0.463 | -0.371 | -0.872 to 0.131 | 0.218 |
| More time consuming | 0.076 | -0.402 to 0.554 | | -0.190 | -0.688 to 0.310 | |
| **Child's likely response** | | | | | | |
| Accepting (reference level) | | | | | | |
| Resistant | -1.380 | -1.729 to -1.030 | <0.001 | -1.647 | -1.999 to -1.294 | <0.001 |
| **Support from co-parent** | | | | | | |
| Supportive | 0.711 | 0.388 to 1.035 | <0.001 | 1.011 | 0.665 to 1.358 | <0.001 |
| Unsupportive (reference level) | | | | | | |
| **Support from friends** | | | | | | |
| Supportive | 0.445 | 0.102 to 0.789 | 0.011 | 0.449 | 0.113 to 0.785 | 0.009 |
| Unsupportive (reference level) | | | | | | |
| **Type of food** | | | | | | |
| Everyday foods | 1.782 | 1.381 to 2.183 | <0.001 | 1.397 | 1.039 to 1.755 | <0.001 |
| Sometimes foods (reference level) | | | | | | |
| **Neither alternative** | -1.397 | -2.181 to -0.613 | <0.001 | -1.466 | -2.222 to -0.709 | <0.001 |
| **Model fit statistics** | | | | | | |
| Log likelihood of model | -318.24 | | | -329.47 | | |
| Log likelihood of model without predictors | -486.93 | | | -490.53 | | |
| Likelihood ratio $X^2$ | 337.38 | | | 322.12 | | |
| Norm. AIC | 1.438 | | | 1.488 | | |
| Pseudo $R^2$ | 0.346 | | | 0.328 | | |

Abbreviations: AIC: Akaike information criterion; SE: standard error; $X^2$: chi-square; 95%CI: 95% confidence interval

[1] No. of respondents n=91, No. of observations n=455. Adjusted for condition order effects.

[2] Wald test p value presented for time attribute (quick + more time consuming = 0)

Table 4.13: Multinomial logit model for parents living in higher SEIFA areas provision of snack decisions in non-social and social occasions[1]

| | Non-social occasions | | | Social occasions | | |
|---|---|---|---|---|---|---|
| **Attributes** | **Coefficient** | **95% CI** | **P value** | **Coefficient** | **95%CI** | **P value** |
| **Cost** | | | | | | |
| Cheaper (reference level) | | | | | | |
| More expensive | -0.315 | -0.654 to 0.025 | 0.070 | -0.214 | -0.522 to 0.094 | 0.173 |
| **Time**[2] | | | | | | |
| Instant (reference level) | | | | | | |
| Quick | 0.014 | -0.439 to 0.467 | 0.539 | 0.076 | -0.358 to 0.510 | 0.776 |
| More time consuming | -0.274 | -0.748 to 0.201 | | -0.190 | -0.631 to 0.251 | |
| **Child's likely response** | | | | | | |
| Accepting (reference level) | | | | | | |
| Resistant | -1.792 | -2.097 to -1.488 | <0.001 | -1.448 | -1.725 to -1.170 | <0.001 |
| **Support from co-parent** | | | | | | |
| Supportive | 1.263 | 0.943 to 1.583 | <0.001 | 1.110 | 0.819 to 1.402 | <0.001 |
| Unsupportive (reference level) | | | | | | |
| **Support from friends** | | | | | | |
| Supportive | 0.457 | 0.145 to 0.768 | 0.004 | 1.015 | 0.723 to 1.308 | <0.001 |
| Unsupportive (reference level) | | | | | | |
| **Type of food** | | | | | | |
| Everyday foods | 2.053 | 1.706 to 2.400 | <0.001 | 1.356 | 1.054 to 1.658 | <0.001 |
| Sometimes foods (reference level) | | | | | | |
| **Neither alternative** | -1.159 | -1.875 to -0.444 | 0.002 | -0.863 | -1.516 to -0.209 | 0.010 |
| **Model fit statistics** | | | | | | |
| Log likelihood of model | -426.64 | | | -487.05 | | |
| Log likelihood of model without predictors | -712.22 | | | -710.76 | | |
| Likelihood ratio $X^2$ | 571.16 | | | 447.42 | | |
| Norm. AIC | 1.310 | | | 1.492 | | |
| Pseudo $R^2$ | 0.401 | | | 0.315 | | |

Abbreviations: AIC: Akaike information criterion; SE: standard error; $X^2$: chi-square; 95%CI: 95% confidence interval
[1] No. of respondents n=133, No. of observations n=665. Adjusted for condition order effects.
[2] Wald test p value presented for time attribute (quick + more time consuming = 0)

Table 4.14 and 4.15 present outputs by child weight status subgroups to investigate how the importance of opportunity attributes differ in parents with children of healthy weight status versus those with overweight or obesity. Relative importance of attributes in both the non-social and social contexts were the same in both subgroups. However, as per parents living in higher SEIFA areas, the cost attribute was no longer significant in either context for parents of children with overweight or obesity. There was a slightly greater representation of parents living in lower SEIFA areas (+4.7% vs healthy weight range) with children within the overweight and obesity weight status group; suggesting this finding was not confounded by socio-economic position. When comparing the magnitude of importance of attributes by children's weight status groups, larger utility weights were seen for type of food (1.4 times importance) and child's likely response (1.4 times importance) for parents of children within the healthy weight range compared with those who were above, in non-social contexts. This higher magnitude of importance on decision-making was not seen in social contexts.

Table 4.14: Multinomial logit model for parents of children within the healthy weight range provision of snack decisions in non-social and social occasions[1]

| | Non-social occasions | | | Social occasions | | |
|---|---|---|---|---|---|---|
| **Attributes** | **Coefficient** | **95% CI** | **P value** | **Coefficient** | **95%CI** | **P value** |
| **Cost** | | | | | | |
| Cheaper (reference level) | | | | | | |
| More expensive | -0.393 | -0.754 to -0.032 | 0.033 | -0.364 | -0.677 to -0.050 | 0.023 |
| **Time**[2] | | | | | | |
| Instant (reference level) | | | | | | |
| Quick | -0.070 | -0.544 to 0.404 | 0.381 | -0.265 | -0.703 to 0.172 | 0.150 |
| More time consuming | -0.300 | -0.764 to 0.165 | | -0.316 | -0.765 to 0.132 | |
| **Child's likely response** | | | | | | |
| Accepting (reference level) | | | | | | |
| Resistant | -1.823 | -2.147 to -1.500 | <0.001 | -1.609 | -1.909 to -1.310 | <0.001 |
| **Support from co-parent** | | | | | | |
| Supportive | 1.063 | 0.754 to 1.372 | <0.001 | 1.046 | 0.747 to 1.346 | <0.001 |
| Unsupportive (reference level) | | | | | | |
| **Support from friends** | | | | | | |
| Supportive | 0.440 | 0.119 to 0.760 | 0.007 | 0.759 | 0.463 to 1.055 | <0.001 |
| Unsupportive (reference level) | | | | | | |
| **Type of food** | | | | | | |
| Everyday foods | 2.280 | 1.900 to 2.659 | <0.001 | 1.381 | 1.071 to 1.692 | <0.001 |
| Sometimes foods (reference level) | | | | | | |
| **Neither alternative** | -1.679 | -2.437 to -0.921 | <0.001 | -1.453 | -2.147 to -0.760 | <0.001 |
| **Model fit statistics** | | | | | | |
| Log likelihood of model | -394.12 | | | -444.06 | | |
| Log likelihood of model without predictors | -661.50 | | | -660.99 | | |
| Likelihood ratio $X^2$ | 534.76 | | | 433.86 | | |
| Norm. AIC | 1.300 | | | 1.461 | | |
| Pseudo $R^2$ | 0.404 | | | 0.328 | | |

Abbreviations: AIC: Akaike information criterion; SE: standard error; $X^2$: chi-square; 95%CI: 95% confidence interval
[1] No. of respondents n=124, No. of observations n=620. Adjusted for condition order effects.
[2] Wald test p value presented for time attribute (quick + more time consuming = 0)

Table 4.15: Multinomial logit model for parents of children with overweight or obesity provision of snack decisions in non-social and social occasions[1]

| | Non-social occasions | | | Social occasions | | |
|---|---|---|---|---|---|---|
| **Attributes** | **Coefficient** | **95% CI** | **P value** | **Coefficient** | **95%CI** | **P value** |
| **Cost** | | | | | | |
| Cheaper (reference level) | | | | | | |
| More expensive | -0.088 | -0.519 to 0.343 | 0.689 | -0.180 | -0.604 to 0.244 | 0.405 |
| **Time**[2] | | | | | | |
| Instant (reference level) | | | | | | |
| Quick | 0.401 | -0.226 to 1.028 | 0.665 | 0.126 | -0.471 to 0.724 | 0.902 |
| More time consuming | -0.155 | -0.762 to 0.453 | | -0.060 | -0.649 to 0.530 | |
| **Child's likely response** | | | | | | |
| Accepting (reference level) | | | | | | |
| Resistant | -1.281 | -1.661 to -0.901 | <0.001 | -1.351 | -1.736 to -0.967 | <0.001 |
| **Support from co-parent** | | | | | | |
| Supportive | 0.871 | 0.470 to 1.272 | <0.001 | 1.302 | 0.895 to 1.710 | <0.001 |
| Unsupportive (reference level) | | | | | | |
| **Support from friends** | | | | | | |
| Supportive | 0.480 | 0.079 to 0.882 | 0.019 | 0.844 | 0.434 to 1.254 | <0.001 |
| Unsupportive (reference level) | | | | | | |
| **Type of food** | | | | | | |
| Everyday foods | 1.606 | 1.177 to 2.034 | <0.001 | 1.309 | 0.899 to 1.719 | <0.001 |
| Sometimes foods (reference level) | | | | | | |
| **Neither alternative** | -0.906 | -1.823 to 0.011 | 0.053 | -0.638 | -1.522 to 0.245 | 0.157 |
| **Model fit statistics** | | | | | | |
| Log likelihood of model | -241.14 | | | -258.45 | | |
| Log likelihood of model without predictors | -367.54 | | | -366.74 | | |
| Likelihood ratio $X^2$ | 252.80 | | | 216.58 | | |
| Norm. AIC | 1.471 | | | 1.573 | | |
| Pseudo $R^2$ | 0.344 | | | 0.295 | | |

Abbreviations: AIC: Akaike information criterion; SE: standard error; $X^2$: chi-square; 95%CI: 95% confidence interval

[1] No. of respondents n=68, No. of observations n=340. Adjusted for condition order effects.

[2] Wald test p value presented for time attribute (quick + more time consuming = 0)

## 4.5. Discussion

The current study sought to determine the relative importance of components of physical and social opportunity as influences of parents' unhealthy food provision decision-making. Albeit subject to social desirability bias, type of food was identified as the most important influence in parents' decision-making in the non-social context. Social opportunity components—child resistance, co-parent and family friends support—were found to rank of higher importance than physical opportunity attributes of cost and time. There were few differences in attribute importance when comparing parent decision-making in social and non-social occasions. Selected explanatory variables primarily failed to aid understanding of opportunity attributes in snack provision. Although there were subtle differences in important attributes when exploring parent subgroups by socio-economic position and child weight status, the top-ranking attributes were consistent. The top three ranking attributes across subgroups remained the same: type of food (proxy for food availability), child resistance and co-parent support. The current study highlights the importance of home food availability, the influence of children and co-parent support in parent snack provision decision-making, regardless of social context, socio-economic position or child weight status.

### 4.5.1. Relative importance of social opportunity attributes

Food availability and child resistance were significant independent factors influencing parental food provision choices. Although food availability could not be directly included in the discrete choice experiment, as the nature of the choice task requires both alternatives to be available, it was included via a proxy measure. The 'type of food' attribute acted as a proxy measure for availability of healthy versus unhealthy foods. Past research in other parent samples have reported food availability as a key barrier to healthy food provision[132, 138, 148] and unhealthy food provision[138, 147, 148]. Peters and colleagues[138] reported on a qualitative exploration into Australian parents of children with healthy or unhealthy diets. They found parents of children with healthier diets more commonly reported restricting unhealthy food availability within the home. In a survey of Australian parents (with children 2—16yo), availability of healthy food (72% parents reported as a barrier) was rated the second most important barrier to healthy food provision, following child resistance which was identified as the most important barrier (89%)[132]. Resistance from children or their preferences have been raised in many previous studies as a challenge for parents' food provision[69, 132, 146-148, 152]. Targeting changes in home food availability could also indirectly address child resistance, as unhealthy foods would not be in sight or reach in the home. Current findings, using a new study design addressing limitations such as social desirability bias and self-reported barriers, support previous literature suggesting food availability and child resistance are important for both healthy food provision as well as limiting unhealthy food provision.

Support, or lack thereof, from co-parents was found to be an important social opportunity influence on parents' snack provision decision-making. Co-parent influence has been explored in four qualitative studies. Qualitative studies have reported co-parents[69, 138, 146, 153] and grandparents[69, 138, 147] behaviours, predominately as undermining parents' provision. Peters and colleagues[138] reported differences in partners' support, with parents of children with healthier diets more often reporting partners were supportive compared with unsupportive partners noted in the unhealthy diet group. For example, *"My wife and I have fairly similar approaches and I guess we try and send the same messages…"*[138](p 133). In another qualitative study, parents summarised the conflicts between parents' provision as *"I try to limit fries to once a week, although I get sabotaged by his dad. He likes the fries and he will buy the fries regardless if he has already had fries"* and *"We do not have a ton of snack food and honestly, if we do, my husband brought it in, and I don't have much control over that"*[146](p 162). Hence, current findings add to qualitative literature noting co-parents as an important influence on food provision.

Parenting research aligns with the current findings, with May and colleagues[321] reinforcing the importance of the co-parenting relationship for child outcomes including psychological adjustment, and potential influence on risk of becoming overweight. Co-parent support is one element of the co-parenting relationship, which also encompasses agreement on childrearing issues, division of parenting roles and responsibilities and joint management of family interactions[322]. Co-parent support has also been found to be the strongest influence on parents' self-efficacy, which in turn could enhance favourable food provision[323]. Past child nutrition and obesity prevention interventions have commonly targeted one parent within a family, primarily mothers[321]. The current study findings assist in building evidence and support the notion of intervening on the co-parenting relationship to support parents' food provision directly through increasing co-parent support. Support from co-parents, or the co-parenting relationship, appears an important influence to consider in limiting unhealthy food provision.

Despite cost and time being commonly raised as barriers to healthy food provision, they were not found to be important components of opportunity influencing parental food provision decisions in the current study. In numerous qualitative and quantitative studies, parents have reported the high costs of healthy foods and the time required to prepare healthy meals as key barriers to providing a healthy diet (i.e. limiting unhealthy food provision)[69, 138, 146, 148, 149]. In a study by Smit and colleagues[149], of parents of primary school children in South Africa, cost was found to be the strongest self-reported influence on parents' food choices regardless of school socio-economic position. This finding was most pronounced in parents from lower socio-economic areas. The same study found that lack of time was a greater barrier in parents of higher socio-economic background than lower socio-economic position[149]. Similarly in the United States, parents expressed cost and time as key barriers to food provision in a qualitative study by Nepper and Chai[146]: *"Cost is a big motivator", "Healthy foods are way more expensive", "Not enough time to cook. I am busy and I* *don't feel like cooking, so I will go buy fast food"*(p 159). However, in the current study sample time was not found to significantly influence parent choice, and cost was often the lowest ranking opportunity attribute in analyses. This contradictory finding may suggest there are important differences in barriers to meal versus snack provision, with snacks commonly being quicker to prepare and perhaps perceived as cheaper. In a qualitative study exploring food parenting practices relating to snacks in low income families, food preparation was found not to be relevant for child snacking[324], supporting the idea that importance of snack attributes may differ from meals.

Alternatively, the contrasting importance of cost and time in the current study and past research may be a result of methodological differences. Past research has used more descriptive analyses from qualitative and rating approaches compared with the empirical approaches used in the current study by discrete choice experiment methods. There were also somewhat conflicting results between importance scores and parent-reported barriers. This finding suggests a divide between parent report of barriers in isolation, and their trade-offs between influences in combination. The purpose of a discrete choice experiment design is to force parents to make trade-offs to identifying attributes of underlying importance, more similar to real world provision. Physical opportunity aspects, such as cost and time, may quickly come to mind, are easy to recall, and relatively self-explanatory barriers to report. There is a disconnect between parent rated barriers and importance revealed through the current choice data analyses.

However, results from three other discrete choice experiments align with the current findings, with cost and time being of lower importance in college students', adults, and older adults' food choices[292, 294, 298]. In the study of college students snack choices, although cheaper and quicker snacks were preferred over more expensive and time consuming snacks, the healthiness of snacks had the largest influence on food choice (accounting for 55% of the log-likelihood)[292]. The study finding suggests students were willing to pay more for healthier snack options[292]. Likewise, regarding adults and older adults' food choices, healthiness, followed by taste were identified as the most influential factors on meal decisions[294, 298]. In the adults sample, cost and time attributes ranked lowest[298]; and within the older adults study, preparation time was not found to be a significant influence on choice[294]. Current findings suggest cost and time are of low relative importance in parents' snack provision decision-making.

#### 4.5.2. Similar attribute importance in social and non-social conditions

The relative importance of opportunity attributes were similar in social and non-social occasions. It was predicted the addition of visitors in the social context would have altered the importance of attributes. For example, that food availability would not be a significant influence in the presence of visitors, and that support from family friends would have been the most important attribute influencing parents' snack provision decision-making in social context, but not be significant in non-social context. Instead food availability was of lower importance in social rather than non-social contexts but still a significant influence. Support from family friends was a significant influence, of similar relative importance in both contexts, but with a higher magnitude of importance of 1.8 times in the social context compared with non-social context. Although there were some differences in the magnitude of attribute utility weights there was little variation in attribute relative importance between contexts, except for food availability and child resistance. Child resistance obtained the highest ranking in decision-making in social occasions, which is understandable. Current findings suggest, in the presence of family friends, parents' place a greater importance on snacks children will be more accepting of (i.e. less likely to throw a tantrum) and lower importance on the availability of healthier foods. The role of child resistance was highlighted in a qualitative study when parents described providing sugar-sweetened beverages to avoid conflict and have a calm environment, such as *"Don't want to fight with kids so we just buy them what they ask for"* and *"soda keeps them [kids] happy…so the kids leave them [parents] alone"*[148](p 5 of 14).

Limited variation in attribute importance between social and non-social contexts, may have been influenced by the selected scenario of weekend snack provision and reflect differences in food provision by day of week. Weekend provision context may have attenuated differences between social and non-social occasions. A study of mothers of seven to 11-year-olds in the United States, exploring feeding goals and perceptions, found parents placed a higher importance on health (wk: 4.01, SD 0.70, wkend: 3.89, SD 0.75; $p<0.001$) and price (wk: 3.69, SD 0.90, wkend: 3.57, SD 0.95; $p<0.01$) goals on weekdays compared to weekends[325]. In addition, parents perceived certain foods as weekend foods, such as fast food, pizza and soda (i.e. unhealthy foods), with larger portion sizes more commonly served on weekends, compared with weekdays[325]. Providing snacks that a child will be more likely to accept was of greatest importance in social occasions, compared with food availability in non-social occasions. However, other influences were found to be the same relative importance in parents' snack provision decision-making in a weekend context.

### 4.5.3. Lack of interaction effects between global measures of temperament and self-efficacy

Child temperament and parenting self-efficacy did not help in understanding the role of social opportunity in parents' food provision decision-making. Child temperament traits have been associated with higher weight status in preschool children, as well as with restrictive feeding practices[286] and permissive feeding styles[287] associated with obesity risk. Therefore, temperament traits were anticipated to mediate the importance parents place on child resistance. However, there was no interaction observed in the current study. It should be highlighted the measure used in the current study was extremely brief, with only three items, compared with other short tools measuring child temperament (36 items in very short version; 94 in short version)[307]. The selected measure may not have been sensitive enough to observe differences in child temperament traits in this sample. Measures such as the Child Eating Behaviour Questionnaire may be required to provide assessment of food specific mediators of child behaviour[326]. The Child Eating Behaviour Questionnaire captures children's eating / food specific behaviours under the domains of responsiveness to food, enjoyment of food, satiety responsiveness, slowness in eating, fussiness, emotional overeating, emotional undereating, and desire for drinks[326].

Similarly, global measures of general parenting self-efficacy were not seen to influence the role of co-parent or friends support in parents' decision-making. It was predicted higher levels of self-efficacy would lead to higher resilience in parents to make snack choices regardless of the support or lack of support from others. Parents were not asked about the provision practices and beliefs of their friends and co-parents to understand whether they align with those of responding parents. It may be that the current sample had homogenous beliefs to their social supports; this requires consideration in future research. Alternatively, perhaps more targeted items regarding nutrition-specific self-efficacy may have been a better explanatory variable to include. Research outlined in Chapter 3 (Study 1), did include measures of self-efficacy towards limiting unhealthy foods as part of the Parental Food Attitude Questionnaire, however this sub-component has not been validated for use in isolation. The lack of interaction effects of child temperament and parenting self-efficacy may suggest global measures may not be appropriate to understand food provision behaviour.

### 4.5.4. Frequency of social occasions influence on snack provision

Parents of children with more frequent social occasions appeared to place a greater importance on healthier foods in the social context. Although there is a paucity of research, based on clinical reasoning a higher frequency of social occasions were predicted to mediate the importance placed on food availability within social occasions. This was based on the assumption that more frequent social occasions would contribute to a greater proportion of children's intake and become less 'special'. Hence, treated more like an everyday context rather than a 'special or celebratory' occasion. To date there has been no published research regarding children's frequency of social occasions. Preliminary research from Chapter 3 (Study 1) found that children (n=328; 3—7yo) had on average three (range 0 to 8) types of social occasions in a week, yet frequency of social occasions was not examined. In the current study children were found to have a median of five social occasions per week (range 0 to 28 times per week). The social occasions frequency explanatory variable measure was developed for this study and has not undergone any psychometric testing. Regardless, initial findings saw frequency of social occasions interacted with everyday foods, had a significant positive influence on parents' snack decision-making. Yet, the main effects of frequency of social occasions did not have a significant influence on choice, and when examined as a categorical rather than continuous variable differing results were obtained. Given use of the study-developed item that was a sensitive measure, results need to be interpreted with caution, but do signal the need to further explore the role of social occasions on children's unhealthy food intake.

#### 4.5.5. Similarities and variations in importance of cost in socio-demographic subgroups

Current findings suggest there may be limited differences in parents' snack provision decision-making based on parent or child characteristics. Subtle differences were observed in the importance of attributes in subgroups of parents based on socio-economic position and child weight status. When examining attribute importance in samples of parents residing in lower versus higher Socio-Economic Index For Areas (SEIFA) differences were seen in the importance of the cost attribute. Cost was not found to be a significant influence on snack decision-making for parents living in higher SEIFA areas, in both social and non-social contexts. Within social contexts cost ranked as a slightly higher overall relative importance in lower SEIFA sample, ranking as forth most influential opportunity attribute, compared with fifth in higher SEIFA and overall sample.

Findings of the current study align with a discrete choice experiment of adults' meal choices, finding cost was of higher relative importance in most disadvantaged subgroups, but still following healthiness and taste as the most important influences[298]. The current study finding is consistent with a qualitative study of Australian parents, where parents from lower socio-economic backgrounds described that cost often determined decisions to purchase convenience foods[69]. Yet, the study found cost was still an important consideration for parents from higher socio-economic backgrounds[69]. Similarly, a study by Smit and colleagues[149] comparing barriers to food provision reported by South African parents of children attending school in different socio-economic areas, found cost was a commonly reported barrier across socio-economic areas. Albeit more frequently reported by parents of children attending school in the most disadvantaged tertile (71.8%) compared with the advantaged tertile (50.4%)[149]. Current findings suggest cost is an important consideration for parents of lower socio-economic position background, but of lower importance that previously discussed influences, such as food availability and child resistance. However, if specifically targeting parents from lower socio-economic position background cost of snacks should be considered and addressed in an intervention.

Within the subgroup of parents of children with overweight or obesity, cost was also seen to no longer be a significant influence on parent decision-making. This finding could suggest there are other factors more important than cost when choosing snacks for children with overweight or obesity. The one qualitative study by Nepper and Chai[146] comparing parent reported barriers by child weight status found cost was a barrier in both groups. Relative importance of the top five attributes were consistent across parents of children within the healthy weight range or above a healthy weight. However, there were differences in the magnitude of importance. The most notable differences were in the importance of food availability and child resistance that were both 1.4 times higher in parents of children with a healthy weight, suggesting a greater influence in decision-making than for parents of children above a healthy weight, in the non-social context. Yet, there was no large difference in influence of type of food and child resistance in social contexts (1.1 and 1.2 times, respectively). Children's weight status appears to play a small role in parents' decision making.

The qualitative exploration mentioned earlier, found lack of co-parent support only in parents of children with overweight or obesity[146]. Co-parent support was seen to be of the same relative importance in the current study. Yet, the magnitude of importance noted lower importance in the overweight subgroup in non-social context, but the reverse was seen in social occasions. Regardless of slight subgroup differences, there is support for consistent primary intervention targets, such as child resistance and food availability regardless of weight status. Hence, allowing for generic intervention messages at a population level without separating intervention strategies parents by child weight status.

#### 4.5.6. Study strengths and limitations

There are several strengths of the current study. Having parents complete both social (manipulated) and non-social (control) conditions provided a case-matched sample to allow comparisons between conditions. Additionally, this method supported collection of large quantity of choice data to exceed sample size requirements for the discrete choice experiment design. Randomising parents within the online survey tool controlled for any bias from order in which conditions were presented. Similarly, by manually randomising the attribute order within choice tasks, potential bias from attribute order was mitigated. Although not formally pilot tested given the project scope, the convenience sample pilot did allow for improvements to be made in the discrete choice experiment prior to participant data collection. The use of available qualitative and quantitative research to inform attribute selection was also a strength.

Several quality assurance checks were included within the online survey, specifically choice of attributes and usual attribute levels. Prior to the discrete choice experiment, parents rated potential barriers to food provision which were cross-checked with opportunity attributes. Majority of the selected design attributes were identified as common barriers for the target sample, hence giving confidence in the external validity of the findings. After the discrete choice experiment, parents also rated their usual snack provision against the design attribute levels. Usual attribute levels were compared with the marginal means for each condition to further strengthen confidence in the findings. In addition, average survey duration suggested parents engaged with the choice tasks and allowed sufficient time to make trade-offs. Contrasting two conditions which differ in social context is a novel methodological contribution to the choice research field. This approach to include two conditions has not been used in other applications of discrete choice experiment methods, however, scientific rigour was ensured by a supervisor (EKH) who is an expert in discrete choice experiments in health care applications. Lastly a key strength of the design itself being that parents completed repeated hypothetical choice tasks. This repeated choice process overcomes the reliance on self-report or rating of the importance of influences on parents' provision. Traditional approaches to measure influences on food choices often require parents to report what they think is important, this may be influenced by what is easy to recall regardless of its relative importance. Alternatively, a discrete choice experiment provides numerous very similar choice tasks that provide multiple attributes for parents to consider when making choices. The slight variations in each task mean that parents may unconsciously focus on certain attributes when making choices when moving through the tasks quickly, much like we do unconsciously when making real life decisions. Therefore, the underlying drives of food choice can be revealed which may not align with what is self-reported when asked in a traditional approach, which is what was found in the current study when comparing the parent perceived barriers to discrete choice outputs. Combined there are important strengths of the current project demonstrating appropriate discrete choice experiment design.

There are still several limitations to keep in mind when interpreting these findings and implications. Discrete choice experiments provide evidence of hypothetical decision-making contexts (i.e. simulations). Although care is taken to minimise outside factors and to make choice tasks realistic, they are still subject to hypothetical and reporting bias; thus, are limited to providing information about intended provision. Similarly, as choices were reliant on parent report there is potential for social desirability bias, though this is somewhat mitigated by discrete choice experiment approach over traditional qualitative or survey methods. The selected proxy measure for food availability of 'type of food' attribute could also be considered somewhat as a measure of healthiness given the attribute levels were presented as everyday and sometimes foods. Hence, may have been influenced by social desirability bias, inflating its importance. Given the choice scenarios were based on weekend snack provision it would have been ideal for parents to complete the tasks on a Saturday, as other factors related to weekday provision may have unconsciously influenced parent choice, hence unobserved variability[2]. Similarly, the selected scenario referring to a Saturday morning was selected based on anecdotal evidence and may or may not be a common time for socialising with family friends and could have also impacted on unobserved variability.

Other limitations relating to the discrete choice experiment design of this study include the use of unlabelled generic snacks, subjective attributes and end-point attribute levels. Unlabelled snacks rather than specific food items, may have added to the cognitive burden of the choice tasks as parents had to imagine the type of snacks. However, unlabelled snacks were selected to allow parents to think of snack items relevant to their family and focus attention on the opportunity attributes. Conversely, specific food items have the disadvantage of brand recognition or non-familiarity with the product, as well as child preferences for certain snacks that would have contributed to the limitations of a labelled design approach. The inclusion of opportunity attributes, rather than traditional snack item characteristics (e.g. price, energy value) may have also contributed to the cognitive burden as these attributes are more abstract and required parents to interpret them in relation to the glossary provided. The inclusion of social opportunity attributes also required attributes to be listed, rather than having 'hidden' attributes as linked characteristics of different snack items which is possible for physical opportunity aspects. For example, a packet of crisps being instant to prepare, a fixed cost, classified as a sometimes food. Additionally, the use of listed attributes may have required parents to use reflective, rather than automatic thinking processes. If parents' food choice decision-making is usually automatic the choice tasks may not represent real life processes. However, this issue speaks to the broader challenge of attempting to measure variables that are not observable, such as thought processes. A small number of parents reported difficulties in completing the choice tasks, due to the trade-offs, but also the complexities of the task with the type of attributes included in this study. The complexity may have led to random selection of alternatives in these parents. End-point attribute levels were limited to capture only extreme levels, therefore may have missed variation within more specified levels[290]. For example, three to five attribute levels as commonly used in discrete choice experiments[327]. Restricting the number of attribute levels was necessary to include all six attributes and keep the required sample size feasible for the recruitment period available with the confines of the project and to reduce task complexity[2].

Regarding recruitment, the sampling strategy was a non-random approach which is not representative of the parent population[328, 329], therefore does limit the generalisability of the findings. In addition, self-selection bias may have led to parents more interested in nutrition and health choosing to participate. Hence, food availability to be prioritised higher (relative importance score) than what it might be by parents less interested. However, this is a common risk across nutrition research using a non-random approach. The recruitment strategies implemented did reach parents across socio-economic areas but was not able to adequately represent parents of lower education levels, or fathers. Assessment of parents' current snack provision (quasi revealed preference) was conducted using a very crude measure of the proportion of unhealthy snack reported. Although the proportion of unhealthy foods reported is similar to population data on the percentage of total energy from unhealthy foods. There were no details collected about portion size or nutritional quality, instead limited to frequency of unhealthy snacks and relied on researcher knowledge and use of food classification systems[10]. Selection of generic brief measures of child temperament and parenting self-efficacy, may have also limited the ability to determine mediating effects on parents' snack decision-making. Finally, this study did not assess parents' nutrition knowledge, motivation, overall food provision nor detailed information of social supports, all of which would provide a deeper interpretation of the current findings and to be further explored in future studies. Current findings still provide initial insights into the relative importance of opportunity influences on parents' food provision decision-making.

#### 4.5.7. Implications for future research

The investigations in this chapter also highlight further research potential in interventions to increase parents' opportunity, further understand opportunity, explore social occasions and applications of discrete choice experiment methods to continue to understand parental provision. Firstly, the current findings prioritise home food availability, child resistance and co-parents as key targets in future interventions and dietetic practice. In addition to strategies to improve food availability, strategies could be designed to support parents' social opportunity within the family unit. A consistent approach between co-parents is likely to further assist in managing child resistance in relation to snack and meal provision more broadly. Whilst the current study contributes to building the evidence base in opportunity influences using a new methodology, it also raises some inconsistencies that can be further explored. For example, the lower priority of cost and time, based on significance and relative importance, in the current study should be investigated in future research. Specifically, to understand whether this finding is specific to snack provision decision-making, compared with meals, or if it is influenced by the advantages of the discrete choice experiment methods.

Current reported frequency of social occasions in early childhood highlight the need to better understand the role of unhealthy foods in social occasions. Are there different types of social occasions that are likely to impact on parents' provision and subsequently children's intake of unhealthy foods? Gathering information about children's current dietary intake alongside social context would assist researchers in answering such questions and directly the next steps in this area of research. Lastly, this study provides another nutrition example using discrete choice experiment methods. The application of discrete choice experiment methods in nutrition are in their infancy, hence there are numerous opportunities for future research to consider other food provision contexts and attributes, such as weekdays or out of home intake with additional attribute levels to be more sensitive in measuring parents' utility. The current study informs a range of avenues for future research related to opportunity, social occasions and discrete choice experiments methods.

## 4.6. Conclusion

Food availability (type of food), child resistance and co-parent support were found to be the most important opportunity factors influencing parents' snack provision decision-making. Although there were slight differences between social and non-social occasions and within subgroups of parents, the top three intervention targets were consistent. Findings provide additional support for prior observational research in the importance of home food availability, managing child resistance and gaining support from co-parents. But, strengthened by a different methodological design and by determining the relative importance when considering several physical and social opportunity attributes in the one parent sample. Initial intervention strategies should target important aspects of social opportunity and consider food availability. Initial implications for intervention design have been provided as well as guidance for other areas of research into parents' opportunity. Specifically, a greater understanding of the role of social occasions in unhealthy food provision is warranted.

## ***<u>Chapter 4 findings at a glance</u>***

*Which components of physical and social opportunity are most important in parents' food provision decision-making?*

Food availability (type of food as proxy), child resistance and co-parent support were of greatest relative importance of opportunity aspects influencing parents' snack provision on weekends decision-making. In general, with the exception of food availability, social opportunity components were found to be of greater importance than physical opportunity components.

*Does the importance of opportunity components differ in social versus non-social occasions?*

Largely the relative importance of opportunity components were consistent in social and non-social occasions. The one exception was the order of the top two attributes:

- Non-social occasions: 1) food availability, 2) child resistance, 3) co-parent support
- Social occasions: 1) child resistance, 2) food availability, 3) co-parent support

Subtle differences were observed between contexts when examining the magnitude of utility weights.

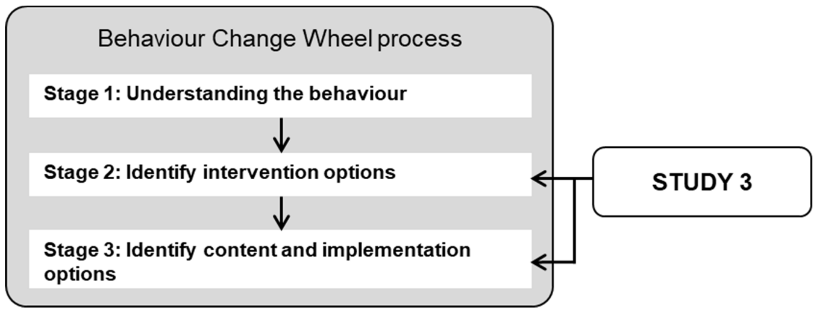
*Can child temperament, parenting self-efficacy and frequency of social occasions help to understand the role of physical and social opportunity in parents' decision-making?*

Global measures of child temperament and parenting self-efficacy were not found to significantly influence parents' snack decision-making or the role of child resistance or co-parent or friend support, respectively. Hence were not able to help understand the role of social opportunity.
Initial findings suggest frequency of social occasions may influence parents snack decision-making, by mediating the influence of food availability, where a higher frequency of social occasions was found to be associated with a greater influence of 'everyday' (healthier) foods on parents' decision-making.

*Does the importance of opportunity components differ by socio-economic position or child weight status?*

Relative importance of opportunity attributes were parallel in subgroups of socio-economic position and child weight status, except for cost. Cost was no longer found to significantly influence snack decision-making in parents of higher socio-economic position and in parents of children above the healthy weight range. Subtle differences were observed between subgroups when examining the magnitude of utility weights. Initial intervention targets of food availability, child resistance and co-parent support remained.

# 5. DECONSTRUCTING THE BEHAVIOUR CHANGE CONTENT OF PAST INTERVENTIONS USING THE BEHAVIOUR CHANGE WHEEL: A SYSTEMATIC REVIEW




This chapter addresses the overall thesis objective 2: to examine behaviour change content of interventions to reduce parents' unhealthy food provision to inform intervention design. This chapter presents the systematic identification of past interventions focussed on parents with at least one strategy aimed at reducing young children's unhealthy food intake. The Behaviour Change Wheel framework was used in a retrospective application to deconstruct the past interventions into their behaviour change components including sources of behaviour, intervention functions, policy categories and Behaviour Change Techniques. The resulting deconstructed content can inform the development of forthcoming next generation intervention design.

This systematic review has been published in *Obesity Reviews*, a quartile one journal, ranked fourth of 526 in *Public Health, Environmental and Occupational Health* by SCImago Journal Rankings. The publication has been cited three times since being published in October 2018 and has an Altmetric score of 20 (in the top 25% of all research outputs scored by Altmetric).

This chapter contains a pre-print version of the publication. Formatting has been modified to suit the thesis format, including addition of subheadings, study objectives, adjusted numbering of figures, tables and appendices, and minor language changes to match the overall thesis style. Please see Appendix 2 for formatted published version.

## 5.1. Introduction

### 5.1.1. Importance of parents in reducing children's intake of unhealthy foods

Parents are a key influence on young children's food intake[107, 330], as previously discussed in Chapter 1 (Literature Review). Highlighting parental provision of food as an ideal target for intervention in the home setting[73, 164]. A past review by Golley and colleagues[164] found that effective family-based obesity prevention interventions included meaningful parent involvement, use of Behaviour Change Techniques (BCTs) covering the behaviour change process and targeted strategies towards energy intake / density or food choices. Yet, no review has focussed specifically on parent interventions to reduce unhealthy food provision[73, 107, 164]. There is a need to improve the effectiveness of nutrition promotion and obesity prevention interventions[172, 173, 331]. A prime avenue for investigation is the best approaches to reduce children's intake of unhealthy foods.

### 5.1.2. Improving intervention design by deconstructing behaviour change content of existing interventions

Supporting parents to reduce provision of unhealthy foods to children requires behaviour change. Changing behaviour is complex. There are additional challenges when targeting children's intake as it requires changing parent food provision which is a mediator to changing children's intake. Little is known about the behaviour change content of interventions that aim to support parents to reduce provision of unhealthy foods to their children. Utilising behavioural analysis and behaviour change theory[3] will provide new insights into behaviour change interventions. The United Kingdom Medical Research Council have produced guidelines to support the design of complex behaviour change interventions[181], with complementary frameworks, such as the RE-AIM[182], Intervention Mapping[183] and Behaviour Change Wheel[174], suggested to support the design of evidence-informed and theoretically underpinned interventions. These frameworks all combine multiple theories or frameworks and can be applied across multiple behaviours.

Deconstructing past interventions to identify the components of greatest potential for effectively changing parents food provision is a crucial step to guide innovation and improvements in next generation interventions[167]. The Behaviour Change Wheel provides a systematic approach to design or deconstruct the elements of an intervention[174]. This theoretical framework is more comprehensive than previously suggested models by incorporating specific behaviour change taxonomy, providing a systematic method to understanding behaviour and allowing researchers to integrate discipline specific behaviour change theories[174]. The Behaviour Change Wheel consists of: the sources of behaviour (capability, opportunity and motivation)—the required components for a behaviour to occur; intervention functions—approaches which can be implemented to change behaviour; BCTs—individual strategies or techniques to initiate or maintain behaviour change; and policy categories—approaches of intervention delivery in a policy context[3, 174]. By understanding the behaviour change content of past interventions, interventions can be developed building on the strengths of effective interventions or trial approaches not yet investigated.

### 5.1.3. Study aim

This systematic assessment aimed to use the Behaviour Change Wheel to evaluate controlled interventions that support parents of three to eight-year-olds to reduce their provision of unhealthy foods to children in the home environment. To achieve this aim common characteristics of interventions and the key gaps in the Behaviour Change Wheel not addressed in current intervention development were identified.

## 5.2. Methods

This review protocol is registered on PROSPERO International prospective register of systematic reviews (protocol CRD42016048678). This chapter was prepared using the PRISMA[332] guidelines for reporting systematic reviews (Appendix 4).

### 5.2.1. Selecting papers for review

***Inclusion and exclusion criteria***

Interventions were included if they i) involved active participation by parents of children aged three to eight years (mean age >2.5 to <8.5 years at baseline), who were fluent in written English; ii) included at least one strategy targeting a reduction in unhealthy foods provided from the home setting; iii) had a control group; and iv) child unhealthy food intake (e.g. number of serves, score) or energy, saturated fat, sugars and/or sodium from unhealthy foods were reported for both the intervention and control group at baseline and at least three months following baseline. All studies were completed prospective studies, published in English, with no limits on publication date applied.

Interventions were excluded if they included children with a clinical condition precluding dietary guidelines adherence (e.g. cystic fibrosis), or a nominal parent focus, for example targeting the school setting or child knowledge with limited parental engagement. Protocol or pilot studies, conference abstracts and theses were excluded.

***Search strategy and selection process***

A systematic search was performed on the 12th January 2017, and updated 22nd March 2018, in Ebscohost (CINAHL), Ovid (Epub Ahead of Print, EMBASE, PyscINFO), Scopus and Web of Science, following test searches in Ovid databases to refine the search terms. The final search terms (Appendix 8) were limited to English language, human subjects and child age range when available; example search terms included: i) child* and preschool; AND parent or care giver; AND,

ii) nutrition and education or behaviour and change; AND, iii) discretionary food or treats or energy dense or nutrient poor or takeaway food; AND, iv) controlled clinical trial or randomised controlled trial or evaluation stud*.

All results were imported into EndNote and duplicates removed, prior to independent duplicate (BJJ and RKG/GAH/DZ) title and abstract screening, and full text review in Covidence systematic review software (Veritas Health Innovation, Melbourne Australia) using the pre-defined selection criteria. There was 95% agreement between reviewers in title and abstract screening with conflicts resolved by the primary reviewer (BJJ). In the full text review, there was 81% agreement between reviewers with conflicts resolved by the screening researchers to reach consensus. Searches of grey literature included reference lists of key review articles and of included studies for keywords, which were imported to Covidence for screening in duplicate (BJJ and RKG/GAH/DZ). To aid complete data extraction, a secondary hand search was conducted to identify published and unpublished protocols and pilot studies of the included interventions. Corresponding authors of included studies were contacted via email to request additional unpublished intervention content, with a reminder after two weeks. Fifteen of the 16 authors contacted responded to the request, many providing additional publications, with eight authors providing unpublished content in English.

### 5.2.2. Data extraction

The primary reviewer (BJJ) completed data extraction, using an instrument developed for this review, piloted with five studies. Data extraction was cross checked by a second reviewer (CEM). Items extracted included study characteristics, such as: behaviour change theory, participants, location, primary aim, sample size calculation, outcome measure and key results; and intervention characteristics and content, such as: unhealthy food strategies, setting, duration, delivery, materials and procedure.

### 5.2.3. Risk of bias

Two reviewers (BJJ and CEM) independently rated study quality using a standardised critical appraisal tool[333]. Rating conflicts were discussed and resolved by the two reviewers. The tool considers eight quality areas: selection bias, study design, confounders, blinding, data collection methods, withdrawals and drop outs, intervention integrity and analyses. The first six areas are given a rating of strong, moderate or weak, which are combined to give an overall quality rating of strong (no weak ratings), moderate (one weak rating) or weak (two or more weak ratings).

### 5.2.4. Coding of behaviour change intervention content

Behaviour change intervention content was coded against the Behaviour Change Wheel framework by the PhD candidate as a trained reviewer (BJJ; University College London, Centre for Behaviour Change Summer School 2017). Sources of behaviour (six categories spanning capability, opportunity, motivation), intervention functions (nine categories; e.g. education, enablement, restrictions), and policy categories (seven categories; e.g. guidelines, communication / marketing, legislation), were coded [174]. Behaviour Change Techniques (BCTs) were coded using the BCT Taxonomy v1[166]. Coding followed standard processes including only coding content where it was clear the BCT was present, and where the BCT related to the target population and behaviour (i.e. parents food provision). Coding was performed independently by two trained reviewers (BJJ and CEM; [http://www.bct-taxonomy.com/](http://www.bct-taxonomy.com/)); discrepancies were discussed and consensus reached. Primary analyses were performed on published intervention content including protocols, main results and follow up publications. Sensitivity analyses were performed comparing BCTs in published and unpublished intervention content. Techniques in unpublished intervention content were coded by the primary reviewer, and any uncertainties discussed with a second reviewer. There was substantial (Kappa mean 0.68, range 0.49 to 1.00) to almost perfect (PABAK mean 0.94, range 0.87 to 1.00) agreement between coders[334].

### 5.2.5. Synthesis of results

Cohen's d effect size for unhealthy foods outcome(s), between intervention and control group (end of intervention or change from baseline), was calculated from the published results[335]. Behaviour Change Wheel components and BCTs were mapped for each study, with one matrix developed for primarily group-based approach interventions and one for primarily individual focussed interventions. To control an element of heterogeneity comparisons were made for intervention content between individual versus group-based delivery approach. The relationship between intervention content, specifically Behaviour Change Wheel components, BCTs or study characteristics and intervention effectiveness was explored qualitatively using study effect size. A sensitivity analysis was also conducted to compare intervention content between obesity prevention and weight management interventions to account for any differences in content or effectiveness when preventing versus managing obesity. Data are presented for unhealthy foods strategies and outcome measures from the parent-focussed aspects of interventions only. Results relating to healthy foods or other health behaviours, or non-parent components of the interventions are not presented.

## 5.3. Results

Eighteen articles, describing 17 interventions, with a total of 18 intervention arms were included (Figure 5.1). Table 5.1 presents study details and quality ratings. Studies were largely conducted in the United States (n=6) and Australia (n=5), and all except one study[336] were individual (n=13) or cluster (n=4) randomised controlled trials. Combined participants totalled 5,824 (mean 341 participants per study, range 54—1138) with a mean child age of 6.1±1.6 years. The median duration of interventions was six months (range 1—12 months) with a six month follow up period from the end of the intervention (range 0—18 months).

Interventions addressed weight management (n=10), or obesity prevention (n=8). Only three studies included a primary aim to reduce unhealthy foods[162, 337, 338]. The majority of interventions targeted weight status (n=11), followed by healthy eating (n=6), and included multiple dietary and lifestyle behaviours. Control groups primarily (n=12) received general nutrition information (e.g. pamphlet) or were complete waitlist controls. Unhealthy foods were mainly measured as serves or units of discrete unhealthy foods (n=13), with six studies reporting an unhealthy food score (n=3) or total unhealthy food serves (n=3). Just over half (n=11) of the studies reported using a theoretical framework. Theories used were heterogeneous, the most commonly reported were social cognitive and learning theories (n=5).

Majority of studies were rated as weak (n=10), with only four studies rated as strong[161, 223, 308, 339]. Studies tended to rate poorly on selection bias (weak n=10, moderate n=8) and data collection tools (weak n=7, moderate n=5).

Interventions had a small to moderate effect size (-0.2 to -0.4), with some studies reporting negative intervention impacts, i.e. an increase in unhealthy food intake[162, 340]. Gerards and colleagues[308] was the only study to have a moderate to large effect size (-0.7), on sugar-sweetened soft drinks intake, however this reduction was not maintained at nine month follow up. Two studies[340, 341] found a similar reduction in sugar-sweetened beverage measures, and again these effects were not maintained at follow up[341]. Across studies there were few statistically significant reductions in any unhealthy food measures, with four studies reporting primarily statistically significant findings[308, 337, 342, 343], and for studies two effect sizes could not be calculated[337, 342].

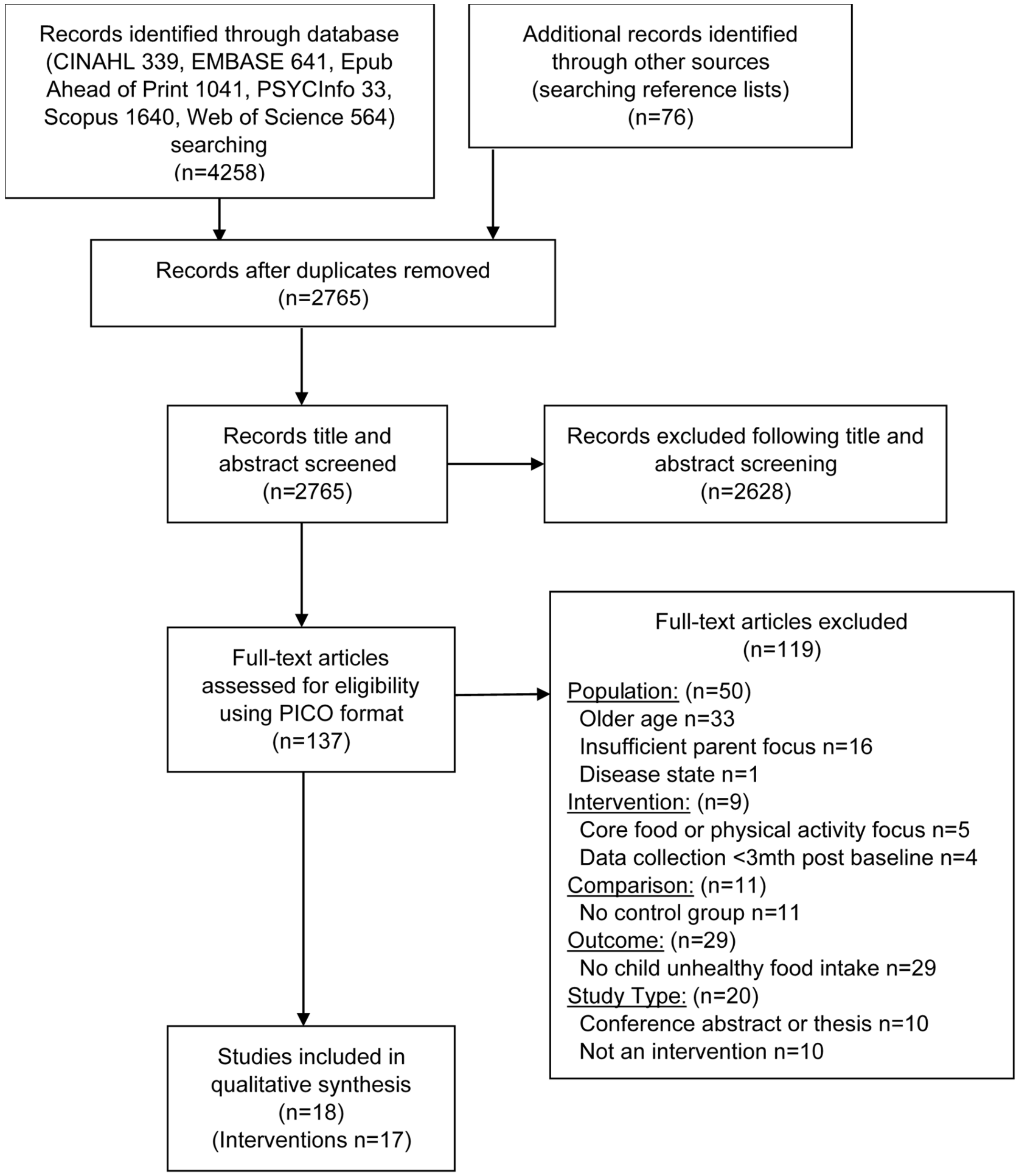



Figure 5.1: PRISMA Statement Flow Diagram: Parent-focussed interventions to reduce unhealthy foods intake in three to eight-year-old children

Abbreviations: PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyse; PICO: Population, Intervention, Comparison, Outcome

Table 5.1: Summary of parent-focussed intervention characteristics

| Reference | Participant age range & weight status | Primary aim | Unhealthy food targets | Other targets | Intervention type and duration | Setting and delivery | Theory | Unhealthy food measure | Effect size[1] |
|---|---|---|---|---|---|---|---|---|---|
| **Primarily program-based approach** | | | | | | | | | |
| Gerards[308]<br>The Netherlands<br>Strong | 4—8yo<br><br>Overweight and obesity | BMI, WC, skinfolds | SSB | Y<br>Fruit and veg intake<br>Water<br>Physical activity<br>Parenting strategies | Group program and phone calls<br><br>14wks | Public health service and home<br><br>Health professional | Unclear | Glasses of soft drink* | -0.7 |
| Burrows[340]<br>Australia<br>Weak | 5.5—9.9yo<br><br>Overweight | BMI, WC | Takeaway<br>Soda<br>Baked goods<br>Snack bars<br>Potato chips<br>Sweets | Y<br>Healthy eating<br>Physical activity | Group program and phone calls<br><br>6mths | University/ research setting and home<br><br>Dietitian | Health belief model | Serves of common unhealthy foods* | 0.4 to -0.7 |
| Raynor[341]<br>– Int. 1<br>USA<br>Weak | 4—9yo<br><br>Overweight and obesity | BMI | SSB<br>Sweet and salty snack foods | Y<br>Growth | Group program and growth monitoring<br><br>6mths | Research / primary care setting<br><br>Research staff-therapists | Unclear | Serves of sweet & salty snacks &SSB | -0.4 to -0.6 |
| Golley[339]<br>Australia<br>Strong | 6—9yo<br><br>Overweight and obesity | BMI, WC | Sweet grain-based snacks<br>SSB<br>Ice cream | Y<br>Healthy eating<br>Physical activity<br>Parenting strategies | Group program and phone calls<br><br>6mths | Hospital and home<br><br>Dietitian | Child development theory and social learning principles | Serves of unhealthy foods* | -0.3 |
| Raynor[341]<br>– Int. 2a (traditional)<br>USA<br>Weak | 4—9yo<br><br>Overweight and obesity | BMI | SSB | Y<br>Growth<br>Physical activity | Group program and growth monitoring<br><br>6mths | Research / primary care setting<br><br>Research staff-therapists | Unclear | Serves of SSB | -0.3 |

Abbreviations: BMI: body mass index; WC: waist circumference; SSB: sugar-sweetened beverages; Y: yes; yo: years old

[1] Effective size for end of intervention result; classified as >0.2 small effect size, >0.5 medium effect size and >0.8 large effect size. Unable to calculate for Davoli[342], Lin[337], Nyberg[344] and van Grieken[345].

* Difference in change in result between intervention and control, all other studies represent difference in result at end of intervention between intervention and control

Table 5.1: Summary of parent-focussed intervention characteristics (cont.)

| Reference | Participant age range & weight status | Primary aim | Unhealthy food targets | Other targets | Intervention type and duration | Setting and delivery | Theory | Unhealthy food measure | Effect size[1] |
|---|---|---|---|---|---|---|---|---|---|
| Skouteris[338] Australia Weak | 1.7—3.5yo All | Fruit and veg intake and unhealthy foods | SSB Snack foods | Y Fruit and veg Eating behaviours Physical activity Sedentary time | Group program 10wks | Health centres Trained community members | Learning and social cognitive theories | Serves of high energy snacks & sweet beverages | -0.2 to -0.3 |
| Elder[343] USA Moderate | 5—8yo All | BMI | Sugary beverages Takeaway | Y Healthy eating Family meal practice Physical activity | Group workshops and motivational interviewing 24mths | Recreation centre and home Family health coaches | Unclear | Fat intake & SSB intake scores | -0.2 to -0.3 |
| Raynor[341] – Int. 2b (substitution) USA Weak | 4—9yo Overweight and obesity | BMI | SSB | Y Growth Physical activity | Group program and growth monitoring 6mths | Research / primary care setting Research staff-therapists | Unclear | Serves of SSB | 0.1 |
| **Primarily individual focussed approach** | | | | | | | | | |
| Taylor[223] New Zealand Strong | 4—8yo Overweight | BMI | Takeaway Biscuits Snack bars | Y Healthy eating Physical activity Home food environment | Motivational interviewing 24mths | University / research setting Health professional and mentor | Unclear | Unhealthy food & sweet beverages subscale scores | -0.1 to -0.4 |
| Viitasalo[336] Finland Weak | 6—8yo All | Physical activity, sedentary behaviour and diet quality | Foods high in saturated fat, sugar, salt or energy | Y Physical activity Sedentary behaviour Diet quality | Motivational interviewing 24mths | Unclear Clinical nutritionist | Unclear | Grams of common unhealthy foods | 0.0 to -0.4 |

Abbreviations: BMI: body mass index; WC: waist circumference; SSB: sugar-sweetened beverages; Y: yes; yo: years old

[1] Effective size for end of intervention result; classified as >0.2 small effect size, >0.5 medium effect size and >0.8 large effect size. Unable to calculate for Davoli[342], Lin[337], Nyberg[344] and van Grieken[345].

* Difference in change in result between intervention and control, all other studies represent difference in result at end of intervention between intervention and control

Table 5.1: Summary of parent-focussed intervention characteristics (cont.)

| Reference | Participant age range & weight status | Primary aim | Unhealthy food targets | Other targets | Intervention type and duration | Setting and delivery | Theory | Unhealthy food measure | Effect size[1] |
|---|---|---|---|---|---|---|---|---|---|
| Fletcher[161] / Wolfenden [346]<br>Australia<br>Strong | 3—5yo<br><br>All | Fruit and veg intake | Non-core foods | Y<br>Fruit and veg intake | Telephone counselling<br><br>1mth | Home<br><br>Trained interviewer | Socio-ecological theory | Unhealthy foods subscale score | -0.2 |
| Ostbye[347]<br>USA<br>Weak | 2—5yo<br><br>All with mothers who were overweight and obesity | Healthy eating<br>Physical Activity<br>BMI | SSB<br>Takeaway | Y<br>Parental feeding practices<br>Healthy eating<br>Fruit and veg intake<br>Physical (in)activity<br>Screen time | Home interactive kits and motivational interviewing<br><br>8mths | Home<br><br>Health coaches | Social cognitive theory | Serves / ounces of takeaway foods & SSB* | -0.1 to -0.2 |
| Taveras[348]<br>USA<br>Moderate | 2—6.9yo<br><br>Overweight and obesity | BMI | Takeaway<br>SSB | Y<br>Limit TV use | Motivational interviewing and paediatrician visits<br><br>12mths | Primary care centres<br><br>Paediatric nurse practitioners | Chronic care model | Serves of SSB & takeaway foods | 0.0 to -0.2 |
| Duncanson[162]<br>Australia<br>Moderate | 2—5yo<br><br>All | Unhealthy foods and healthy foods | Unhealthy foods<br>Junk food | Y<br>Healthy eating | Technology-based resources<br><br>Once off | Home<br><br>Self-directed | Theory of Planned Behaviour | Energy & serves of unhealthy foods | 0.6 to 0.3 |
| Davoli[342] / Broccoli[349]<br>Italy<br>Weak | 4—7yo<br><br>Overweight | BMI | Sweet snacks/ candies<br>Desserts<br>Salty snacks<br>Fried food<br>Sweetened beverages | Y<br>Healthy eating<br>Physical activity | Motivational interviewing<br><br>12mths | Paediatric practice<br><br>Paediatrician | Transtheoretical model of addiction and behaviour change | % children with positive change in common unhealthy foods | - |

Abbreviations: BMI: body mass index; WC: waist circumference; SSB: sugar-sweetened beverages; Y: yes; yo: years old
[1] Effective size for end of intervention result; classified as >0.2 small effect size, >0.5 medium effect size and >0.8 large effect size. Unable to calculate for Davoli[342], Lin[337], Nyberg[344] and van Grieken[345].
* Difference in change in result between intervention and control, all other studies represent difference in result at end of intervention between intervention and control

Table 5.1: Summary of parent-focussed intervention characteristics (cont.)

| **Reference** | **Participant age range & weight status** | **Primary aim** | **Unhealthy food targets** | **Other targets** | **Intervention type and duration** | **Setting and delivery** | **Theory** | **Unhealthy food measure** | **Effect size[1]** |
|---|---|---|---|---|---|---|---|---|---|
| Lin[337]<br>China<br>Weak | 3—6yo<br><br>All | Unhealthy food | Takeaway<br>SSB<br>Fried food | Nil reported | Behavioural cards<br><br>4mths | Kindergarten<br><br>Teachers | Social cognitive theory | Frequency of takeaway foods, SSB, fried foods | - |
| Nyberg[344]<br>Sweden<br>Weak | 6yo<br><br>All | Healthy eating<br>Physical activity | Sweets<br>Snacks<br>Ice cream<br>SSB | Y<br>Parental feeding practices<br>Healthy eating<br>Fruit and veg intake<br>Physical inactivity<br>Screen time | Motivational interviewing and homework tasks<br><br>6mths | Schools and home<br><br>Research assistants and motivational counsellors | Social cognitive theory | Serves of unhealthy food & beverages | - |
| van Grieken[345]<br>The Netherlands<br>Weak | 5yo<br><br>Overweight | BMI and WC | SSB | Y<br>Having breakfast<br>Limit TV use<br>Playing outside<br>Parenting practices<br>Home environment | Motivational interviewing<br><br>24mths | Youth health care centres<br><br>Youth health care professionals | ASE model, Precaution Adoption Process Model, Elaboration Likelihood Model, stages of change model | % children with <2 serves SSB | - |

Abbreviations: BMI: body mass index; WC: waist circumference; SSB: sugar-sweetened beverages; Y: yes; yo: years old
[1] Effective size for end of intervention result; classified as >0.2 small effect size, >0.5 medium effect size and >0.8 large effect size. Unable to calculate for Davoli[342], Lin[337], Nyberg[344] and van Grieken[345].
* Difference in change in result between intervention and control, all other studies represent difference in result at end of intervention between intervention and control

### 5.3.1. Behavioural content description

Table 5.2 and 5.3 map each intervention against the components of the Behaviour Change Wheel framework[174]. Sources of behaviour are the required components for a behaviour to occur, namely physical and psychological capability, physical and social opportunity, and reflective and automatic motivation[3]. Three of the six sources of behaviour were targeted in at least one intervention. Most studies targeted reflective motivation (n=17) and psychological capability (n=15). No study targeted physical capability, automatic motivation or social opportunity, and only one intervention targeted physical opportunity[161].

Intervention functions is the term given to various intervention options or approaches which can be implemented to change behaviour[174]. Four of the nine Behaviour Change Wheel intervention functions were used in at least one of the interventions. Education (n=15) and enablement (n=15) were the most frequently used intervention functions. Training (n=5) was underused in contrast to education, and only one study used environmental restructuring[161]. No studies used persuasion, incentivisation, coercion, modelling or restriction intervention functions.

Policy categories are how the intervention functions could be delivered in a policy context[174]. Three of the seven policy categories were used in at least one intervention. Unanimously the service provision (n=18) policy category was used. Three intervention arms by the same researchers[341] used guidelines, and one study[162] used communication and marketing policy categories.

Table 5.2: Mapping of intervention description by the Behaviour Change Wheel of primarily group program approach studies

| | | | Sources of behaviour[2] | | | | | | Intervention functions[3] | | | | | | | | | Policy categories[4] | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Study** | **Outcome** | **Effect size[1]** | Physical capability | **Psychological capability** | **Reflective motivation** | Automatic motivation | Social opportunity | Physical opportunity | **Education** | Persuasion | Incentivisation | Coercion | Training | **Enablement** | Modelling | Environmental restructuring | Restrictions | Guidelines | Environmental / social planning | Communication / marketing | Legislation | **Service provision** | Regulation | Fiscal measures |
| Gerards[308] | Glasses of soft drink* | -0.7 | | X | X | | | | X | | | | X | X | | | | | | | | X | | |
| Burrows[174] | Serves of common unhealthy foods* | 0.4 to -0.7 | | X | X | | | | X | | | | X | X | | | | | | | | X | | |
| Raynor[341] Int. 1 | Serves of sweet & salty snacks & SSB | -0.4 to -0.6 | | X | X | | | | X | | | | | X | | | | X | | | | X | | |
| Golley[350] | Serves of unhealthy foods* | -0.3 | | X | X | | | | X | | | | X | X | | | | | | | | X | | |
| Raynor[107] Int. 2a[341] | Serves of SSB | -0.3 | | X | X | | | | X | | | | | X | | | | X | | | | X | | |
| Skouteris[348] | Serves of high energy snacks & sweet beverages | -0.2 to -0.3 | | X | | | | | X | | | | X | | | | | | | | | X | | |
| Elder[343] | Fat intake & SSB intake scores | -0.2 to -0.3 | | X | X | | | | X | | | | | X | | | | | | | | X | | |
| Raynor Int. 2b[341] | Serves of SSB | 0.1 | | X | X | | | | X | | | | | X | | | | X | | | | X | | |
| Total | | | - | 8 | 7 | - | - | - | 8 | - | - | - | 4 | 7 | - | - | - | 3 | - | - | - | 8 | - | - |

Abbreviations: SSB: sugar-sweetened beverages

[1] Effect size for end of intervention result; 0.2 small effect size, 0.5 medium effect size and 0.8 large effect size[335]. Primarily statistically significant reductions reported in studies by Gerards[308] and Elder[343].

[2] Sources of behaviour are the required components for a behaviour to occur[3].

[3] Intervention functions is the term given to various intervention options or approaches which can be implemented to change behaviour[174].

[4] Policy categories are how the intervention functions could be delivered in a policy context[174]. Policy categories were coded based on potential policy categories if wider implementation of the intervention were to occur.

* Difference in change in result between intervention and control, all other studies represent difference in result at end of intervention between intervention and control

Table 5.3: Mapping of intervention description by the Behaviour Change Wheel of primarily individual focussed studies

| | | | Sources of behaviour[2] | | | | | | Intervention functions[3] | | | | | | | | | Policy categories[4] | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Study** | **Outcome** | **Effect size[1]** | Physical capability | **Psychological capability** | **Reflective motivation** | Automatic motivation | Social opportunity | Physical opportunity | **Education** | Persuasion | Incentivisation | Coercion | Training | **Enablement** | Modelling | Environmental restructuring | Restrictions | Guidelines | Environmental / social planning | Communication / marketing | Legislation | **Service provision** | Regulation | Fiscal measures |
| Taylor[223] | Unhealthy food & sweet beverages subscale scores | -0.1 to -0.4 | | X | X | | | | X | | | | | X | | | | | | | | X | | |
| Viitasalo[336] | Grams of common unhealthy foods | 0.0 to -0.4 | | | X | | | | | | | | | X | | | | | | | | X | | |
| Fletcher[161] | Unhealthy food subscale score | -0.2 | | X | X | | | X | X | | | | X | X | | X | | | | | | X | | |
| Ostbye[347] | Serves/ounces of takeaway foods & SSB* | -0.1 to -0.2 | | X | X | | | | X | | | | | X | | | | | | | | X | | |
| Taveras[348] | Serves of SSB & takeaway foods | 0.0 to -0.2 | | X | X | | | | X | | | | | X | | | | | | | | X | | |
| Duncanson [162] | Energy & serves of unhealthy foods | 0.6 to 0.3 | | X | X | | | | X | | | | | | | | | | | X | | X | | |
| Davoli[342] | % children with positive change in common unhealthy foods | - | | | X | | | | | | | | | X | | | | | | | | X | | |
| Lin[337] | Frequency of takeaway foods, SSB, fried foods | - | | X | X | | | | X | | | | | | | | | | | | | X | | |
| Nyberg[344] | Serves of unhealthy foods & beverages | - | | X | X | | | | X | | | | | X | | | | | | | | X | | |
| van Grieken[345] | % children with <2 serves SSB | - | | | X | | | | | | | | | X | | | | | | | | X | | |
| Total | | | - | 7 | 10 | - | - | 1 | 7 | - | - | - | 1 | 8 | - | 1 | - | - | - | 1 | - | 10 | - | - |

Abbreviations: SSB: sugar-sweetened beverages
1 Effect size for end of intervention result; 0.2 small effect size, 0.5 medium effect size and 0.8 large effect size[335]. Unable to calculate for Davoli[342], Lin[337], Nyberg[344] and van Grieken[345]. Primarily statistically significant reductions reported in studies by Davoli[342] and Lin[337].
2 Sources of behaviour are the required components for a behaviour to occur[3].
3 Intervention functions is the term given to various intervention options or approaches which can be implemented to change behaviour[174].
4 Policy categories are how the intervention functions could be delivered in a policy context[174]. Policy categories were coded based on potential policy categories if wider implementation of the intervention were to occur
* Difference in change in result between intervention and control, all other studies represent difference in result at end of intervention between intervention and control

### 5.3.2. Behaviour change techniques

Overall 24 (of 93) unique Behaviour Change Techniques (BCTs) were coded in the reported intervention descriptions, with a mean of five techniques (range 1-13) per intervention (Table 5.4). The most commonly used techniques were *Goal setting (behaviour)* (BCT 1.1, n=15), *Social support (unspecified)* (BCT 3.1, n=12), *Instruction on how to perform the behaviour* (BCT 4.1, n=11) and *Identification of self as a role model* (BCT 13.1, n=8). Several of the coded BCTs were only used in one intervention including *Feedback on behaviour* (BCT 2.2)[161], *Information about antecedents* (BCT 4.2)[340], *Information about health consequences* (BCT 5.1)[337], *Demonstration of the behaviour* (BCT 6.1)[338], *Behavioural practice / rehearsal* (BCT 8.1)[340], *Pros and cons* (BCT 9.2)[342], *Restructuring the physical environment* (BCT 12.1)[161], and *Avoidance / reducing exposure to cues for the behaviour* (BCT 12.3)[340]. Twelve of the 16 hierarchical cluster groups of BCTs[166] were included in at least one intervention, whereas BCTs in the clusters *Regulation*, *Scheduled consequences*, *Self-belief*, and *Covert learning* were not included in any studies. Given control groups were primarily waitlist, physical activity or parenting style focussed controls, BCTs for control groups are not presented in the tables. Only three of the control groups targeted dietary change with BCTs: *Instruction on how to perform the behaviour* (BCT 4.1)[161, 340], *Feedback on behaviour* (BCT 2.2)[223] and *Social support (unspecified)* (BCT 3.1)[223].

Sensitivity analyses of BCT coding were performed with the eight interventions[161, 162, 223, 339, 341, 343] where authors provided additional unpublished intervention content such as procedures, manuals and resources (Appendix 8). Coding of unpublished content identified an additional eight unique BCTs, totalling 32 unique BCTs across published and unpublished content. On average, an additional nine BCTs (range 0—13) were coded in unpublished content, giving a total mean 14.5 BCTs (range 1—22) per intervention. The most frequently coded BCT in the interventions with combined published and unpublished content was again *Goal setting (behaviour)* (BCT 1.1, n=7), followed by *Problem solving* (BCT 1.2, n=6) and *Review behavioural goal(s)* (BCT 1.5, n=5). The same hierarchical cluster groups were included as for published content.

### 5.3.3. Association between behaviour change content and intervention effectiveness

Examination of the Behaviour Change Wheel components, BCTs and study characteristics to identify potential predictors of intervention effectiveness yielded mixed results. There were no clear patterns for any behaviour change content with unhealthy food outcome effect sizes (data not shown).

Table 5.4: Use of Behaviour Change Techniques[1] by, primarily group program and individual, parent-focussed interventions (published intervention content)

| **Study** | Total | **Primarily group program** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **Gerards**[308] Strong[3] | **Burrows**[340] Weak | **Raynor**[341] **Int. 1** Weak | **Golley**[339] Strong | **Raynor**[341] **Int. 2a** Weak | **Skouteris**[338] Weak | **Elder**[343] Moderate | **Raynor**[341] **Int. 2b** Weak |
| **Effect size[2]** | | -0.7 | 0.4 to -0.7 | -0.4 to -0.6 | -0.3 | -0.3 | -0.2 to -0.3 | -0.2 to -0.3 | 0.1 |
| **1.1 Goal setting (behaviour)** | **15** | X | X | X | X | X | X | X | X |
| 1.2 Problem solving | 5 | | X | | X | | X | X | |
| 1.4 Action planning | 2 | | X | | X | | | | |
| 1.5 Review behaviour goal(s) | 6 | | X | | X | | | X | |
| 1.6 Discrepancy between current behaviour & goal | 2 | | | | X | | | | |
| 2.2 Feedback on behaviour | 1 | | | | | | | | |
| 2.3 Self-monitoring of behaviour | 6 | | | X | | X | | | X |
| **3.1 Social support (unspecified)** | **12** | X | X | | X | | | X | |
| **4.1 Instruction on how to perform the behaviour** | **11** | X | X | | X | | X | X | |
| 4.2 Information about antecedents | 1 | | X | | | | | | |
| 5.1 Information about health consequences | 1 | | | | | | | | |
| 5.3 Information about social & environmental consequences | 3 | | | | | | | | |
| 6.1 Demonstration of the behaviour | 1 | | | | | | X | | |
| 6.2 Social comparison | 2 | | X | | | | X | | |
| 7.1 Prompts / cues | 1 | | | | | | | | |
| 8.1 Behavioural practice / rehearsal | 1 | | X | | | | | | |
| 8.7 Graded tasks | 2 | | | | | | | | |
| 9.1 Credible source | 2 | | X | | X | | | | |
| 9.2 Pros and cons | 1 | | | | | | | | |
| 10.3 Non-specific reward | 4 | | X | X | | X | | | X |
| 12.1 Restructuring the physical environment | 1 | | | | | | | | |
| 12.3 Avoidance / reducing exposure to cues for the behaviour | 1 | | X | | | | | | |
| 12.5 Adding objects to the environment | 4 | X | | | | | | | |
| **13.1 Identification of self as role model** | **8** | | X | X | X | X | | | X |
| Total # of BCTs | | 4 | 13 | 4 | 9 | 4 | 5 | 5 | 4 |
| **Inter-rater agreement[4]** | | | | | | | | | |
| Kappa | | 0.85 | 0.73 | 0.66 | 0.54 | 0.66 | 0.56 | 0.56 | 0.66 |
| PABAK | | 0.98 | 0.89 | 0.96 | 0.87 | 0.96 | 0.94 | 0.94 | 0.96 |

Abbreviations: BCT: Behaviour Change Techniques; PABAK: prevalence-adjusted bias-adjusted Kappa
[1] Behaviour Change Techniques as defined in the BCTTv1 by Michie et al.[166]
[2] Effect size for end of intervention result; 0.2 small effect size, 0.5 medium effect size and 0.8 large effect size[335]. Unable to calculate for Davoli[342], Lin[337], Nyberg[344] and van Grieken[345].
[3] Study quality as rated by the Effective Public Health Practice Project Quality Assessment Tool for Quantitative Studies[333]
[4] Inter-rater agreement calculated between two raters by Kappa and PABAK[334]
* Difference in change in result between intervention and control, all other studies represent difference in result at end of intervention between intervention and control
**Bold** text indicates the most commonly used BCTs

Table 5.4: Use of Behaviour Change Techniques[1] by, primarily group program and individual, parent-focussed interventions (published intervention content) (cont.)

| **Study** | Total | **Primarily individual** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Taylor**[223] Strong | **Viitasalo**[336] Weak | **Fletcher**[161] Strong | **Ostbye**[347] Weak | **Taveras**[348] Moderate | **Duncanson**[162] Moderate | **Davoli**[342] Weak | **Lin**[337] Weak | **Nyberg**[344] Weak | **van Grieken**[345] Weak |
| **Effect size**[2] | | -0.1 to -0.4 | 0.0 to -0.4 | -0.2 | -0.1 to -0.2 | 0.0 to -0.2 | 0.6 to 0.3 | - | - | - | - |
| **1.1 Goal setting (behaviour)** | **15** | X | | X | X | X | | X | X | X | |
| 1.2 Problem solving | 5 | | | X | | | | | | | |
| 1.4 Action planning | 2 | | | | | | | | | | |
| 1.5 Review behaviour goal(s) | 6 | X | | X | | | | X | | | |
| 1.6 Discrepancy between current behaviour & goal | 2 | | | | | X | | | | | |
| 2.2 Feedback on behaviour | 1 | | | X | | | | | | | |
| 2.3 Self-monitoring of behaviour | 6 | | | X | | | | | X | | X |
| **3.1 Social support (unspecified)** | **12** | X | X | X | X | X | | X | | X | X |
| **4.1 Instruction on how to perform the behaviour** | **11** | X | | X | X | X | X | | | X | |
| 4.2 Information about antecedents | 1 | | | | | | | | | | |
| 5.1 Information about health consequences | 1 | | | | | | | | X | | |
| 5.3 Information about social & environmental consequences | 3 | | | X | | | | | X | | X |
| 6.1 Demonstration of the behaviour | 1 | | | | | | | | | | |
| 6.2 Social comparison | 2 | | | | | | | | | | |
| 7.1 Prompts / cues | 1 | | | X | | | | | | | |
| 8.1 Behavioural practice / rehearsal | 1 | | | | | | | | | | |
| 8.7 Graded tasks | 2 | | | X | | | | | X | | |
| 9.1 Credible source | 2 | | | | | | | | | | |
| 9.2 Pros and cons | 1 | | | | | | | X | | | |
| 10.3 Non-specific reward | 4 | | | | | | | | | | |
| 12.1 Restructuring the physical environment | 1 | | | X | | | | | | | |
| 12.3 Avoidance / reducing exposure to cues for the behaviour | 1 | | | | | | | | | | |
| 12.5 Adding objects to the environment | 4 | | | X | X | X | | | | | |
| **13.1 Identification of self as role model** | **8** | | | X | X | | | | X | | |
| Total # of BCTs | | 4 | 1 | 13 | 5 | 5 | 1 | 4 | 6 | 3 | 3 |
| **Inter-rater agreement**[4] | | | | | | | | | | | |
| Kappa | | 0.74 | 0.49 | 0.86 | 0.56 | 0.56 | 1.00 | 1.00 | 0.37 | 0.80 | 0.65 |
| PABAK | | 0.96 | 0.96 | 0.94 | 0.94 | 0.94 | 1.00 | 1.00 | 0.87 | 0.98 | 0.94 |

Abbreviations: BCT: Behaviour Change Techniques; PABAK: prevalence-adjusted bias-adjusted Kappa
[1] Behaviour Change Techniques as defined in the BCTTv1 by Michie et al.[166]
[2] Effect size for end of intervention result; 0.2 small effect size, 0.5 medium effect size and 0.8 large effect size[335]. Unable to calculate for Davoli[342], Lin[337], Nyberg[344] and van Grieken[345].
[3] Study quality as rated by the Effective Public Health Practice Project Quality Assessment Tool for Quantitative Studies[333]
[4] Inter-rater agreement calculated between two raters by Kappa and PABAK[334]
* Difference in change in result between intervention and control, all other studies represent difference in result at end of intervention between intervention and control
**Bold** text indicates the most commonly used BCTs

### 5.3.4. Group vs individual approach interventions

There were similarities in the behaviour change content coded in the group (n=8) and individual (n=10) intervention approaches. Interventions with a primarily group approach, psychological capability and reflective motivation were targeted together (except for one study[338]), all included education intervention function and generally utilised enablement, with[308, 339, 340] or without[341, 343] training, all using the policy category service provision. Individual focussed interventions targeted reflective motivation alone or in combination with psychological capability, and utilised either education or enablement intervention functions alone[162, 336, 337, 342, 345], or together[161, 223, 344, 347, 348]. These studies used service provision, and one[162] study using communication and marketing policy category.

The average number of BCTs was higher in primarily group based interventions (mean 6 BCTs, range 4—13), compared with individual approaches (mean 4.5 BCTs, range 1—13). The most commonly used BCTs were similar across group and individual approach interventions, apart from *Social support (unspecified)* (BCT 3.1) which was twice as frequent in individual-focussed interventions. Other differences in BCTs used, were *Problem solving* (BCT 1.2, n=4) and *Non-specific reward* (BCT 10.3, n=4) were more commonly identified in group programs, and *Information about social consequences* (BCT 5.3, n=3) and *Adding objects to the environment* (BCT 12.5, n=3) more commonly used in individual approaches.

### 5.3.5. Sensitivity analysis: Obesity prevention vs weight management interventions

There were similarities in the behaviour change content coded in the obesity prevention (n=8) and weight management (n=10) interventions. Obesity prevention focussed interventions targeted psychological capability (n=7) and reflective motivation (n=7), primarily together (with the exception of two studies[336, 338]), all except for one[336] included education intervention function, all solely using the policy category service provision, except for one study[162], which combined this with communication and marketing. Weight management focussed interventions targeted reflective motivation alone[342, 345] or in combination with psychological capability (n=8), and utilised enablement intervention functions alone[342, 345], or commonly together with education[223, 341, 348] and in some studies the additional of training[308, 339, 340]. These studies used service provision, with the group of interventions by the same author also combining the policy category guidelines[341].

The average number of BCTs was the same mean five BCTs with a wider range of BCTs in obesity prevention interventions (range 1—13) compared with weight management focussed interventions (range 3—13). The most commonly used BCTs were similar across the two interventions types with the most common BCTs being *Goal setting (behaviour)* (BCT 1.1, prevention n=6, management n=9), *Social support (unspecified)* (BCT 3.1, prevention n=5, management n=7) and

*Instruction on how to perform the behaviour* (BCT 4.1, prevention n=6, management n=5), and *Identification of self as a role model* (BCT 13.1) emerging as a common BCT in weight management interventions (n=5). A key difference in BCTs used, was *Non-specific reward* (BCT 10.3, n=4) only reported in weight management interventions.

## 5.4. Discussion

The current review aimed to evaluate the behaviour change content of interventions designed to support parents to reduce their provision of unhealthy foods to children. Interventions were generally focussed on unhealthy foods in the context of prevention and management of obesity. Unhealthy food or beverage intake was one of multiple dietary behaviours targeted by the interventions, with small effect sizes observed in outcome measures. This review used the Behaviour Change Wheel framework to code intervention content. Psychological capability and reflective motivation sources of behaviour, education and enablement intervention functions, and service provision policy category were the most common behaviour change content across evaluated interventions. Four BCTs commonly utilised across these interventions were goal setting, social support, instruction on how to perform the behaviour and role modelling. The findings of this review highlight many untapped intervention and behaviour change approaches that could be leveraged to enhance intervention effectiveness. For example, physical and social opportunity and automatic motivation, as well as numerous BCTs which were largely unused by interventions and provide areas to explore in next generation intervention design.

### 5.4.1. Effectiveness of past parent-focussed interventions

Effectiveness of changing unhealthy food intake varied dramatically with Cohen's d ranging from a reduction (0.7) to an increase (0.6) in unhealthy food outcomes. Interventions in general saw effect sizes in the range of -0.2 to -0.4, with the exception being one study focussed solely on sugar-sweetened beverage reductions, which resulted in moderate to large effect size of -0.7, in the short term[308]. A meta-analysis by Vargas-Garcia and colleagues[163] reported a moderate effect (standardised mean difference -0.48, 95%CI -0.73 to -0.24) of interventions to reduce sugar-sweetened beverages in children, which was higher than the current outcomes for sugar-sweetened beverages alone (mean -0.3, range 0.1 to -0.7). Although some unhealthy food measures noted beneficial small to moderate effect sizes, within the same interventions there were null effects[336, 348] or increases in unhealthy food intakes[162, 340, 341]. These mixed results are consistent with previous reviews focussing on parent food provision and obesity prevention[164, 170, 172, 351, 352]. The review findings highlight a need for evaluating novel ways to reduce unhealthy food intake as a discrete behavioural target considering the number of targets and behaviour change content.

### 5.4.2. Behavioural targets and appropriateness of behaviour change components

Interventions reviewed targeted multiple behaviours in the context of obesity prevention and management. For example, only a few studies had a primary aim of unhealthy foods[162, 337, 338]. This multi-focus, with studies including many healthy food, physical activity and parenting strategies, may have diluted the potential impact of intervention strategies targeting unhealthy foods. It is important that future studies focus directly on reducing unhealthy foods or subgroups of unhealthy foods. Ideally to test discrete strategies in feasibility or pilot studies, to combine only effective strategies into multi-component complex behaviour change interventions. It is important to determine the impact of targeting all subgroups of unhealthy foods, rather than a sole focus on sugar-sweetened beverages as is seen in many interventions in this review and is the focus of a previous review by Vargas-Garcia and colleagues[163]. Concurrently intake of a range of unhealthy foods needs to be measured to ensure positive dietary changes are being achieved, rather than replacing one unhealthy food with another, with no measure to capture this change.

There are several factors that could have influenced potential intervention impact. One factor is leveraging all necessary sources that support behaviour change, namely having the capability, opportunity and motivation to perform the required behaviour[174]. From the interventions reviewed here, there appears to be a gap in interventions that consider aspects of opportunity, with only Fletcher and colleagues[161] addressing physical opportunity by including food access and availability within the home. Parents may have the knowledge—psychological capability—that unhealthy foods should be limited, and be motivated to reduce their child's intake (given the negative health consequences), but not have the physical opportunity via access to alternative healthy foods in their neighbourhood, or the social opportunity in form of support from caregivers, thereby limiting their ability to achieve behaviour change. By performing behavioural analysis, researchers can better understand where additional supports might be needed to alter parents' provision, to enhance intervention effectiveness. Given the  role of unhealthy foods in current day[353], it may be useful to target social opportunity, using persuasion or modelling intervention functions, to create more favourable social norms. The effectiveness of current interventions targeting psychological capability and the tendency to focus on education which taps into knowledge of what to do, but the less common focus on training may suggest a deficit in development of the essential skills to undertake the behaviour. Duncanson and colleagues[162] saw a null effect of their intervention targeting the education intervention function in isolation. Knowledge alone may be insufficient to change behaviour[131].

### 5.4.3. Opportunities to enhance effectiveness through selection of behaviour change techniques

Behaviour Change Techniques are commonly referred to as the 'active ingredients' of behavioural interventions[166]. Although comparisons were not made between intervention effectiveness and the type or dose of BCTs used, several conclusions can still be drawn. *Goal setting (behaviour)* (BCT 1.1) and *Instruction on how to perform the behaviour* (BCT 4.1) were commonly used across interventions regardless of intervention effect. It can be suggested that these techniques may be necessary in interventions, but not sufficient to result in behaviour change. These could be considered as foundation techniques that need to be combined with additional support to achieve effective behaviour change. For example, *problem solving* (BCT 1.2), *feedback* (BCT 2.2 to 2.7) or *review goals* (BCT 1.5), may be needed to enable parents to accomplish the goals they set[164, 168, 354-356]. Similarly, as well as knowing how to perform a behaviour, researchers may need to include the intervention function environmental restructuring to create the opportunity using techniques focussed on restructuring the physical or social environment[164, 355].

There are also numerous untapped BCTs (in this review 61 of 93) that could be used in future interventions by drawing on applications of these techniques in adult health behaviours[191, 354, 355] and childhood obesity literature[164, 168]. For example, *Verbal persuasion about capability* (BCT 15.1)[191, 354], and other *Self-belief* techniques could be used to tap into automatic motivation. *Generalisation of the target behaviour* (BCT 8.6), could also be used to initiate automatic motivation, and appears to be a worthy technique[168, 354], yet was not included in any of the interventions in this review. *Reduce negative emotions* (BCT 11.2)[354] and *Conserving mental resources* (BCT 11.3), which fall under *Regulation* techniques[168], could be used to help minimise stress and the mental load to target different components of behaviour resulting from a behavioural analysis.

### 5.4.4. Clear reporting of behavioural intervention content

As retrospective analyses of the behavioural content of past interventions continue to grow[164, 170, 191, 351], a key issue in need of addressing is the lack of clarity in intervention reporting[357]. Whilst improvements have been made with the emergence of reporting checklists (e.g. CONSORT[358], TIDieR[359]), a large discrepancy was seen in the number of BCTs extracted from published intervention descriptions compared with unpublished content. Detailed intervention reporting, utilising protocol publications, online supplementary files and repositories of intervention materials, will better position researchers to evaluate the effectiveness of BCTs and how interventions are (or are not) effective in changing behaviour. Not only would greater guidance from past interventions support the development of new interventions, it would also assist in the scaling and broad implementation in a more cost-effective manner[181]. By focussing on unhealthy food intake, which was generally a secondary aim or sub-focus in interventions, it was difficult to discriminate the BCTs targeting healthy foods versus unhealthy foods. Greater detail in reporting each strategy mapped to the target behaviour will largely expand what evidence can be drawn from past interventions.

#### 5.4.5. Study strengths and limitations

There are several strengths to the current review methods including independent duplicate study selection, quality assessment and coding of BCTs, as well as reviewer training in the Behaviour Change Wheel and BCT taxonomy. A high response rate from intervention authors for additional intervention content, allowed sensitivity analyses of BCT coding in published versus unpublished content. Calculating Cohen's d effect size for all interventions provided a standard comparison measure and reduced reliance on statistical significance. There are however several limitations to be acknowledged. The lack of detailed intervention reporting and limited focus on unhealthy food as a behavioural target may have led to coding BCTs related to dietary strategies not targeting unhealthy foods; alternatively, strategies may have been implemented in the intervention but not coded due to insufficient reporting. Varied unhealthy food measures and intervention targets, as well as limited detail of the validity and reliability of the self-reported tools made it difficult to draw conclusions about intervention effectiveness. The overall low rating of study quality reduces the ability to draw firm recommendations and generalisability of the review findings. However, given the uncertainty of intervention intensity of BCTs and unhealthy foods focus, recommendations are focussed on the avenues to strengthen the quality of future research.

The degree of overlap in literature (ten out of 18) investigating the younger and older age groups prevented findings being examined per age bracket, instead results were presented considering the broader age range of three to eight-year-olds across the transition period. Heterogeneity in study design and the inclusion of obesity management interventions in the one review, adds to the complexity of result interpretation; however, was necessary due to the scare literature solely focussed on obesity prevention. Nonetheless, unhealthy food focussed strategies were similar across intervention type, for example, reduce sugar-sweetened beverage consumption; as unhealthy food intake impacts on children's diet quality regardless of weight status, and weight management in childhood is focussed on diet in line with the dietary guidelines[360]. In addition, sensitivity analyses comparing behaviour change content between obesity prevention and weight management focussed interventions found very few differences. Low effectiveness of interventions impacted comparisons of BCTs by intervention effect size. Lastly, the review was restricted to interventions published in English and limited the ability to include unpublished intervention content in intervention authors' native language (other than English).

### 5.4.6. Implications for future research

This review used the Behaviour Change Wheel framework and BCT taxonomy to critique interventions that aim to support parents to reduce provision of unhealthy foods to children. This is an important area with policy and practice relevance to maximise limited funding and resources across the preventative health sector. These findings can help to revise current practice and optimise future intervention design to include those BCTs likely to result in meaningful changes in children's intake of unhealthy foods. Intervention designers can draw on the broader behaviour change literature and conduct thorough behavioural analyses (e.g. as per the Behaviour Change Wheel) to help select untapped BCTs that are most promising. This review also highlights the need to focus attention to directly reducing unhealthy foods at a government level, for example social communication and marketing campaigns to reduce unhealthy foods rather than purely promoting healthy foods[361], as well as considering the array of policy categories within the Behaviour Change Wheel. Current interventions have been limited primarily to service provision, a largely resource intensive category. However, there are opportunities to explore other functions such as environmental / social planning, guidelines and regulation at a policy sector level to create healthier environments providing the physical and social opportunity to reach more parents and support behaviour change. It is therefore essential for researchers to work with those in the policy and practice setting when designing next generation multi-component interventions to maximise these policy categories.

## 5.5. Conclusion

The current review highlights several opportunities for novel application of the Behaviour Change Wheel and broader use of a range of BCTs in interventions to support parents to reduce unhealthy food provision to their children. Variation in characteristics and components of these interventions, as well as limited effectiveness, emphasize there is currently no one best approach. Rather, it reinforces the importance of conducting behavioural analyses to understand and address the cause of unhealthy food provision. There is an ongoing need to improve intervention reporting in terms of intervention content[167, 357] and methodological quality[173], to improve the body of evidence to guide the development of the next generation of interventions. This critique of current interventions also identifies several intervention strategies to investigate using best-practice intervention design. Specifically designing interventions targeting opportunity through intervention functions such as persuasion, modelling or environmental restructuring. As well as, interventions using different policy categories, such as regulation and environmental / social planning, to provide an evidence-base to inform policy and practice.

## ***Chapter 5 findings at a glance***

*How many past parent-focussed interventions were identified through the systematic search?*

Seventeen interventions were included describing 18 intervention arms, from the search of the following databases: Ebscohost, Ovid, Scopus and Web of Science. Studies were eligible for inclusion if they were controlled interventions with active parent involvement, at least one intervention strategy and outcome measure for unhealthy foods at least three months from baseline.

*Which components of the Behaviour Change Wheel (sources of behaviour, intervention functions, policy categories) have commonly been included in past parent-focussed interventions?*

Interventions frequently targeted parents' reflective motivation (n=17) and psychological capability (n=15), through education (n=15) or enablement (n=15) intervention functions and service provision (n=18) policy category.

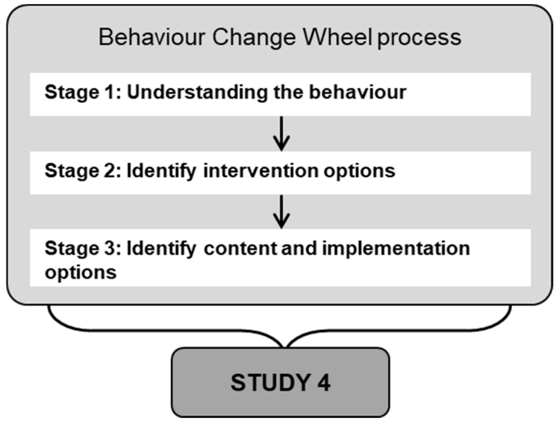
*Which Behaviour Change Techniques were identified in past parent-focussed interventions?*

Only 24 of the 93 Behaviour Change Techniques (BCTs) were used with an average of five techniques used per intervention. Commonly used BCTs included *Goal setting (behaviour)* (BCT 1.1, n=15), *Social support (unspecified)* (BCT 3.1, n=12), *Instruction on how to perform the behaviour* (BCT 4.1, n=11) and *Identification of self as a role model* (BCT 13.1, n=8).

*What can we learn from this study to take forward in future intervention design?*

Existing interventions achieving small reductions in unhealthy food intake, are homogenous in approach. Very few (nil) behaviour change content features qualitatively appear to be associated with effectiveness. There is potential to utilise untapped BCTs, through comprehensive intervention design and behavioural analysis guided by the Behaviour Change Wheel. Interventions targeting opportunity through persuasion, modelling or environmental restructuring, and using different policy categories are urgently needed to provide an evidence-base to inform policy and practice.

# 6. APPLICATION OF THE BEHAVIOUR CHANGE WHEEL: BEST-PRACTICE INTERVENTION DEVELOPMENT PROCESS




This chapter addresses the overall thesis objective 3: to identify behavioural supports and corresponding intervention content to inform future interventions to reduce parents' unhealthy food provision to their children. This chapter presents the behavioural analysis and design of intervention content to reduce parental provision of unhealthy foods to their children. The behavioural analysis was based on the COM-B model introduced in Chapter 2 (Theoretical Frameworks). Design of intervention content was based on a prospective application of the Behaviour Change Wheel process, also introduced in Chapter 2 (Theoretical Frameworks).

This chapter synthesises findings presented in Chapter 3 (Study 1), Chapter 4 (Study 2), and Chapter 5 (Study 3), as well as broader published literature of current progress towards reducing children's unhealthy foods intake across the socio-ecological model.

## 6.1. Introduction

### 6.1.1. Past interventions aiming to support parents to reduce children's unhealthy food intake

Parents are an important agent of change to shift young children's unhealthy food consumption. Past parent-focussed interventions have shown to be somewhat effective at reducing children's unhealthy food intake (Chapter 5, Study 3). Yet, there is potential to design interventions to achieve greater reductions in children's unhealthy food intake. Past interventions have been largely homogenous in their behaviour change approach, using only a small number of Behaviour Change Techniques (BCTs) and targeting few areas of the Behaviour Change Wheel[159]. Interventions have primarily targeted psychological capability and reflective motivation, through education or enablement functions via provision of services[159]. Analysis of intervention components of past parent-focussed interventions revealed no clear patterns between intervention effectiveness and certain BCTs, sources of behaviour (i.e. elements of the COM-B model), intervention functions or policy categories[159]. Hence, innovative intervention content is warranted and requires researchers to follow best-practice intervention design approaches. Results from deconstructing past interventions provides guidance for next generation innovative intervention design by drawing on gaps in intervention behaviour change components.

### 6.1.2. Best-practice approaches to intervention design

Reducing children's unhealthy food consumption is a complex issue and requires intervention strategies to be designed and tested using best-practice, systematic approaches. As highlighted in Chapter 1 (Literature Review) there have been calls to improve the quality of behaviour change interventions[172, 173]. One such way to improve quality of interventions is to ensure interventions are designed with an understanding of what needs to change. A behavioural analysis provides an approach to understanding what needs to change. This can be achieved by comprehensively assessing the barriers and enablers to change the behaviour, including examining behaviours in the complex systems in which they occur[3]. It is important to consider influences on parents' provision beyond their individual characteristics, such as influences within the broader socio-ecological environment including community, food supply, government and society, mentioned in Chapter 1 (Literature Review, Figure 1.3). Additional considerations when designing dietary behaviour change interventions include the burden placed on individuals, scalability and socio-economic inequalities.

There has been debate between individual and family responsibility versus societal responsibility for children's' weight management[353]; the same could be argued of excess unhealthy food intake. Many of the past parent-focussed interventions reviewed in Chapter 5 (Study 3) targeted changes in unhealthy foods in the home setting[73, 159]. The focus on the home may be due to strategies in broader settings often being perceived as less acceptable to the various implementation stakeholders, such as policy makers, food industry[362]. Yet, interventions solely targeting families and the home setting take a more individual responsibility approach and requires a higher level of individual agency or personal resources[362]. Adams and colleagues[362], proposed that new interventions are required to reduce the level of agency by individuals, through population level low agency strategies (e.g. food reformulation) that can work synergistically with high agency strategies (e.g. social marketing campaign). For example, targeting reductions of unhealthy foods in the broader environmental levels that require little action by parents, at the same time, empowering parents, but through modes that are less burdensome.

To address a wide spread issue, such as children's excessive unhealthy food intake, requires interventions to reach large numbers of families within the Australian population. Intervention design needs to consider strategies that can be implemented at scale to reach the whole parent population. Population level approaches aligns with those of other preventative health changes, where population benefits can be achieved by smaller changes across many people[363]. The traditional research approach is to determine effectiveness in a complex, multifaceted, often resource intensive randomised controlled trial, then adapt this to be scalable or assessing the most effective components to be more cost efficient at a population level[364]. The research to practice process produces a gap of a median 16.5 years[365] and can result in less effective behaviour change when implemented at scale[366]. New approaches are being used where interventions are designed for scale at the outset and tested in more realist ways, such as step-wedge design or effectiveness-implementation hybrid evaluations[364]. In designing new interventions, it is important to consider scalability of intervention content, so that strategies can be disseminated at a population level to achieve meaningful change in unhealthy foods.

Population level approaches have an additional benefit of reaching families in lower socio-economic circumstances. It is important to consider the specific needs of families experiencing socio-economic disadvantage as their children are often seen to have poorer diet quality and higher weight status[12-15]. Unhealthy food intake is somewhat socio-economically patterned, although has been seen to differ based on age, gender and socio-economic indicator[13, 15-17]. Only three past parent-focussed interventions reviewed in Study 3 (Chapter 5) targeted families of low or moderate socio-economic position[161, 162, 344]. It is therefore important to ensure the needs of families in lower socio-economic circumstances, are considered through undertaking targeted behavioural analyses. Key findings from such behavioural analyses need to be prioritised in intervention design, as well as considered throughout later stages of stakeholder consultation, feasibility testing and implementation. Adams and colleagues[362] also caution sole focus on high agency interventions as they may reinforce or widen socio-economic inequalities. To achieve designs of population interventions with low agency strategies researchers need to consider levers of change (i.e. implementation stakeholders) in multiple socio-ecological levels to support parents to reduce unhealthy food provision in an equitable fashion. Systematic consideration of different settings in intervention design can be achieved through the Behaviour Change Wheel process.

### 6.1.3. Underpinning framework: Behaviour Change Wheel process

The Behaviour Change Wheel was selected as the best-practice intervention design framework to underpin this study. The Behaviour Change Wheel process has been introduced in Chapter 2 (Theoretical Frameworks) and 5 (Study 3). To recap, the Behaviour Change Wheel process provides a systematic approach to best-practice intervention design linking intervention functions and policy categories to elements within the Capability, Opportunity, Motivation and Behaviour (COM-B) model[3]. The process focusses on undertaking a behavioural analysis and provides a systematic approach to designing the corresponding intervention content. The Behaviour Change Wheel process guides researchers through eight steps across three stages of intervention design, which are: 1) Understand the behaviour, 2) Identify the intervention options, and 3) Identify content and implementation options[3]. The Behaviour Change Wheel process integrates several theoretical models and frameworks to assist the design process, including the COM-B model, Theoretical Domains Framework and BCT taxonomy[3].

The first stage of understanding the behaviour includes a step to develop an understanding of what needs to change for the individual and the environment to action the desired behaviour—this process is referred to as conducting a behavioural analysis. Michie and colleagues[3] (authors of the Behaviour Change Wheel) describe this step as crucial and acknowledge it is often overlooked in intervention design. The behavioural analysis is primarily based on the elements within the COM-B model. To enable behaviour change there needs to be a shift in one or more of the elements within the COM-B model, for the behaviour itself, or behaviours that complete with or support the desired behaviour to take place[3]. Triangulation of multiple sources of evidence and methods is encouraged to provide a comprehensive behavioural analysis[3]. The Behaviour Change Wheel process includes an optional step to include the Theoretical Domains Framework in the behavioural analysis. Inclusion of the Theoretical Domains Framework provides an avenue to further elaborate elements of the COM-B model in the behavioural analysis. Domains relevant to reflective motivation were introduced in Chapter 3 (Study 1). In brief, Theoretical Domains Framework is a synthesis of 14 domains identified in numerous theoretical frameworks used to understand behaviour[186].

The second stage of identifying the intervention options incorporates intervention functions and policy categories. As introduced in Chapter 5 (Study 3) intervention functions are defined as *"broad categories of means by which and intervention can change behaviour"* [(p 109)], and policy categories are how the intervention functions could be delivered in a policy context[3]. Table 6.1 provides a list of all nine intervention functions and seven policy categories with an example of their application in the context of nutrition interventions. The Behaviour Change Wheel process provides information for researchers to systematically consider each intervention function likely to be effective in changing the selected capability, opportunity or motivation components from the behavioural analysis. Intervention functions that are likely to be effective have been identified by a group of experts and provides a starting point for intervention designers to consider functions most appropriate for the behaviour change enabler[3]. One intervention strategy can use multiple intervention functions. For example, persuasive communication about the risks of unhealthy foods would include both education and persuasion intervention functions. The process also provides information about which policy categories are likely suitable to deliver each intervention function to determine the potential policy categories that could be leveraged to support the intervention[3]. For example, communication / marketing and service provision policy categories are appropriate to deliver the intervention function of modelling.

Table 6.1: Applied nutrition examples of the intervention functions and policy categories in the Behaviour Change Wheel process[1]

| **Intervention option** | **Example in the nutrition context** |
|---|---|
| *Intervention functions* | |
| Education | Providing information about the discrepancy between current excessive unhealthy foods intake and recommended limits |
| Persuasion | Using images of the large amount of sugar in sweetened drinks inspire people to reduce sugar-sweetened beverage consumption |
| Incentivisation | A supermarket loyalty program with points awarded for not purchasing unhealthy foods |
| Coercion | A tax on sugar-sweetened beverages |
| Training | Imparting food preparation skills through an interactive cooking program |
| Restriction | Using rules or policies to reduce the availability of unhealthy foods by implementing a health levy to food industry on unhealthy foods products |
| Environmental Restructuring | Changing the physical or social food environment such as the location of vending machines in a school or workplace to make unhealthy foods harder to access |
| Modelling | Providing a video of people demonstrating how to prepare snacks for others to copy and try at home |
| Enablement | Ways to support capability or opportunity beyond the above, such as nutrition counselling where goals and a meal plan are developed together |
| *Policy categories* | |
| Communication / marketing | Using passive, one-way communication such as providing pamphlets with healthy eating tips in a child care centre newsletter or a TV advert promoting the recommended number of vegetable servings |
| Guidelines | Developing guidelines for nutrition screening and referral for certain conditions |
| Fiscal measures | Using the tax system to raise the cost of unhealthy foods or subsidise healthy foods |
| Regulation | Establishing rules or principles of behaviour or practice |
| Legislation | Making or changing laws regarding front-of-package food labelling |
| Environmental/ social planning | Designing the location of fresh food stores and community vegetable gardens in a new suburb |
| Service provision | Delivering a group nutrition program or an interactive mobile app to monitor dietary intake |

[1] Intervention option terms/headings replicated from Michie et al.[3], examples developed for nutrition context using definitions from Michie et al.[3].

The final stage seeks to identify content and implementation options, which involves selecting appropriate BCTs and mode(s) to deliver the intervention. Behaviour Change Techniques are defined as *"an active component of an intervention designed to change behaviour"*(p 145); they are observable, replicable and irreducible behaviour change components of an intervention[3]. The BCT taxonomy version one (BCTTv1) contains 93 unique BCTs, grouped under 16 hierarchical clusters[166]. The hierarchical clusters include: *Goals and planning, Feedback and monitoring, Social support, Shaping knowledge, Natural consequences, Comparison of behaviour, Associations, Repetition and substitution, Comparison of outcomes, Reward and threat, Regulation, Identity, Scheduled consequences, Self-belief,* and *Covert learning* (see Appendix 9 for list of BCTs under each cluster). The Behaviour Change Wheel process provide a list of the most frequently used and less frequently used, but still appropriate, BCTs for each intervention function[3]. A limitation of the BCT taxonomy is that it was developed from interventions primarily targeting individuals with a focus on changing the way people think, feel and react, therefore there are no BCTs linked to the *restriction* intervention function[3].

Michie and colleagues[3] also provide a simple taxonomy of modes of delivery that apply to a subset of intervention functions. For example, proposed modes of delivery may be via face-to-face at the individual or group level, or be via distance at the population or individual level, of which there are numerous media or technology modes that could be used. On completion of the Behaviour Change Wheel process researchers are equipped with theoretically grounded, evidence-informed intervention content to take forward into feasibility testing.

In summary, there are few interventions that have directly targeted reductions in parents' provision of unhealthy foods. Critique of the past parent-focussed interventions highlights there are opportunities to enhance their effectiveness through best-practice intervention design approaches and by capitalising on underutilised behaviour change components. Reducing parents' provision of unhealthy foods to their children is a highly complex behaviour that requires researchers to consider influences and levers of change across the socio-ecological model. This includes considering potential synergies in high and low agency intervention strategies within the different environmental levels. To lead to meaningful reductions in unhealthy food provision population wide, interventions need to be designed with scalable population level approaches in mind, whilst ensuring strategies should not widen socio-economic inequalities. The Behaviour Change Wheel process provides a systematic framework for best-practice intervention design, capable of addressing the aforementioned considerations when designing intervention strategies to support parents to reduce unhealthy food provision to their children.

### 6.1.4. Study aim and considerations

This study addresses the overall thesis aim to use the Behaviour Change Wheel to develop theoretically grounded, evidenced-informed intervention content to support parents to reduce provision of unhealthy foods to their three to seven-year-old children from within the home. Intervention content is used to refer collectively to a group of intervention strategies or proposed packages of strategies to inform future program approaches, rather than specific resources or material wording to deliver an intervention.

There were several important considerations throughout the Behaviour Change Wheel process to ensure the theoretically grounded and evidenced-informed elements of the thesis aim were met, whilst addressing recommendations for intervention design mentioned earlier.

Considerations were to ensure designed intervention content:

*1) was supported by behaviour change theory;*

*2) was informed by the evidence base including research studies within this PhD or broader published literature;*

*3) was suitable for scale, considered the needs of families in lower socio-economic circumstances and includes low agency strategies (i.e. to be implemented by stakeholders in multiple environmental settings)*

## 6.2. Methods

### 6.2.1. Materials and processes

This study was informed by various sources of evidence regarding parents' unhealthy food provision. Specifically, the new knowledge generated in the three prior studies in this PhD (Chapters 3, 4 and 5), and published literature including studies introduced in Chapter 1 (Literature Review), were used to complete the Behaviour Change Wheel process.

To recap, the earlier studies in this project were:

1. An observational study of 495 parents of three to seven-year-olds exploring parental reflective motivation towards limiting unhealthy food provision (Study 1, Chapter 3). This included parents completing an online survey containing validated questionnaires measuring parents' motivational constructs[220] and children's unhealthy food intake[230]. Data were analysed descriptively, and using structural equation modelling to identify important motivational predictors of children's unhealthy food intake. Self-efficacy, intention and planning were the greatest predictors of children's unhealthy food intake, as well as noting a mis-match between parents risk perception and provision.

2. A discrete choice experiment with 225 parents of three to seven-year-olds exploring how parents' food provision choices are influenced by physical and social opportunity factors (Study 2, Chapter 4). This included parents completing five hypothetical snack provision choice tasks per social and non-social occasion context within an online survey. Analysis of choice data determined the relative importance of opportunity factors influencing parents' unhealthy snack provision choices. Food availability, child resistance and co-parent support were the greatest influences on parents' snack provision decision-making.

3. A systematic review and assessment of 18 past parent-focussed interventions that included a strategy aimed at reducing young children's unhealthy food intake (Study 3, Chapter 5). The review sought to examine behaviour change content (i.e. components of the Behaviour

Change Wheel) in these past interventions, including identifying gaps to direct future novel intervention design. Key gaps included: no reviewed study had used persuasion, incentivisation, coercion, modelling and restriction intervention functions, similarly, no reviewed study had used environmental / social planning, legislation, regulation or fiscal measures policy categories. Mapped BCTs and modes of delivery provided insight into appropriate BCTs, gaps identifying novel BCTs and feasible modes of delivery.

In addition, existing evidence reviewed in Chapter 1 (Literature Review) were used where suitable to inform steps in the Behaviour Change Wheel process. Evidence focussed on unhealthy food provision and young children were prioritised, but where gaps remained in the literature, evidence focussed on healthy food provision or older age groups were used. Original evidence in this PhD was favourably weighted in prioritising intervention content, as it provided direct evidence in the target population and specifically focussed on unhealthy food provision. In the current study, primarily parent voices were represented by investigations in Chapter 3 (Study 1) and 4 (Study 2) and in literature to understand capability (Chapter 1 Literature Review). Whilst also drawing on the research team to provide expert opinions from research and practice experience, when gaps in the literature remained. Ethics approval was not required for this study; refer to Chapter 3 (section 3.2.1) and 4 (section 4.2.1) for ethics approval statements for original data collection. This chapter was prepared using published examples of intervention design using the Behaviour Change Wheel as a reporting guide[187, 188, 190].

### 6.2.2. Research team and use of the Behaviour Change Wheel process

The intervention design process was undertaken by the PhD candidate, over a series of intensive design sessions during February to April 2019. I have a background in public health and community nutrition practice (eight years), including working with families in lower socio-economic circumstances. I have also undertaken training in the Behaviour Change Wheel process (University College London, Centre for Behaviour Change Summer School 2017). On two occasions the drafted intervention content was formally workshopped with three members of the supervisory panel (RKG, GAH, DZ). These researchers (RKG, GAH, DZ) have extensive experience in public health nutrition and intervention design (e.g. [18, 367-372]).

Intervention design followed the three stages including a total of eight steps, and utilised the corresponding worksheets, recommended by Michie and colleagues[3] in the Behaviour Change Wheel book. Table 6.2 presents a brief overview of the design process and key evidence sources. Considerations outlined earlier in this chapter were kept forefront when completing each step, based on researcher expertise and available evidence, in particular when prioritising intervention strategies based on feasibility. The considerations were namely, that intervention content was supported by behaviour change theory, informed by the evidence base, was suitable for scale, considered the needs of families in lower socio-economic circumstances and included implementation stakeholders in multiple environmental settings. Implementation stakeholders refers to key players who would be responsible for implementing certain intervention content, for example policy makers, educators, parents.

Michie and colleagues[3] emphasise the importance of spending sufficient time in the first four steps (Stage 1: Understand the behaviour), as a lack of thorough assessment of the problem and behaviour may result in an ineffective intervention, leading to a waste of resources. Therefore, this study focussed on stage one of understanding the behaviour and provides initial assessment of stages two and three, as well as providing suggestions for future research to build upon this work. Formal stakeholder feasibility assessment of stage two and three was out of scope for the current project (see Chapter 7: General Discussion). For example, determining the affordability, practicability, effectiveness and cost-effectiveness, acceptability, side-effects / safety and equity of proposed intervention content. Results are presented as per the steps in the Behaviour Change Wheel process.

Table 6.2: Brief overview of the Behaviour Change Wheel intervention design process and corresponding sources of evidence

| **Stages and Steps**[1] | | **Evidence sources** |
|---|---|---|
| *Stage 1: Understanding the behaviour* | | |
| Step One: | Define the problem in behavioural terms<br>• Including refining target foods and eating occasion | Literature Review (Chapter 1) |
| Step Two & Three: | Select and specify the target behaviour<br>• Selecting the target behaviour<br>• Specifying the who, what, when, where, how often, with whom relating to the selected target behaviour | Literature Review (Chapter 1) |
| Step Four: | Behavioural analysis to identify what needs to change<br>• Utilises the COM-B model and the Theoretical Domains Framework<br>• Involves determining behaviour change enablers[2] based on the sources of behaviour (COM-B elements) by a researcher synthesising the available evidence and subjectively rating need for change | Study 1 (Chapter 3)<br>Study 2 (Chapter 4)<br>Literature Review (Chapter 1)<br>COM-B-D behavioural diagnosis form[3]<br>Past interventions developed using the process[187, 188, 200] [3] |
| *Stage 2: Identify intervention options* | | |
| Behaviour change enablers were then translated to specific strategies (i.e. what it would look like in an intervention) using the selected intervention options | | Literature Review (Chapter 1) |
| Step Five: | Identify appropriate intervention functions<br>• Involves selecting intervention functions | Study 3 (Chapter 5)<br>Broader nutrition and public health initiatives (e.g. smoking) |
| Step Six: | Identify appropriate policy categories<br>• Involves selecting policy categories | Study 3 (Chapter 5)<br>Broader nutrition and public health initiatives (e.g. smoking) |
| *Stage 3: Identify content and implementation options* | | |
| Step Seven: | Identify Behaviour Change Techniques (BCTs)<br>• Involves selecting BCTs to create change in the selected sources of behaviour using a matrix of commonly used BCTs for each intervention function | Study 3 (Chapter 5)<br>Review mapping BCT to theoretical domains[373] |
| Step Eight: | Recommend potential mode/s of delivery | Study 3 (Chapter 5) |

[1] Stages and step headings adapted from Michie et al.[3]
[2] Behaviour change enabler for the purpose of this project is defined as something that will facilitate the behaviour or overcome a barrier to the behaviour.
[3] Past interventions were used as a guide to cross-check different elements of behaviour that may be needed to support parents to reduce unhealthy food provision.

## 6.3. Results

### 6.3.1. Step One: Define the problem in behavioural terms

The overarching issue the current intervention design sought to address was children's overconsumption of unhealthy foods. Reducing excessive unhealthy food intake can be conceptualised as a barrier behaviour, preventing efforts to increase healthy food intake. Hence, reducing unhealthy foods is an important preliminary problem to address children's overall diet quality. Chapter 1 (Literature Review) summarised the potential settings to reduce children's unhealthy food intake, including government and society, food supply, community and the home. Home food availability is an ideal focus, as according to dietary intake data from Australia, United States and United Kingdom, on average approximately two-thirds (65-71%) of children's food consumption occurs in the home[110-113]. Parents influence over young children's food access and consumption data support the intervention design focus to be parents' provision of unhealthy foods in excess of dietary guideline recommendations to their three to seven-year-old children, from within the home.

Unhealthy foods, as defined in Australia, are a highly diverse group of foods, clustered together on the basis that they are not necessary for health and contain higher saturated fat, added sugars and/or sodium and often energy, than healthy foods[5]. If chosen to be consumed these foods are all recommended to only be consumed 'sometimes and in small amounts'[6]. Yet, various types of unhealthy foods are consumed in different ways and likely require different strategies to reduce consumption. Therefore, the types of unhealthy foods and eating occasions were considered as part of Step One to refine the intervention design focus and allow for a more specified target behaviour to be selected.

As discussed in the Chapter 1 (Literature Review), approximately 50% of young children's unhealthy food serves are consumed in snack eating occasions[67], making snack occasions a key intervention target. Our past analysis of commonly consumed unhealthy foods and their contribution to total energy, saturated fat, added sugars and sodium[7], also support the selection of snack occasions as the most commonly consumed foods are types of sweet and savoury foods commonly eaten as snacks. For example, sweet biscuits, cakes / muffins / scones, muesli bars, confectionary, ice cream / blocks, could all be grouped as types of sweet snacks. Similarly, savoury biscuits and potato snacks are key examples of savoury snacks. Hence, unhealthy sweet and savoury snacks between main meals are an ideal intervention focus.

Therefore, the behavioural problem for this intervention design was parents' provision of unhealthy sweet and savoury snack foods at snack eating occasions. The term provision refers to a range of behaviours relating to food provision including planning, purchasing, preparation, and direct provision. Unhealthy sweet and savoury snacks captures commonly consumed unhealthy foods provided in snack occasions, thus between main meals including recess packed in school lunches.

### 6.3.2. Step Two and Three: Select and specify the target behaviour

***Select the target behaviour***

There are many different behaviours that could be targeted to reduce parents' provision of unhealthy sweet and savoury snacks. A behaviour is defined as *"anything a person does in response to internal or external events. Actions may be: overt (motor or verbal) and directly* *measurable or, covert (activities not viewable but involving voluntary muscles) and indirectly measurable. Behaviours are physical events that occur in the body and are controlled by the brain*"[374](p 36). Potential target behaviours to support reducing provision and intake of unhealthy sweet and savoury snacks are summarised in Figure 6.1—separated into parental behaviours and child behaviours. Within parental behaviours, purchasing or directly providing unhealthy snacks were deemed most relevant behaviours for snacks intake. Purchasing behaviour was prioritised as the focus for initial intervention design—considered as an upstream behaviour. Selection of an upstream behaviour could mitigate the need for interventions to support downstream behaviours. For example, by targeting purchasing behaviour (home food availability; parent provides) is likely to reduce need for parent feeding practices (child decides)[375]. Targeting purchasing is a way to change the home food availability, which was identified as the factor of highest importance in Study 2 (Chapter 4; non-social context), hence of greatest importance in parents snack provision decision-making.

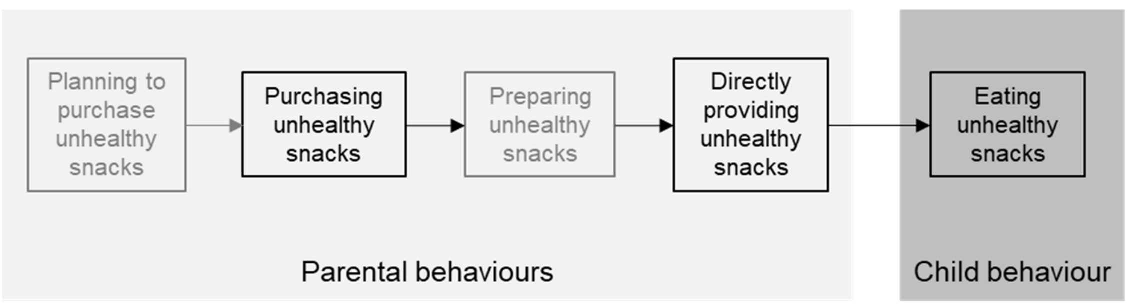



Figure 6.1: Behaviours involved in parents' provision and children's consumption of unhealthy sweet and savoury snacks

Grey text indicates behaviour was hypothesised as not essential in snack occasions process

Further original research findings from Study 1 (Chapter 3) and 2 (Chapter 4) support selection of purchasing over direct provision, as this takes a whole of family approach, which may help to reduce child resistance and gain co-parent support, as well as support aspects of motivation, in particular planning. For example, changes to home food availability would lead to environmental prompts (e.g. seeing healthy snacks) that support automatic motivation and habit formation. Self-efficacy, intention and planning that were the most important motivational constructs in Study 1 (Chapter 3) would relate to purchasing, rather than direct provision, there may mitigate the need for confidence in challenging situations. How parents choose to reduce their purchasing of snacks may vary but can be summarised as purchasing less unhealthy snacks (i.e. moderating the portion size or frequency) or substituting unhealthy snacks for alternative healthier snacks (i.e. from healthy food groups).

***Specify target behaviour***

The Behaviour Change Wheel process recommends detailing the who, what, where, when, how often and with whom of the selected target behaviour to assist the behavioural analysis in Step Four[3]. Parents (*who*) may reduce purchasing unhealthy sweet and savoury snacks (*what*) when purchasing food (*when and how often*) at the supermarket or other food outlet (*where*), either alone or with co-parent—depending on family roles, with or without child/ren present (*with whom*). Hence, parents need to purchase less unhealthy sweet and savoury snacks than usual, either smaller amounts or less frequently (moderation), and potentially, purchase healthy snacks in place of unhealthy sweet snacks and savoury snacks currently purchased (substitution)[370].

### 6.3.3. Step Four: Behavioural analysis to identify what needs to change

The behavioural analyses identified what needs to shift for the behaviour to occur, termed behaviour change enablers. Behaviour change enabler for the purpose of this project is defined as something that will facilitate the behaviour or overcome a barrier to the behaviour, these are what is targeted in the resulting intervention. Behavioural analyses were conducted for the general population targeting an average Australian parent and tailored towards families from lower socio-economic backgrounds. The tailored behavioural analysis was informed by published literature in samples of lower socio-economic position (e.g. [88]) or when published findings were reported by socio-economic position (e.g. [149]). As well as, drawing on original research derived from subgroup data analyses in Chapter 3 (Study 1) and 4 (Study 2).

Available evidence was used to subjectively rate behaviour change enablers according to three categories: 1) an area where change is needed (i.e. current gap in knowledge, skills, motivation, resources or supports), 2) no change is needed, or 3) where there is insufficient evidence to determine need for change[3]. Rating was performed separately for intervention content for the general population and tailored towards families from lower socio-economic backgrounds, using the process described in the Behaviour Change Wheel guide to determine areas for interventions to target. Behaviour change enablers were prioritised to provide a reduced list of proposed intervention targets combining the results from the two behavioural analyses. Priority was assessed based on current literature, novel intervention approaches, and original evidence.

Behavioural analyses revealed behaviour change enablers for reducing unhealthy sweet and savoury snack purchasing from all areas of the COM-B model, except for physical capability (Table 6.3). Thus, to purchase less unhealthy snacks intervention strategies are needed to enhance parents' psychological capability, reflective and automatic motivation, physical and social opportunity. Behaviour change enablers were identified for majority of theoretical domains (12 of 14), with the exception of social / professional role and identity, and optimism.

Overall, 26 behaviour change enablers were identified. For the general population, 15 were rated as change needed, two were rated as mixed, two rated as no change needed, and seven rated unclear due to insufficient evidence to rate. For families from low socio-economic backgrounds, 17 were rated as change needed, three were rated as mixed, and six rated unclear due to insufficient evidence to rate. A total of 16 behaviour change enablers were prioritised as initial intervention targets regardless of population focus. Table 6.3 presents the rationale for prioritised behaviour change enablers. As per the overall behaviour change enablers (i.e. all 26), the 16 prioritised behaviour change enablers covered psychological capability, physical opportunity, social opportunity, reflective motivation and automatic motivation. Prioritised enablers included the following theoretical domains (9 of 14): knowledge, skills, environmental context and resources, social influences, beliefs about capabilities, beliefs about consequences, intentions, goals, and reinforcement. Appendix 9 presents the remaining behaviour change enablers and rationale for not taking forward in initial intervention design. Behaviour change enablers that were not selected was primarily due to lack of evidence currently available or deemed less important for changing purchasing, for example support from other parents.

Of the 16 prioritised behaviour change enablers, 11 were rated as change needed for both the general population and families from lower socio-economic backgrounds. Clear differences between populations were noted in four of the prioritised behaviour change enablers. Two enablers, namely '*Learning that current portion sizes of unhealthy sweet and savoury snacks are bigger than recommended serving sizes*' (psychological capability: knowledge) and '*Developing better if-then plans for reducing unhealthy sweet and savoury snack purchasing*' (reflective motivation: goals), were identified as a priority for the general population, but not for families from lower socio-economic backgrounds due to a lack of research this population. There were also two enablers that were considered a priority for families from lower socio-economic backgrounds, but not for the general population, specifically '*Redistributing the household food budget to have enough money to purchase alternative healthy snacks*' (physical opportunity: environmental context and resources) and '*Believing there is a need to reduce unhealthy sweet and savoury snack purchasing and consumption*' (reflective motivation: beliefs about consequences).

Table 6.3: Prioritised behaviour change enablers for the general population and families from lower socio-economic backgrounds

| **COM-B** *TDF* | **Behaviour change enablers** (What needs to happen for the behaviour to occur?) | **Rationale** | **Evidence**[1] Direct | **Evidence**[1] Indirect | **Priority for target population** |
|---|---|---|---|---|---|
| **Psychological capability** *Knowledge* *Skills* | 1. Learning that unhealthy sweet and savoury snacks are high in energy, saturated fat, added sugars and sodium, and their associated consequences | Considered essential but not sufficient knowledge to enable behaviour change[131]. Important to support increased risk perception, particularly regarding awareness of long term consequences currently lacking. Interacts with risk perception under reflective motivation. | [69] | [18, 147, 376, 377] | General population and low SEP |
| | 2. Learning that current portion sizes of unhealthy sweet and savoury snacks are bigger than recommended serving sizes | Important to support intention to change and awareness that current intake is excessive. Current single serve portion sizes (e.g. commercial muffins) contain on average/up to three serves of unhealthy foods, hence contributes to portion distortion / deceives consumers. Approximately half of parents (48% generic, 44% low SEP tertile) rated current provision as above the dietary guidelines in the Parental Food Attitude Questionnaire. Limited data available for low SEP families to determine need for change. | Study 1 [148] | [199] | General population |
| | 3. Learning how to identify unhealthy sweet and savoury snacks (incl. considering energy, saturated fat, added sugars and sodium) and appropriate portion sizes | Developing skills to determine food classification is more sustainable than knowledge based on currently available foods, to be lasting with product changes or food industry reformulation. Prior nutrition research support the importance of skills not just knowledge to change behaviour[331, 378]. Gap identified in Study 3 with lower frequency of training vs education functions, hence contributes to the novelty of this intervention. | Study 3 [69, 88, 148] | [199] | General population and low SEP |
| **Physical opportunity** *Environmental context and resources* | 4. Having smaller portion sizes or suitable healthy alternative snacks[2] available in food outlets (i.e. food system changes) | Key influence determining home food availability, which was identified as a priority intervention target in the discrete choice experiment (Study 2). The Healthy Food Partnership is currently working with industry to target portion size, which is an indicator that appropriate portions are not currently available. Supports nudging changes at a population level and reduces the individual behaviour change burden[362]. | Study 2 | [276, 379] | General population and low SEP |

Abbreviations: COM-B: Sources of behaviour within the Capability, Opportunity, Motivation and Behaviour model; SEP: socio-economic position; TDF: Theoretical Domains Framework

[1] Direct evidence refers to those in the same age population and unhealthy food focussed; indirect evidence refers to research in different age groups or healthy food focus.

[2] Alternative healthy snacks could include any snacks composed of vegetables, fruits, wholegrains, milk products or alternatives, or meat products or alternatives. For example: vegetable sticks, ½ cheese sandwich, tub of yoghurt, piece of fruit, small tin of tuna, hummus on corn thins, air-popped popcorn.

Table 6.3: Prioritised behaviour change enablers for the general population and families from lower socio-economic backgrounds (cont.)

| **COM-B** *TDF* | **Behaviour change enablers** (What needs to happen for the behaviour to occur?) | **Rationale** | **Evidence**[1] Direct | **Evidence**[1] Indirect | **Priority for target population** |
|---|---|---|---|---|---|
| **Physical opportunity** *Environmental context and resources* | 5. Redistributing the household food budget to have enough money to purchase alternative healthy snacks | Costs were a lower priority target in the discrete choice experiment (Study 2), but still significant influence on snack choice, particularly for lower SEIFA group (ranked 4th importance in subgroup analysis). | Study 2 [69] | [149, 380] | Low SEP |
| | 6. Having less environmental prompts to purchase unhealthy snacks (e.g. advertising) and have more prompts to reduce unhealthy sweet and savoury snack purchases (e.g. warning labels) | Changing the physical environment to prompt behaviour to support habit changes. Reduce triggers to encourage unhealthy snack purchasing.<br>Supports nudging changes at a population level and reduces the individual behaviour change burden[362]. | [69, 88, 138, 148] | [132, 147, 149, 291, 380, 381] | General population and low SEP |
| **Social opportunity** *Social influences* | 7. Having a shift in the social norms to support reduce purchasing unhealthy sweet and savoury snack | Unhealthy snacks are embedded within norms, changing norms will support habit changes, and likely flow on to other areas within COM-B and other unhealthy food no currently targeted.<br>Whilst ambitious, it is possible to change social norms as evident by the example of smoking behaviour change, where once smoking cigarettes was socially acceptable and favourable, multi-approach initiatives have led to the social norms in Australia to discourage smoking, particularly in public spaces. | [69, 88, 382] | [139, 147] | General population and low SEP |
| | 8. Having more support from other family members (e.g. child, co-parent) to help reduce purchasing of unhealthy sweet and savoury snacks | Co-parent support (ranked 3rd) and child resistance (ranked 2nd non-social and 1st social contexts) were both identified as important influences in the discrete choice experiment (Study 2), in whole sample and lower SEIFA subgroups.<br>There is potential to include co-parents and children in intervention strategies to further enhance this behaviour change enabler. | Study 2<br>Co-parent: [69, 122, 138, 144, 153]<br>Child: [69, 81, 88, 144, 383] | Co-parent: [146, 150, 199]<br>Child: [132, 139, 147] | General population and low SEP |

Abbreviations: COM-B: Sources of behaviour within the Capability, Opportunity, Motivation and Behaviour model; SEP: socio-economic position; TDF: Theoretical Domains Framework

[1] Direct evidence refers to those in the same age population and unhealthy food focussed; indirect evidence refers to research in different age groups or healthy food focus.

Table 6.3: Prioritised behaviour change enablers for the general population and families from lower socio-economic backgrounds (cont.)

| **COM-B**<br>*TDF* | **Behaviour change enablers**<br>(What needs to happen for the behaviour to occur?) | **Rationale** | **Evidence**[1]<br>Direct | <br>Indirect | **Priority for target population** |
|---|---|---|---|---|---|
| **Reflective motivation**<br>*Beliefs about capabilities*<br>*Beliefs about consequences*<br>*Intentions*<br>*Goals* | 9. Having more confidence to reduce unhealthy sweet and savoury snack home food availability | Self-efficacy was identified as a key target in structural equation modelling and received mixed confidence ratings from Parental Food Attitude Questionnaire (Study 1). Having higher confidence for purchasing behaviour is likely to support self-efficacy for provision and managing child resistance. | Study 1 [384] | [18, 132, 150, 199] | General population and low SEP |
| | 10. Believing there is a need to reduce unhealthy sweet and savoury snack purchasing and consumption (incl. current intake is above recommendations, there are risks associated, health is important) | Based on findings from Study 1, there appears to be a disconnect between unhealthy food provision and Parental Food Attitude Questionnaire ratings, as well as distorted norms (i.e. provision is better than other parents), awareness of recommended serves and portion distortion.<br>There is potentially a lower perceived risk for snacks vs meals in lower SEP groups[385].<br>Likely barrier to forming intention (risk perception larger associations with intention in Study 1). Interacts with psychological capability re: consequences of unhealthy foods. | Study 1 [69, 138, 382, 385] | [132, 147, 199, 376, 386] | Low SEP |
| | 11. Intending to reduce availability of unhealthy sweet and savoury snacks in the home | Key priority identified in structural equation modelling (Study 1) and needed to initiate reflective behaviour change. Currently mixed intention from Parental Food Attitude Questionnaire ratings. | Study 1 [69] | | General population and low SEP |
| | 12. Developing better 'if-then' plans for reducing unhealthy sweet and savoury snack purchasing | Key priority identified in structural equation modelling (Study 1) and important for habit formation[387]. Habit formation requires 'if-then' plans which link new behaviours to cues for purchasing unhealthy snacks in food outlets.<br>Limited available evidence; research gap to gain greater understanding, particularly in low SEP families. Greater priority suggested for social occasions context. | Study 1 | [146] | General population |

Abbreviations: COM-B: Sources of behaviour within the Capability, Opportunity, Motivation and Behaviour model; SEP: socio-economic position; TDF: Theoretical Domains Framework

[1] Direct evidence refers to those in the same age population and unhealthy food focussed; indirect evidence refers to research in different age groups or healthy food focus.

Table 6.3: Prioritised behaviour change enablers for the general population and families from lower socio-economic backgrounds (cont.)

| **COM-B** *TDF* | **Behaviour change enablers** (What needs to happen for the behaviour to occur?) | **Rationale** | **Evidence**[1] | | **Priority for target population** |
|---|---|---|---|---|---|
| | | | Direct | Indirect | |
| **Automatic motivation** *Reinforcement* | 13. Developing shopping habits for reducing unhealthy sweet or savoury snack purchasing, without requiring conscious intention | Important for sustained behaviour change and currently a research gap with behaviour maintenance or habit formation not often captured in nutrition interventions (Study 3).<br>Informed by behaviour change theory[184, 388] rather than nutrition research. | Study 3 | | General population and low SEP |
| | 14. Having more deterrents for purchasing unhealthy sweet and savoury snacks (e.g. tax, warning labels) | Priority based on broader evidence such as case study of smoking cessation history in Australia[389], sugar-sweetened beverage taxes in other countries[390] and computer modelling research[391, 392].<br>Supports changes in norms and nudging changes at a population level and reduces the individual behaviour change burden[362]. | [69, 211] | [390-393] | General population and low SEP |
| | 15. Having more incentives to encourage alternative healthy snack purchases (e.g. rewards program, subsidy) | Priority based on broader evidence, such as case study of smoking cessation history in Australia[389], and computer modelling research[394].<br>Supports changes in norms and nudging changes at a population level and reduces the individual behaviour change burden[362]. | [69, 211] | [394] | General population and low SEP |
| | 16. Reducing parents own intake of unhealthy sweet and savoury snacks | Parents own eating habits and preferences reinforce current purchasing and provision practices that can be a barrier to changing intake.<br>There is research to support associations between parental intake and child intake. Aligns with family focussed lifestyle changes as is best practice approach to childhood obesity management. | [102, 114, 122, 385] | [147, 199, 330, 379, 380, 386, 395] | General population and low SEP |

Abbreviations: COM-B: Sources of behaviour within the Capability, Opportunity, Motivation and Behaviour model; SEP: socio-economic position; TDF: Theoretical Domains Framework
[1] Direct evidence refers to those in the same age population and unhealthy food focussed; indirect evidence refers to research in different age groups or healthy food focus.

### 6.3.4. Step Five and Six: Identify appropriate intervention functions and policy categories

Intervention content was developed by translating behaviour change enablers to specific strategies. Strategies were based on examples from broader nutrition and public health initiatives (e.g. to reduce smoking another 'stop' behaviour) and the suitable behaviour change approaches to create a change in capability, opportunity or motivation. Intervention strategies were designed to be implemented by stakeholders in the various settings within the socio-ecological model to ensure the overall intervention content would support parents to change their food provision behaviour. Implementation stakeholders—key players responsible for implementing certain intervention content—were prioritised as policy makers within the government and society setting, food outlets within the food supply setting, educators and health workers within the community setting, and parents and families within the home setting[73]. Thirteen intervention strategies were developed that could be implemented using a combination of all nine intervention functions, and all seven policy categories. Guided by Michie and colleagues[3] intervention options (Table 6.1) strategies ranged from implementation of taxes or legislation to a parent resource package (Figure 6.2).


Figure 6.2: Prioritised intervention strategies to support parents to reduce unhealthy sweet and savoury snack purchasing across key settings and approaches

Table 6.4 presents the proposed priority intervention content for implementation stakeholders in government and society, food supply and community settings. Five intervention strategies were prioritised for the government and society setting that would be implemented by policy makers, many would also involve food industry. These strategies predominately addressed gaps in opportunity and motivation; and could use seven intervention functions and three policy categories. The most commonly proposed intervention function across strategies in government and society setting were environmental restructuring (4 of 5) or restriction (3 of 5). These could be delivered by the policy categories fiscal measures (2 of 5) for the tax or levy, and regulation (3 of 5) or legislation (3 of 5) for the other strategies depending on whether they were voluntary or mandatory policy actions.

There were three proposed strategies to be implemented in the food supply setting, by food outlets or supermarkets. The three intervention strategies would predominately address gaps in automatic motivation and physical opportunity. These could use up to six intervention functions including enablement, environmental restructuring, coercion, education, incentivisation and persuasion, and three policy categories, namely guidelines, environmental / social planning, and communication / marketing.

Three intervention strategies were prioritised for the community setting to be implemented in education or health services. These strategies primarily addressed gaps in motivation and opportunity but were varied within these elements of the COM-B model—i.e. reflective or automatic motivation, physical or social opportunity. Intervention strategies proposed for implementation by educators or health workers in community settings could use five of the intervention functions: training, education, enablement, environmental restructuring or persuasion. The strategies could be delivered by the guidelines (2 of 3) or environmental / social planning (1 of 3) policy categories.

Table 6.5 presents the proposed priority intervention content for parents and families within the home setting. Children focussed strategies were out of scope of the current project but could compliment the current intervention design. Two primary intervention strategies were prioritised for implementation in the home setting—a campaign seeking to shift social norms / attitudes and a resource package, as well as an optional strategy to combine with the resource package strategy. These strategies included multiple campaign messages or modules, therefore addressed gaps in all areas from the behavioural analysis (i.e. capability, motivation, opportunity). The campaign messages and modules would require consultation with stakeholders to reduce the number of components in the development of intervention materials. The strategies could use up to eight of the intervention functions, but most commonly included education, modelling, persuasion and enablement functions. They could be delivered by communication / marketing (2 of 3) or service provision (2 of 3) policy categories.

Table 6.4: Proposed priority intervention content for implementation in government / society, food supply and community settings

| Intervention strategies [Behaviour Change Techniques[1]] | Behaviour change enablers[2] | COM-B (TDF) | Intervention functions | Policy categories |
|---|---|---|---|---|
| ***Policy makers / Government and society setting*** | | | | |
| Develop and implement mandatory[3] informative front-of-package labelling [BCT 7.1, 11.3] on unhealthy sweet and savoury snacks including warnings (e.g. high in nutrients to reduce, health consequences, carbon emissions) [BCT 5.1, 5.3, if graphic images 5.2], number of unhealthy food servings, and unhealthy food symbol.<br>*Supporting evidence:* [4, 89, 90, 291, 396-398] | 1, 2<br>10, 11<br>14, 15, 16 | Psychological capability (Knowledge)<br>Reflective motivation (Beliefs about consequences; Intention)<br>Automatic motivation (Reinforcement) | Coercion<br>Education<br>Environmental restructuring<br>Incentivisation<br>Persuasion | Legislation |
| Implement a health levy for food companies producing unhealthy snacks to encourage development of alternative snacks [BCT 12.1, 12.5], based on nutrient levels or quotas for healthy vs unhealthy snacks per food company (*Substitution*); revenue used to fund other intervention strategies outlined.<br>*Supporting evidence:* [399, 400] | 4 | Physical opportunity (Environmental context and resources) | Environmental restructuring<br>Restriction | Fiscal measures |
| Develop and implement voluntary/mandatory reformulation targets for unhealthy sweet and savoury snacks to reduce portion sizes (e.g. maximum of 600kJ per serve) (*Moderation*) [BCT 12.1, 12.5].<br>*Supporting evidence:* [89, 276, 370, 401, 402] | 4 | Physical opportunity (Environmental context and resources) | Environmental restructuring<br>Restriction | Regulation<br>Legislation |
| Implement a tax on unhealthy sweet and savoury snacks (*Moderation*) [BCT 14.1] <u>and</u> a subsidy on healthy alternative snacks and foods (*Substitution*) that reach the consumer level [BCT 14.8].<br>*Supporting evidence:* [4, 391-394, 403, 404] | 5, 6<br>7<br>11<br>13, 14, 15, 16 | Physical opportunity (Environmental context and resources)<br>Social opportunity (Social influences)<br>Reflective motivation (Intention)<br>Automatic motivation (Reinforcement) | Coercion<br>Incentivisation<br>Restriction | Fiscal measures |
| Develop and implement a voluntary/mandatory code to limit promotion (incl. marketing, advertising, display) of unhealthy sweet and savoury snacks in all contexts (e.g. media, supermarket) [BCT 12.2, 12.3]. This would include any media (e.g. TV, online, open spaces, Instagram influences, government assets), sales/promotions in food outlets (e.g. specials, discounts, end of isle displays).<br>*Supporting evidence:* [4, 381, 405-409] | 6<br>7<br>13 | Physical opportunity (Environmental context and resources)<br>Social opportunity (Social influences)<br>Automatic motivation (Reinforcement) | Enablement<br>Environmental restructuring | Regulation<br>Legislation |

[1] Behaviour Change Technique (BCT) Taxonomy V1[166] (Appendix 9).
[2] See Table 6.3 for corresponding numbered behaviour change enablers
[3] Proposed content includes voluntary regulation initially until mandatory legislation could be approved.

Table 6.4: Proposed priority intervention content for implementation in government / society, food supply and community settings (cont.)

| Intervention strategies [Behaviour Change Techniques[1]] | Behaviour change enablers[2] | COM-B (TDF) | Intervention functions | Policy categories |
|---|---|---|---|---|
| ***Food outlets / Food supply setting*** | | | | |
| Develop, disseminate and implement 'health promotion stores' standards for food outlets with limits on the proportion of unhealthy snacks displayed, reduce prompts for unhealthy snacks (e.g. no end of isle displays) and layout of stores to avoid unhealthy snacks (e.g. not in the same isle as healthy alternatives or essentials) [BCT 12.1, 12.3]. For example, templates for floor plans and shelves (e.g. number / spacing for unhealthy sweet and savoury snacks).<br>*Supporting evidence:* [91, 410] | 4, 6<br><br>13 | Physical opportunity (Environmental context and resources)<br>Automatic motivation (Reinforcement) | Enablement<br>Environmental restructuring | Guidelines<br>Environment / social planning |
| Design and implement social norm based prompts within the supermarket [BCT 7.1]. For example, dividing baskets and shopping trollies / carts to have only a small section for unhealthy food purchases and displaying messages (as per those outlined in Table 6.5).<br>*Supporting evidence:* [411, 412] | 6<br><br>7<br><br>13 | Physical opportunity (Environmental context and resources)<br>Social opportunity (Social influences)<br>Automatic motivation (Reinforcement) | Coercion<br>Environmental restructuring<br>Persuasion | Communication / marketing<br>Environment / social planning |
| Design additional information to be included in shopping list receipts tallying unhealthy snack purchasing (e.g. total dollars spent or proportion of receipt) with negative message / warnings (e.g. negative health consequences) [BCT 2.2, 5.1, 5.3] if excessive or positive message (e.g. congratulations, you have reduced risk of xxx) if limited purchasing [BCT 2.2, 5.1, 5.3, 10.4]. Optional tallying of healthy alternative snack purchasing with a positive message (i.e. positive reinforcement or consequence, e.g. you purchased mostly healthy snacks today – great work, keep it up) [BCT 13.2, 14.8]. | 1, 2<br><br>10, 11<br><br>14, 15 | Psychological capability (Knowledge)<br>Reflective motivation (Beliefs about consequences; Intention)<br>Automatic motivation (Reinforcement) | Coercion<br>Education<br>Incentivisation<br>Persuasion | Communication / marketing |

[1] Behaviour Change Technique (BCT) Taxonomy V1[166] (Appendix 9).
[2] See Table 6.3 for corresponding numbered behaviour change enablers
[3] Proposed content includes voluntary regulation initially until mandatory legislation could be approved.

Table 6.4: Proposed priority intervention content for implementation in government / society, food supply and community settings (cont.)

| Intervention strategies [Behaviour Change Techniques[1]] | Behaviour change enablers[2] | COM-B (TDF) | Intervention functions | Policy categories |
|---|---|---|---|---|
| ***Educators and health workers / Community settings*** | | | | |
| Implement snack provision [BCT 12.5] through educational institutions, either at a charge to parents or subsidised (in addition to or incorporated into school fees). For example, healthy alternative snacks purchased through schools in place of food provided from home for recess / snack occasions. (*Substitution*)<br>*Supporting evidence:* [4, 74] | 6<br><br>7 | Physical opportunity (Environmental context and resources)<br>Social opportunity (Social influences) | Enablement<br>Environmental restructuring | Environment / social planning |
| Develop and implement protocols for dissemination of information to parents at (pre)school enrolment or health checks. Information would include dietary guideline recommendations regarding unhealthy foods and serve sizes, health and social consequences of unhealthy sweet and savoury snack consumption [BCT 4.1, 5.1, 5.3, 5.6].<br>*Supporting evidence:* [4, 413] | 1, 2, 3<br><br>10 | Psychological capability (Knowledge; Cognitive and interpersonal skills)<br>Reflective motivation (Beliefs about consequences) | Education<br>Training | Guidelines |
| Develop and implement unhealthy snack practice guidelines for health workers to discuss / promote favourable norms regarding unhealthy snacks, and parents' abilities to change intake and their own intake as a potential barrier to making changes [BCT 6.2, 12.2, 13.1, 13.2, 13.3, 15.1, 15.3, 15.4]. For example, health workers at four-year-old health checks.<br>*Supporting evidence:* [4, 413] | 7<br><br>9<br><br>16 | Social opportunity (Social influences)<br>Reflective motivation (Beliefs about capabilities)<br>Automatic motivation (Reinforcement) | Enablement<br>Environmental restructuring<br>Persuasion<br>Training | Guidelines |

[1] Behaviour Change Technique (BCT) Taxonomy V1[166] (Appendix 9).
[2] See Table 6.3 for corresponding numbered behaviour change enablers
[3] Proposed content includes voluntary regulation initially until mandatory legislation could be approved.

Table 6.5: Proposed priority intervention content for implementation in the home setting

| Intervention strategies [Behaviour Change Techniques[1]] | Behaviour change enablers[2] | COM-B (TDF) | Intervention functions | Policy categories |
|---|---|---|---|---|
| ***Parents and families[2] / Home setting*** | | | | |
| Design and implement a campaign (e.g. via TV, online, social media, public spaces) seeking to shift social norms and attitudes (i.e. designed in a way to induce feelings or initiate action) related to the following messages/topics:<br>1) Consequences of unhealthy snacks: Provide information about the consequences (positive or negative; incl. health, social and environmental, emotional) of unhealthy sweet and savoury snacks, including long term [BCT 5.1, 5.2, 5.3, 5.6]<br>2) Discrepancy between intake and recommendations: Provide information about current population unhealthy sweet and savoury snack intake and portion sizes vs recommendations, including tips to changing purchasing habits [BCT 6.1]<br>3) Positive norms: Parent (influencer) promoting positive social norms towards reducing unhealthy snack purchasing [BCT 6.1]<br>4) Comparative norms: Provide information about other parents' provision, encouraging comparison, and highlighting others approval of reducing unhealthy snacks [BCT 6.2, 6.3]<br>5) Family support: Families modelling favourable norms towards snacks and being supportive of reduced unhealthy snack purchasing, including providing practical and emotional support [BCT 6.1]<br>6) Parent confidence: Provide information to reinforce parents' abilities to change family home food availability, including modelling parent confidence [BCT 6.1, 15.1]<br>7) Benefits to family: Highlight the benefits to changing snack purchasing, including importance of changing parents' intake/ whole of family intake [BCT 5.1, 5.2, 5.3, 5.6, 13.1]<br>*Supporting evidence:* [4, 361, 414, 415] | 1, 2<br><br>7, 8<br><br>9, 10, 11<br><br><br><br><br>16 | Psychological capability (Knowledge)<br>Social opportunity (Social influences)<br>Reflective motivation (Beliefs about capabilities; Beliefs about consequences; Intention)<br>Automatic motivation (Reinforcement) | Coercion<br>Education<br>Modelling<br>Persuasion | Communication / marketing |

[1] Behaviour Change Technique (BCT) Taxonomy V1[166] (Appendix 9).
[2] See Table 6.3 for corresponding numbered behaviour change enablers

Table 6.5: Proposed priority intervention content for implementation in the home setting (cont.)

| Intervention strategies [Behaviour Change Techniques[1]] | Behaviour change enablers[2] | COM-B (TDF) | Intervention functions | Policy categories |
|---|---|---|---|---|
| ***Parents and families[2] / Home setting*** | | | | |
| Develop and deliver a resource package for parents regarding unhealthy snacks. The resource package would include modules / components on:<br>1) Information about the negative consequences of unhealthy sweet and savoury snacks [BCT 5.1, 5.2, 5.3, 5.6]<br>2) Current unhealthy sweet and savoury snack intake and portion sizes vs recommendations, including self-assessment [BCT 2.2, 4.1, 6.1]<br>3) Strategies for 'how to' identify unhealthy snacks and judge portion sizes [BCT 4.1]<br>4) Food budgeting training (e.g. proportion of budget to allocate to unhealthy snacks) [BCT 4.1]<br>5) Strategies for 'how to' reduce exposure to prompts (e.g. online shopping) and interpret/de-escalate prompts (e.g. reflect on motivations vs prompts) [BCT 4.1, 12.3; 13.2]<br>6) Strategies to develop family rules regarding purchasing / availability of snack foods at home [BCT 3.2, 3.3, 4.1, 12.1, 12.2]<br>7) Information about parents' abilities to change family home food availability, tips to increase confidence and 'challenge'/ experiment to test confidence [BCT 4.4, 6.1, 15.1, 15.2, 15.3, 15.4]<br>8) Setting intention (including goals, plans, 'if-then' plans), including examples of parents balancing conflicting goals, intending for whole family benefit etc. [BCT 1.1, 1.2, 1.4, 2.2, 6.1, 9.2, 13.1, 13.2, 13.3].<br>9) Strategies for 'how to' develop routines and habits, including 'challenge'/ experiment to test reduced purchasing [BCT 1.4, 4.1, 4.4, 8.2, 8.4, 8.7, 10.9]<br>10) Strategies for 'how to' plan a supportive family food environment [BCT 3.2, 3.3, 4.1, 12.1, 12.2]<br>11) Highlight the benefits to changing snack purchasing, including importance of changing parents' intake/ whole of family intake and strategies to changing own intake [BCT 4.3, 5.1, 5.2, 5.3, 5.6, 13.1, 13.2, 15.1] | 1, 2, 3<br><br>5, 6<br><br>7, 8<br><br>9, 10, 11, 12<br><br>13, 16 | Psychological capability (Knowledge; Cognitive and interpersonal skills)<br>Physical opportunity (Environmental context and resources)<br>Social opportunity (Social influences)<br>Reflective motivation (Beliefs about capabilities; Beliefs about consequences; Intention; Goals)<br>Automatic motivation (Reinforcement) | Education<br>Enablement<br>Environmental restructuring<br>Modelling<br>Persuasion<br>Training | Communication / marketing<br>Service provision |

[1] Behaviour Change Technique (BCT) Taxonomy V1[166] (Appendix 9).
[2] See Table 6.3 for corresponding numbered behaviour change enablers

Table 6.5: Proposed priority intervention content for implementation in the home setting (cont.)

| Intervention strategies [Behaviour Change Techniques[1]] | Behaviour change enablers[2] | COM-B (TDF) | Intervention functions | Policy categories |
|---|---|---|---|---|
| ***Parents and families[2] / Home setting*** | | | | |
| When possible parent case studies / strategies will be included [BCT 6.1, 6.2], specifically to model favourable norms, approaches to gain family support, confidence, belief in needing to change, intention.<br><br>This could be through digital technology (e.g. mobile app, website) or a self-guided resource package disseminated through institutions (e.g. education, health); or as a train-the-trainer package [BCT 3.1].<br>*Supporting evidence:* [4] | | | | |
| Optional add-ons to the parent resource package:<br>1) Behavioural supports – online or phone counselling support [BCT 3.1] that could assist in tailoring information<br>a. revise food budgets<br>b. develop leaders / act against social norms<br>c. negotiate /initiate support from other family members<br>d. reflect and enhance belief in abilities<br>2) Establishing peer support systems – online or through existing parent groups (e.g. register group) [BCT 3.1, 3.3]<br>a. enhance confidence<br>*Supporting evidence:* [416, 417] | 5<br>7<br>8<br>9<br><br>9 | Physical opportunity (Environmental context and resources)<br>Social opportunity (Social influences)<br>Reflective motivation (Beliefs about capabilities) | Enablement | Service provision |

[1] Behaviour Change Technique (BCT) Taxonomy V1[166] (Appendix 9).
[2] See Table 6.3 for corresponding numbered behaviour change enablers

### 6.3.5. Step Seven: Identify Behaviour Change Techniques (BCTs)

Thirty-eight (of 93) unique BCTs, reaching across all but one of the hierarchical clusters (15 of 16), were selected (by BJJ) to initiate the required behaviour change in the proposed intervention content. Selected BCTs are presented in Table 6.4 and 6.5, translated into proposed intervention content—the specific behaviour change intervention strategies to be implemented. To keep with the consideration of including multiple environmental settings, intervention content was designed for various implementation stakeholders, yet with BCTs focussed on parents as the primary target population. For example, an intervention strategy may be designed to be implemented by policy makers but the suitable BCTs were those to create change for parents, rather than what BCTs might be used to entice policy makers to implement the strategy.

The five intervention strategies within the government and society setting could include 11 (of 93) unique BCTs. The BCTs were most commonly from the hierarchical clusters of *Natural consequences* (e.g. health and social consequences), *Antecedents* (environmental prompts) and *Scheduled consequences* (behaviour cost and reward). For example, warnings with information about the health consequences associated with unhealthy snacks (BCT 5.1), increasing the availability of smaller portions of unhealthy snacks or healthy alternatives (BCT 12.1, 12.5), and greater price of unhealthy snacks and cheaper healthy alternative snacks due to a taxation and subsidy (BCT 14.1, 14.8).

Within the food supply setting intervention strategies included nine (of 93) unique BCTs, most frequently from the hierarchical clusters of *Natural consequences* or *Antecedents*. For example, positive consequences from purchasing less unhealthy snacks (BCT 5.3) and changing the layout within supermarkets to discourage purchasing unhealthy snacks (BCT 12.1, 12.5).

The proposed strategies for community settings included 13 (of 93) unique BCTs, primarily from within *Natural consequences, Identity* (including being a role model), and *Self-belief* (strategies to increase confidence) hierarchical clusters. For example, reducing environmental impact by purchasing less unhealthy snacks (BCT 5.3), parents' identifying as a positive role modelling for their child (BCT 13.1), and encouraging parents to use positive self-talk that they can change purchasing (BCT 15.4)

Proposed intervention strategies for the home setting contained substantially more BCTs, with 32 (of 93) unique BCTs included. Proposed BCTs in the home setting were from within 14 hierarchical clusters, most frequently *Social support* (practical or emotional support strategies), *Natural consequences*, *Comparison of behaviour* (includes demonstration of how to do the behaviour), *Antecedents*, *Identity* and *Self-belief*. For example, developing family rules regarding unhealthy snacks at home (BCT 3.2), information about the health consequences associated with unhealthy snacks (BCT 5.1), providing an example of how another parent reduced unhealthy snack purchasing (BCT 6.1), strategies for how to reduce prompts to purchasing unhealthy snacks (BCT

12.3), highlighting the discrepancy between parents' snack provision and identity of doing what is best for their child (BCT 13.2), and persuading parents' they have the ability to change their children's diet through changing home food availability (BCT 15.1).

### 6.3.6. Step Eight: Propose modes of delivery

Although parents are the target for the behaviour change, interventions may not always require change by only parents, such as when intervention strategies are implemented by other key stakeholders to support parents to achieve the behaviour change. Several possible modes to deliver intervention content were identified for implementation stakeholders within each socio-ecological setting. Step Eight is focussed on a key logistical consideration to implementing an intervention, therefore the proposed modes of delivery are targeted at the relevant stakeholders.

Identified strategies within the government and society setting, especially voluntary strategies would require partnerships between government, food industry and nutrition researchers or health sector. For example, similar to the current Australian Commonwealth Healthy Food Partnership[89]. These strategies would likely utilise a range delivery of modes including face-to-face approaches to build collaborative relationships, as well as distance modes to communicate across Australia. Other strategies in this setting would require compliance by numerous media channels including broadcast, digital, outdoor and print media modes. Intervention strategies delivered in the food supply setting would require buy-in from food outlets or partnerships between researchers and food companies to implement strategies, hence could use similar modes of delivery as the government and society setting. Community setting strategies would primarily require dissemination of protocols and guidelines, likely via both distance and face-to-face modes to support uptake and implementation of strategies. Strategies within the home setting could include distance modes at population level to support widespread reach. Specifically, distance modes could include a combination of broadcast and digital media for the social norms campaign intervention content. Whereas, a resource package for parents could include digital or print media distance modes of delivery, such as website or mobile phone application, or written materials, respectively.

## 6.4. Discussion

Best-practice intervention design was utilised to develop theoretically grounded, evidence-informed intervention content to support parents to reduce unhealthy food provision to their young children. Intervention content was prioritised to target parental purchasing of unhealthy sweet and savoury snacks for the home, as an upstream behaviour to change home food availability. Intervention content was designed to increase parents' psychological capability, physical and social opportunity, reflective and automatic motivation. The inclusion of physical and social opportunity and automatic motivation, as well as several underutilised BCTs addresses gaps in past parent-focussed interventions. Hence, proposed intervention content is novel in its behaviour change approach, yet inspiration and application of intervention strategies from the broader nutrition field enhance the likely intervention feasibility. Several considerations were kept forefront throughout the design process; for example, caution to not widen socio-economic inequalities by the proposed content. Intervention strategies were designed to be implemented within multiple environmental settings by various stakeholders, and that could be implemented at scale if effective. The multi-environment approach supports development of habits and favourable social norms, and reduces parental burden, to ensure content would *support* parents. Proposed intervention content is novel for parent-focussed nutrition interventions and can lead to a shift towards next generation interventions to create meaningful reductions in children's unhealthy food intake.

### 6.4.1. Primary intervention focus on purchasing behaviour

Purchasing behaviour is an ideal primary intervention target. The focus on purchasing allows for intervention approaches to reduce individual parent burden, ensures a whole of family approach, and seeks to intervene on the home food availability and accessibility that is supported by published literature. Purchasing dictates home food availability, which has been found to be associated with intake[102, 104, 418]. As stated by Rosenkranz and Dzewaltowski[77] *"Children are unable to eat foods not available to them."*(p 134). Home food availability has been raised as an important influence on provision of unhealthy foods in past research[69, 77, 138, 153], as well as in original research in Chapter 4 (Study 2). The approach to limit home food availability of unhealthy foods could further support families of lower socio-economic position, who have been found to have higher availability of unhealthy foods[419].

Past parent-focussed interventions to reduce unhealthy foods (Chapter 5, Study 3) have often targeted either the outcome of reduced child consumption without specifying the behaviours for how to achieve this[162, 336-338, 341, 346], or targeted direct food provision behaviours. For example, targeting direct food provision through certain parent feeding practices[308, 339, 344, 345, 347], such as monitoring, which adds to parental mental load and greater burden to resist child requests. If researchers can intervene effectively on home food availability through purchasing behaviour, secondary interventions targeting direct provision may not be needed. This aligns with stimulus control approach in behavioural psychology, where changes in the environment can reduce unfavourable behaviours, an approach that has been used to decrease children's sedentary behaviour[420]. Therefore, the current intervention content is hypothesised to reduce pressures in the home, including pressures from tension with co-parent provision and in resisting child unhealthy food requests. In addition, restructuring home food availability supports a whole of family approach, as is recommended for child weight management interventions and has the potential to positively influence all family members dietary intake[360]. Altering the food environment has been advocated for in public health obesity prevention[421, 422], proposed intervention content encapsulates this within government and community settings, as well as implementing strategies at a more controlled environment within the home setting. Proposed intervention content aimed at supporting parents in reducing unhealthy snack purchasing has numerous benefits over other behaviours, such as direct provision.

### 6.4.2. Interventions using novel behaviour change components

Although the proposed intervention strategies are not necessarily new ideas in the nutrition field, they do contain novel components of the Behaviour Change Wheel and have not yet been implemented in the context of unhealthy sweet and savoury snack provision. Key gaps in sources of behaviour identified from past parent-focussed interventions, include physical and social opportunity, and automatic motivation (Chapter 5, Study 3). Only one study, by Fletcher and colleagues[161], included physical opportunity as an approach by seeking to restructure the pantry or limit unhealthy food purchases to reduce children's access and availability of unhealthy foods at home. Proposed intervention content has a strong focus on addressing behaviour change enablers to address these gaps. Strategies to enhance physical opportunity include having appropriate snacks available in food outlets and restricting prompts for unhealthy foods. Social opportunity enablers include creating a shift in social norms and having more support from family members to provide appropriate snacks to children. Lastly, content to support automatic motivation include strategies to develop habits, restructure the environment and change parent's own intake.

Several intervention function, specifically persuasion, incentivisation, coercion, modelling and restriction were not identified in past interventions (Chapter 5, Study 3) and provide new avenues to change behaviour. More than half (21 of 38) proposed content BCTs were not identified in past parent-focussed interventions, hence provide new approaches to reduce unhealthy foods. Intervention strategies proposed for broader environments primarily included BCTs from the hierarchical clusters of *Natural consequences* and *Antecedents*. These BCT clusters are well suited to the types of strategies appropriate for broader environmental settings, such as raising awareness of consequences and restructuring the environment. Whereas, BCTs proposed for strategies in the home more commonly covered *Social support, Comparison of behaviour, Identity* and *Self-belief*, as well as *Natural consequences* and *Antecedents.*

The novel target behaviour of reducing purchasing of unhealthy snacks and inclusion of multiple implementation stakeholders allowed for inclusion of incentivisation, coercion, and restriction approaches that can be implemented at the government or community level, by policy categories such as legislation, regulation or fiscal measures, not used in past interventions (Chapter 5, Study 3). A recent review of food environment policy regulatory interventions found immediate dietary improvements, yet they failed to reach clinically significant improvements as a result of such regulatory interventions[423]. However, not all studies reviewed were focussed on unhealthy foods and majority were set in the United States[423], therefore may not directly relate to the Australian context. In addition, it may be that both regulatory interventions and individual focussed interventions are needed, to synergistically create meaningful reductions in unhealthy food intakes. Incorporating intervention strategies to increase physical and social opportunity and automatic motivation, through underutilised intervention functions and policy categories leads the way in next generation interventions.

Whilst the proposed intervention strategies are novel in the context of reducing parents' unhealthy snack purchasing, they are likely to be suitable for implementation as there is already some action in the broader nutrition context. In the current Australian context, political action for preventative nutrition tends to be provision of guidelines or voluntary regulation approaches. For example, the Australian Commonwealth Healthy Food Partnership, which is a collaboration between government, public health sector and food industry, are working on various voluntary initiatives to improve population diet[89]. However, such voluntary regulation approaches require interest and engagement by food industry to make changes to the food supply, and there is limited progress to date in modifying portion sizes and multi-nutrient reformulation approaches of snack foods[89].

Similarly, there has been implementation of regulation strategies to limit free-to-air unhealthy food advertising to children during children's television viewing times. Regulation only begins to moderate the degree of marketing children are exposed to and does not impose limits on unhealthy food advertising[424]. For example, such regulation does not apply to popular programs in family viewing times or the range of new media such as online viewing and games, as well as outdoor advertising and print media[82]. There are also self-regulated food industry codes, however these rely on a loose definition of unhealthy food advertising 'directed primarily to children' and have several loop holes[425]. A recent economic modelling study by Brown and colleagues[426] predicted legislation to restrict unhealthy food advertising to children reduce energy intake by 115kJ per day in children aged five to 15 years, saving over a 130 times that amount in health care cost-savings over a lifetime, with total savings of AUD783.8 million (95% uncertainty level 375.6 million—1.2 billion). There is a need to expand current policy action in Australia to focus directly on unhealthy snacks and include other policy categories such as legislation. The current study findings provide a clear rationale for a comprehensive approach reducing unhealthy sweet and savoury snack purchasing. As such, the resulting next generation interventions may be able to create meaningful reductions in children's unhealthy food intake by leveraging existing opportunities, that have not been achieved by past parent-focussed intervention approaches.

### 6.4.3. Differences in behaviour changes enablers by socio-economic background

There appear more similarities than difference in behaviour change enablers, between parents from lower socio-economic backgrounds and the general parent population. The behavioural analyses in this study allowed comparison of current evidence of the barriers and enablers to unhealthy snack provision by socio-economic position. Important elements of the COM-B model were consistent between groups despite minor differences in prioritising behaviour change enablers—primarily relating to influences of costs and friends. One of the past qualitative studies compared Australian parents understanding and approaches to providing unhealthy foods, between those of low and high socio-economic position, concluded there were few differences between groups[69]. However, key differences noted were that although cost was a driver regardless of socio-economic position, it was a primary influence for parents of low socio-economic position, and the influence of friends and social occasions predominantly raised by parents of high socio-economic position[69].

Although there are associations between higher socio-economic position and lower unhealthy food intake[13, 15-17], there is limited evidence of differences in the drivers of this variation[419]. There may be different drivers of unhealthy food provision, such as more emphasis on cost in families of lower socio-economic position and focus on child resistance in families of higher socio-economic position as seen in Study 2 (Chapter 4), but regardless result in provision above recommendations. In addition, this study did not include the subsequent steps of designing intervention materials that may require different approaches for families of lower socio-economic position. Nevertheless, inclusions of intervention content for lower socio-economic specific behaviour change enablers, based on available evidence is crucial to avoid widening socio-economic inequalities.

### 6.4.4. Levers of change in multiple environmental settings

Complex behaviours require intervention strategies in multiple environmental settings to achieve meaningful change and reduce individual burden[427]. A recent review suggested multi-component environmental (e.g. home, school, and community) strategies are needed for obesity prevention to create more significant and sustainable changes in dietary behaviours[422]. Though there is still a need for parent targeted strategies, inclusion of intervention strategies in other settings, provides an opportunity for strategies to value add and have synergistic benefits on reducing unhealthy snack purchasing and hence child intake. The Health Exercise Nutrition for the Really Young program in Leeds, United Kingdom, is a key example of the importance of involving parents to improve children's health behaviours via interventions delivered through other settings[413]. Leeds is one of the few cities in the world to create a reduction in early childhood obesity prevalence, with the citywide implementation of the aforementioned program thought to be responsible for this decrease[428]. In addition, the benefits of a multi-environmental approach include: reducing parental burden, creating a shift in social norms and supporting habit formation, all to support sustained behaviour change.

***Limiting parental burden***

There is a tendency for interventions targeting a change in parental provision to impose high levels of individual burden. Targeting intervention content towards numerous implementation stakeholders emphasizes the societal responsibility in tackling excessive unhealthy food intake, as argued by Schwartz and Puhl[353] in the area of childhood obesity. Combining both low and high individual agency strategies aims to synergistically support reductions in children's unhealthy food intake[362]. For example, combining strategies in the broader environments that require little parental effort, with strategies within the home to empower parents. Where possible strategies directly targeting parents would be delivered in a way to minimise the level of individual agency, such as automating process to reduce the steps parents need to participate. For example, receipts automatically calculating the amount spent on unhealthy foods, rather than relying on parents self-monitoring. Reducing the mental load and individual agency aims to make change easier for parents and may lead to more effective interventions. In addition, a review of healthy eating interventions found approaches that were less individual focussed (e.g. upstream approaches-policy, environment, promotion), rather than for example nutrition education, appeared to decrease socio-economic inequalities[429]. Complementary intervention strategies with a range of implementation stakeholders across socio-ecological settings ensures the resulting intervention truly *supports* parents to change provision, to reduce individual burden.

***Creating a shift in social norms***

Intervention content crossing socio-ecological levels is likely to help create a favourable change in norms[427], where prompts and supports in various broader environmental settings can reinforce strategies within the home. As previously mentioned social norms can impact on how and what individuals choose to eat, with food patterns influenced by those of friends, family and broader social network[430]. Research has shown that if those in our social network regularly consume unhealthy foods, we are also likely to regularly consume unhealthy foods[431]. Past parent-focussed interventions have required parents to develop the competence to change provision generally against the established unfavourable norms. Behaviour change experts have suggested that norms may not be modifiable by BCTs and instead requires environmental change, hence making it difficult to target through an individual focussed intervention[373]. The aim to shift social norms aligns with suggestions from researchers for what is needed to alter obesity prevalence[427, 432]. The multicomponent approach to create a shift in social norms parallels the approach taken to successfully reduce cigarette smoking rates and reverse the social norms within Australia and the

United Kingdom, another ‘stop / reduction’ behaviour[433, 434]. Successes to date to shift prevalence rates and norms related to smoking can be attributed to the policy changes regarding advertising, packaging, pricing and restricting where people can smoke, in combination with individuals being supported to change behaviour, over a long period of time[433, 434]. Intervention strategies in multiple environmental settings are needed to enhance the intervention chances to shift social norms and sustainable change.

***Importance of habit development***

Prior intervention design tends to focus heavily on initiating behaviour change, rather than incorporating approaches to support development of habits. Some behaviours only require initiation, for example certain immunisations requiring a once off action, whereas eating behaviour requires multiple interrelated behaviours on an ongoing basis. Past parent-focussed intervention have often focussed on initiating behaviour change, which has led to some reductions in unhealthy food intake in the short term, that are not maintained[308, 341]. Behaviour change theory highlights the importance of habit development, swapping from reflective motivation driving behaviour to automatic motivation for behaviour maintenance[3]. There are several ways to support habit formation in behaviour change, including intervening at a time where there are natural shifts in parents’ capability, opportunity and motivation[185, 388], such as children’s transition to formal education. Habit theory suggests that establishing new habits is easier when there is already disruption in usual routine[388]. Hence, making intervening in the targeted age group an ideal time to support swapping unfavourable habits and create favourable habits.

In addition, the proposed intervention content includes strategies to restructure the environment to alter physical and social cues to behaviour that further support establishing habits. This is as habits are behaviours triggered by an automatic response to a learned context-behaviour association[184]. Certain BCTs, such as *Behavioural substitution* (BCT 8.2) and *Habit reversal* (BCT 8.4), were also selected that are designed primarily to support development of habits and by addressing unfavourable habits. Targeting purchasing behaviour itself may also assist in developing habits. The focus at point of purchase, rather than direct food provision, may help parents to act on favourable intentions without other influences such as child resistance that are more likely present in direct provision contexts. Proposed intervention content incorporates aspects of multiple environmental settings, shifting social norms, and certain BCTs to assist development of habits.

### 6.4.5. Study strengths and limitations

There are numerous strengths of the current study. Intervention content was developed using a systematic approach underpinned by several theoretical frameworks in the Behaviour Change

Wheel process. The systematic process allowed for all sources of behaviour, intervention functions and policy categories to be considered, as well as the use of theories including COM-B model, Theoretical Domains Framework and BCT taxonomy to ensure content was theoretically grounded. The Behaviour Change Wheel process aims for researchers to consider options outside of traditional approaches, which has led to novel parent-focussed intervention development. There were no preconceived ideas at the outset of what the intervention would look like. This combined with completing the Behaviour Change Wheel process prior to stakeholder consultation has led to open-minded intervention design, rather than simply conforming to what has been tested in past interventions. The open-minded thinking has however resulted in rather ambitious intervention strategies. Once refined through stakeholder consultation, ambitious intervention strategies will likely require advocacy and collaborations between researchers and implementation stakeholders to come to fruition. Lastly, an important strength of the current study is the incorporation of numerous sources of evidence to inform and refine intervention target behaviour, behaviour change enablers, as well as translated strategies including BCTs, hence was evidence-informed.

Limitations identified can direct the next steps in development and feasibility testing. As previously mentioned the current intervention content requires stakeholder consultation to determine feasibility and refine strategies. One approach is to assess intervention content with the APEASE criteria—affordability, practicability, effectiveness and cost-effectiveness, acceptability, side-effects / safety and equity—as recommended by Michie and colleagues[3]. For example, to determine whether proposed strategies involving regulation (policy category) of food products is acceptable to policy makers and food industry. Whilst scalability was considered when prioritising intervention strategies this was not extensive given the scope of the project. Frameworks such as the Consolidated Framework for Implementation Research could be used to further consider implementation of the proposed intervention content at scale[435]. The number of intervention strategies identified in this study also leads to additional challenges when it comes to the testing and implementing stages, requiring a series of complimentary interventions. Engaging researchers and policy makers working in each setting, as well as using realist evaluation approaches such as stepped-wedge cluster randomised controlled design[436, 437], would help to moderate this limitation and provide a more coordinated and comprehensive approach to reducing unhealthy food provision.

Although, multiple sources of original and published literature were used, there are numerous gaps in the current evidence base regarding unhealthy foods, particularly related to parents in lower socio-economic circumstances. Similarly, the subgroup analyses in the current project and some published studies, socio-economic position was based on a geographic measure of socio-economic position (e.g. Socio-Economic Indexes For Areas), rather than predictors specific to the individual family, such as parent education or household income that are more strongly related to dietary intake[17]. Finally, a key limitation related to the Behaviour Change Wheel process is the lack of BCTs for group or population focussed interventions, such as restriction approaches. Current BCT taxonomy (BCTTv1) and evidence to suggest which BCTs relate to certain intervention functions are primarily based on individual centric interventions. Slight adaptations in some BCTs were incorporated to address this limitation. For example, '*Avoidance / reducing exposure to cues for the behaviour'* (BCT 12.3) definition was adapted to include 'change' along with 'advise', consistent with the definitions for other BCTs (12.1, 12.2) within the hierarchical cluster *Antecedents.* Similarly, the definition for '*Conserving mental resources'* (BCT 11.3) was adapted to include '*change, or advise on ways of minimising demands on mental resources to facilitate behaviour change*'.

#### 6.4.6. Implications for future research

This chapter provides theoretically grounded, evidence-informed intervention content targeting parents to take forward to stakeholder consultation and feasibility testing, prior to wide scale implementation and evaluation. Future directions relate heavily to progressing the current intervention content through stakeholder consultation and feasibility testing. The logical next step for future research is to take the designed intervention content forward into stakeholder consultation for assessment by the APEASE criteria[3]. Stakeholders should include all implementation stakeholders, such as parents, educators, health workers, food outlets and industry, policy makers and public health advocates. Additional research may be needed to inform the APEASE assessment, for example, computer modelling of a combined tax on unhealthy snacks and subsidy on healthy snack alternatives to determine any potential inequalities (i.e. assess equity of proposed strategies). Following stakeholder consultation intervention content requires feasibility testing prior to wide spread implementation and evaluation as is recommended when designing complex interventions[181]. One approach to feasibility testing content could include the Multiphase Optimisation STrategy, which uses a fractional factorial phased approach to optimising intervention components[438]. Future evaluation of the proposed content will also provide greater insight into whether next generation interventions can achieve larger and sustainable reductions in unhealthy foods.

## 6.5. Conclusion

Best-practice intervention design involves a thorough development process, such as that of the Behaviour Change Wheel used in this chapter. Sufficient time invested into the behavioural analysis—supported by behaviour change theory and numerous evidence sources—has led to the design of theoretically grounded, evidence-informed intervention content for reducing unhealthy snack provision. Prioritising behaviour change components identified as gaps in prior intervention research has ensured proposed intervention content results from next generation design in the space of parent-focussed interventions to reduce provision of unhealthy foods. Key intervention content identified included strategies within multiple environmental levels and involves multiple stakeholders to support the implementation. Special consideration of the need of parents from lower socio-economic backgrounds in the behavioural analysis has helped to design content that should not widen socio-economic inequalities. Scalability of intervention content has been considered from the outset, to help reduce the research to practice lag-time and lead to population level changes in parents unhealthy sweet and savoury snack purchasing. Involving implementation stakeholders across environmental settings helped to ensure next generation interventions truly *support* parents and enhance shifts in social norms and development of habits to create sustainable, meaningful reductions in children's unhealthy food intake. The suite of intervention strategies provides an ambitious, coordinated approach to support parents to reduce unhealthy snack purchasing, yet draws on strategies from the broader nutrition field. Prioritised intervention content can now be taken forward to stakeholder appraisal and feasibility testing.

**_Chapter 6 findings at a glance_**

Intervention content developed was theoretically grounded, evidenced-based, as a result of meeting the following considerations throughout the Behaviour Change Wheel process. Specifically, designed intervention content:

*1) was supported by behaviour change theory*

Intervention content was supported by behaviour change theory through use of the COM-B model and Theoretical Domains Framework to identify and rate behaviour change enablers, as well as in selection of appropriate BCTs in proposed intervention strategies.

*2) was informed by the evidence base including research studies within this PhD or broader published literature*

Findings from new research generated as part of this PhD (Chapters 3, 4 and 5) and published literature was used throughout the Behaviour Change Wheel process from Steps Two to Seven.

*3) was suitable for scale, considered the needs of families in lower socio-economic circumstances and includes low agency strategies (i.e. to be implemented by stakeholders in multiple environmental settings)*

Selected intervention strategies could be implemented at scale as they involve either broad environmental changes, or could be delivered via distance, population level modes. A separate behavioural analysis conducted based on available evidence for families in lower socio-economic circumstances, assisted in prioritising behaviour change enablers to meet the needs of such families. Although there were few differences in the behavioural analyses for the general population and families from lower socio-economic backgrounds.

Intervention strategies were designed for policy makers within the government and society setting, food outlets within the food supply, educators and health workers within the community setting, and parents and families within the home setting, therefore included intervention strategies in all settings of the socio-ecological framework. Including intervention strategies across the socio-ecological framework can support reducing parental burden, creating a shift in social norms and enhancing habit formation.

# 7. GENERAL DISCUSSION AND CONCLUSION

This final chapter provides a brief recap of the main findings of the four studies that make up this thesis, to lead into a general discussion of the consolidated findings. Overall strengths and limitations of the thesis are discussed, future directions are outlined, and conclusions drawn.

## 7.1. Overview

Young children's intake of unhealthy foods—high in saturated, added sugars, sodium and often energy—remains well above recommendations. There are many factors that influence children's intake, across multiple socio-ecological settings[73]. The home setting and parental influences are the most direct and important influencing factors for young children[102, 103]. Best-practice intervention design frameworks, such as the Behaviour Change Wheel process, provides an approach to systematically design intervention content to reduce children's unhealthy food intake[3]. This PhD project used this framework to develop theoretically grounded, evidence-informed content to support parents to reduce unhealthy food provision to their three to seven-year-old children. A key theoretical model within the Behaviour Change Wheel, is the Capability, Opportunity, Motivation and Behaviour (COM-B) model[3], which formed the basis of the behavioural analysis in the current project. To complete the Behaviour Change Wheel process (Chapter 6, Study 4), new knowledge was generated to understand parents' reflective motivation (Chapter 3, Study 1), physical and social opportunity (Chapter 4, Study 2), and the behaviour change components of past parent-focussed interventions (Chapter 5, Study 3). This chapter provides a discussion on several main findings being the use of behaviour change theory in intervention design, the role of reflective motivation, importance of physical and social opportunity and consistent intervention targets across subgroups. It also summarises the future directions for research in this area to support reduction of children's unhealthy food intake.

## 7.2. Summary of main findings

### 7.2.1. Reflective motivation

Chapter 3 (Study 1) involved comprehensively examining parental reflective motivation towards limiting unhealthy food provision to their children. Reflective motivation includes evaluations, intention and conscious decision-making[3]. Self-rated parental motivational constructs were analysed using structural equation modelling to examine the overall influence, and relative influence, of reflective motivation on provision. Parental self-efficacy, both in ideal conditions and in the face of barriers (e.g. visitors present), were identified as the most important constructs. Hence, self-efficacy is a suitable primary target to enhance reflective motivation. Intention and planning were also significantly related to parent provision, with higher intention associated with higher planning, which in turn was inversely associated with lower child unhealthy food intake (proxy for provision). Therefore, intention and planning provide ideal secondary motivational intervention targets. Whilst, the mentioned constructs are important components of reflective motivation is it worth noting that the overall model tested in this study only accounted for 9.2% of the variance in children’s intake. Hence, motivation alone cannot change behaviour. This finding highlights the importance of other components of behaviour such as capability and opportunity. Parental reflective motivation, specifically aspects of self-efficacy, intention and planning, appear an important, but not sufficient for initiating behaviour change.

### 7.2.2. Physical and social opportunity

Chapter 4 (Study 2) investigated the role of physical and social opportunity in parents’ unhealthy food provision. Specifically, exploring opportunity in parental snack provision decision-making. Physical opportunity includes the physical resources available or what is afforded by the physical environment, for example cost, time and food availability. Social opportunity refers to the social supports and norms that may enhance or inhibit behaviour change, such as child resistance, support from co-parents and family friends. Discrete choice experiment methods were used to determine the relative importance of components of opportunity. Food availability, child resistance and co-parent support were of greatest relative importance in parents’ decision-making regardless of socio-economic position or whether visitors (i.e. family friends) were present or not. In contrast to past research, time was not found to significantly influence snack choice. Although still a significant influence, cost was of lowest relative importance. However, exploring differences by socio-economic position revealed cost was of greater importance in parents in lower socio-economic circumstances, but only of more relative importance than family friends support and time. Components of both physical and social opportunity—food availability (within family resources), child resistance and co-parent support—appear important influences on parental snack provision, hence present key considerations for future intervention design.

### 7.2.3. Deconstructing past interventions by the Behaviour Change Wheel

Chapter 5 (Study 3) used the Behaviour Change Wheel to evaluate the behaviour change content of controlled interventions designed to support parents to reduce their provision of unhealthy foods in the home environment. Study 3 involved deconstructing past parent-focussed interventions into their behaviour change components, namely, sources of behaviour (COM-B components), intervention functions, policy categories and Behaviour Change Techniques (BCTs). Past interventions have led to small to moderate (Cohens d -0.2 to -0.4) decreases in children's unhealthy food intake[159]. Past interventions often targeted multiple behaviours, such as healthy food and physical activity. This raises questions of the attention given to unhealthy food focussed strategies within these complex interventions. Past interventions were found to be homogenous in terms of behavioural components incorporated. Intervention use of behavioural theory was often unclear, or when described interventions commonly used theories to explain behaviour such as the social cognitive theory, rather than theories to predict behaviour change. The majority of interventions targeted reflective motivation and psychological capability, using education and enablement functions, via service provision. Few BCTs were utilised in past interventions, highlighting greater potential to draw on additional behaviour change approaches. There are several behaviour change components that have not, or rarely, been included in past intervention, namely physical and social opportunity, automatic motivation, and numerous intervention functions and policy categories. These underutilised components can inform next generation interventions to improve the effectiveness, and lead to more meaningful reductions in children's unhealthy food intake.

### 7.2.4. Application of the Behaviour Change Wheel to design intervention content

Chapter 6 (Study 4) used best-practice intervention design, the Behaviour Change Wheel process, to develop theoretically grounded, evidence-informed intervention content to support parents to reduce unhealthy food provision. The design of intervention content drew on findings from the original research in this thesis, and available published literature. The Behaviour Change Wheel process included comprehensive analysis of the behaviour using the COM-B model. Limiting purchasing of unhealthy sweet and savoury snacks for the home was selected as the initial intervention behavioural target, over direct provision. The behavioural analysis was conducted targeting parents from lower socio-economic backgrounds, as well as for the general parent population. The behavioural analyses prioritised intervention content targeting parents' psychological capability, physical and social opportunity, reflective and automatic motivation. Several considerations were kept forefront in the design process, including implementation stakeholders at multiple settings, scalability to the population level, and efforts to minimise socio-economic inequalities. Thirteen intervention strategies were prioritised in the intervention design that could be implemented using a combination of all nine intervention functions, and all seven policy categories, and can be taken forward into stakeholder consultation. Resulting intervention content was designed using numerous untapped BCTs and underutilised intervention functions and policy categories providing a non-traditional approach to decreasing unhealthy foods. Whilst proposed intervention content is novel in its behaviour change approach, the intervention strategies were developed from examples from the broader nutrition field, hence may enhance the likely intervention feasibility. Designed initial intervention content meets several considerations to ensure next generation interventions can be incrementally implemented across multiple settings to enhance likelihood of creating sustainable, equitable change in children's unhealthy food intake.

## 7.3. Discussion of main findings

### 7.3.1. Behaviour change theory to design interventions

Use of behaviour change theory and thorough theory application via completing a behavioural analysis, helps to ensure interventions are designed based on evidence, rather than researchers' perception of population need. Conducting a thorough behavioural analysis is stressed as a crucial step in best-practice intervention design to avoid designing ineffective interventions that do not address population needs and contribute to research waste[3]. There has been some debate to whether a theory basis improves intervention success[180]. Results from meta-regressions in a recent review assessing the relationships between the extent and type of theory use, and nutrition or physical activity intervention effectiveness were inconsistent, and when present only weak associations were seen[180]. Clear issues in this space are assessing how the theory has been used in intervention design, and whether interventions are based on theories to understand behaviour or to predict behaviour change. For example, whether general theoretical principles were considered or whether theory use was extensive throughout the process, or in fact retrospectively fitted.

Another potential consideration regarding the effectiveness of theory-based interventions is the ability of selected theories to capture the complexity of health behaviours. For example, consideration of both multi-level environmental, as well as individual theory of change. King[178], supports this approach suggesting that *"to truly have a population health impact in the behavioural health field, theoretical approaches that embrace complexity and create multi-level solutions"*[(p 2)]. The application of multiple theories in the current project was heavily integrated in understanding current behaviour as well as in behaviour change. Complementary theories were used such as individual focussed with the Health Action Process Approach model to further understand the motivational constructs within the COM-B model, as well as BCT taxonomy. Individual focussed theories were combined with the socio-ecological model to look outward to the environmental influences, potential for population level intervention and the interrelation of multiple behaviours. Future evaluations once intervention content is implemented will provide insight into the benefits, or lack thereof, of this comprehensive behaviour change theory approach to intervention design.

### 7.3.2. Reflective motivation is important but not sufficient to change behaviour

Reflective motivation alone does not result in behaviour change but still an important element to initiate behaviour change. Parental self-efficacy, intention and planning appear crucial to reducing unhealthy food provision. Intervention strategies developed in Study 4 (Chapter 6) focussed on food supply changes and shifts in the social norms could support enhancing parents' self-efficacy and intention. Higher agency strategies for implementation in the home such as a resource package could provide tips and information to help increase parents' self-efficacy, intention and planning. Study 1 (Chapter 3) examined the ability of a model of motivational constructs to explain children's unhealthy food intake, a proxy measure for parental provision. The model, which comprehensively captured numerous motivational constructs, accounted for less than ten percent of the variance in children's unhealthy food intake. The amount of variance explained is lower than other models of reflective motivation in predicting behaviour[215, 217, 218]. Regardless, dietary intake is complex and multifactorial, hence one factor alone is unlikely to explain behaviour[78]. Current findings provide further support of this complexity, with motivation alone appearing insufficient to change behaviour.

Motivational constructs, particularly those theorised to inform intention, were predominately rated favourably towards reducing unhealthy foods by parents. Importantly, this finding also suggests not just the need to enhance reflective motivation, but also to address physical and social opportunity to support parents to act on their intention. There also appeared to be a miss-match between children's unhealthy food intake and parents' perception of suitable intake. For example, where parents were aware of the risks of unhealthy foods and reported the confidence to change provision yet didn't consider their child's intake to be above recommendations, hence no need for change. There are parallels with parents' inability to accurately identify their child as being above a healthy weight[254-258]. Psychological capability (knowledge, skills) is likely still important to develop favourable reflective motivation to enhance intention, such as perception of risk for their own child, based on intake above recommendations. Self-efficacy, intention and planning are important components of reflective motivation to consider in intervention design to create change, in combination with other elements, such as opportunity.

### 7.3.3. Importance of food availability and social supports

Strategies to support physical and social opportunity are often underutilised in intervention design, despite being commonly reported barriers to food provision. Researchers cannot ignore these important components of behaviour by simply considering them as static barriers to behaviour change. Study 2 (Chapter 4) identified the relative importance of common components of physical and social opportunity, to be able to prioritise intervention targets. Although social opportunity components were often ranked higher than physical opportunity, food availability was identified as a primary target. The current finding, using a novel methodology, confirms previous observational research finding home food availability associated with children's healthy and unhealthy food intake[103]. A meta-analysis of studies in children under 18 years old reported food availability was a significant predictor of children's unhealthy food intake (r = .34, $p$<.001, 95%CI .21 to .46; 6 studies, n=3421), and was the second strongest predictor behind parental modelling (r = .35, $p$<0.001)[103].

Interventions are required to actively target food availability, for example through food purchasing to create a shift in home food availability. Such a change has the potential dual benefit on intake if healthy food availability increases in their place. Aspects of social opportunity were identified as secondary targets, in non-social occasions. Intervention strategies are needed to focus on child resistance / acceptance and co-parent support. It is conceivable that child resistance could be mitigated by changing food availability and shifting family norms[77, 102]. There are several ways support from other family members can be incorporated into intervention design. For example, targeting the co-parenting partnership in intervention strategies or including co-parents in the intervention delivery, rather than one co-parent engaging in the intervention[321]. There is growing evidence in early childhood of the importance of engaging all parents and caregivers in interventions, particularly fathers who are underrepresented in diet focussed obesity prevention interventions[439, 440]. Intervention designers need to increase consideration of physical opportunity, such as food availability, and social opportunity, such as support from children and co-parents.

#### 7.3.4. Consistent initial intervention targets across subgroups and social contexts

Tailoring intervention content to individuals or sub-populations has been suggested as a promising approach to increase effectiveness of nutrition interventions[441]. However, excessive unhealthy food intake in children is a widespread problem of across a range of subgroups and contexts. The breadth of the issue may explain the lack of variation in intervention targets within subgroups in the current study. Considering the needs of parents from lower socio-economic backgrounds in designing intervention content remains an important first step to reduce socio-economic inequalities. Across Study 1 (Chapter 3) and Study 2 (Chapter 4) there were more similarities than differences in parental reflective motivation and opportunity targets in subgroups of parents of lower versus higher socio-economic position. However, alternative indicators of socio-economic position (i.e. not area level indicators) may reveal differences relevant for intervention design or delivery.

A focus on inequalities should still be kept forefront in the following intervention feasibility and evaluation stages. In addition, it is crucial to consider the broader issues experienced by families in low socio-economic circumstances that may impact the success of future interventions, such as food insecurity, low quality or unstable housing and exposure violence[442]. There is evidence to suggest healthy eating interventions that rely solely on implementation by individuals may widen socio-economic inequalities and health burden, compared with interventions that are less reliant on an individual's resources that can reduce inequalities[429]. Yet, the example of the Health Exercise Nutrition for the Really Young intervention in Leeds, United Kingdom, mentioned in Chapter 6 (Study 4), focussed on increasing parents' knowledge, skills and confidence, resulted in reductions in children's unhealthy food intake including in families living in the most disadvantaged areas[413]. This example intervention achieved reduced health inequalities by targeting the intervention delivery to disadvantaged areas of the community[413, 428]. Differences in importance of physical and social opportunity were examined in subgroups of parents of children with overweight or obesity and those within the healthy weight range, as well as by social context (Chapter 4, Study 2). As with analyses by socio-economic position, the top three opportunity intervention targets were consistent across subgroups by children's weight status and regardless of social context where family friends were present or not.

Research into unhealthy foods and social occasions is extremely scarce therefore only speculative explanations can be discussed. Similarities in opportunity targets in social and non-social contexts, may be different on weekdays, out of home provision, or celebrations rather than social occasions. Celebratory occasions such as birthdays or cultural celebrations are often raised in the literature as exceptions to usual provision, where unhealthy foods are often seen as central to the celebration[68, 70, 211]. The current findings suggest tailoring to sub-populations or contexts of unhealthy food provision is not needed at this time. Findings from the current studies suggest initial intervention targets are consistent across subgroups of parents of low socio-economic background, or differing child weight status, as well as in social and non-social occasions.

## 7.4. Strengths and limitations

### 7.4.1. Overall thesis strengths

There are many strengths of the current PhD project. Firstly, the application of comprehensive theoretical guidance, combining behaviour change and socio-ecological approaches was a key strength. My expertise in these areas, from prior work in public health nutrition practice, past applications of the socio-ecological framework, and training undertaken contributed to the development of theoretically grounded intervention content. There are several novel components within this overall body of work. This is the first application of the Health Action Process Approach model focussed on unhealthy foods and the first to explore parental motivation on child outcomes. The systematic review deconstructing past interventions is only one of a few reviews in any field to extract comprehensive behaviour change components including sources of behaviour and intervention functions. In addition, the review is also still one of few within the children's nutrition field to code BCTs and the only published study to code BCTs in unpublished content, to my knowledge. This project is also one of few to use the Behaviour Change Wheel process to design intervention content targeting parent provision, and the first specifically targeting unhealthy food purchasing behaviour.

Secondly, this project utilised rigorous data driven approaches when generating new research, hence provided a more objective approach to identify intervention targets. For example, the use of validated questionnaire items to collect information about reflective motivation to feed into structural equation modelling within Study 1 (Chapter 3). Study 2 (Chapter 4) used a highly novel methodology within the nutrition field, of a discrete choice experiment to identify the relative importance of opportunity aspects through a statistical approach to detangle the complex factors influencing snack provision decision-making. Use of this methodology was possible with guidance from my supervisor with expertise in health care discrete choice experiments. The complex analyses were possible due to the large sample sizes recruited, with participants in both Study 1 and 2 exceeding sample size calculations. The large sample sizes in Study 2 also allowed for subgroup analyses to be undertaken to explore differences by socio-economic position and child weight status. Both of the data driven approaches were still informed and guided by theory and current available evidence. For example, structural equation modelling was based on the Health Action Process Approach framework, and attributes in the discrete choice experiment were selected from the literature.

Another key strength was the thorough and rigorous evidence-informed intervention design approach. For example, deconstructing past parent-focussed interventions to their behaviour change components to help identify gaps to ensure novel strategies, whilst drawing on behaviour change theory. Intervention design incorporated multiple theoretical avenues to produce content with the greatest chances of success[3, 166, 208]. In addition to specific behaviour change theory within the Behaviour Change Wheel, the design process considered evidence to reduce parental burden, shift social norms and utilise habit theory[362, 388, 427]. Parent burden was kept forefront throughout the design process with proposed content synergistically combining traditional high agency parent-focussed strategies to empower parents with population level low agency strategies such as restructuring the broader environment[362]. Social norms have received little attention in relation to unhealthy foods, but pose an important barrier or enabler to behaviour change[430], hence directly seeking to shift norms is another strength of the current project. Past interventions have also focussed primarily on initiation of behaviour change, with future iterations tackling sustaining change[159]. In the current project formation of habits have been considered from the outset to try to not only initiate behaviour change, but also develop habits to create sustainable improvements in children’s unhealthy food intake. In addition, drawing inspiration for intervention strategies from the broader nutrition field (see Table 6.4 and 6.5 in Chapter 6), resulted in intervention content that is likely practical, whilst incorporating novel behaviour change components in the area of unhealthy food provision. All three considerations are support by designing intervention content in multiple environmental settings to provide a more comprehensive intervention, where different strategies may enhance the success of the others.

Finally, this project includes highly transparent intervention design. Clear reporting in intervention design has improved in recent years with adoption of reporting guidelines for intervention protocols (TIDieR[359]) and evaluations (CONSORT[358]). As well as, through greater emphasis on publishing study protocols, online supplementary files with many journals and a push to make data and intervention materials available in online repositories[443-445]. However, even with reporting guidelines explicit descriptions of theory use in the design process or explanations of how researchers predict intervention strategies will change behaviour are limited. The Human Behaviour Change Project based in the United Kingdom are seeking to code and synthesis such information retrospectively to help build a collective multidisciplinary understanding of behaviour change interventions[446]. The current project prospectively and thoroughly reports the intervention design process, including theory application and proposed behaviour change enablers.

### 7.4.2. Overall thesis limitations

Individual study limitations are discussed in further detail in the preceding chapters. However, there are also important limitations relevant across studies to consider when moving forward with the developed intervention content.

Firstly, a limitation of the current intervention design process if the lack of stakeholder consultation and feasibility assessment, such as by the APEASE criteria. This is not because stakeholder input is not valued but rather to keep the project within the scope of a PhD. Original evidence was needed as a starting point, therefore the current PhD focussed on generating new knowledge regarding unhealthy food provision to young children. Parents' perspectives were however considered through original research with parents conducted as part of Study 1 (Chapter 3) and 2 (Chapter 4), and in the qualitative literature used to inform the behavioural analysis and prioritisation of intervention content. Regardless, the current intervention content is limited to theoretical and practical assessment by researchers not by key stakeholders, such as parents, food outlets and policy makers. This highlights areas for future research (detailed further in section 7.5.1).

The overall generalisability of the parent samples in this project to the Australian population is limited. Across both original data collections within this project, participating parents had a higher education level, on average 73% with a tertiary degree or higher versus 36% of Australian mothers[329]. Parents in Study 1 (Chapter 3) also had a higher household income, 52% of the sample had an annual income of AUD$104,000 and over versus an estimated $90,168 median annual income of Australian families (2016 census)[328]. The more affluent sample was regardless of actively and successfully recruiting parents from across SEIFA areas, more so in Study 2 (Chapter 4) with 53% of families residing in the lowest three quintiles, compared with 51% in the 2016 census[302]. A key learning from this is to consider the indicators of socio-economic position used when seeking to target recruitment strategies[17]. The self-selection sampling strategy employed in the current project is common in nutrition research. Hence parents interested in nutrition, of higher education levels or income choosing to take part is often the case. This can be regardless of stratified recruitment by low socio-economic position areas; within the past parent-focussed interventions reviewed in Study 3 (Chapter 5), there was an overall skewed sample towards families in higher socio-economic circumstances. The three studies included in the review directly recruiting disadvantaged families through education institutions in low socio-economic position areas, obtained samples with a higher proportion of parents with a tertiary degree than anticipating[161, 162, 344]. To mitigate the potential bias of using evidence from a higher socio-economic skewed sample, subgroup analyses were performed in Study 1 (Chapter 3) and 2 (Chapter 4), and a separate behavioural analysis performed in Study 4 (Chapter 6) for families from lower socio-economic position, using a mixture of individual and area level indictors.

Another limitation of this project is the broad child age range, while selected to cover the transition to school period as an under studied age range it is acknowledged that there are likely differential influences for a three-year-old compared with a seven-year-old. For example, a seven-year-old is likely to have greater independence in selecting and serving foods (including access to foods in the fridge and pantry), more established habits and routines, and be exposed to greater peer influences at school and playdates. In future, to account for such potential differences' subgroup analyses could be performed by age within the selected age range.

Lastly, application of behaviour change theory is somewhat subjective, hence was influenced by my interpretation. However, comprehensive training in the behaviour change theory was undertaken, during which experts in the Behaviour Change Wheel provided critique and input into a preliminary behavioural analysis at the University College London Centre for Behaviour Change Summer School. The detailed step-by-step Behaviour Change Wheel guide to intervention design book[3] and related publications[166, 186, 208] were constantly referred to, ensuring the integrity of the theory and process. I have experience in using the BCT taxonomy and Behaviour Change Wheel in different applications, in collaborative projects outside the current thesis. Initial selection of the motivational framework, Health Action Process Approach model, was also informed by a behavioural scientist. Yet this led to a limitation of this project, which is the disproportionate focus on reflective motivation, compared with the remaining five sub-components of the COM-B model. In hindsight it would have been ideal to explore all six sub-components of the COM-B model in equal depth. However, the HAPA model was pre-specified at the outset of the project as this theory informed the development of the only validated questionnaire to measure constructs of parental motivation towards provision of unhealthy foods, albeit limited to reflective motivation. The focus on reflective motivation and use of the HAPA model allowed me to extend the depth in understanding of this area from my prior honours research[220]. The transition from the HAPA model to the COM-B model demonstrates the growth in my knowledge and understanding of behaviour change science and as such the COM-B model will guide future research stemming from this thesis. As behaviour change frameworks are designed for multidisciplinary application a wealth of information was available to support their use, minimising this potential limitation.

## 7.5. Future directions

This section provides a brief discussion of the future directions for research following the current project. There are several implications for future research, including the logical next steps for taking the proposed intervention content forward to stakeholder consultation and feasibility testing. Findings from this PhD also provide direction for future intervention design more broadly to consider supporting key areas of reflective motivation and opportunity, and additional intervention targets, as well as recommendations for intervention design and reporting. Several gaps in the evidence were identified through the current project and recommendations made to inform future observational research.

### 7.5.1. Progressing the proposed intervention content

***Stakeholder consultation***

The designed intervention content requires refinement through stakeholder consultation. As previously mentioned, the stakeholder assessment of intervention content was out of scope of the current thesis, yet an important component prior to feasibility testing. Suggested stakeholders include: parents, with a focus on parents from low socio-economic backgrounds; food retailers / outlet representatives, primarily from the supermarket sector given the focus on home food provision; policy makers, such as those in local council, state and national government; health workers engaging with families, for example child health nurses, general practitioners; and educators across early childhood settings, such as child care, kindergarten, primary school. One approach to consultation would be to have stakeholder groups undertake assessment of the proposed intervention content using the APEASE criteria[3]. From the APEASE appraisal, consistently highly rating intervention content could be taken forward for feasibility testing. Alternative intervention content not prioritised in the current thesis could also be considered if needed during future rounds of stakeholder consultation and with emerging evidence to support suitability. One method that could be used in group stakeholder sessions is the nominal group technique. This method involves individual quantitative data, as well as collective group problem solving or prioritising qualitative information[447]. Key benefits of the nominal group technique are that all individuals’ views are represented through initial assessment ratings that then guide the group discussion, and consensus of priorities are reached at the end of the session, hence provides rich data[447]. Stakeholder consultation is an important next step to prioritise proposed intervention content for feasibility testing.

***Feasibility test components of intervention content***

The United Kingdom Medical Research Council guidelines for best-practice in developing complex interventions stress the importance of feasibility testing prior to widespread implementation and evaluation, including effectiveness and efficacy trials[181]. Undertaking appropriate feasibility testing helps to reduce longer term costs and research waste. The following paragraphs provide initial avenues for testing selected intervention content. It is important to note the exact intervention strategies is likely to differ based on the preceding stakeholder consultation.

Intervention strategies to create a shift in social norms by implementing a social norm messaging campaign could be tested in a few stages. Firstly, testing the suitability and effectiveness of the messages themselves could for example use a discrete choice experiment to test different message options and evaluate changes in purchasing intention as a result. A discrete choice experiment approach has been used to test different messages regarding smoking cessation[448]. Once messages have been refined, they could be pilot tested in a local council area or state, with comparison sites without the social norms campaign to assess changes in awareness and intention. For example, testing social norms messaging using a combination of modes within a supermarket and assessing customer awareness and self-reported intention, as well as unhealthy food sales data to evaluate impact on behaviour. Similar approaches have been used in supermarkets in the United States to examine the influence of shopping trollies / carts social norms (messages, partitions) on purchasing of fruits and vegetables[412, 449].

Later stages of feasibility testing could be evaluated using similar approaches to the LiveLighter mass media campaign to reduce sugar-sweetened beverages in Australia. In the LiveLighter initiative frequency and quantity of sugar-sweetened beverages and knowledge and beliefs about health effects were measured pre-post in the intervention state of Victoria and the comparison state of South Australia[414]. Evaluation of social norms campaign broadly could include longitudinal monitoring of unhealthy food intake. For example, using computer assisted recalls such as the ASA24 where data around social context could also be reported[450], or food purchasing sales data linked to social networks. Ideally dietary intake and social context, data would be collected from multiple people within a social network. For example, not only children in the target group, but also their parents, siblings, extended family (e.g. grandparents) and friends (e.g. school class or parenting group). One option could be to recruit through school classrooms where there are existing networks between parent and child peers. Recruitment of social networks and data collection would likely need to be technology assisted to realistically be collected to evaluate changes on a larger scale.

There are existing platforms within Australia that could be leveraged to explore feasibility testing of food outlet and policy focussed intervention strategies, namely the Healthy Food Partnership. As mentioned in Chapter 1 (Literature Review) and 6 (Study 4) the Healthy Food Partnership is working on various voluntary initiatives to improve population diet[89]. Current activities already involve nutrient reformulation targets for certain food categories (e.g. sodium: breads, processed meats; total sugars: soft drinks, fruit drinks; saturated fats: pastries) and front-of-pack nutrition labelling[89]. The existing relationships within the partnership could support pilot testing of proposed intervention strategies, such as multi-nutrient reformulation targets with unhealthy sweet and savoury snacks as additional food category.

Another example would be for proposed intervention strategies for alternative front-of-pack warnings to be evaluated by consumers' ability to use correctly and stakeholder consultation alongside the existing Health Star Rating front-of-pack nutrition information system[451]. The Health Star Rating system has been criticised for 17% of unhealthy food items obtaining a rating of 3.5 or higher stars, indicating a healthier choice within the food category[396]. There is potential for a combined front-of-pack information systems, such as unhealthy food warnings. This could help to overcome some of this confusion and make information about unhealthy foods easier for the public to interpret. As for in-supermarket social norms campaign, evaluation of pilot food reformulation or labelling changes could include customer awareness and self-reported intention, as well as unhealthy food sales data. Such strategies could be piloted outside of the Healthy Food Partnership, however, would require researchers to develop relationships with food industry, which could emerge out of the earlier mentioned stakeholder consultation processes.

A series of parent directed intervention strategies were included in the prioritised intervention content. There are numerous approaches to testing individual intervention strategies, one such approach is the Multiphase Optimisation STrategy (MOST)[438]. The MOST method has advantages over traditional randomised controlled trials as it seeks to not only evaluate behavioural interventions but to optimise components using a fractional factorial phased approach[452]. For example, the MOST method can be used to obtain the most cost-effective or briefest intervention to achieve a certain reduction in unhealthy food purchasing[438]. The current proposed parent intervention content consists of several different topic areas and interactive strategies that could each form a different module or component of an intervention. Feasibility testing using the MOST method could help to limit the number of modules to those most likely to lead to the greatest reductions in unhealthy food purchasing, whilst reducing parent burden. Evaluation using this method could also optimise the delivery approaches[438]. In addition, feasibility testing could explore which modules are of most relevance to certain profiles of parents to help tailor content to different parent subgroups. A key component of testing dietary changes of the parent-focussed strategies would be to ensure whole of diet measures are collected. Whole of diet measures will help to assess whether reductions in target unhealthy foods are being compensated by increases in other unhealthy foods or more ideally being replaced by healthy foods. Feasibility testing will clarify uncertainties in the designed intervention content to increase the chances of implemented content effectively and sustainably changing unhealthy food provision.

### 7.5.2. Future intervention design

***Strategies to address key findings in reflective motivation, physical and social opportunity***

Strategies are needed to support changes in parents' reflective motivation. Self-efficacy was identified as a key component of parents' reflective motivation. Behaviour Change Techniques in the hierarchical cluster of *Self-belief*, such as verbal persuasion of ones' capabilities (BCT 15.1) or self-talk (BCT 15.4), could be incorporated in future intervention designs. Inclusion of such techniques could increase parents' self-perception of such capabilities, when possessing the capability and opportunity to reduce unhealthy food provision. Intention and planning were also seen as important motivational constructs. Future interventions could include strategies to enhance intention and support detailed planning, such as implementation intentions and cue monitoring. Behaviour Change Techniques to support implementation intentions and cue monitoring include problem solving (BCT 1.2) and action planning (BCT 1.4) to consider how and when intentions can be acted upon and identifying prompts and cues (BCT 7.1) to encourage the behaviour initiation and habit formation.

The scarcity of interventions to measure changes in parents' reflective motivation should also be addressed in future research. One study by Van Allen and colleagues[140] examined the association between parents change in motivation with the intervention's outcome variables of child weight status, dietary and physical activity measures. Incorporating such additional analyses and including pre-post measures of reflective motivation will provide researchers with insight into mediators of intervention effect to direct further research in the area. The Parental Food Attitude Questionnaire or key constructs from within this tool could be used to capture such changes in parental motivation in future interventions.

Key barriers related to physical and social opportunity can be translated to behavioural strategies in future intervention design. Food availability, child resistance and co-parent support are important aspects of opportunity influencing snack provision decision-making. For example, BCTs such as identify self as a role model (BCT 13.1) could be used by parents to role model healthy snack habits with children to reduce resistance. Another strategy may be to restructure the physical (BCT 12.1) and social environment (BCT 12.2). For example, so that only healthy snacks are available within the home and so that children come to expect snacks as healthy foods, reserving unhealthy foods for dessert and special occasions. These strategies would also be options to modify the food availability, another intervention target. Similar techniques may be used to enhance support from co-parents. Such as restructuring the social environment (BCT 12.2), so there are consistent provision goals and expectations between parents or restructure the physical environment (BCT 12.1) so that unhealthy snacks are less available for co-parents to provide.

Other intervention delivery aspects may further increase support from co-parents, such as including all parents and carers in interventions to reduce unhealthy food provision. Including co-parents would allow for strategies around practical social support (BCT 3.2) and conserving mental resources (BCT 11.3) to be incorporated in an intervention, as well as for consistency in provision for the child. More broadly changes to the out of home environment would also support these areas of parents' opportunity. Such as having appropriate alternative healthy snacks available in the supermarket (restructuring the physical environment BCT 12.1; i.e. food system change) or strategies to support changes in the social norms to reduce unhealthy food intake, such as a credible source (BCT 9.1) demonstrating the favourable norms and behaviour (BCT 6.1).

***Targeting home unhealthy food intake***

Current intervention content prioritised unhealthy sweet and savoury snacks as initial food targets, however future research is required to design interventions to reduce home food provision of remaining unhealthy food subgroups. The same approach to intervention design used in Chapter 6 (Study 4) can be used to design intervention content for other unhealthy food targets. Such other targets could include fried potatoes and takeaway style foods, processed meats, pastries (e.g. meat pies) and sugary beverages. If children's intakes of unhealthy foods remain above recommendations following implementation and evaluation of interventions targeting unhealthy food purchasing, other behaviours such as direct parental provision should be considered. Again, the same approach to intervention design in the current project can be used where a behavioural analysis is conducted for direct unhealthy food provision. Intervention strategies targeting direct provision are likely to consist of greater strategies to enhance self-efficacy and skills in managing child resistance.

Additional behavioural targets are likely a natural progression for research in this area, not only considering other parental behaviours but also interventions targeting child behaviours. For example, future research should also include a behavioural analysis and complete the intervention design process with young children as the target population. Child focussed intervention design could act as complementary intervention strategies. Intervention content targeting young children could also include parents' as implementation stakeholders to support delivery of intervention strategies, which may be taken from the current project intervention content. Future intervention content, for other unhealthy food targets, parental behaviours or with children as the target population, could be implemented in addition to current intervention content to provide complementary interventions.

***Recommendations for intervention design and reporting***

The intervention design process undertaken in the current project provides an example for nutrition researchers to utilise in designing and reporting interventions across a range of target foods and consumption settings. Intervention design directly targeting unhealthy foods is still relatively new. One other study has used the Behaviour Change Wheel to design a childcare centre based intervention to reduce unhealthy foods being packed in the lunchbox—the trial is currently underway[201]. Future research should repeat this design process for the numerous out of home eating locations, such as schools and food outlets (e.g. cafes, restaurants), for the many potential target behaviours and populations. Given the complexity of the behaviour, it is likely that multiple settings and sectors will need to work together implement new interventions and to meaningfully reduce children's unhealthy food intake. Regardless of target behaviour and population researchers are encouraged to conduct behavioural analyses using the COM-B model to provide theory information assessment of needs when designing future interventions. As previously mentioned conducting a thorough behavioural analysis as part of the design process, gives an intervention a strong foundation and greater chance of resulting in meaningful behaviour change[3].

When deconstructing past parent-focussed interventions (Chapter 5, Study 3) as part of this project, numerous limitations in current intervention reporting were apparent. Clear reporting of the intervention design process is invaluable to assist in understanding how behaviour change occurs and to inform future intervention design. This project sought to provide an example of transparent intervention design reporting. Consideration should be given in future to further modify reporting checklists, such as TIDieR[359] and CONSORT[358] statements. For example, to include reporting of BCTs as a minimum for transparent intervention design. It would also be valuable to report on the dose of BCTs to allow future work to better estimate the effectiveness of certain BCTs incorporating their dose within interventions and to evaluate intervention components when using the MOST approach. Future intervention design and reporting can be guided by the Behaviour Change Wheel and draw on the current project as an exemplar.

### 7.5.3. Gaps for future observational research

Unhealthy foods present a key public health issue and warrant investment in ongoing observational research, to continue to feed into future intervention design and monitoring. Research areas are presented in relation to reflective motivation, physical and social opportunity, psychological capability, and understanding the role of social occasions in unhealthy food intake. Future applications of discrete choice experiment methods are also outlined.

***Further understanding motivation***

In relation to motivation broadly there are several avenues to explore including various constructs of self-efficacy and automatic motivation. Self-efficacy has been discussed in detail in Chapter 3 (Study 1) regarding its importance as a predictor of parental provision of unhealthy foods. Further research, such as qualitative investigations would provide more in-depth understanding of why parents currently perceive their capabilities quite poorly (i.e. low self-efficacy). Are there additional skills that parents' feel they need to enhance their confidence levels?—this question needs to be addressed in future exploratory research. It also appears important to understand parents' perception of their self-efficacy for reducing unhealthy foods in ideal conditions (action self-efficacy), in the face of barriers such as visitors (maintenance self-efficacy), and after a lapse in provision (recovery self-efficacy).

Parents' automatic motivation has received little attention in past research. The lack of research is likely in part due to the challenges in measuring or assessing process that are by definition unconscious[3]. Key areas for future investigations relate to understanding the emotion drivers and responses to unhealthy food provision broadly. Emotional drivers of food choice could be explored through understanding parents own food preferences and cravings. Research into emotional responses to unhealthy food purchasing and provision could be directly observed (i.e. covert video) or self-reported through hypothetical food choice experiments.

***Further understanding opportunity***

Novel findings resulting from Chapter 4 (Study 2) signal future qualitative research to further explore several concepts. Primarily investigations to further unpack cost and time as physical opportunity barriers to favourable food provision in meal versus snack provision. A prior qualitative study, mothers of pre-schoolers highlighted differences in provision of snacks versus meals relating to food preparation, portion sizes, types of foods and variety of foods offered[385]. Conducting a discrete choice experiment, as per Study 2 (Chapter 4), including a scenario based on a main meal eating occasions, could provide guidance regarding cost and time importance by eating occasion. In addition, scenarios for weekday and weekends could be included to control for any differences in day of week. Alternatively, qualitative approaches could be used to further explore the low importance of cost and time in snack provision with a diverse group of parents (i.e. different socio-economic position and weight status) reflecting on the influence of these factors in different eating occasions and contexts, including social, out of home, weekdays and weekends.

Though there is work emerging from child obesity prevention interventions of the importance of co-parents, particularly fathers[439, 440, 453, 454], co-parents support has rarely been raised as a consideration of food provision within qualitative explorations to date. It would be of interest to further explore this finding in future qualitative studies with interview frames to guide parents through all components of the COM-B model, with a focus on social opportunity as an under researched aspect. Research exploring social opportunity influences, including peer parent influences, in families from lower socio-economic backgrounds is needed.

***Further understanding psychological capability***

Although interventions have often sought to increase parents' psychological capability, performing the behavioural analysis in Study 4 (Chapter 6) revealed several gaps in the current literature. Research is needed to assess whether parents possess the skills and strategies to choose between different snack options, particularly those less obvious such as muesli bars, fruit-based cakes and homemade biscuits. Memory abilities to repeatedly perform a behaviour (i.e. reduced unhealthy snack purchasing) is an important skill to support habit formation, yet has not been examined. There is also a lack of evidence to determine whether parents have the skills to create 'if-then' plans or strategies for monitoring children's current unhealthy food intake. There is insufficient evidence to determine whether parents have many of the cognitive skills, memory or behavioural regulation skills to limit unhealthy foods, hence are can be explored in future research.

There is currently limited research[148, 199] assessing parents' knowledge of appropriate portion sizes and recommended serves of unhealthy foods. As mentioned in Chapter 3 (Study 1) generally parents are unable to recognise their child as overweight or with obesity[254-258]. It is proposed parents' also struggle to accurately compare their child's intake of unhealthy foods with the recommendations. There are many possible reasons for a discrepancy in parents' assessment of children's intake including: the broad range of foods and beverages captured as unhealthy foods (some are unknown to parents, e.g. muesli bars), variability in portion sizes of unhealthy foods, and the variety of eating occasions involving unhealthy foods[455]. In addition, the dietary guideline recommendations lack transparency in both the number of serves and types of foods grouped as unhealthy foods[6]. Furthermore, the recommended serves are an energy value rather than standard household measures (e.g. cups), which may also complicate the issue. A lack of accurate awareness of children's intake of unhealthy foods is likely to hinder parents' intention to reduce unhealthy foods and future intervention efforts. Hence, research is required to understand how parents compare their child's intake of unhealthy foods with the dietary guidelines including their knowledge of the guideline recommendations, as this would then influence their intention to change.

***Delving deeper into social occasions***

The high frequency of social occasions reported in Study 2 (Chapter 3) suggests a need to further understand social occasions and impacts on children's dietary intake. The median frequency of five social occasions within one week, suggests than many children take part in social occasions most days of the week. Changes in society where family life gets 'busier' may also mean an increase in social occasions, which would further emphasise the need to understand this context. It would be beneficial to understand both the frequency of social occasions involving food and the contribution to children's overall unhealthy food intake. Such detailed data collection of children's dietary intake could gather information on the frequency of social occasions including food, the types of food and the settings, but could be resource intensive. This level of detail is not available in national dietary surveys. However, could be collected in a well-designed assessment of intake and its context. Automated dietary collection tools, such as the ASA24[450], are available and equipped to collect information on the eating context and could be used in large diverse samples, but participant burden must be considered. Alternatively, questions could be developed and validated to collect information about the frequency and type of foods included in social occasions, with appropriate consideration and testing for accuracy of this more detailed recall, such as cognitive interviewing and predictive modelling[455]. A deeper understanding could also be gained through qualitative interviews with parents of diverse backgrounds, including socio-economic position, reflective motivation and provision practices. Though not within the focus of the current project, it would be interesting to contrast investigations of social occasions with special or celebratory occasions, as well as with what is already understood about food provision in routine contexts. The more researchers understand about social occasions the better equipped to prioritise and design effective intervention strategies.

***Future discrete choice experiments***

Chapter 4 (Study 2) demonstrates how discrete choice experiments can be used to better understand parents' preferences in their provision of snacks. There are opportunities for future studies into parent provision using discrete choice experiment methods, including preferences for intervention content and logistical considerations[295]. As well as the examples highlighted above to include different meal occasions, for example main meals versus snacks, there are also options to explore numerous different food provision contexts, such as weekdays, out of home, or social occasions with extended family. Research should be prioritised to contexts associated with high intakes of unhealthy foods and that occur frequently, to achieve the biggest gains in understanding parents' provision to meaningfully influence children's intake.

To obtain greater insight into the differences in attribute importance a greater number of attribute levels should be included, within the limits of what has been found acceptable in prior discrete choice experiment literature, such as five levels[327]. Conducting these expanded discrete choice experiments in large samples of parents will also allow for more sophisticated analyses, such as latent class model analyses or hybrid choice model analyses. Latent class model analysis provides information about segments of parents with similar choice patterns, which could then be used to tailor intervention strategies based on parent profiles[456]. Whereas, hybrid choice model analysis combines attitudinal data (e.g. psychological variables such as reflective motivation) with choice attribute data (stated preference data), as well as options to capture social influences, such as social norms[457]. Incorporating unobserved choice information, including attitudes and social influences, aims to provide more realistic models to comprehensively capture choice decisions[457].

In addition, future research could further explore interactions of child and parent characteristics using more proximal measures to food behaviour, such as child eating behaviour rather than child temperament. Alternatively, other explanatory variables such as parents' feeding goals or other COM-B components could be considered. There are near endless opportunities to apply discrete choice experiment methods to other aspects of food provision decision-making, including different subgroups of parents or to include attributes from across the COM-B model to understand parent trade-offs in combination. Additional discrete choice experiments will continue to inform an understanding of parents' decision-making without relying on parent reported influences.

## 7.6. Conclusions

Creating meaningful reductions in children's current excessive unhealthy food intake requires innovative parent-focussed interventions designed to support complex behaviour change. The current project contributes to this gap by designing theoretically grounded, evidence-informed intervention content to support parents to reduce unhealthy food provision to their young children. Best-practice, systematic design approach guided by the Behaviour Change Wheel process was utilised, including undertaking a behavioural analysis.

New knowledge was generated in the first study to comprehensively explore parents' motivational constructs using the Health Action Process Approach model. Parental self-efficacy, intention and planning were identified as important motivational constructs for reducing parental provision of unhealthy foods. New knowledge was generated by the novel application of discrete choice experiment methods to explore opportunity influences on parents' snack provision decision-making. Home food availability, child resistance and co-parent support were identified as opportunity components of greatest relative importance in parents' snack provision decision-making. These components of opportunity remained of most importance regardless of social context and within subgroups of parents based on socio-economic position and child weight status.

Gaps were identified from deconstructing past parent-focussed interventions, to identify novel behaviour change components to include in next generation intervention design. Combined findings from the aforementioned studies, existing literature and strategies in the broader nutrition field, informed the behavioural analysis and design of intervention content. Intervention content was designed to engage implementation stakeholders in multiple socio-ecological levels, be scalable to the population level and avoid widening socio-economic inequities. Resulting intervention content can be used to: increase awareness of unhealthy foods such as informative front-of-package labelling and online campaign strategies; increase availability of healthier alternatives and smaller portion sizes through food industry focussed strategies; and shift social norms including strategies to limit promotion of unhealthy foods in the media and within supermarkets.

Future research to support parents to reduce unhealthy food provision should focus on automatic motivation—a key gap in the literature. Targeting changes to physical and social opportunity will support parents' automatic motivation by producing environmental prompts for limiting unhealthy foods and shifting the social norms to reinforce and encourage desirable food provision. Shifting social norms is an enormous challenge, but with large returns, and has been achieved in other behaviours such as smoking. Creating a change in the social norms where limiting unhealthy foods to only sometimes and in small amounts becomes the norm again will result in sustainable, lasting behaviour change.

This project provides an example for the nutrition field of thorough intervention design using behaviour change theory and systematic processes. It also provides an example of a comprehensive application of extended health psychology frameworks to measure parental motivation towards behaviour change, and use of advanced quantitative methods, such as discrete choice experiments. Recommendations are provided for stakeholder consultation to further prioritise the designed intervention content and for progressing this work through feasibility testing. The current thesis provides one piece, in the greater research agenda surrounding unhealthy foods, needed to improve child intake in a meaningful and sustainable way, for better population health into the future.

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# APPENDICES

## Appendix 1: Achievements During PhD

### *Publications relating to PhD project*

**Johnson BJ**, Hendrie GA, Zarnowiecki D, Huynh EK, Golley RK. Examining constructs of parental reflective motivation towards reducing unhealthy food provision to young children. *Nutrients*, 2019; 11(7). DOI:10.3390/nu11071507

**Johnson BJ**, Zarnowiecki D, Hendrie GA, Mauch CE, Golley RK. How to reduce parental provision of unhealthy foods to 3- to 8-year-old children in the home environment? A systematic review utilizing the Behaviour Change Wheel framework. *Obes Reviews,* 2018; 19(10): p. 1359-70. DOI:10.1111/obr.12702.

### *Publications during candidature relating to other projects*

**Johnson BJ,** Grieger JA, Wycherley TP, Golley RK. Theoretical Reductions in Discretionary Choices Intake via Moderation, Substitution, and Reformulation Dietary Strategies Show Improvements in Nutritional Profile: A Simulation Study in Australian 2- to 18-Year-Olds. *J Acad Nutr Diet,* 2019; 119(5): p. 782-798.e6. DOI:10.1016/j.jand.2018.10.016

Mauch CE, Wycherley TP, Laws RA, **Johnson BJ**, Bell LK, Golley RK. Mobile Apps to Support Healthy Family Food Provision: Systematic Assessment of Popular, Commercially Available Apps. *JMIR Mhealth Uhealth,* 2018; 6: p. e11867. DOI:10.2196/11867.

**Johnson BJ**, Zarnowiecki D, Hendrie GA, Golley RK. Predictors of parental discretionary choice provision using the Health Action Process Approach framework: Development and validation of a self-reported questionnaire for parents of 4-7-year-olds. *Nutr Diet*, 2018; 75: p. 431-42. DOI:10.1111/1747-0080.12413.

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### *Presentations relating to PhD project*

Reducing parents' provision of unhealthy foods to kids, Final Thesis Review, College of Nursing & Health Sciences, Flinders University, Adelaide, Australia, Aug 2019

The influence of cost, time, food availability, child resistance, support from co-parents and friends on parents' provision of snacks to their children: A discrete choice experiment, International

Society of Behavioral Nutrition & Physical Activity Annual Meeting, Prague, Czech Republic, June 2019

The Health Action Process Approach model for understanding parents' reflective motivation towards reducing unhealthy foods, International Society of Behavioral Nutrition & Physical Activity Annual Meeting, Prague, Czech Republic June 2019 (poster)

Understanding parents' reflective motivation towards reducing unhealthy foods, College of Nursing & Health Sciences Conference, Flinders University, Adelaide, Australia, Nov 2018

Treats or Trouble? Supporting parents to reduce children's unhealthy food intake, 3MT: Three Minute Thesis Competition Flinders University (heat, semi-final), Adelaide, Australia, Jul-Aug 2018

Parental Food Attitude Questionnaire: A new tool to understand potential levers to changing parental provision of unhealthy foods, American Society of Nutrition Conference, Boston, United States, June 2018

Behaviour Change Wheel Workshop, Centre for Research Excellence of Early Prevention of Obesity in Childhood Annual Meeting, Sydney, Australia, May 2018

What can we learn from past interventions to reduce parental provision of unhealthy foods?, School of Pharmacy & Medical Sciences Symposium, University of South Australia, Adelaide, Australia Sept 2017

Equipping parents of 3 to 7 year olds to reduce their children's unhealthy food intake, Energy Balance Group, University College London, London, United Kingdom, Aug 2017

### *Presentations during candidature relating to honours project*

Predictors of parental unhealthy food and beverage provision using the Health Action Process Approach framework, Asia Pacific Conference on Clinical Nutrition, Adelaide, Australia, Nov 2017

Predictors of parental unhealthy food and beverage provision using the Health Action Process Approach framework, Student presentations, Nutrition Society Australia, Adelaide, Australia, Nov 2017

Parents' attitudes and beliefs: a new avenue to reduce provision of unhealthy foods to children, Australian New Zealand Obesity Society ANZOS-OSSANZ-AOCO Joint Annual Scientific Meeting, Adelaide, Australia Oct 2017 (poster)

Reducing discretionary food and beverage intake in early childhood: A systematic review within an ecological framework, School of Pharmacy & Medical Sciences Symposium, University of South Australia, Adelaide, Australia Sept 2017 (poster)

'Treats' or trouble: Predictors of parental discretionary food choices provision using the Health Action Process Approach framework: Development and validation of a self-reported questionnaire for parents of 4-8 year olds, International Congress of Dietetics, Granada, Spain, Sept 2016

### *Awards, scholarships and grants*

National Health and Medical Research Council Ideas Grant, *TOPCHILD (Transforming Obesity Prevention for CHILDren). Looking into the black box of interventions,* Grant no. 1186363 (CIE, $411,926 2020-2023)

Best Student Abstract in the International Society of Behavioral Nutrition & Physical Activity (ISBNPA) Children and Families Special Interest Group at ISBNPA Annual Meeting 2019

Healthy Development Adelaide Travel Grant ($750 2019)

Flinders University Research Student Travel grant ($1290 2019)

Flinders University Top-Up Scholarship ($10000pa 2018)

Flinders University Research Scholarship ($27082pa, Feb 2018-July 2019)

O'Malley Trust Home Economics Postgraduate Scholarship ($7500 2018)

The Co-op High Achiever Research Grant 2017 ($5000)

Australian Government Research Training Program Scholarship ($26,682pa, July 2016-Feb 2018)

### *Professional service and development*

Communications committee member of the Network of Early career researchers and Students of ISBNPA Executive Committee, International Society for Behavioural Nutrition and Physical Activity, 2018 onwards

Casual peer reviewer for Nutrition Reviews, Nutrition & Dietetics

Committee member of the Home Economics Institute of Australia SA Executive Committee, 2019

Representative for School of Pharmacy and Medical Sciences Higher Degree Research candidates, University of South Australia, 2017

Mentee in Industry Mentoring Network in STEM (IMNIS) Mentoring Program (Mentor: Barbara Erichsdotter), 2017-2018

### *Key skills training courses*

Behaviour Change: Principles and Practice course 2017, University College London Centre for Behaviour Change

Applied Structural Equation Modelling course 2017, Australian Consortium for Social and Political Research Incorporated University of Queensland

Behaviour Change Technique Taxonomy online training 2017, University College London Centre for Behaviour Change

Research Commercialisation e-Grad School ENGAGE module 2017, Queensland University Technology

### *Research student supervision*

Nutrition and Dietetics Honours student 6-month project 'Understanding children and adolescent's weekday vs weekend intake of discretionary choices' Jul-Dec 2018 (co-supervisor)

High Achiever Research Vacation Scholarship student 6-week project 'Understanding the role of social occasions in children's food intake' Nov 2017-Feb 2018 (primary supervisor)

### *Media exposure*

Interview on ABC Riverland breakfast program about Study 2 recruitment (20 August 2018; Advertising Sales Rates: AUD$634; Duration: 5 mins 10 secs)

Article on the Australian Medical Association website 'Aussie diet research discussed at Prague' about Study 1 and 2 research being presented at ISBNPA annual meeting (7 June 2019; Advertising Sales Rates: AUD$1,248; 534 words; https://ama.com.au/ausmed/aussie-diet-research-discussed-prague)

## Appendix 2: Publications

### *Published manuscript: Examining constructs of parental reflective motivation towards reducing unhealthy food provision to young children*



nutrients

MDPI

*Article*

# Examining Constructs of Parental Reflective Motivation towards Reducing Unhealthy Food Provision to Young Children

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**Abstract:** Parents are an ideal target to reduce children's unhealthy food intake. Motivation is one component of behavior change; however, there is a paucity of research exploring parental motivation in unhealthy food provision. This study aimed to understand the relationships between, and relative importance of, constructs of parents' reflective motivation and children's intake of unhealthy foods. An online survey captured parent-rated reflective motivation constructs based on the health action process approach (HAPA) model, and children's intake of unhealthy food using the short food survey. The HAPA model includes constructs of self-efficacy, risk perception, outcome expectancies, intention, and planning. Structural equation modelling was used to examine relationships between constructs and the HAPA model in its structural form. Four-hundred and ninety-five parents of three to seven-year olds completed the study. Model fit statistics ($X^2 = 210.03$, $df = 83$, $p < 0.001$; Comparative fit index (CFI) = 0.96; Tucker Lewis index (TLI) = 0.94) supported suitability of the HAPA model. The HAPA model explained 9.2% of the variance in children's unhealthy food intake. Constructs of self-efficacy (action to maintenance $\beta = 0.69$; maintenance to recovery $\beta = 0.70$; maintenance to planning $\beta = 0.82$) were found to be the most important constructs for reducing children's unhealthy food intake, followed by planning (to unhealthy food intake $\beta = -0.32$) and intention (to planning $\beta = 0.21$). This study provides an initial insight into parental motivation and identifies primary intervention targets to enhance parental motivation to reduce unhealthy food provision, and subsequently children's unhealthy food intake.

**Keywords:** unhealthy food; motivation; parents; early childhood; health action process approach model; self-efficacy; child nutrition

## 1. Introduction

It is well known that globally children overconsume unhealthy foods, whilst they concurrently fail to meet recommendations for healthy food groups, such as vegetables [1]. Recent Australian data shows 37% of four to eight-year old's total energy intake is derived from unhealthy foods [2], with cakes and biscuits, takeaway foods, and savory pastries being key contributors [3]. At the same time, less than 5% of Australian children in this age group are meeting vegetable recommendations [4]. This dietary imbalance contributes to poor diet quality and can lead to an increased risk of nutrient deficiencies and chronic conditions, as well as obesity when excess energy is consumed [5].

There are numerous factors reported to influence children's intake. Examples of such influences include children's preferences, food availability and budget, and parent's knowledge, attitudes, and beliefs [6]. Parents are a key influence, making parental provision a pragmatic behavior to target to moderate children's unhealthy food intake [7,8]. Influences on parent provision can be broadly categorized as aspects of capability (e.g., knowledge and skills), opportunity (e.g., physical resources and social supports), and motivation (e.g., emotion/impulse driven or reflective) [9]. Michie and colleagues [9] suggest that for any behavior to occur we need the right balance of capability, opportunity, and motivation. When it comes to changing a behavior, even if we have the capability and opportunity to perform the new behavior, if we do not have the motivation, behavior change will not occur. Hence, parents' motivation is an important aspect in initiating behavior change to reduce unhealthy food provision to their children.

Motivation can be described as reflective motivation, including self-conscious planning and evaluations; or automatic motivation, including habitual processes, desires, and emotion responses [9]. There are several constructs including self-efficacy, beliefs, outcome expectancies, intentions, goals, action planning, identity and optimism that are associated with reflective motivation, referred to hereafter as motivational constructs [9]. Whilst planning can be classified by theoretical domains that relate to psychological capability (i.e., behavioral regulation) and reflective motivation (i.e., goals) [9], for this study, action planning is conceptualized as contributing to reflective motivation. Few studies relating to young children's dietary intake have comprehensively examined parental motivational constructs [10] and have often been limited to reporting associations between motivational constructs and parental intention, rather than children's intake [11,12], or exploring constructs such as self-efficacy alone [13–15]. Greater understanding of reflective motivation can improve the development of interventions to enhance parents' reflective motivation to support behavior change.

The health action process approach (HAPA) model provides a theoretical framework to comprehensively understand constructs contributing to parents' reflective motivation [16]. In brief, the model consists of two phases, the motivational phase that captures constructs leading to intention, and the volitional phase that includes post-intentional constructs of self-efficacy and planning leading to the behavior itself [16]. The motivational phase of the model is akin to the theory of planned behavior, commonly used in past nutrition and health research [11,12,17–19]. The theory of planned behavior has been criticized for its poor ability to predict behavior, creating what is referred to as the intention–behavior gap [16,17]. The HAPA model aims to bridge this gap by including the post-intentional constructs, however this requires further testing.

The current study aimed to use the HAPA model to improve our understanding of the relationships between, and relative importance of, motivational constructs and children's intake of unhealthy foods. Specific questions in relation to this aim were: Can the HAPA model be applied to understand parents' reflective motivation for reducing provision of unhealthy foods? Which constructs within the HAPA model are of most importance to reducing parental provision of unhealthy foods? Does the HAPA model help to bridge the intention–behaviour gap? Understanding important motivational constructs will assist in designing interventions to reduce children's unhealthy food intake.

## 2. Materials and Methods

This study used a cross-sectional design to measure motivational constructs influencing parents' provision of unhealthy foods to their young children. Prior to commencing the study, parents were presented with a participant information sheet and consented to take part through the online survey tool. Ethics approval was obtained from the University of South Australia human research ethics committee (number 0000033798). Ethics endorsement was received from CSIRO health and medical human research low risk ethics committee (number LR 2/2015). The study was retrospectively registered with Australian New Zealand Clinical Trials Registry (ACTRN12617000603314).

### 2.1. Settings and Participants

The study was conducted online and included families across all states and territories in Australia. Recruitment of participants took part in two waves, one in April to August 2015 and one in March to July 2017 (to obtain a larger sample for analyses). Participants were recruited via online advertisements (i.e., Facebook, parenting magazines/forums), paper flyers, and snowball recruitment strategies, whereby participants referred others in their social network. An incentive was offered during the first wave only, with a chance to win one of ten double movie passes.

Parents of children aged three to seven years, living in Australia, fluent in written English were eligible for the study. Parents were excluded if their child was not within the specified age range (<3.0 or ≥8.0 years) at the time of the study, or if their child had a medical condition requiring a special diet inconsistent with the Australian dietary guidelines (e.g., cystic fibrosis) [20].

### 2.2. Variables

Children's mean daily servings of unhealthy foods was the primary outcome used as a proxy measure of parent provision of unhealthy foods. Children's intake of unhealthy foods was deemed a suitable proxy measure due to the associations between home food availability and children's food intake [21,22]. Food and drink items were considered unhealthy foods as per the Australian dietary guidelines, for example: cakes, sweet biscuits, crisps, processed meats, and sugar-sweetened drinks [20].

Predictor variables were motivational constructs within the HAPA model (motivational and volitional phases). Constructs included: risk perception, positive and negative outcome expectancies, action self-efficacy, intention, maintenance self-efficacy, action planning, coping planning, and recovery self-efficacy [16].

Additional variables were collected to understand the parent sample. Parent variables included: age, gender, number of children, marital status, employment, education, household income, socio-economic status, and weight status. Child variables included: age, gender, and weight status.

### 2.3. Measurement Tools

Children's intake of unhealthy foods was measured by the unhealthy foods subset of the short food survey—a food frequency questionnaire [23]. The unhealthy food subset has been found to have appropriate relative validity (correlation coefficient 0.44, $p < 0.01$) and reliability (correlation coefficient 0.87, $p < 0.01$) [23]. The questionnaire has been described in detail elsewhere [23]; in brief, the short food survey items selected included 15 questions about healthy foods and 20 detailed items about unhealthy foods. For example, 'How often does your child usually eat savory pastries?' with the response options of 'each day', 'each week', 'each month,' or 'doesn't eat savory pastries'; followed by 'How many times does your child usually eat savory pastries?' with a free text field for parents to enter the quantity. The frequency of unhealthy foods was converted to overall mean daily servings of children's unhealthy foods, where one serving was equivalent to 600 kJ.

Predictor variables were collected using the parental food attitude questionnaire [24]. The parental food attitude questionnaire contains 57 items that measure 14 motivational constructs of the HAPA framework (motivational and volitional phases), specifically for parental provision of unhealthy foods. Our previous work has found the parental food attitude questionnaire to have good face and content validity [24]. The initial validation tests supported appropriate construct validity with predominately high factor loadings (motivational phase 0.43–0.89; volitional phase 0.53–0.85) and high internal consistency (Cronbach's alpha motivational phase 0.77–0.88; volitional phase 0.85–0.92) [24].

Socio-demographic items were adapted or replicated from previous nutrition surveys and the Australian government census [25–27]. Parent self-reported weight and height were used to calculate body mass index (BMI; kg/m$^2$) and classify weight status as underweight, healthy weight, overweight, or obesity [28]. Parent-reported child weight and height were converted to BMI *z*-scores by the least mean squares method, which adjusts for age and gender, using an add-in to Microsoft Excel [29]. Children's BMI *z*-scores were then classified into weight status categories as underweight, healthy weight, overweight, or obesity using the international obesity task force definitions [30,31].

Socio-economic status was classified using the socio-economic indexes for areas (SEIFA) of relative advantage and disadvantage by matching parent-reported postcodes to SEIFA scores [32,33].

### 2.4. Data Collection Procedure, Bias, and Sample Size

All data were parent reported through an online survey (SurveyMonkey®). The survey took approximately 30–40 min to complete; an estimate time was presented to parents prior to the survey. The order of the questionnaire was designed to reduce the influence of social desirability bias and to reduce over- and under-reporting, for example by first collecting the whole of diet food frequency items to mask the focus on unhealthy food consumption.

Sample size was calculated based on the requirements for structural equation modelling. As the chance of error increases with the complexity of the model being tested in structural equation modelling, sample size is commonly calculated by the N:q rule, where q is the number of variables in the model [34]. A N:q ratio of 15 to 20 participants per variable is an accepted sample size guide [34,35]. The estimated sample size required for this study was 285 to 380 parents (assuming 19 variables).

### 2.5. Data Analysis

Data were exported from the online survey to Microsoft Excel (2011; Microsoft Corporation) for data cleaning, and where relevant parental food attitude questionnaire items were reverse scored. Normality was checked, extreme outliers were censored (to one unit above the closest plausible response within two standard deviations of the mean), and missing data were examined, then inputted using the full information maximum likelihood method in IBM® SPSS® (Version 25; SPSS Inc., Chicago, IL, USA). As Little's missing completely at random test was significant ($p = 0.21$), a sensitivity analysis was performed for the final model, excluding participants with any missing data (Supplementary Material File S1). The outcome variable of children's mean servings of unhealthy foods was square-root transformed to correct for skewness, and to be appropriate for use in structural equation modelling.

Structural equation modelling was performed to determine the relative importance of the motivational constructs and to test the suitability of the theorized HAPA model to capture parents' intention to reduce unhealthy food provision. Structural equation modelling involves two stages: (1) measurement stage, and (2) structural stage, which includes confirmatory structural equation modelling when testing a theorized model, and exploratory structural equation modelling when testing a new model.

In the first stage, confirmatory factor analysis was performed initially for one factor models to examine the suitability of individual parental food attitude questionnaire sub-items at measuring each reflective motivation latent constructs, by examining model fit. Models were informed by preliminary exploratory factor analysis grouping parental food attitude questionnaire sub-items into motivation constructs. Once each construct was finalized, combined measurement models were tested for the HAPA motivational and volitional phases to complete the measurement stage of structural equation modelling.

In the second stage, each latent construct and measured variable (action self-efficacy, intention, and unhealthy food servings) were incorporated to form a theorized model (i.e., confirmatory structural equation modelling). Composite constructs were created for each latent construct to provide the statistical power to test the complex model; weighted composites were created using rescaled factor weight scores as constructs were found to be congeneric (i.e., unequal factor loadings for sub-items) [36]. Prior to running the final model, second order confirmatory factor analysis models were run when high correlations were observed between constructs, which aligned with the HAPA model structure.

For example, high correlations were seen between Risk perception 1 and 2, so therefore all risk perception items were tested as a higher order construct for risk perception. The final model (Supplementary Materials Figure S1) consisted of 16 latent constructs (unmeasured; shown as ellipses) and three measured variables (shown as rectangles), including transformed mean unhealthy food servings as the outcome variable. In addition, a new model similar to the theory of planned behavior was tested using exploratory structural equation modelling to test whether the volitional phase constructs help to reduce the intention–behavior gap.

Confirmatory factor analyses and structural equation modelling were performed in IBM® SPSS® Amos (Version 25; SPSS Inc., Wexford, PA, USA) using the following model of fit assessment: chi-square ($X^2$), comparative fit index (CFI), Tucker Lewis index (TLI), root mean square error of approximation (RMSEA), and standardized root mean-square residual (SRMR). A non-significant ($p > 0.05$) smaller $X^2$ value is desirable but rarely achieved in large samples and complex models, therefore improvements were an indicator of better fit [37]. Comparative fit index and TLI were considered acceptable if >0.95, indicating normed and relative fit, respectively [38]. A RMSEA <0.05 and corresponding PCLOSE of >0.05 indicated suitable fit, taking into account the error of approximation in the population [37,39]. Standardized root mean-square residual was considered acceptable if <0.6 [37,39]. Multiple model fit statistics were evaluated to determine fit to provide robust assessment of model fit and overcome limitations of individual tests [34]. Bootstrap procedure of 500 samples for bias-corrected confidence intervals was used to obtain significance of overall indirect effects from within the model; though it should be noted that these estimates may be inaccurate with smaller sample sizes [34].

## 3. Results

### 3.1. Sample Characteristics

Seven-hundred and sixty-six parents commenced the online survey, with a 67% completion rate, resulting in 495 parents completing the entire questionnaire (2015: $n$ = 167; 2017: $n$ = 328; Supplementary Materials Figure S2). Twenty-eight participants were excluded due to ineligible child age (below 3.0 years old: $n$ = 17; above 7.9 years old: $n$ = 4), respondent was not the study child's parent ($n$ = 1), or the child had a medically indicated special diet precluding the Australian dietary guidelines ($n$ = 6).

Parent and child characteristics are presented in Table 1. Participants were predominately mothers (94.9%), with a mean age of 36.8 (SD = 5.3) years, the majority were partnered (90.3%), with high education levels (73.7% tertiary degree or above) and high annual household income (52.3% $104,000 or more). There was representation from each socio-economic group, yet the lowest SEIFA tertile was underrepresented. Children had a mean age of 5.3 (SD = 1.6) years, and approximately half were female. Children's intake of unhealthy foods was a median of 2.7 (IQR = 2.7) servings per day.

**Table 1.** Descriptive characteristics of parents and children sampled ($n$ = 495).

| Characteristic | Parent | Characteristic | Child |
|---|---|---|---|
| Age, years (mean, SD) | 36.8 (5.3) | Age, years (mean, SD) | 5.3 (1.3) |
| Gender (%, count) | | Gender (%, count) | |
| Male | 5.1 (25) | Male | 47.5 (235) |
| Female | 94.9 (470) | Female | 52.5 (260) |
| BMI [1] (mean, SD) | 26.0 (5.5) | BMI z-score (mean, SD) | −0.15 (1.97) |
| Weight status (%, count) | | Weight status (%, count) | |
| Underweight | 1.3 (6) | Underweight | 22.8 (107) |
| Healthy weight | 52.7 (252) | Healthy weight | 57.4 (270) |
| Overweight | 28.0 (134) | Overweight | 12.1 (57) |
| Obesity | 18.0 (86) | Obesity | 7.7 (36) |
| Number of children living at home (<18 years old) (%, count) | | Education setting attendance (%, count) | |
| | | Child care center | 22.9 (122) |
| 1 | 16.4 (81) | Family day care | 1.9 (10) |
| 2 | 54.9 (272) | Kindergarten | 21.1 (112) |
| 3 | 22.2 (110) | Primary school | 50.4 (268) |
| 4 or more | 6.4 (32) | n/a [5] | 3.8 (20) |
| Relationship to child (%, count) | | Median (IQR) mean servings of unhealthy foods | 2.7 (2.7) |
| Mother | 93.5 (463) | | |
| Father | 5.1 (25) | | |
| Caregiver or other | 1.4 (7) | | |
| Marital status (%, count) | | Residential area (%, count) | |
| Married/Living as married | 90.3 (447) | Metropolitan | 73.1 (362) |
| Single/Separated | 9.7 (48) | Non-metropolitan | 26.9 (133) |
| Education level (%, count) | | | |
| High school completion or below | 7.6 (38) | | |
| Tech or trade qualification | 18.6 (92) | | |
| Tertiary degree or higher | 73.7 (365) | | |
| Employment status (%, count) | | | |
| Employed | 68.7 (340) | | |
| Not in the workforce [2] | 31.3 (155) | | |
| Annual household income [3] (%, count) | | | |
| Less than $52,000 | 14.4 (64) | | |
| $52,000 to $103,999 | 33.4 (149) | | |
| $104,000 and over | 52.3 (233) | | |
| SEIFA [4] Index of Advantage and Disadvantage (%, count) | | | |
| Low | 19.2 (95) | | |
| Medium | 33.4 (165) | | |
| High | 47.4 (234) | | |

Abbreviations: BMI: body mass index; IQR: Interquartile range; SEIFA: Socio-Economic Indexes for Areas; SD: standard deviation. [1] Missing anthropometric responses for parent ($n$ = 17) and child ($n$ = 25); [2] Not in the workforce includes full time homemaker, student, volunteer work. [3] Missing income responses ($n$ = 49) selected 'I'd prefer not to answer'. [4] SEIFA scores were divided into tertiles: low (588–953), medium (954–1018), and high (1019–1191) as per Australian Bureau of statistics [32]. [5] n/a refers to children who do not attend an education setting.

### *3.2. Stage One: Measurement Stage of Structural Equation Modelling*

#### Motivational Latent Constructs

Confirmatory factor analyses outputs from each one-factor model are presented in Tables 2 and 3. The measurement model resulted in 13 latent constructs consisting of 40 items and two single measured items, hence 42 items from the initial parental food attitude questionnaire. The initial parental food attitude questionnaire contained 57 items, four were removed during exploratory factor analysis (due to low communalities and one item for affecting the internal reliability), and 11 sub-items were removed during confirmatory factor analysis (Supplementary Materials Table S1 and S2). One to two sub-items were removed from most constructs, with three sub-items removed from each negative outcome expectancies, maintenance self-efficacy, and action planning constructs.

**Table 2.** Final one factor model confirmatory factor analysis regression weights for motivational phase latent constructs.

| **Latent Constructs** | **Factor Loading** [1] | |
|---|---|---|
| **Items** | **β** | **Unstandardized Coefficient (SE)** |
| Risk perception 1—absolute risk | | |
| child's activity levels | 0.793 | 0.779 (0.044) |
| child's overall diet | 0.878 | 0.952 (0.044) |
| Risk perception 2—absolute risk | | |
| other children the same age | 0.888 | 0.918 (0.039) |
| other children the same size | 0.916 | 0.912 (0.037) |
| Risk perception 3—severity assessment | | |
| being overweight | 0.749 | 0.823 (0.045) |
| tooth decay | 0.753 | 0.614 (0.033) |
| behavioral issues | 0.789 | 0.709 (0.036) |
| too much energy and associated nutrients | 0.794 | 0.733 (0.037) |
| Risk perception 4 [2]—risk for child | | |
| becoming overweight | 0.927 | 0.879 (0.093) |
| developing tooth decay | 0.687 | 0.556 (0.063) |
| Positive outcome expectancies | | |
| be healthy | 0.649 | 0.530 (0.038) |
| healthy eating habits | 0.736 | 0.552 (0.034) |
| eat more fruit and vegetables | 0.764 | 0.735 (0.044) |
| environmentally-friendly | 0.380 | 0.331 (0.043) |
| Negative outcome expectancies | | |
| throw a tantrum or pester | 0.569 | 0.504 (0.044) |
| miss out on having treats | 0.582 | 0.410 (0.035) |
| affect family time | 0.564 | 0.404 (0.036) |
| overeat unhealthy foods when available | 0.565 | 0.482 (0.043) |
| miss out on eating what their friends eat | 0.602 | 0.465 (0.038) |

Abbreviations: β: standardized regression coefficient; SE: standard error; [1] All regression weights were statistically significant with $p < 0.001$. [2] Note: Risk perception 4 model was run in combination with risk perception 3 to meet required degrees of freedom.

**Table 3.** Final one factor model confirmatory factor analysis regression weights for volitional phase latent constructs.

| **Latent Constructs** | | **Factor Loading** [1] |
|---|---|---|
| **Items** | **β** | **Unstandardized Coefficient (SE)** |
| Maintenance self-efficacy 1 | | |
| partner is undermining you | 0.697 | 0.733 (0.043) |
| financial pressures | 0.792 | 0.752 (0.037) |
| school/child care holidays | 0.750 | 0.689 (0.037) |
| takes a long time to make it habit | 0.749 | 0.666 (0.036) |
| food marketing on television | 0.659 | 0.626 (0.040) |
| family time | 0.609 | 0.562 (0.039) |
| Maintenance self-efficacy 2 | | |
| child is pestering for unhealthy foods | 0.936 | 0.822 (0.031) |
| child is resistant to limiting unhealthy foods | 0.949 | 0.819 (0.030) |
| Maintenance self-efficacy 3 | | |
| you are tired | 0.944 | 0.902 (0.033) |
| having a very busy day | 0.921 | 0.874 (0.033) |
| Action planning | | |
| weekdays | 0.914 | 0.805 (0.033) |
| weekend days | 0.845 | 0.775 (0.035) |
| packing lunchbox | 0.696 | 0.570 (0.034) |
| takeaway meals and snacks | 0.612 | 0.587 (0.041) |
| Coping planning 1 | | |
| friends undermine my plans | 0.924 | 0.877 (0.036) |
| relatives undermine my plans | 0.813 | 0.738 (0.036) |
| Coping planning 2 | | |
| certain situations | 0.768 | 0.689 (0.037) |
| set-backs when unhealthy foods have been provided | 0.863 | 0.791 (0.037) |
| Recovery self-efficacy [2] | | |
| small relapse (2 days) | 0.793 | 0.661 (0.032) |
| moderate relapse (2-6 weeks) | 0.927 | 0.785 (0.030) |
| large relapse (weeks-months) | 0.846 | 0.763 (0.034) |

Abbreviations: β: standardized regression coefficient; SE: standard error; [1] All regression weights were statistically significant with $p < 0.001$; [2] Note: Recovery self-efficacy model was run in combination with maintenance self-efficacy constructs to meet required degrees of freedom.

### 3.3. *Stage Two: Structural Stage of Structural Equation Modelling*

#### 3.3.1. Confirming the Health Action Process Approach Structural Model

Higher order latent constructs were proposed and tested for risk perception, maintenance self-efficacy, and planning based on the theoretical framework and correlations between latent variables (Table 4). A risk perception second order construct was initially tested with the four risk perception latent constructs, yet findings supported the second order construct to include only risk perception 1 and 2, both measures of absolute risk perception.

All first and second order latent constructs and measured variables were combined to form one model replicating the HAPA model (Supplementary Materials Figure S1). Model fit statistics supported adequate model fit. Chi-square was elevated and significant (210.03, $df = 83$, $p < 0.001$), as expected, given the large sample and complex model. Tucker Lewis index was near to an ideal fit at 0.94 (≥0.95 target), and CFI was ideal at 0.96. Root mean square error of approximation was acceptable at 0.056 with a related p value (PCLOSE) of 0.153, and SRMR was appropriate at 0.06.

**Table 4.** Second order confirmatory factor analysis regression weights for latent constructs of risk perception, maintenance self-efficacy, and planning [1].

| Higher Order Construct | Factor Loading | |
|---|---|---|
| **First Order Constructs** | **β** | **Unstandardized Coefficient (SE)** |
| Risk perception | | |
| Risk perception 1—absolute risk | 0.894 | 0.893 (0.054) |
| Risk perception 2—absolute risk | 0.820 | 0.819 (0.052) |
| Maintenance self-efficacy | | |
| Maintenance self-efficacy 1 | 0.912 | 0.911 (0.041) |
| Maintenance self-efficacy 2 | 0.845 | 0.844 (0.040) |
| Maintenance self-efficacy 3 | 0.797 | 0.796 (0.041) |
| Planning | | |
| Action planning | 0.783 | 0.782 (0.046) |
| Coping planning 1 | 0.600 | 0.599 (0.050) |
| Coping planning 2 | 0.837 | 0.835 (0.048) |

Abbreviations: β: standardized regression coefficient; CFI: comparative fit index; RMSEA: mean square error of approximation; SRMR: standardized root mean-square residual; SE: standard error; TLI: Tucker Lewis index; root. [1] All three final models were run in combination to meet required degrees of freedom. Model fit: $X^2 = 31.522$, $df = 16$, $p = 0.012$; CFI = 0.991; TLI = 0.985; RMSEA = 0.044, PCLOSE = 0.629; SRMR = 0.0255.

Figure 1 presents the final confirmatory structural equation model. The six motivational phase constructs accounted for 32.8% of the variance in parental intention to limit children's intake of unhealthy foods. The overall HAPA model was found to explain 9.2% of the variance in children's mean servings of unhealthy foods (proxy measure for parental provision). The majority of paths within the model were significant, with the exception of negative outcome expectancies and risk perception 3—severity assessment to intention in the motivational phase, and maintenance self-efficacy and recovery self-efficacy to children's servings of unhealthy foods in the volitional phase.

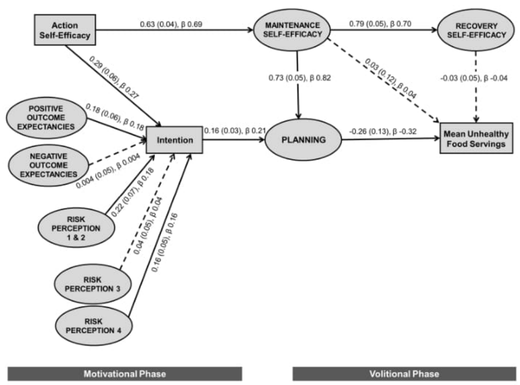


**Figure 1.** Final confirmatory structural equation modelling of the health action process approach model with unstandardized and standardized regression coefficients. Model fit: $X^2 = 210.033$, $df = 83$, $p < 0.001$; CFI = 0.956; TLI = 0.936; RMSEA = 0.056, PCLOSE = 0.153; SRMR = 0.0601. Model explains 9.2% of the variance in mean unhealthy food servings. Weights presented as: unstandardized regression coefficient (standard error), standardized regression coefficient; rectangles represent measured constructs; ellipses represent latent constructs; solid line indicates statistically significant relationship ($p < 0.05$); dashed line indicates non-significant relationship.

Maintenance self-efficacy to planning was the strongest relationship in the model, with a standardized regression coefficient (β) of 0.816 (unstandardized: $b = 0.730$, $p < 0.001$), suggesting that if you have higher maintenance self-efficacy (confidence to maintain limited provision in the face of barriers) you are more likely to also have higher levels of plans or strategies to manage both usual routine and more challenging circumstances (e.g., when visitors are present). There were also strong positive associations between parental confidence constructs. Amongst the motivational phase predictors, action self-efficacy was the strongest predictor of intention ($\beta = 0.269$, $b = 0.289$, $p < 0.001$). Intention had a positive association with planning, which in turn was inversely associated with unhealthy foods, implying that a higher level of planning was associated with lower servings of unhealthy foods.

The majority of overall indirect effects within the model were small, with the largest significant pathway being from action self-efficacy to recovery self-efficacy ($\beta = 0.477$, $b = 0.496$, $p = 0.004$), mediated by maintenance self-efficacy. Absolute risk perception 1 and 2 ($\beta = 0.037$, $b = 0.035$, $p = 0.002$), risk perception 4—for child ($\beta = 0.032$, $b = 0.026$, $p = 0.002$), and positive outcome expectancies ($\beta = 0.037$, $b = 0.029$, $p = 0.002$) all had significant indirect effects on planning, through intention. Whereas, negative outcome expectancies ($\beta = 0.001$, $b = 0.001$, $p = 0.916$) and risk perception 3—severity assessment ($\beta = 0.007$, $b = 0.006$, $p = 0.390$) did not. Action self-efficacy ($\beta = 0.615$, $b = 0.505$, $p = 0.006$) had a significant indirect effect on planning through intention or maintenance self-efficacy. Action self-efficacy was also indirectly inversely associated with children's servings of unhealthy foods ($\beta = -0.184$, $b = -0.124$, $p = 0.004$) through intention or maintenance self-efficacy and planning. No other motivational phase construct had a significant indirect relationship with children's servings of unhealthy foods.

### 3.3.2. Exploring the Intention–Behavior Gap

A new model was tested using exploratory structural equation modelling to explore the intention–behavior gap. Figure 2 shows the model, composed of the HAPA motivational phase and children's mean servings of unhealthy foods, hence removing the post-intentional volitional phase constructs of maintenance, recovery self-efficacy, and planning. The model fit statistics were appropriate ($X^2 = 55.294$, $df = 12$, $p < 0.001$; TLI = 0.847; CFI = 0.949; RMSEA = 0.085, PCLOSE = 0.005; SRMR = 0.0496). A significant inverse direct association was observed between parental intention and children's intake of unhealthy foods ($\beta = -0.234$, $b = -0.147$, $p < 0.001$). The new model accounted for 5.5% of the variance of unhealthy food servings. Inclusion of the volitional phase constructs (i.e., Figure 1) was seen to moderately bridge the intention–behavior gap (contributing 3.7% (of 9.2% total) of variance explained).

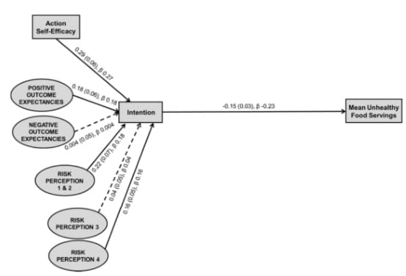


**Figure 2.** Exploratory structural equation modelling testing the predictive ability of intention to action unstandardized and standardized regression coefficients. Model fit: $X^2 = 55.294$, $df = 12$, $p < 0.001$; TLI = 0.847; CFI = 0.949; RMSEA = 0.085, PCLOSE = 0.005; SRMR = 0.0496. Model explains 5.5% of the variance in mean unhealthy food servings. Weights presented as: unstandardized regression coefficient (standard error), standardized regression coefficient; rectangles represent measured constructs; ellipses represent latent constructs; solid line indicates statistically significant relationship ($p < 0.05$); dashed line indicates non-significant relationship.

## 4. Discussion

The current study provides initial insight into motivational constructs contributing to parents' unhealthy food provision using a theory-based approach. Specifically, we sought to understand the relationship between, and relative importance of, motivational constructs and children's intake of unhealthy foods (proxy for provision). Findings supported the health action process approach (HAPA) model as a suitable framework to explain parents' reflective motivation by capturing several motivational constructs. Parental action and maintenance self-efficacy (confidence to limit unhealthy food provision in ideal conditions, and to maintain confidence in the face of barriers, respectively) were found to play a key role in children's unhealthy food intake, followed by planning and intention. Whereas, recovery self-efficacy (i.e., to again limit after unhealthy food provision) and negative outcome expectancies were not significant predictors of children's unhealthy food intake, indicating that they may play less of a role in unhealthy food provision, or be areas where the model or measurement tool could be improved. Exploratory analyses highlighted additional benefits of the HAPA model, by the inclusion of post-intentional constructs, over the theory of planned behavior. Yet, the overall variance of children's unhealthy food intake explained reinforced that there are other important aspects of parental provision or children's intake of unhealthy foods not captured by motivation alone. Parents can be supported to reduce unhealthy food provision by designing interventions that enhance reflective motivation by targeting motivational constructs of self-efficacy, planning, and intention.

Model fit supported the HAPA model as an appropriate model to explain children's unhealthy food intake by capturing motivational constructs contributing to parental reflective motivation. The model was found to account for nine percent of the variance in children's unhealthy food intake. We had anticipated the explanatory ability of the model to be greater, but this may have been impacted by using child intake as a proxy measure for parents' provision. Although there are no other studies using the HAPA model and children's intake, the HAPA model has previously been found to account for 15–33% of the behavior of physical activity and healthy eating when investigating adult's own behavior [40–42]. Several nutrition-related studies have explored some motivational constructs, such as attitudes, subjective norms, and perceived behavioral control, in relation to unhealthy foods or beverages, primarily using the theory of planned behavior; hence, somewhat comparable to the motivational phase of the HAPA model. Two studies have used the theory of planned behavior to understand sugar-sweetened beverage provision to preschoolers or adolescents, reporting the motivational constructs accounted for 48% and 32% of the variance in parental intention, respectively [11,43]; somewhat comparable to 33% of the variance in intention to reduce unhealthy foods in our study. Whereas, a meta-analysis of studies using the theory of planned behavior in various populations noted models accounted for, on average, 21% of the variance in intention to perform dietary behaviors [17]. Current findings support the use of the HAPA model to explain parents' provision by capturing motivational constructs, yet the overall model could be improved to better explain children's unhealthy food intake.

Parental confidence, or self-efficacy, was found to be the most important motivational factor. Specifically, our analyses found action self-efficacy (i.e., to limit unhealthy food provision in ideal conditions) and maintenance self-efficacy (i.e., to maintain limited provision in the face of barriers) the most important motivational constructs related to children's unhealthy food intake. Studies in adults have also highlighted self-efficacy as the most important constructs with the HAPA model regarding physical activity and dietary change in intention and/or behavior [40–42,44]. Self-efficacy can enhance a parent's mental strength and stamina to persist with performing or changing a behavior in line with their intentions. Previous studies in parents of young children and dietary intake have highlighted the importance of self-efficacy, noting inverse relationships between self-efficacy and children's intake of select unhealthy foods and/or beverages [13–15]. In our study, recovery self-efficacy (i.e., to again limit after unhealthy food provision) was not associated with unhealthy foods intake in our sample. As self-rating of self-efficacy is highly influenced by past experiences [16], we speculate that, given intake data, parents in general have not yet reduced unhealthy foods to experience a set-back to enact recovery self-efficacy. Self-efficacy, specifically in ideal conditions (action self-efficacy) and in the face of barriers (maintenance self-efficacy) should form an initial intervention target.

Secondary intervention targets were identified to build comprehensive intervention supports, and to tailor intervention strategies and content, if parents already posed high levels of self-efficacy. Intention and planning (including action and coping planning) were found to be the next most important constructs within the HAPA model for reduced unhealthy food provision. Higher levels of intention were associated with higher levels of planning, which in turn was associated with lower child intake of unhealthy foods. Both intention and/or planning have also been identified as the second most important constructs in adults, specifically intention for physical activity, and intention and planning in dietary behaviors [40,41,44]. Intention alone may not be sufficient for a behavior to occur but including detailed plans such as implementation intentions and cue monitoring might help to reduce the intention–behavior gap [45]. Implementation intentions and cue monitoring involve problem solving and action planning to consider how and when intentions can be translated to behavior and identify prompts to encourage the behavior [45]. Intention and planning form complementary secondary intervention targets.

The intention–behavior gap was investigated in this study through exploratory structural equation modelling. We examined a modified version of the HAPA model, removing the volitional phase constructs, leaving a model representing the theory of planned behavior. These analyses revealed the addition of the volitional phase constructs within the HAPA model began to bridge this gap. Volitional constructs contributed nearly half of the total variance in children's unhealthy food intake, explained by the model (i.e., 3.7% of variance). Albeit, the total variance explained by the HAPA model was small at 9.2%, signaling the need to capture other important aspects of children's intake of unhealthy foods. Exploratory analyses provide support for advantages of the HAPA model, over the theory of planned behavior, to predict behavior.

### 4.1. Strengths and Limitations

The current findings need to be considered within the limitations of this study. Firstly, the cross-sectional design, in which the outcome of children's unhealthy food intake was measured at the same time point as the predictor variables. Ideally, in future, children's intake should be collected one month following parents' stated intention as per the parental food attitude questionnaire phrasing. There are further limitations with parent-reported child intake, with a potential for social desirability bias and measurement error of the tool. Nonetheless, we did obtain a wide range in children's servings of unhealthy foods, ranging from zero to 13 servings per day, with many exceeding dietary guideline recommendations. The non-random sampling approach also raises the potential for response bias. In addition, the resulting parent demographic of this sample was skewed towards mothers of higher education and income levels and did not adequately represent fathers' motivation, hence limits generalizability of the findings to the Australian parent population [46]. Finally, there are other potentially important influences on children's intake of unhealthy foods that were not captured within the HAPA model, such as parent feeding styles and practices, children's preferences, and behavior. In addition, aspects of parents' capability (i.e., knowledge and skills) and opportunity (i.e., physical resources and supports) were not measured given the scope of the current project, to focus on comprehensively examining motivation. Future studies can now use the prioritized important motivational constructs, in combination with capability and opportunity, to further explore unhealthy food behavior change.

There were, however, several strengths of this study. Firstly, the large sample recruited allowed for structural equation modelling of the complex model to be undertaken. Secondly, this study provided large quantitative data on motivation to be collected using a validated tool, though the reliability of the tool has not yet been assessed. Finally, the study was strengthened by the strong theoretical underpinning, allowing a comprehensive approach to understanding parents' reflective motivation, and this provides direction for future intervention design.

### *4.2. Implications for Future Research and Practice*

Several recommendations can be made for further research. Cross validation is required to confirm the suitability of the HAPA model, and it would be ideal for future work to recruit parent samples with a greater representation of parents of lower socio-economic background (under-represented in our sample). It would also be of interest to examine subgroups of parents, such as by intention status (e.g., pre-intenders, intenders, and actioners) or based on socio-demographic characteristics, to tailor supports to subsets of the parent population. Based on the current findings, future interventions can be designed to enhance parents' motivation through prioritizing intervention strategies for self-efficacy, intention, and planning. Other theories, such as Bandura's socio cognitive theory, could be used to design strategies to enhance parents' self-efficacy [47]. In addition, tools such as the parental food attitude questionnaire can be used to evaluate changes in reflective motivation in such interventions. The refined parental food attitude questionnaire could also be used to assess a parent's level of motivation in practice settings to tailor advice based on constructs obtaining low ratings; for example, towards enhancing self-efficacy, developing intention, or making plans to act on intention.

Lastly, from this exploration of motivation we are unable to determine what competing intentions parents may hold regarding food provision. For example, a recent review of qualitative studies synthesized parents' motivations towards food provision into four key themes: promoting good health, building positive relationships, as well as practicalities and constraints, and emotional motivations [48]; the current study assumes parents are motivated by promoting good health, however these competing motivations require further exploration.

## 5. Conclusions

Parents' reflective motivation to reduce unhealthy foods is needed to initiate a change in parents' provision of unhealthy foods to their children. Current analyses provide guidance to prioritize the key constructs to be targeted in future interventions, namely action and maintenance self-efficacy to develop intention, and self-efficacy and planning for complex situations (i.e., in the face of barriers) to support parents to act on their intentions. Our results support the use of the HAPA model to explain motivational constructs contributing to parents' reflective motivation towards reducing unhealthy foods. The overall model variance does, however, signal that there are other important factors that influence children's unhealthy food intake not accounted for by motivation alone, such as parental capability or opportunity.

**Supplementary Materials:** The following are available online at http://www.mdpi.com/2072-6643/11/7/1507/s1, Figure S1: Theorized health action process approach model to examine using structural equation modelling; Figure S2: Flow of parent completion of the online survey; Table S1: Parental food attitude questionnaire motivational phase; Table S2: Parental food attitude questionnaire volitional phase; Supplementary File S1: Results from structural equation modelling sensitivity.

**Author Contributions:** All authors were involved in the project conceptualization. B.J.J. conducted the research, performed the data analysis and drafted the manuscript. G.A.H., D.Z., E.K.H., and R.K.G. provided academic supervision and support for the work. All authors interpreted the results, contributed to, read, and approved the final manuscript. Conceptualization, B.J.J., G.A.H., D.Z., E.K.H., and R.K.G.; Formal analysis, B.J.J.; Investigation, B.J.J.; Methodology, B.J.J., G.A.H., D.Z., E.K.H., and R.K.G.; Project administration, B.J.J.; Supervision, G.A.H., D.Z., E.K.H., and R.K.G.; Writing—original draft, B.J.J.; Writing—review and editing, B.J.J., G.A.H., D.Z., E.K.H., and R.K.G.

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**Examining constructs of parental reflective motivation towards reducing unhealthy food provision to young children**

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## Supplementary Materials

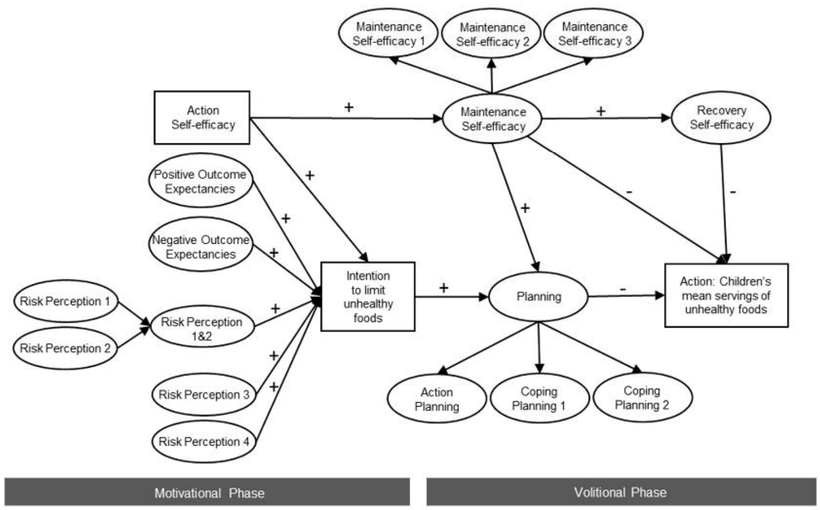


**Figure S1.** Theorized Health Action Process Approach model to examine using structural equation modelling. Adapted from Schwarzer [9]. Rectangles represent measured constructs; ellipses represent latent constructs; + represents hypothesized positive relationship and – represents a hypothesized negative relationship between variables.

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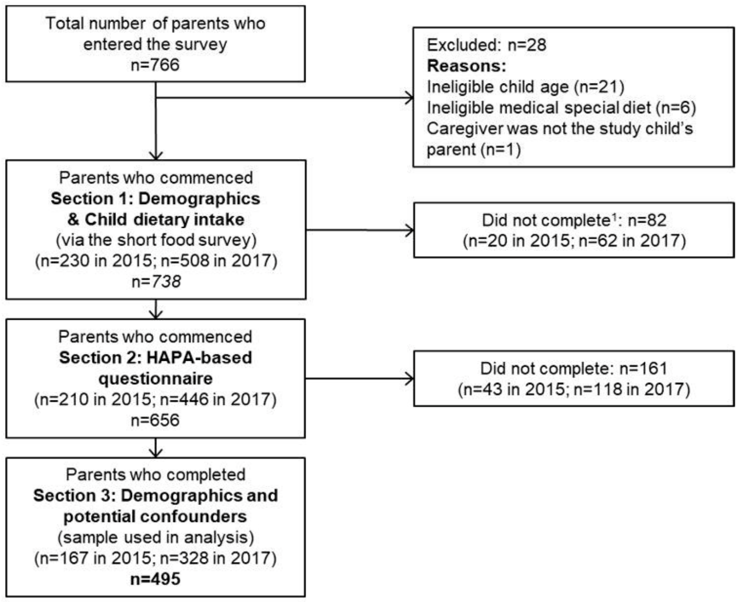


**Figure S2.** Flow of parent completion of the online survey
[1]Non-completers were excluded from all analyses.

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**Table S1:** Parental Food Attitude Questionnaire[1] motivational phase

| Motivation construct | Final question | Scoring criteria | Scoring range |
|---|---|---|---|
| Risk perception 1 – absolute risk | 1. Considering the extras you provide to your child from within the home, choose if you think this is lower to higher than the following statements.<br>*'Extras from within the home' refers to all home made or brought extras provided within the home, as well as those packed from the home e.g. lunchboxes and picnics.*<br>a) Compared with how active my child is the amount of extras I provide to my child is…<br>b) Compared with how healthy my child's overall diet is the amount of extras I provide to my child is… | 5 = Lower<br>4 = Slightly lower<br>3 = Same<br>2 = Slightly higher<br>1 = Higher | 2 - 10 |
| Risk perception 2 – absolute risk | c) Compared with that of other children the same age as my child the amount of extras I provide to my child is…<br>d) Compared with that of other children the same size (weight and height) as my child the amount of extras I provide to my child is… | | 2 - 10 |
| Risk perception 3 - severity assessment | 2. For 4-7 year old children (i.e. similar age and size to your child), in general, how serious a concern do you think the following are:<br>a) being overweight<br>b) tooth decay<br>c) behavioural issues<br>d) too much energy (calories), saturated fat, added sugar and salt | 1 = Not serious at all (can be ignored)<br>2 = Somewhat serious<br>3 = Moderately serious<br>4 = Serious<br>5 = Very serious (life threatening) | 4 - 20 |
| Risk perception 4 – risk for child | 3. How much do you agree or disagree with the following statements. If I limit the extras I provide to my child, I think that I can reduce their chances of…<br>a) becoming overweight in the next 2-3 years<br>b) developing tooth decay | 5 = Strongly agree<br>4 = Agree<br>3 = Neither agree nor disagree<br>2 = Disagree<br>1 = Strongly disagree | 2 - 10 |

[1] The term 'extras' is used to describe unhealthy foods.

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**Table S1:** Parental Food Attitude Questionnaire motivational phase (continued)

| Motivation construct | Final question | Scoring criteria | Scoring range |
|---|---|---|---|
| Positive outcome expectancies | 4. How true are the following statements for you? If I limit my provision of extras from within the home…<br>a) …my child will be healthy (i.e. weight, teeth)<br>c) ...my child will continue healthy eating habits into adulthood<br>e) …my child will eat more fruit and vegetables<br>g) …I'll be seen to be environmentally-friendly | 1 = Not at all true<br>2 = Somewhat true<br>3 = Mostly true<br>4 = Exactly true | 4 - 16 |
| Negative outcome expectancies | b) …my child will throw a tantrum or pester me for extras<br>d) …my child will miss out on having treats<br>f) …it will affect what we do in family time (i.e. movie nights, baking, celebrations etc)<br>h) …my child will overeat extras when they are available<br>i) ...my child will miss out on eating what their friends eat | 4 = Not at all true<br>3 = Somewhat true<br>2 = Mostly true<br>1 = Exactly true | 5 - 20 |
| Action self-efficacy | 5. How confident are you that you can limit the extras you provide to your child from within the home over the next month?<br>I am… | 1 = Not at all confident<br>2 = Somewhat confident<br>3 = Moderately confident<br>4 = Extremely confident | 1 - 4 |
| Intentions | 6. In the next month, I intend to start or continue to limit the extras I provide to my child from within the home.<br>I… | 1 = Don't intend at all<br>2 = Somewhat intend<br>3 = Moderately intend<br>4 = Strongly intend | 1 - 4 |

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**Table S2:** Parental Food Attitude Questionnaire volitional phase

| Motivation construct | Final question | Scoring criteria | Scoring range |
|---|---|---|---|
| Maintenance self-efficacy 1 | 7. Some situations can make it hard to maintain certain behaviours. How confident are you, that you could limit providing extras to your child from within the home, even if…<br>e) …your partner is undermining you<br>f) …you have other financial pressures<br>g) …it is school/child care holidays<br>h) …it takes you a long time to make it habit<br>i) …your child sees food marketing on television<br>j) …you are having family time (i.e. movie night, baking, celebrations etc) | 1 = Not at all confident<br>2 = Somewhat confident<br>3 = Moderately confident<br>4 = Extremely confident | 6 - 24 |
| Maintenance self-efficacy 2 | a) …your child is requesting/ demanding/ fussing/ pestering you for extras<br>b) …your child is resistant to limiting extras | | 2 - 8 |
| Maintenance self-efficacy 3 | c) …you are tired<br>d) …you are having a very busy day | | 2 - 8 |
| Action planning | 8. Some parents would like to limit the extras they provide. How true are the following statements for you? I already have strategies for how to limit extras…<br>a) …at home on weekdays<br>b) …at home on weekend days<br>c) …when packing lunch for childcare / kindergarten / school<br>d) …when buying takeaway meals and snacks for eating at home | 1 = Not at all true<br>2 = Somewhat true<br>3 = Mostly true<br>4 = Exactly true | 4 - 16 |
| Coping planning 1 | 9. Some parents would like to limit the extras they provide. How true are the following statements for you? I already have strategies for…<br>b) …how to manage when friends undermine my plans to limit extras<br>c) …how to manage when relatives (e.g. grandparents) undermine my plans to limit extras | 1 = Not at all true<br>2 = Somewhat true<br>3 = Mostly true<br>4 = Exactly true | 2 - 8 |
| Coping planning 2 | a) …how to deal with certain situations in order to stick to my intentions (e.g. where I know only extras may be available, when I'm in a hurry, school holidays)<br>d) …how to deal with set-backs when I provide extras outside of my intentions | | 2 - 8 |

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**Table S2:** Parental Food Attitude Questionnaire volitional phase (continued)

| Motivation construct | Final question | Scoring criteria | Scoring range |
|---|---|---|---|
| Recovery self-efficacy | 10. Sometimes we don't always stick to our intentions. Imagine you have increased the extras you provide to your child for some time. How confident are you about re-limiting the extras you provide to your child after…<br>a) …2 days (e.g. after a special occasion)<br>b) …2 to 6 weeks (e.g. after school holidays, Christmas period etc)<br>c) …weeks to months (e.g. after a period of change in family routine) | 1 = Not at all confident<br>2 = Somewhat confident<br>3 = Moderately confident<br>4 = Extremely confident | 3 - 12 |

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**Supplementary File S1: Results from structural equation modelling sensitivity analysis**

Sensitivity analysis of the HAPA-based structural equation model was performed on a sub-sample (n=339) excluding all respondents with any missing data (n=156). Model fit statistics ($X^2$=160.233, df=83, p<0.001; CFI=0.962; TLI=0.945; RMSEA=0.052, PCLOSE=0.355; SRMR=0.0606) supported appropriateness of the HAPA model. The model accounted for 11.0% of the variance in children's servings of unhealthy foods, with primarily similar regression coefficients. The largest paths were as per the primary analysis structural equation model, specifically *Maintenance self-efficacy* to *Planning* (β=.858, b=.723, p<0.001), and between constructs of self-efficacy (action self-efficacy to maintenance self-efficacy β=.719, b=.669, p<0.001; maintenance self-efficacy to recovery self-efficacy β=.728, b=.803, p<0.001).

***Published manuscript: How to reduce parental provision of unhealthy foods to 3- to 8-year-old children in the home environment? A systematic review utilizing the Behaviour Change Wheel framework***

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**Pediatric Obesity/Obesity Prevention**

# How to reduce parental provision of unhealthy foods to 3- to 8-year-old children in the home environment? A systematic review utilizing the Behaviour Change Wheel framework

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## Summary

**Background and objective:** The effectiveness of obesity prevention interventions to improve children's diet can be enhanced. Deconstructing past interventions can identify components with potential to change behaviour. This systematic review using the Behaviour Change Wheel aimed to examine the behaviour change content of interventions supporting parents of 3- to 8-year olds to reduce provision of unhealthy foods to children.

**Methods:** Ebscohost, Ovid, Scopus and Web of Science were searched. Eligible studies included controlled interventions with active parent involvement, at least one intervention strategy and outcome measure for unhealthy foods ≥3 months from baseline. Seventeen interventions were included describing 18 intervention arms.

**Results:** Interventions frequently targeted parents' reflective motivation ($n$ = 17) and psychological capability ($n$ = 15), through education ($n$ = 15) or enablement ($n$ = 15) intervention functions and service provision ($n$ = 18) policy category. Only 24 of the 93 behaviour change techniques were used with an average of five techniques used per intervention.

**Conclusions:** Existing interventions achieving small reductions in unhealthy food intake are homogenous in approach. There is potential to utilize untapped behaviour change techniques, through comprehensive intervention design and behavioural analysis guided by the Behaviour Change Wheel. Interventions targeting opportunity through persuasion, modelling or environmental restructuring, and using different policy categories are urgently needed to provide an evidence base to inform policy and practice.

**Keywords:** Behaviour Change Wheel, children, parents, unhealthy foods.

**Abbreviation:** BCTs, behaviour change techniques.

## Introduction

Population dietary intake is poorly aligned with national dietary guidelines designed to prevent the development of obesity (1,2). Unhealthy foods, defined as foods and beverages generally higher in energy, saturated fat, added sugar and/or sodium, are overconsumed across the globe (3–6). These unhealthy foods, including cakes, biscuits, processed meats, salty snacks and sugar-sweetened beverages, contribute between 27% and 40% of Australian 2- to 13-year-old children's total energy intake (2). The greatest increase in this intake appears between the 3- to 4-year-old and 5- to 8-year-old age brackets (2). This excessive consumption of unhealthy foods and beverages can directly increase risk of obesity and related chronic conditions – cardiovascular disease, hypertension, fatty liver (3,7) – and indirectly by displacing nutrient-dense foods from the diet (8). Interventions are required to limit children's intake of unhealthy foods to reduce risks of obesity and chronic conditions and improve diet quality. A key transition period in childhood appears between the 3- to 8-year-old group where children are commencing formal education (3–5 years old) and establishing school and food routines (6–8 years old). Research exploring this wide transition period to both preschool and primary school setting is required given the variation in transition periods and ages in different countries (9,10).

Parents are a key influence on young children's food intake (11,12); highlighting parental provision of food as an ideal target for intervention in the home setting (13,14). A past review by Golley *et al.* (13) found that effective family-based obesity prevention interventions included meaningful parent involvement, use of behaviour change techniques (BCTs) covering the behaviour change process and targeted strategies towards energy intake/density or food choices. Yet no review has focused specifically on parent interventions to reduce unhealthy food provision (11,13,14). There is a need to improve the effectiveness of obesity prevention interventions (15,16). A prime avenue for investigation is the best approaches to reduce children's intake of unhealthy foods.

Supporting parents to reduce provision of unhealthy foods to children requires behaviour change. Changing-behaviour is complex. There are additional challenges where parents are the mediators to changing children's intake. Little is known about the behaviour change content of interventions that aim to support parents to reduce provision of unhealthy foods to their children. Utilizing behavioural analysis and behaviour change theory (17) will provide new insights into behaviour change interventions. The UK Medical Research Council has produced guidelines to support the design of complex behaviour change interventions (18), with complementary frameworks, such as RE-AIM (19), Intervention Mapping (20) and Behaviour Change Wheel (21), suggested to support the design of evidence-based and theoretically underpinned interventions. These frameworks all combine multiple theories or frameworks and can be applied across multiple disciplines.

Deconstructing past interventions to identify the components of greatest potential is a crucial step in intervention design to more rapidly build targeted and effective next generation interventions (22). The Behaviour Change Wheel provides a systematic approach to design or deconstruct the elements of an intervention (21). This theoretical framework is more comprehensive than previously suggested models by incorporating specific behaviour change taxonomy, providing a systematic method to understanding behaviour and allowing researchers to integrate discipline specific behaviour change theories (21). The Behaviour Change Wheel consists of the sources of behaviour (capability, opportunity and motivation) – the required components for a behaviour to occur; intervention functions – approaches that can be implemented to change behaviour; BCTs – individual strategies or techniques to initiate or maintain behaviour change and policy categories – approaches of intervention delivery in a policy context (17,21). By understanding the behaviour change content of past interventions, we can develop interventions building on the strengths of effective interventions and trial aspects not yet investigated. This review aimed to use the Behaviour Change Wheel to evaluate controlled interventions that support parents of 3- to 8-year olds to reduce their provision of unhealthy foods to children in the home environment. To achieve this aim, we identified characteristics of interventions and the key gaps in the Behaviour Change Wheel not addressed in current intervention development.

## Methods

This review protocol is registered on PROSPERO International prospective register of systematic reviews (protocol CRD42016048678).

### Selecting papers for review

#### *Inclusion and exclusion criteria*

Interventions were included if they (i) involved active participation by parents of children aged 3–8 years (mean age > 2.5 to <8.5 years at baseline), who were fluent in written English; (ii) included at least one strategy targeting a reduction in unhealthy foods provided from the home setting; (iii) had a control group and (iv) child unhealthy food intake (e.g. number of serves and score) or energy, saturated fat, sugar and/or sodium from unhealthy foods were reported for both the intervention and control group at baseline and at least 3 months following baseline. All studies were completed prospective studies, published in English, with no limits on publication date applied.

Interventions were excluded if they included children with a clinical condition precluding dietary guidelines adherence (e.g. cystic fibrosis), or a nominal parent focus, e.g. targeting the school setting or child knowledge with limited parental engagement. Protocol or pilot studies, conference abstracts and theses were excluded.

#### *Search strategy and selection process*

A systematic search was performed on the 12 January 2017, and updated 22 March 2018, in Ebscohost (CINAHL), Ovid (Epub Ahead of Print, EMBASE, PyscINFO), Scopus and Wed of Science, following test searches in Ovid databases to refine the search terms. The final search terms (File S1) were limited to English language, human subjects and child age range when available; example search terms included (i) child* and preschool; AND parent or care giver; AND (ii) nutrition and education or behaviour and change; AND (iii) discretionary food or treats or energy dense or nutrient poor or takeaway food; AND (iv) controlled clinical trial or randomized controlled trial or evaluation stud*.

All results were imported into EndNote and duplicates removed, prior to independent duplicate (B. J. J. and R. K. G./G. A. H./D. Z.) title and abstract screening, and full text review in Covidence systematic review software (Veritas Health Innovation, Melbourne Australia) using the predefined selection criteria. There was 95% agreement between reviewers in title and abstract screening with conflicts resolved by the primary reviewer (B. J. J.). In the full text review, there was 81% agreement between reviewers with conflicts resolved by the screening authors to reach consensus. Searches of grey literature included reference lists of key review articles and of included studies for keywords, which were imported to Covidence for screening in duplicate (B. J. J. and R. K. G./G. A. H./D. Z.). To aid complete data extraction, a secondary hand search was conducted to identify published and unpublished protocols and pilot studies of the included interventions. Corresponding authors of included studies were contacted via email to request additional unpublished intervention content, with a reminder after 2 weeks. Fifteen of the 16 authors contacted responded to the request, many providing additional publications, with eight authors providing unpublished content in English.

### Data extraction

The primary reviewer (B. J. J.) completed data extraction, using an instrument developed for this review, piloted with five studies. Data extraction was cross-checked by a second reviewer (C. E. M.). Items extracted included study characteristics, such as behaviour change theory, participants, location, primary aim, sample size calculation, outcome measure and key results; and intervention characteristics and content, such as unhealthy food strategies, setting, duration, delivery, materials and procedure.

### Risk of bias

Two reviewers (B. J. J. and C. E. M.) independently rated study quality using a standardized critical appraisal tool (23). Rating conflicts were discussed and resolved by the two reviewers. The tool considers eight quality areas: selection bias, study design, confounders, blinding, data collection methods, withdrawals and dropouts, intervention integrity and analyses. The first six areas are given a rating of strong, moderate or weak, which are combined to give an overall quality rating of strong (no weak ratings), moderate (one weak rating) or weak (two or more weak ratings).

### Coding of behaviour change content

Behaviour change intervention content was coded against the Behaviour Change Wheel framework by a trained reviewer (University College London, Centre for Behaviour Change Summer School 2017). Sources of behaviour (six categories spanning capability, opportunity, motivation), intervention functions (nine categories; e.g. education, enablement and restrictions) and policy categories (seven categories; e.g. guidelines, communication/marketing and legislation) were coded (21). BCTs were coded using the BCT Taxonomy v1 (24). Coding was performed independently by two trained reviewers (http://www.bct-taxonomy.com/); discrepancies were discussed and consensus reached. Primary analyses were performed on published intervention content including protocols, main results and follow-up publications. Sensitivity analyses were performed comparing BCTs in published and unpublished intervention content. Techniques in unpublished intervention content were coded by the primary reviewer, and any uncertainties discussed with a second reviewer. There was substantial (Kappa mean 0.68, range 0.49 to 1.00) to almost perfect (PABAK mean 0.94, range 0.87 to 1.00) agreement between coders (25)

### Synthesis of results

Cohen's d effect size for unhealthy foods outcome(s), between intervention and control group (end of intervention or change from baseline), was calculated from the published results (26). Behaviour Change Wheel components and BCTs were mapped for each study, with one matrix developed for primarily group-based approach interventions and one for primarily individual-focused interventions. Intervention content was compared with effect size across all intervention approaches to seek Behaviour Change Wheel components, BCTs or study characteristics predicting intervention effectiveness. To control an element of heterogeneity, comparisons were also made for intervention content between individual versus group-based delivery approach. Data are presented for unhealthy food strategies and outcome measures from the parent-focused aspects of interventions only; e.g. results relating to healthy foods or other health behaviours, or non-parent components of the interventions are not presented.

## Results

Eighteen articles, describing 17 interventions, with a total of 18 intervention arms were included (Fig. 1). Table S1 presents study details and quality ratings. Studies were largely conducted in the United States (*n* = 6) and Australia (*n* = 5), and all except one study (27) were individual (*n* = 13) or cluster (*n* = 4) randomized controlled trials. Combined participants totalled 5,824 (mean 341 participants per study, range 54–1,138) with a mean child age of 6.1 ± 1.6 years. The median duration of interventions was 6 months (range 1–12 months) with a 6-month follow-up period from the end of the intervention (range 0–18 months).

Interventions addressed weight management (*n* = 10), or obesity prevention (*n* = 8). Only three studies included a primary aim to reduce unhealthy foods (28–30). The majority of interventions targeted weight status (*n* = 11), followed by healthy eating (*n* = 6) and included multiple dietary and lifestyle behaviours. Control groups primarily (*n* = 12) received general nutrition information (e.g. pamphlet) or were complete waitlist controls. Unhealthy foods were mainly measured as serves or units of discrete unhealthy foods (*n* = 13), with six studies reporting an unhealthy food score (*n* = 3) or total unhealthy food serves (*n* = 3). Just over half (*n* = 11) of the studies reported using a theoretical framework. Theories used were heterogeneous, the most commonly reported were social cognitive and learning theories (*n* = 5).

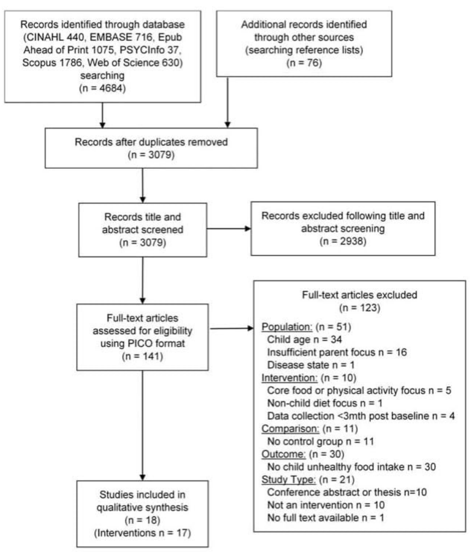


**Figure 1** PRISMA statement flow diagram: parent-focused interventions to reduce unhealthy foods intake in 3- to 8-year-old children.PICO, population, intervention, comparison, outcome; PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyse.

Majority of studies were rated as weak (*n* = 10), with only four studies rated as strong (31–34). Studies tended to rate poorly on selection bias (weak *n* = 10, moderate *n* = 8) and data collection tools (weak *n* = 7, moderate *n* = 5).

Interventions had a small to moderate effect size (−0.2 to −0.4), with some approaches resulting in negative intervention impacts (i.e. an increase in unhealthy food intake). Gerards *et al.* (32) was the only study to have a moderate to large effect size (−0.7), on sugar-sweetened soft drinks intake; however, this reduction was not maintained at 9-month follow-up. Two studies (35,36) found a similar reduction in sugar-sweetened beverage measures, and again not maintained at follow-up (36). Across studies, there were few statistically significant reductions in any unhealthy food measures, with four studies reporting primarily statistically significant findings (29,32,37,38), and for two, we could not calculate effect sizes (29,37).

### Behavioural content description

Table S2a and S2b maps each intervention against the components of the Behaviour Change Wheel framework (21). Sources of behaviour are the required components for a behaviour to occur, namely, physical and psychological capability, physical and social opportunity, and reflective and automatic motivation (17). Three of the six sources of behaviour were targeted in at least one intervention. Most studies targeted reflective motivation (*n* = 17) and psychological capability (*n* = 15). No study targeted physical capability, automatic motivation or social opportunity, and only one intervention targeted physical opportunity (31).

Intervention functions is the term given to various intervention options or approaches that can be implemented to change behaviour (21). Four of the nine Behaviour Change Wheel intervention functions were used in at least one of the interventions. Education (*n* = 15) and enablement (*n* = 15) were the most frequently used intervention functions. Training (*n* = 5) was underused in contrast to education, and only one study used environmental restructuring (31). No studies used persuasion, incentivization, coercion, modelling or restriction intervention functions.

Policy categories are how the intervention functions could be delivered in a policy context (21). Three of the seven policy categories were used in at least one intervention. Unanimously, the service provision (*n* = 18) policy category was used. Three intervention arms by the same researchers (36) used guidelines, and one study (28) used communication and marketing policy categories.

 

### Behaviour change techniques

Overall, 24 (of 93) unique BCTs were coded in the reported intervention descriptions, with a mean of five techniques (range 1–13) per intervention (Table 1). The most commonly used techniques were *1.1 Goal setting (behaviour)* (*n* = 15), *3.1 Social support (unspecified)* (*n* = 12), 4.*1 Instruction on how to perform the behaviour* (*n* = 11) and *13.1 Identification of self as a role model* (*n* = 8). Several of the coded BCTs were only used in one intervention including *2.2 Feedback on behaviour* (31), *4.2 Information about antecedents* (35), *5.1 Information about health consequences* (29), *6.1 Demonstration of the behaviour* (30), *8.1 Behavioural practice/rehearsal* (35), *9.2 Pros and cons* (37), *12.1 Restructuring the physical environment* (31) and *12.3 Avoidance/reducing exposure to cues for the behaviour* (35). Twelve of the 16 hierarchical cluster groups of BCTs (24) were included in at least one intervention, whereas BCTs in the clusters *Regulation*, *Scheduled consequences*, *Self-belief* and *Covert learning* were not included in any studies. Given control groups were primarily waitlist, physical activity or parenting style focused controls, BCTs for control groups are not presented in the tables. Only three of the control groups targeted dietary change with BCTs: *4.1 Instruction on how to perform the behaviour* (31,35), *2.2 Feedback on behaviour* (34) and *3.1 Social support (unspecified)* (34).

Sensitivity analyses of BCT coding were performed with the eight interventions (28,31,33,34,36,38) where authors provided additional unpublished intervention content such as procedures, manuals and resources (Table S3). Coding of unpublished content identified an additional eight unique BCTs, totalling 32 unique BCTs across published and unpublished content. On average, an additional nine BCTs (range 0–13) were coded in unpublished content, giving a total mean 14.5 BCTs (range 1–22) per intervention. The most frequently coded BCT in the interventions with combined published and unpublished content was again *1.1 Goal setting (behaviour)* (*n* = 7), followed by *1.2 Problem solving* (*n* = 6) and *1.5 Review behavioural goal(s)* (*n* = 5). The same hierarchical cluster groups were included as for published content.

### Association between behaviour change content and intervention effectiveness

Examination of the Behaviour Change Wheel components, BCTs and study characteristics to identify potential predictors of intervention effectiveness yielded mixed results. There were no clear patterns for any behaviour change content with unhealthy food outcome effect sizes (data not shown).

### Group versus individual approach interventions

There were similarities in the behaviour change content coded in the group (*n* = 8) and individual (*n* = 10) intervention approaches. Interventions with a primarily group approach, psychological capability and reflective motivation were targeted together (except for one study (30)), all included education intervention function and generally utilized enablement, with (32,33,35) or without (36,38) training, all using the policy category service provision. Individual-focused interventions targeted reflective motivation alone or in combination with psychological capability and utilized either education or enablement intervention functions alone (27–29,37,43), or together (31,34,40–42). These studies used service provision, and one (28) study using communication and marketing policy category.

The average number of BCTs was higher in primarily group-based interventions (mean 6 BCTs, range 4–13), compared with individual approaches (mean 4.5 BCTs, range 1–13). The most commonly used BCTs were similar across group and individual approach interventions, apart from *3.1 Social support (unspecified)* that was twice as frequent in individual-focused interventions. Other differences in BCTs used, were *1.2 Problem solving* (*n* = 4) and *10.3 Non-specific reward* (*n* = 4) were more commonly identified in group programs, and *5.3 Information about social consequences* (*n* = 3) and *12.5 Adding objects to the environment* (*n* = 3) more commonly used in individual approaches.

## Discussion

Our review aimed to evaluate the behaviour change content of interventions designed to support parents to reduce their provision of unhealthy foods to children. Interventions were generally focused on unhealthy foods in the context of prevention and management of obesity. Unhealthy food or drink intake was one of multiple dietary behaviours targeted by the interventions, with small effect sizes observed in outcome measures. This review used the Behaviour Change Wheel framework to code intervention content. Psychological capability and reflective motivation sources of behaviour, education and enablement intervention functions, and service provision policy category were the most common behaviour change content across evaluated interventions. Four BCTs commonly utilized across these interventions were goal setting, social support, instruction on how to perform the behaviour and role modelling. The findings of this review highlight many untapped intervention and behaviour change approaches that could be leveraged to enhance intervention effectiveness. For example, physical and social opportunity and automatic motivation, as well as numerous BCTs that were largely unused by interventions and provide areas to explore in next generation intervention design.

**Table 1** Use of behaviour change techniques* by, primarily group program and individual, parent-focused interventions (published intervention content)

| | | Primarily group program | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Study | Total | Gerards(32) Strong‡ | Burrows(35) Weak | Raynor(36) Int. 1Weak | Golley(33) Strong | Raynor (36) Int. 2aWeak | Skouteris(30) Weak | Elder(38) Moderate | Raynor(36) Int. 2b Weak |
| Effect size† | | −0.7 | 0.4 to −0.7 | −0.4 to −0.6 | −0.3 | −0.3 | −0.2 to −0.3 | −0.2 to −0.3 | 0.1 |
| **1.1 Goal setting (behaviour)** | **15** | X | X | X | X | X | X | X | X |
| 1.2 Problem solving | 5 | | X | | X | | X | X | |
| 1.4 Action planning | 2 | | X | | X | | | | |
| 1.5 Review behaviour goal(s) | 6 | | X | | X | | | X | |
| 1.6 Discrepancy between current behaviour and goal | 2 | | | | X | | | | |
| 2.2 Feedback on behaviour | 1 | | | | | | | | |
| 2.3 Self-monitoring of behaviour | 6 | | | X | | X | | | X |
| **3.1 Social support (unspecified)** | **12** | X | X | | X | | | X | |
| **4.1 Instruction on how to perform the behaviour** | **11** | X | X | | X | | X | X | |
| 4.2 Information about antecedents | 1 | | X | | | | | | |
| 5.1 Information about health consequences | 1 | | | | | | | | |
| 5.3 Information about social and environmental consequences | 3 | | | | | | | | |
| 6.1 Demonstration of the behaviour | 1 | | | | | | X | | |
| 6.2 Social comparison | 2 | | X | | | | X | | |
| 7.1 Prompts/cues | 1 | | | | | | | | |
| 8.1 Behavioural practice/rehearsal | 1 | | X | | | | | | |
| 8.7 Graded tasks | 2 | | | | | | | | |
| 9.1 Credible source | 2 | | X | | X | | | | |
| 9.2 Pros and cons | 1 | | | | | | | | |
| 10.3 Non-specific reward | 4 | | X | X | | X | | | X |
| 12.1 Restructuring the physical environment | 1 | | | | | | | | |
| 12.3 Avoidance/reducing exposure to cues for the behaviour | 1 | | X | | | | | | |
| 12.5 Adding objects to the environment | 4 | X | | | | | | | |
| **13.1 Identification of self as role model** | **8** | | X | X | X | X | | | X |
| Total # of BCTs | | 4 | 13 | 4 | 9 | 4 | 5 | 5 | 4 |
| Inter-rater agreement§ | | | | | | | | | |
| Kappa | | 0.85 | 0.73 | 0.66 | 0.54 | 0.66 | 0.56 | 0.56 | 0.66 |
| PABAK | | 0.98 | 0.89 | 0.96 | 0.87 | 0.96 | 0.94 | 0.94 | 0.96 |

*Behaviour change techniques as defined in the BCTTv1 by Michie *et al.* (24)

†Effect size for end of intervention result; 0.2 small effect size, 0.5 medium effect size and 0.8 large effect size (26). Unable to calculate for Davoli(37), Lin(29), Nyberg(42) and van Grieken(43).

‡Study quality as rated by the Effective Public Health Practice Project Quality Assessment Tool for Quantitative Studies(23).

§Inter-rater agreement calculated between two raters by Kappa and PABAK(25).

¶Difference in change in result between intervention and control, all other studies represent difference in result at end of intervention between intervention and control.

**Bold** text indicates the most commonly used BCTs. Abbreviations: BCT, behaviour change techniques; PABAK, prevalence-adjusted bias-adjusted Kappa.

**Table 1** (Continued)

| Study | Taylor(34) Strong | Viitasalo(27) Weak | Fletcher(31) Strong | Ostbye(41) Weak | Taveras(40) Moderate | Duncanson(28) Moderate | Davoli(37) Weak | Lin(29) Weak | Nyberg(42) Weak | van Grieken(43) Weak |
|---|---|---|---|---|---|---|---|---|---|---|
| | Primarily individual | | | | | | | | | |
| Effect size[†] | −0.1 to −0.4 | 0.0 to −0.4 | −0.2 | −0.1 to −0.2 | 0.0 to −0.2 | 0.6 to 0.3 | – | – | – | – |
| **1.1 Goal setting (behaviour)** | X | | X | X | X | | X | X | X | |
| 1.2 Problem solving | | | X | | | | | | | |
| 1.4 Action planning | | | | | | | | | | |
| 1.5 Review behaviour goal(s) | X | | X | | | | X | | | |
| 1.6 Discrepancy between current behaviour and goal | | | | | X | | | | | |
| 2.2 Feedback on behaviour | | | X | | | | | | | |
| 2.3 Self-monitoring of behaviour | | | X | | | | | X | | X |
| **3.1 Social support (unspecified)** | X | X | X | X | X | | X | | X | X |
| **4.1 Instruction on how to perform the behaviour** | X | | X | X | X | X | | | X | |
| 4.2 Information about antecedents | | | | | | | | | | |
| 5.1 Information about health consequences | | | | | | | | X | | |
| 5.3 Information about social and environmental consequences | | | X | | | | | X | | X |
| 6.1 Demonstration of the behaviour | | | | | | | | | | |
| 6.2 Social comparison | | | | | | | | | | |
| 7.1 Prompts/cues | | | X | | | | | | | |
| 8.1 Behavioural practice/rehearsal | | | | | | | | | | |
| 8.7 Graded tasks | | | X | | | | | X | | |
| 9.1 Credible source | | | | | | | | | | |
| 9.2 Pros and cons | | | | | | | X | | | |
| 10.3 Non-specific reward | | | | | | | | | | |
| 12.1 Restructuring the physical environment | | | X | | | | | | | |
| 12.3 Avoidance/reducing exposure to cues for the behaviour | | | | | | | | | | |
| 12.5 Adding objects to the environment | | | X | X | X | | | | | |
| **13.1 Identification of self as role model** | | | X | X | | | | X | | |
| Total # of BCTs | 4 | 1 | 13 | 5 | 5 | 1 | 4 | 6 | 3 | 3 |
| Inter-rater agreement[§] | | | | | | | | | | |
| Kappa | 0.74 | 0.49 | 0.86 | 0.56 | 0.56 | 1.00 | 1.00 | 0.37 | 0.80 | 0.65 |
| PABAK | 0.96 | 0.96 | 0.94 | 0.94 | 0.94 | 1.00 | 1.00 | 0.87 | 0.98 | 0.94 |

Effectiveness of changing unhealthy food intake varied dramatically with Cohen's d ranging from a reduction (0.7) to an increase (0.6) in unhealthy food outcomes. Interventions in general saw effect sizes in the range of −0.2 to −0.4, with the exception being one study focused solely on sugar-sweetened beverage reductions that resulted in moderate to large effect size of −0.7, in the short term (32). A meta-analysis by Vargas-Garcia *et al.* (44) reported a moderate effect (standardized mean difference −0.48, 95% CI −0.73 to −0.24) of interventions to reduce sugar-sweetened beverages in children, which was higher than the current outcomes for sugar-sweetened beverages alone (mean −0.3, range 0.1 to −0.7). Although some unhealthy food measures noted beneficial small to moderate effect sizes, within the same interventions, there were null effects (27,40) or increases in unhealthy food intakes (28,35,36). These mixed results are consistent with previous reviews focusing on parent food provision and obesity prevention (13,15,45–47). The review findings highlight a need for evaluating novel ways to reduce unhealthy food intake as a discrete behavioural target considering the number of targets and behaviour change content.

Interventions reviewed targeted multiple behaviours in the context of obesity prevention and management. For example, only a few studies had a primary aim of unhealthy foods (28–30). This multi-focus, with studies including many healthy food, physical activity and parenting strategies, may have diluted the potential impact of intervention strategies targeting unhealthy foods. It is important that future studies focus directly on reducing unhealthy foods or subgroups of unhealthy foods, ideally to test discrete strategies in feasibility or pilot studies, to combine only effective strategies into multi-component complex behaviour change interventions. We need to determine the impact of targeting all subgroups of unhealthy foods, rather than a sole focus on sugar-sweetened beverages as is seen in many interventions in this review and is the focus of a previous review by Vargas-Garcia *et al.* (44). Concurrently, we need to measure intake of a range of unhealthy foods to ensure positive dietary changes are being achieved, rather than replacing one unhealthy food with another, with no measure to capture this change.

There are several factors that could have influenced potential intervention impact. One factor is leveraging all necessary sources that support behaviour change, namely, having the capability, opportunity and motivation to perform the required behaviour (21). From the interventions reviewed here, there appears to be a gap in interventions that consider aspects of opportunity, with only Fletcher *et al.* (31) addressing physical opportunity by including food access and availability within the home. Parents may have the knowledge – psychological capacity – that unhealthy foods should be limited and be motivated to reduce their child's intake (given the negative health consequences) but not have the physical opportunity via access to alternative healthy foods in their neighbourhood, or the social opportunity in the form of support from caregivers, thereby limiting their ability to achieve behaviour change. By performing behavioural analysis, we can better understand where additional supports might be needed to alter parents' provision, to enhance intervention effectiveness. Given the societal role of unhealthy foods in current day (48), it may be useful to target social opportunity, using persuasion or modelling intervention functions, to create more favourable social norms. The effectiveness of current interventions targeting psychological capability and the tendency to focus on education that taps into knowledge of what to do, but the less common focus on training may suggest a deficit in development of the essential skills to undertake the behaviour. Duncanson *et al.* (28) saw a null effect of their intervention targeting the education intervention function in isolation, highlighting this alone may be insufficient to change behaviour (49).

Behaviour change techniques are commonly referred to as the 'active ingredients' of behavioural interventions (24). Although comparisons were not made between intervention effectiveness and the type or dose of BCTs used, several conclusions can still be drawn. *Goal setting (behaviour)* and *Instruction on how to perform the behaviour* were commonly used across interventions regardless of intervention effect. It can be suggested that these techniques may be necessary in interventions but not sufficient to result in behaviour change. These could be considered as foundation techniques that need to be combined with additional support to achieve effective behaviour change. For example, problem solving (BCT 1.2), feedback (BCT 2.2 to 2.7) or review goals (BCT 1.5) may be needed to enable parents to accomplish the goals they set (13,50–53). Similarly, as well as knowing how to perform a behaviour, we may need to include the intervention function environmental restructuring to create the *opportunity* using techniques focused on restructuring the physical or social environment (13,52). There are also numerous untapped BCTs (in this review 61 of 93) that we may be able to use in future interventions by drawing on applications of these techniques in adult health behaviours (50,52,54) and childhood obesity literature (13,51). For example, *Verbal persuasion about capability* (BCT 15.1) (50,54) and other *Self-belief* techniques could be used to tap into *automatic motivation*. *Generalization of the target behaviour* (BCT 8.6) could also be used to initiate *automatic motivation* and appears to be a worthy technique (50,51) yet was not included in any of the interventions in our review. *Reduce negative emotions* (BCT 11.2) (50) and *Conserving mental resources* (BCT 11.3), which fall under *Regulation* techniques (51), could be used to help minimize stress and the mental load to target different components of behaviour resulting from a behavioural analysis.

 

As retrospective analyses of the behavioural content of past interventions continue to grow (13,45,46,54), a key issue in need of addressing is the lack of clarity in intervention reporting (55). Whilst improvements have been made with the emergence of reporting checklists (e.g. CONSORT (56), TiDER (57)), we saw a large discrepancy in the number of BCTs extracted from published intervention descriptions compared with unpublished content. Detailed intervention reporting, utilizing protocol publications, online supplementary files and repositories of intervention materials will better position researchers to evaluate the effectiveness of BCTs and how interventions are (or are not) effective in changing behaviour. Not only would greater guidance from past interventions support the development of new interventions but it would also assist in the scaling and broad implementation in a more cost-effective manner (18). By focusing on unhealthy food intake, which was generally a secondary aim or sub-focus in interventions, it was difficult to discriminate the BCTs targeting healthy foods versus unhealthy foods. Greater detail in reporting each strategy mapped to the target behaviour will largely expand what evidence can be drawn from past interventions.

There are several strengths to our methods including independent duplicate study selection, quality assessment and coding of BCTs, as well as reviewer training in the Behaviour Change Wheel and BCT taxonomy. A high response rate from intervention authors for additional intervention content allowed sensitivity analyses of BCT coding in published versus unpublished content. Calculating Cohen's d effect size for all interventions provided a standard comparison measure and reduced reliance on statistical significance. There are however several limitations to be acknowledged. The lack of detailed intervention reporting and limited focus on unhealthy food as a behavioural target may have led to coding BCTs related to dietary strategies not targeting unhealthy foods; alternatively, strategies may have been implemented in the intervention but not coded due to insufficient reporting. Varied unhealthy food measures and intervention targets, as well as limited detail of the validity and reliability of the self-reported tools made it difficult to draw conclusions about intervention effectiveness. The overall low rating of study quality reduces the ability to draw firm recommendations and generalizability of the review findings. However, given the uncertainty of intervention intensity of BCTs and unhealthy foods focus, our review recommendations are focused on the avenues to strengthen the quality of future research. The degree of overlap in literature (10 out of 18) investigating the younger and older age groups prevented findings being examined per age bracket; instead, results were presented considering the broader age range of 3- to 8-year olds across the transition period. Heterogeneity in study design and the inclusion of obesity management interventions in the one review add to the complexity of result interpretation; however, was necessary due to the scare literature solely focused on obesity prevention. Nonetheless, unhealthy food focused strategies were similar across intervention type, e.g. reduce sugar-sweetened beverage consumption; as unhealthy food intake impacts on children's diet quality regardless of weight status, and weight management in childhood is focused on diet in line with the dietary guidelines (3). In addition, sensitivity analyses comparing behaviour change content between obesity prevention and weight management focused interventions found very few differences (File S2, Tables S4–S5). Low effectiveness of interventions impacted comparisons of BCTs by intervention effect size. Lastly, the review was restricted to interventions published in English and limited the ability to include unpublished intervention content in intervention authors' native language.

This review use the Behaviour Change Wheel framework and BCT taxonomy to critique interventions that aim to support parents to reduce provision of unhealthy foods to children. This is an important area with policy and practice relevance to maximize limited funding and resources across the preventative health sector. These findings can help to revise current practice and optimize future intervention design to include those BCTs likely to result in meaningful changes in children's intake of unhealthy foods. This review also highlights the need to focus attention to directly reducing unhealthy foods at a macro level, e.g. social communication and marketing campaigns to reduce unhealthy foods rather than purely promoting healthy foods (58), as well as considering the array of policy categories within the Behaviour Change Wheel. Current interventions have been limited primarily to service provision, a largely resource intensive category; however, there are opportunities to explore other functions such as environmental/social planning, guidelines and regulation at a policy sector level to create healthier environments providing the physical and social opportunity to reach more parents and support behaviour change. It is therefore essential for researchers to work with those in the policy and practice setting when designing next generation multi-component interventions to maximize these policy categories.

## Conclusion

Our review highlights several opportunities for novel application of the Behaviour Change Wheel and broader use of a range of BCTs in interventions to support parents to reduce unhealthy food provision to their children. Variation in characteristics and components of these interventions, as well as limited effectiveness, emphasize that there is currently no one best approach. Rather, it reinforces the importance of conducting behavioural analyses to understand and address the cause of unhealthy food provision. There is an ongoing need to improve intervention reporting in terms of intervention content (22,55) and methodological quality (16), to improve the body of evidence to guide the development of the next generation of interventions. This critique of current interventions also identifies several intervention strategies to investigate using best practice intervention design. Specifically designing interventions targeting opportunity through intervention functions such as persuasion, modelling or environmental restructuring and interventions using different policy categories (e.g. regulation and environmental/social planning) to provide an evidence base to inform policy and practice.

## Conflict of interest statement

R. K. G. was an author of one of the interventions included in the review, however, was not involved in screening, data extraction or coding the intervention.

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## Authorship

B. J. J. developed the research question and review protocol under the supervision of D. Z., G. A. H. and R. K. G. B. J. J. conducted the searches, screening, data extraction (including quality assessment and intervention coding) and drafted the manuscript. D. Z., G. A. H., R. K. G. and C. E. M. acted as second reviewers. All authors approved the final manuscript and declare this content has not been published elsewhere.

## Supporting information

Additional Supporting Information may be found online in the supporting information tab for this article. https://doi.org/10.1111/obr.12702

**File S1:** Final search terms for database search in Epub Ahead of Print
**Table S1:** Summary of parent-focused intervention characteristics
**Table S2a:** Mapping of intervention description by the Behaviour Change Wheel of primarily group program approach studies
**Table S2b:** Mapping of intervention description by the Behaviour Change Wheel of primarily individual focused studies
**Table S3:** Use of Behaviour Change Techniques in published and unpublished parent-focused intervention content
**File S2:** Comparison of obesity prevention versus weight management focused interventions
**Table S4a:** Mapping of *obesity prevention focussed* intervention description by the Behaviour Change Wheel
**Table S4b:** Mapping of *weight management focussed* intervention description by the Behaviour Change Wheel
**Table S5:** Use of Behaviour Change Techniques by, *obesity prevention or weight management*, parent-focussed interventions (published intervention content)

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How to reduce parental provision of unhealthy foods to 3-8 year old children in the home environment? A systematic review utilising the Behaviour Change Wheel framework

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**Supplementary File S1: Final search terms for database search in Epub Ahead of Print**

*Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily and Ovid MEDLINE(R) 1946 to Present*
*Nil refinement of search fields*

1 (child* and (preschool or pre school or "primary school" or junior school)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
2 exp Child/
3 1 or 2
4 (parent or parent$1 or care giver or caregiver or guardian or family or families or step parent$1 or mother$1 or father$1 or step mother or step father or grandparent$1 or grandfather or grandmother).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
5 grandparents/ or parents/ or fathers/ or mothers/ or single parent/
6 4 or 5
7 3 and 6
8 (discretionary food or discretionary choices or treats or extras or non core food or sometimes food$1 or energy dense or nutrient poor or EDNP or empty calor$3 or high kilojoule or high energy or junk food or sofas or unhealthy food or soft drinks or sugar sweetened beverage$1 or SSB or soda or sugary drink or sweet or fast food or takeaway food or take away food or saturated fat or added sugar or salt or sodium or energy intake or calorie intake).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
9 (controlled clinical trial or randomised controlled trial or randomized controlled trial or random allocation or double blind method or single blind method or placebo or intervention stud* or evaluation stud* or comparative study or follow up stud* or prospective stud* or cross-over stud* or clinical trial or latin square or time series or trial or random or RCT or matched or population* or control or comparison or comparative stud* or matched pairs or outcome stud* or quasi or pseudo or non randomi* or prospective or experimental or intervention or evaluation or cross over).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
10 exp clinical trial/ or exp controlled clinical trial/ or comparative study/ or evaluation studies/
11 9 or 10
12 (nutrition and (education or training or information or knowledge)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
13 ((behaviour or behavior) and change).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
14 (program or programme or intervention$1 or prevention or weight management).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
15 12 or 13 or 14
16 7 and 8 and 11 and 15
17 limit 16 to (english language and humans and ("preschool child (2 to 5 years)" or "child (6 to 12 years)"))

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**Supplementary Table S1: Summary of parent-focused intervention characteristics**

| Reference | Participant age range and weight status | Primary aim | Unhealthy food targets | Other targets | Intervention type and duration | Setting and delivery | Theory | Unhealthy food measure | Effect size[1] |
|---|---|---|---|---|---|---|---|---|---|
| **Primarily program-based approach** | | | | | | | | | |
| Gerards 2015 The Netherlands Strong | 4-8yo Overweight and obesity | BMI, WC, skinfolds | SSB | Y Fruit and veg intake Water Physical activity Parenting strategies | Group program and phone calls 14wks | Public health service and home Health professional | Unclear | Glasses of soft drink* | -0.7 |
| Burrows 2011 Australia Weak | 5.5-9.9yo Overweight | BMI, WC | Takeaway Soda Baked goods Snack bars Potato chips Sweets | Y Healthy eating Physical activity | Group program and phone calls 6mths | University/ research setting and home Dietitian | Health belief model | Serves of common unhealthy foods* | 0.4 to -0.7 |
| Raynor 2012 – Int. 1 USA Weak | 4-9yo Overweight and obesity | BMI | SSB Sweet and salty snack foods | Y Growth | Group program and growth monitoring 6mths | Research / primary care setting Research staff-therapists | Unclear | Serves of sweet & salty snacks &SSB | -0.4 to -0.6 |
| Golley 2011 Australia Strong | 6-9yo Overweight and obesity | BMI, WC | Sweet grain-based snacks SSB Ice cream | Y Healthy eating Physical activity Parenting strategies | Group program and phone calls 6mths | Hospital and home Dietitian | Child development theory and social learning principles | Serves of unhealthy foods* | -0.3 |
| Raynor 2012 – Int. 2a (traditional) USA Weak | 4-9yo Overweight and obesity | BMI | SSB | Y Growth Physical activity | Group program and growth monitoring 6mths | Research / primary care setting Research staff-therapists | Unclear | Serves of SSB | -0.3 |
| Skouteris 2016 Australia Weak | 1.7-3.5yo All | Fruit and veg intake and unhealthy foods | SSB Snack foods | Y Fruit and veg Eating behaviours Physical activity Sedentary time | Group program 10wks | Health centres Trained community members | Learning and social cognitive theories | Serves of high energy snacks & sweet drinks | -0.2 to -0.3 |
| Elder 2014 USA Moderate | 5-8yo All | BMI | Sugary beverages Takeaway | Y Healthy eating Family meal practice Physical activity | Group workshops and motivational interviewing | Recreation centre and home Family health coaches | Unclear | Fat intake & SSB intake scores | -0.2 to -0.3 |



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| Reference | Participant age range and weight status | Primary aim | Unhealthy food targets | Other targets | Intervention type and duration | Setting and delivery | Theory | Unhealthy food measure | Effect size[1] |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | 24mths | | | | |
| Raynor 2012 – Int. 2b (substitution) USA Weak | 4-9yo Overweight and obesity | BMI | SSB | Y Growth Physical activity | Group program and growth monitoring 6mths | Research / primary care setting Research staff-therapists | Unclear | Serves of SSB | 0.1 |
| **Primarily individual focused approach** | | | | | | | | | |
| Taylor 2015 New Zealand Strong | 4-8yo Overweight | BMI | Takeaway Biscuits Snack bars | Y Healthy eating Physical activity Home food environment | Motivational interviewing 24mths | University / research setting Health professional and mentor | Unclear | Unhealthy food & sweet drink subscale scores | -0.1 to -0.4 |
| Viitasalo 2016 Finland Weak | 6-8yo All | Physical activity, sedentary behaviour and diet quality | Foods high in saturated fat, sugar, salt or energy | Y Physical activity Sedentary behaviour Diet quality | Motivational interviewing 24mths | Unclear Clinical nutritionist | Unclear | Grams of common unhealthy foods | 0.0 to -0.4 |
| Fletcher 2013 / Wolfenden 2014 Australia Strong | 3-5yo All | Fruit and veg intake | Non-core foods | Y Fruit and veg intake | Telephone counselling 1mth | Home Trained interviewer | Socio-ecological theory | Unhealthy food subscale score | -0.2 |
| Ostbye 2012 USA Weak | 2-5yo All with mothers who were overweight and obesity | Healthy eating Physical Activity BMI | SSB Takeaway | Y Parental feeding practices Healthy eating Fruit and veg intake Physical (in)activity Screen time | Home interactive kits and motivational interviewing 8mths | Home Health coaches | Social cognitive theory | Serves / ounces of takeaway foods & SSB* | -0.1 to -0.2 |
| Taveras 2011 USA Moderate | 2-6.9yo Overweight and obesity | BMI | Takeaway SSB | Y Limit TV use | Motivational interviewing and paediatrician visits 12mths | Primary care centres Paediatric nurse practitioners | Chronic care model | Serves of SSB & takeaway foods | 0.0 to -0.2 |

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| Reference | Participant age range and weight status | Primary aim | Unhealthy food targets | Other targets | Intervention type and duration | Setting and delivery | Theory | Unhealthy food measure | Effect size[1] |
|---|---|---|---|---|---|---|---|---|---|
| Duncanson 2013<br>Australia<br>Moderate | 2-5yo<br><br>All | Unhealthy foods and healthy food | Unhealthy foods<br>Junk food | Y<br>Healthy eating | Technology-based resources<br><br>Once off | Home<br><br>Self-directed | Theory of Planned Behaviour | Energy & serves of unhealthy foods | 0.6 to 0.3 |
| Davoli 2013 / Broccoli 2016<br>Italy<br>Weak | 4-7yo<br><br>Overweight | BMI | Sweet snacks/ candies<br>Desserts<br>Salty snacks<br>Fried food<br>Sweetened drinks | Y<br>Healthy eating<br>Physical activity | Motivational interviewing<br><br>12mths | Paediatric practice<br><br>Paediatrician | Transtheoretical model of addiction and behaviour change | % children with positive change in common unhealthy foods | - |
| Lin 2016<br>China<br>Weak | 3-6yo<br><br>All | Unhealthy food | Takeaway<br>SSB<br>Fried food | Nil reported | Behavioural cards<br><br>4mths | Kindergarten<br><br>Teachers | Social cognitive theory | Frequency of takeaway foods, SSB, fried foods | - |
| Nyberg 2016<br>Sweden<br>Weak | 6yo<br><br>All | Healthy eating<br>Physical activity | Sweets<br>Snacks<br>Ice cream<br>SSB | Y<br>Parental feeding practices<br>Healthy eating<br>Fruit and veg intake<br>Physical inactivity<br>Screen time | Motivational interviewing and homework tasks<br><br>6mths | Schools and home<br><br>Research assistants and motivational counsellors | Social cognitive theory | Serves of unhealthy foods & drinks | - |
| van Grieken 2014<br>The Netherlands<br>Weak | 5yo<br><br>Overweight | BMI and WC | SSB | Y<br>Having breakfast<br>Limit TV use<br>Playing outside<br>Parenting practices<br>Home environment | Motivational interviewing<br><br>24mths | Youth health care centres<br><br>Youth health care professionals | ASE model, Precaution Adoption Process Model, Elaboration Likelihood Model, stages of change model | % children with <2 serves SSB | - |

[1] Effective size for end of intervention result; classified as >0.2 small effect size, >0.5 medium effect size and >0.8 large effect size. Unable to calculate for Davoli et al. [37], Lin et al. [29], Nyberg et al. [40] and van Grieken et al. [39]
* Difference in change in result between intervention and control, all other studies represent difference in result at end of intervention between intervention and control
Note: dietary counselling has been included under motivational interviewing
Abbreviations: BMI: body mass index; WC: waist circumference; SSB: sugar-sweetened beverages; Y: yes; yo: years old



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**Table S2a: Mapping of intervention description by the Behaviour Change Wheel of primarily group program approach studies**

| | | | Sources of behaviour[2] | | | | | | Intervention functions[3] | | | | | | | | | Policy categories[4] | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Study** | **Outcome** | **Effect size[1]** | Physical capability | **Psychological capability** | **Reflective motivation** | Automatic motivation | Social opportunity | Physical opportunity | **Education** | Persuasion | Incentivisation | Coercion | Training | **Enablement** | Modelling | Environmental restructuring | Restrictions | Guidelines | Environmental / social planning | Communication / marketing | Legislation | **Service provision** | Regulation | Fiscal measures |
| Gerards(32) | Glasses of soft drink* | -0.7 | | X | X | | | | X | | | | X | X | | | | | | | | X | | |
| Burrows(21) | Serves of common unhealthy foods* | 0.4 to -0.7 | | X | X | | | | X | | | | X | X | | | | | | | | X | | |
| Raynor(36) Int. 1 | Serves of sweet & salty snacks & SSB | -0.4 to -0.6 | | X | X | | | | X | | | | | X | | | | X | | | | X | | |
| Golley(59) | Serves of unhealthy foods* | -0.3 | | X | X | | | | X | | | | X | X | | | | | | | | X | | |
| Raynor(11) Int. 2a(36) | Serves of SSB | -0.3 | | X | X | | | | X | | | | | X | | | | X | | | | X | | |
| Skouteris(42) | Serves of high energy snacks & sweet drinks | -0.2 to -0.3 | | X | | | | | X | | | | X | | | | | | | | | X | | |
| Elder(38) | Fat intake & SSB intake scores | -0.2 to -0.3 | | X | X | | | | X | | | | | X | | | | | | | | X | | |
| Raynor Int. 2b(36) | Serves of SSB | 0.1 | | X | X | | | | X | | | | | X | | | | X | | | | X | | |
| Total | | | - | 8 | 7 | - | - | - | 8 | - | - | - | 4 | 7 | - | - | - | 3 | - | - | - | 8 | - | - |

[1] Effect size for end of intervention result; 0.2 small effect size, 0.5 medium effect size and 0.8 large effect size(26).
[2] Sources of behaviour are the required components for a behaviour to occur (17).
[3] Intervention functions is the term given to various intervention options or approaches which can be implemented to change behaviour (21).
[4] Policy categories are how the intervention functions could be delivered in a policy context (21), and were coded based on potential policy categories if wider implementation of the intervention were to occur.
* Difference in change in result between intervention and control, all other studies represent difference in result at end of intervention between intervention and control
**Bold** text indicates the most commonly used approaches. Abbreviations: SSB: sugar-sweetened beverages

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**Table S2b: Mapping of intervention description by the Behaviour Change Wheel of primarily individual focused studies**

| | | | Sources of behaviour[2] | | | | | | Intervention functions[3] | | | | | | | | | Policy categories[4] | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Study** | **Outcome** | **Effect size[1]** | Physical capability | **Psychological capability** | **Reflective motivation** | Automatic motivation | Social opportunity | Physical opportunity | **Education** | Persuasion | Incentivisation | Coercion | Training | **Enablement** | Modelling | Environmental restructuring | Restrictions | Guidelines | Environmental / social planning | Communication / marketing | Legislation | **Service provision** | Regulation | Fiscal measures |
| Taylor(34) | Unhealthy food & sweet drinks subscale scores | -0.1 to -0.4 | | X | X | | | | X | | | | | X | | | | | | | | X | | |
| Viitasalo(27) | Grams of common unhealthy foods | 0.0 to -0.4 | | | X | | | | | | | | | X | | | | | | | | X | | |
| Fletcher(31) | Unhealthy food subscale score | -0.2 | | X | X | | | X | X | | | | X | X | | X | | | | | | X | | |
| Ostbye(41) | Serves/ounces of takeaway foods & SSB* | -0.1 to -0.2 | | X | X | | | | X | | | | | X | | | | | | | | X | | |
| Taveras(42) | Serves of SSB & takeaway foods | 0.0 to -0.2 | | X | X | | | | X | | | | | X | | | | | | | | X | | |
| Duncanson (28) | Energy & serves of unhealthy foods | 0.6 to 0.3 | | X | X | | | | X | | | | | | | | | | | X | | X | | |
| Davoli(37) | % children with positive change in common unhealthy foods | - | | | X | | | | | | | | | X | | | | | | | | X | | |
| Lin(29) | Frequency of takeaway foods, SSB, fried foods | - | | X | X | | | | X | | | | | | | | | | | | | X | | |
| Nyberg(40) | Serves of unhealthy foods & drinks | - | | X | X | | | | X | | | | | X | | | | | | | | X | | |
| van Grieken(39) | % children with <2 serves SSB | - | | | X | | | | | | | | | X | | | | | | | | X | | |
| Total | | | - | 7 | 10 | - | - | 1 | 7 | - | - | - | 1 | 8 | - | 1 | - | - | - | 1 | - | 10 | - | - |

[1] Effect size for end of intervention result; 0.2 small effect size, 0.5 medium effect size and 0.8 large effect size(26). Unable to calculate for Davoli[37], Lin[29], Nyberg[40] and van Grieken[39].
[2] Sources of behaviour are the required components for a behaviour to occur (17).



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[3] Intervention functions is the term given to various intervention options or approaches which can be implemented to change behaviour (21).
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**Supplementary Table S3: Use of Behaviour Change Techniques in published and unpublished parent-focused intervention content**

| | Total | Primarily group program | | | | | Primarily individual | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **Raynor 2012 – Int. 1** Weak | **Golley 2011** Strong | **Raynor 2012 – Int. 2a** Weak | **Elder 2014** Moderate | **Raynor 2012 – Int. 2b** Weak | **Taylor 2015** Strong | **Fletcher 2013** Strong | **Duncanson 2013** Moderate |
| **Effect size[1]** | | -0.4 to -0.6 | -0.3 | -0.3 | -0.2 to -0.3 | 0.1 | -0.1 to -0.4 | -0.2 | 0.6 to 0.3 |
| **1.1 Goal setting (behaviour)** | **7** | X | X | X | X | X | X | X | |
| **1.2 Problem solving** | **6** | X | X | X | X | | X | X | |
| 1.4 Action planning | 4 | X | X | X | | | | X | |
| **1.5 Review behaviour goal(s)** | **6** | X | X | X | X | | X | X | |
| 1.6 Discrepancy between current behaviour and goal | 2 | | X | | | | X | | |
| 1.8 Behavioural contract | 2 | | X | | | | | X | |
| 2.2 Feedback on behaviour | 3 | X | | X | | | | X | |
| **2.3 Self-monitoring of behaviour** | **5** | X | X | X | | X | | X | |
| 3.1 Social support (unspecified) | 4 | | X | | X | | X | X | |
| **4.1 Instruction on how to perform the behaviour** | **5** | | X | | X | | X | X | X |
| 4.2 Information about antecedents | 4 | X | X | X | | | | X | |
| **5.1 Information about health consequences** | **5** | X | X | X | X | | | X | |
| 5.2 Salience of consequences | 2 | X | | X | | | | | |
| 5.3 Information about social and environmental consequences | 3 | | | | X | | X | X | |
| 6.1 Demonstration of the behaviour | 0 | | | | | | | | |
| 6.2 Social comparison | 4 | X | X | X | | | | X | |
| 7.1 Prompts / cues | 1 | | | | | | | X | |
| 8.1 Behavioural practice / rehearsal | 4 | X | X | X | | | X | | |
| 8.2 Behavioural substitution | 2 | | X | | | | | X | |
| 8.3 Habit formation | 1 | | X | | | | | | |
| 8.7 Graded tasks | 4 | X | | X | | | X | X | |
| 9.1 Credible source | 1 | | X | | | | | | |
| 9.2 Pros and cons | 1 | | | | | | X | | |
| 10.1 Material incentive (behaviour) | 1 | | | | X | | | | |
| 10.2 Material reward (behaviour) | 1 | | | | X | | | | |
| 10.3 Non-specific reward | 4 | X | | X | X | X | | | |
| 10.4 Social reward | 2 | | | | X | | | X | |
| 12.1 Restructuring the physical environment | 4 | X | X | X | | | | X | |
| 12.2 Restructuring the social environment | 3 | X | | X | | | | X | |
| **12.3 Avoidance / reducing exposure to cues for the behaviour** | **5** | X | X | X | | | X | X | |
| 12.5 Adding objects to the environment | 2 | | | | | | X | X | |
| **13.1 Identification of self as role model** | **5** | X | X | X | | X | | X | |
| Total number of BCTs in published content | | 4 | 9 | 4 | 5 | 4 | 4 | 13 | 1 |
| Total number of BCTs in unpublished content | | 13 | 10 | 13 | 6 | 13 | 8 | 9 | 0 |
| **Overall total number of BCTs** | | **17** | **19** | **17** | **11** | **17** | **10** | **22** | **1** |

Abbreviations: BCT: Behaviour Change Technique

How to reduce parental provision of unhealthy foods to 3-8 year old children in the home environment? A systematic review utilising the Behaviour Change Wheel framework
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## Supplementary File S2: Comparison of obesity prevention versus weight management focused interventions

*Obesity prevention vs weight management interventions*

There were similarities in the behaviour change content coded in the obesity prevention (n=8) and weight management (n=10) interventions. Obesity prevention focused interventions targeted psychological capability (n=7) and reflective motivation (n=7), primarily together (with the exception of 27 and 30), all except for one (27) included education intervention function, all solely using the policy category service provision, except for one study (28) which combined this with communication and marketing. Weight management focused interventions targeted reflective motivation alone (37, 39) or in combination with psychological capability (n=8), and utilised enablement intervention functions alone (37, 39), or commonly together with education (34, 36, 42) and in some studies the additional of training (32, 33, 35). These studies used service provision, with the group of interventions by the same author also combining the policy category guidelines (36).

The average number of BCTs was the same mean 5 BCTs with a wider range of BCTs in obesity prevention interventions (range 1-13) compared with weight management focused interventions (range 3-13). The most commonly used BCTs were similar across the two interventions types with the most common BCTs being 1.1 Goal setting (behaviour) (prevention n=6, management n=9), 3.1 Social support (unspecified) (prevention n=5, management n=7) and 4.1 Instruction on how to perform he behaviour (prevention n=6, management n=5), and 13.1 Identification of self as a role model emerging as a common BCT in weight management interventions (n=5). A key difference in BCTs used, was 10.3 Non-specific reward (n=4) only reported in weight management interventions.

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**Supplementary Table S4a: Mapping of *obesity prevention focussed* intervention description by the Behaviour Change Wheel**

| Study | Outcome | Effect size[1] | Components of behaviour: Physical capability | **Psychological capability** | **Reflective motivation** | Automatic motivation | Social opportunity | Physical opportunity | Intervention functions: **Education** | Persuasion | Incentivisation | Coercion | Training | **Enablement** | Modelling | Environmental restructuring | Restrictions | Policy categories[2]: Guidelines | Environmental / social planning | Communication / marketing | Legislation | **Service provision** | Regulation | Fiscal measures |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Skouteris (30) | Serves of high energy snacks & sweet drinks | -0.2 to -0.3 | | X | | | | | X | | | | X | | | | | | | | | X | | |
| Elder (38) | Fat intake & SSB intake scores | -0.2 to -0.3 | | X | X | | | | X | | | | | X | | | | | | | | X | | |
| Viitasalo (27) | Grams of common unhealthy foods | 0.0 to -0.4 | | | X | | | | | | | | | X | | | | | | | | X | | |
| Fletcher (31) | Unhealthy food subscale score | -0.2 | | X | X | | | X | X | | | | X | X | | X | | | | | | X | | |
| Ostbye (41) | Serves/ounces of takeaway foods & SSB* | -0.1 to -0.2 | | X | X | | | | X | | | | | X | | | | | | | | X | | |
| Duncanson (28) | Energy & serves of unhealthy foods | 0.6 to 0.3 | | X | X | | | | X | | | | | | | | | | | X | | X | | |
| Lin (29) | Frequency of takeaway foods, SSB, fried foods | - | | X | X | | | | X | | | | | | | | | | | | | X | | |
| Nyberg (40) | Serves of unhealthy foods & drinks | - | | X | X | | | | X | | | | | X | | | | | | | | X | | |
| Total | | | - | 7 | 7 | - | - | 1 | 7 | - | - | - | 2 | 5 | - | 1 | - | - | - | 1 | - | 8 | - | - |

[1] Effect size for end of intervention result; 0.2 small effect size, 0.5 medium effect size and 0.8 large effect size. Unable to calculate for Lin[29] and Nyberg[40].
[2] Policy categories were coded based on potential policy categories if wider implementation of the intervention were to occur
* Difference in change in result between intervention and control, all other studies represent difference in result at end of intervention between intervention and control
Abbreviations: SSB: sugar-sweetened beverages



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**Supplementary Table S4b: Mapping of *weight management focussed* intervention description by the Behaviour Change Wheel**

| Study | Outcome | Effect size[1] | Components of behaviour: Physical capability | **Psychological capability** | **Reflective motivation** | Automatic motivation | Social opportunity | Physical opportunity | Intervention functions: **Education** | Persuasion | Incentivisation | Coercion | Training | **Enablement** | Modelling | Environmental restructuring | Restrictions | Policy categories[2]: Guidelines | Environmental / social planning | Communication / marketing | Legislation | **Service provision** | Regulation | Fiscal measures |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gerards (32) | Glasses of soft drink* | -0.7 | | X | X | | | | X | | | | X | X | | | | | | | | X | | |
| Burrows (35) | Serves of common unhealthy foods* | 0.4 to -0.7 | | X | X | | | | X | | | | X | X | | | | | | | | X | | |
| Raynor Int. 1 (36) | Serves of sweet & salty snacks & SSB | -0.4 to -0.6 | | X | X | | | | X | | | | | X | | | | X | | | | X | | |
| Golley (33) | Serves of unhealthy foods* | -0.3 | | X | X | | | | X | | | | X | X | | | | | | | | X | | |
| Raynor Int. 2a (36) | Serves of SSB | -0.3 | | X | X | | | | X | | | | | X | | | | X | | | | X | | |
| Raynor Int. 2b (36) | Serves of SSB | 0.1 | | X | X | | | | X | | | | | X | | | | X | | | | X | | |
| Taylor (34) | Unhealthy food & sweet drinks subscale scores | -0.1 to -0.4 | | X | X | | | | X | | | | | X | | | | | | | | X | | |
| Taveras (42) | Serves of SSB & takeaway foods | 0.0 to -0.2 | | X | X | | | | X | | | | | X | | | | | | | | X | | |
| Davoli (37) | % children with positive change in common unhealthy foods | - | | | X | | | | | | | | | X | | | | | | | | X | | |
| van Grieken (39) | % children with <2 serves SSB | - | | | X | | | | | | | | | X | | | | | | | | X | | |
| Total | | | - | 8 | 10 | - | - | - | 8 | - | - | - | 3 | 10 | - | - | - | 3 | - | - | - | 10 | - | - |

[1] Effect size for end of intervention result; 0.2 small effect size, 0.5 medium effect size and 0.8 large effect size. Unable to calculate for Davoli[37] and van Grieken[39].
[2] Policy categories were coded based on potential policy categories if wider implementation of the intervention were to occur
* Difference in change in result between intervention and control, all other studies represent difference in result at end of intervention between intervention and control
Abbreviations: SSB: sugar-sweetened beverages

## Appendix 3: Definition of Unhealthy Foods

Table A3.1: Dietary guideline definitions and food examples of unhealthy foods from high income English speaking countries

| **Country**<br>**Year**<br>***Term used*** | **Unhealthy foods dietary guidelines** | **Food and beverage examples** | **Recommendations for children and adolescents** |
|---|---|---|---|
| Australia[5]<br><br>2013<br><br>*Discretionary choices* | Guideline 3:<br>Limit intake of foods containing saturated fat, added salt, added sugars and alcohol.<br><br>Food selection guide: *Only sometimes and in small amounts* | Biscuits, cakes, pastries, pies, processed meats, commercial burgers, pizza, fried foods, potato chips, crisps and other savoury snacks, butter, cream, cooking margarine, coconut and palm oil, confectionary, sugar-sweetened soft drinks and cordials, fruit drinks, vitamin waters, energy and sports drinks | 1 serve = 600kJ<br><br>0-8 years old 0 to ½ serve per day (unless child is taller or more active, 0-2 serves per day)<br><br>Older children and adolescents who are more active and not above their healthy weight range, could have 0–2½ serve per day of additional foods (including unhealthy foods) |
| New Zealand[458, 459]<br><br>2015<br><br>*High fat, sugar and salt foods* | Guideline 3:<br>Prepare foods or choose pre-prepared foods, snacks and drinks that are: low in fat, especially saturated fat; low in sugar, especially added sugars; low in salt (if using salt, use iodised salt).<br><br>Booklet: *Children need healthy food most of the time. It's all right to eat foods that are high in fat, sugar or salt occasionally (less than once a week), but not every day.* | Chocolate, confectionery, potato chips, chocolate or cream-filled biscuits, fast food and sugary drinks<br><br>Sodium: savoury snacks (e.g. chippies/ chips/ crisps), processed meat (e.g. sausages, bacon, ham, salami, luncheon sausage), cheese, sauces (e.g. tomato and soy sauce), some breakfast cereals (e.g. cornflakes) and most fast foods and takeaways. | Limit high fat, sugar and salt foods and drinks to occasional (less than once a week) consumption only.<br><br>Saturated and trans fats 10% EI or less (14+ years old)<br><br>Sodium upper limit 1.0 to 2.3g per day (based on age) |
| United Kingdom[460]<br><br>2016<br><br>*Nil collective term – referred only by nutrient* | If consuming foods and drinks high in fat, salt or sugar, have these less often and in small amounts.<br><br>Food selection guide: *Eat less often and in small amounts.* | Chocolate, cakes, biscuits, full-sugar soft drinks, ice-cream, sweets, puddings, pastries, jam, honey, crisps, sauces, butter, cream, mayonnaise | No more than 19g to 30g of free sugars per day (based on age)<br><br>No more than 2g to 6g of salt (0.8g to 2.4g sodium) per day (based on age)<br><br>No more than 20g to 30g of saturated fat per day for adults (based on gender), and less for children |

Table A3.1: Dietary guideline definitions and food examples of unhealthy foods from English speaking countries (cont.)

| **Country**<br>**Year**<br>***Term used*** | **Unhealthy foods dietary guidelines** | **Food and beverage examples** | **Recommendations for children and adolescents** |
|---|---|---|---|
| United States[461, 462]<br><br>2015<br><br>*Nil collective term – referred only by nutrient or as other dietary components* | Guideline 3:<br>Limit calories from added sugars and saturated fats and reduce sodium intake.<br>Consume an eating pattern low in added sugars, saturated fats, and sodium.<br>Cut back on foods and beverages higher in these components to amounts that fit within healthy eating patterns.<br><br>Food selection guide: *Drink and eat less sodium, saturated fat, and added sugars.* | Added sugars: syrups and other caloric sweeteners.<br><br>Saturated fats: mixed dishes containing cheese, meat, or both, such as burgers, sandwiches, and tacos; pizza; rice, pasta, and grain dishes; and meat, poultry, and seafood dishes.<br><br>Sodium: mixed dishes such as burgers, sandwiches, and tacos; rice, pasta, and grain dishes; pizza; meat, poultry, and seafood dishes; and soups. | Consume less than 10 percent of calories per day from added sugars<br><br>Consume less than 10 percent of calories per day from saturated fats<br><br>Consume less than 1,500 to 2,300mg per day of sodium (based on age and gender) |
| Canada[463]<br><br>2019<br><br>*Highly processed foods* | Guideline 2:<br>Processed or prepared foods and beverages that contribute to excess sodium, free sugars, or saturated fat undermine healthy eating and should not be consumed regularly.<br><br>Food selection guide: *Limit highly processed foods. If you choose these foods, eat them less often and in small amounts.* | Processed meat, deep-fried foods, sugary breakfast cereals, biscuits and cake, confectioneries, sugary drinks, and many ready-to-heat packaged dishes | Sodium: Less than 2300 mg per day (ages 14 and older)<br>Free sugars: Less than 10% of total energy intake<br>Saturated fat: Less than 10% of total energy intake |

## Appendix 4: Reporting Checklists

### *Completed STROBE-nut checklist for Study 1 (Chapter 3)*

STROBE-nut: An extension of the STROBE statement for nutritional epidemiology[1]

| Section / topic | Item no | STROBE recommendations | Extension for Nutritional Epidemiology studies (STROBE-nut) | Thesis section |
|---|---|---|---|---|
| Title and abstract | 1 | (a) Indicate the study's design with a commonly used term in the title or the abstract.<br>(b) Provide in the abstract an informative and balanced summary of what was done and what was found. | nut-1 State the dietary/nutritional assessment method(s) used in the title, abstract, or keywords. | n/a |
| **Introduction** | | | | |
| Background rationale | 2 | Explain the scientific background and rationale for the investigation being reported. | | 3.1. |
| Objectives | 3 | State specific objectives, including any pre-specified hypotheses. | | 3.1.3. |
| **Methods** | | | | |
| Study design | 4 | Present key elements of study design early in the paper. | | 3.2.1. |
| Settings | 5 | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection. | nut-5 Describe any characteristics of the study settings that might affect the dietary intake or nutritional status of the participants, if applicable. | 3.2.2. |
| Participants | 6 | Cross-sectional study—Give the eligibility criteria, and the sources and methods of selection of participants. | nut-6 Report particular dietary, physiological or nutritional characteristics that were considered when selecting the target population. | 3.2.2. |
| Variables | 7 | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable. | nut-7.1 Clearly define foods, food groups, nutrients, or other food components.<br>nut-7.2 When using dietary patterns or indices, describe the methods to obtain them and their nutritional properties. | 3.2.3.<br>3.2.4. |
| Data sources - measurements | 8 | For each variable of interest, give sources of data and details of methods of assessment (measurement).<br>Describe comparability of assessment methods if there is more than one group. | nut-8.1 Describe the dietary assessment method(s), e.g., portion size estimation, number of days and items recorded, how it was developed and administered, and how quality was assured. Report if and how supplement intake was assessed.<br>nut-8.2 Describe and justify food composition data used. Explain the procedure to match food composition with consumption data. Describe the use of conversion factors, if applicable.<br>nut-8.3 Describe the nutrient requirements, recommendations, or dietary guidelines and the evaluation approach used to compare intake with the dietary reference values, if applicable.<br>nut-8.4 When using nutritional biomarkers, additionally use the STROBE Extension for Molecular Epidemiology (STROBE-ME). Report the type of biomarkers used and their usefulness as dietary exposure markers.<br>nut-8.5 Describe the assessment of nondietary data (e.g., nutritional status and influencing factors) and timing of the assessment of these variables in relation to dietary assessment.<br>nut-8.6 Report on the validity of the dietary or nutritional assessment methods and any internal or external validation used in the study, if applicable. | 3.2.4.<br>n/a<br>n/a<br>n/a<br>n/a<br>3.2.4. |
| Bias | 9 | Describe any efforts to address potential sources of bias. | nut-9 Report how bias in dietary or nutritional assessment was addressed, e.g., misreporting, changes in habits as a result of being measured, or data imputation from other sources | 3.2.5., 3.5.4. |
| Study Size | 10 | Explain how the study size was arrived at. | | 3.2.6. |
| Quantitative variables | 11 | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why. | nut-11 Explain categorization of dietary/nutritional data (e.g., use of N-tiles and handling of non-consumers) and the choice of reference category, if applicable. | 3.3.1. |

[1] Adapted from Lachet et al.[227]

STROBE-nut: An extension of the STROBE statement for nutritional epidemiology (cont.)

| Section / topic | Item no | STROBE recommendations | Extension for Nutritional Epidemiology studies (STROBE-nut) | Thesis section |
|---|---|---|---|---|
| Statistical Methods | 12 | (a) Describe all statistical methods, including those used to control for confounding<br>(b) Describe any methods used to examine subgroups and interactions.<br>(c) Explain how missing data were addressed.<br>(d) Cross-sectional study—If applicable, describe analytical methods taking account of sampling strategy.<br>(e) Describe any sensitivity analyses. | nut-12.1 Describe any statistical method used to combine dietary or nutritional data, if applicable.<br>nut-12.2 Describe and justify the method for energy adjustments, intake modeling, and use of weighting factors, if applicable.<br>nut-12.3 Report any adjustments for measurement error, i.e,. from a validity or calibration study. | 3.3.2.<br>n/a<br>n/a |
| **Results** | | | | |
| Participants | 13 | (a) Report the numbers of individuals at each stage of the study—e.g., numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analyzed.<br>(b) Give reasons for non-participation at each stage.<br>(c) Consider use of a flow diagram. | nut-13 Report the number of individuals excluded based on missing, incomplete or implausible dietary/nutritional data. | 3.4.1. |
| Descriptive data | 14 | (a) Give characteristics of study participants (e.g., demographic, clinical, social) and information on exposures and potential confounders<br>(b) Indicate the number of participants with missing data for each variable of interest | nut-14 Give the distribution of participant characteristics across the exposure variables if applicable. Specify if food consumption of total population or consumers only were used to obtain results. | 3.4.1. |
| Outcome data | 15 | Cross-sectional study—Report numbers of outcome events or summary measures. | | 3.4.2. |
| Main results | 16 | (a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval).<br>Make clear which confounders were adjusted for and why they were included.<br>(b) Report category boundaries when continuous variables were categorized.<br>(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period. | nut-16 Specify if nutrient intakes are reported with or without inclusion of dietary supplement intake, if applicable. | 3.4.3. |
| Other analyses | 17 | Report other analyses done—e.g., analyses of subgroups and interactions and sensitivity analyses. | nut-17 Report any sensitivity analysis (e.g., exclusion of misreporters or outliers) and data imputation, if applicable. | 3.4.3., 3.4.4. |
| **Discussion** | | | | |
| Key results | 18 | Summarize key results with reference to study objectives. | | 3.5. |
| Limitation | 19 | Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias. | nut-19 Describe the main limitations of the data sources and assessment methods used and implications for the interpretation of the findings. | 3.5.4. |
| Interpretation | 20 | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence. | nut-20 Report the nutritional relevance of the findings, given the complexity of diet or nutrition as an exposure. | 3.5.1., 3.5.2., 3.5.3. |
| Generalizability | 21 | Discuss the generalizability (external validity) of the study results. | | 3.5.4. |
| **Other information** | | | | |
| Funding | 22 | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based. | | n/a |
| *Ethics* | | | nut-22.1 Describe the procedure for consent and study approval from ethics committee(s). | 3.2.1. |
| *Supplementary material* | | | nut-22.2 Provide data collection tools and data as online material or explain how they can be accessed. | Appendix 6 |

***Completed STROBE checklist for Study 2 (Chapter 4)***

STROBE Statement: Checklist of items that should be included in reports of ***cross-sectional studies***[1]

| **Section / topic** | **Item No** | **Recommendation** | **Thesis Section** |
|---|---|---|---|
| **Title and abstract** | 1 | (a) Indicate the study's design with a commonly used term in the title or the abstract | n/a |
| | | (b) Provide in the abstract an informative and balanced summary of what was done and what was found | n/a |
| **Introduction** | | | |
| Background/rationale | 2 | Explain the scientific background and rationale for the investigation being reported | 4.1 |
| Objectives | 3 | State specific objectives, including any prespecified hypotheses | 4.1.5. |
| **Methods** | | | |
| Study design | 4 | Present key elements of study design early in the paper | 4.2.1., 4.2.3. |
| Setting | 5 | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection | 4.2.2. |
| Participants | 6 | (a) Give the eligibility criteria, and the sources and methods of selection of participants | 4.2.2. |
| Variables | 7 | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable | 4.2.3., 4.2.4., 4.2.5. |
| Data sources/ measurement | 8* | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group | 4.2.3., 4.2.4., 4.2.5. |
| Bias | 9 | Describe any efforts to address potential sources of bias | 4.2.6. |
| Study size | 10 | Explain how the study size was arrived at | 4.2.7. |
| Quantitative variables | 11 | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why | 4.3.1. |
| Statistical methods | 12 | (a) Describe all statistical methods, including those used to control for confounding | 4.3.2. |
| | | (b) Describe any methods used to examine subgroups and interactions | 4.3.2. |
| | | (c) Explain how missing data were addressed | 4.3.1 |
| | | (d) If applicable, describe analytical methods taking account of sampling strategy | n/a |
| | | (e) Describe any sensitivity analyses | 4.3.2. |

[1] Adapted from Vandenbroucke et al.[464]

STROBE Statement: Checklist of items that should be included in reports of ***cross-sectional studies*** (cont.)

| Section / topic | Item No | Recommendation | Thesis Section |
|---|---|---|---|
| **Results** | | | |
| Participants | 13* | (a) Report numbers of individuals at each stage of study—e.g. numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed | 4.4.1. |
| | | (b) Give reasons for non-participation at each stage | 4.4.1 |
| | | (c) Consider use of a flow diagram | 4.4.1. |
| Descriptive data | 14* | (a) Give characteristics of study participants (e.g. demographic, clinical, social) and information on exposures and potential confounders | 4.4.1 |
| | | (b) Indicate number of participants with missing data for each variable of interest | 4.4.1 |
| Outcome data | 15* | Report numbers of outcome events or summary measures | 4.4.1., 4.4.2. |
| Main results | 16 | (a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included | 4.4.3. |
| | | (b) Report category boundaries when continuous variables were categorized | 4.4.3. |
| | | (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period | 4.4.3. |
| Other analyses | 17 | Report other analyses done—e.g. analyses of subgroups and interactions, and sensitivity analyses | 4.4.3. |
| **Discussion** | | | |
| Key results | 18 | Summarise key results with reference to study objectives | 4.5 |
| Limitations | 19 | Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias | 4.5.6. |
| Interpretation | 20 | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence | 4.5.1., 4.5.2., 4.5.3., 4.5.4., 4.5.5. |
| Generalisability | 21 | Discuss the generalisability (external validity) of the study results | 4.5.6. |
| **Other information** | | | |
| Funding | 22 | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based | n/a |

***Completed ESTIMATE checklist for Study 2 (Chapter 4)***

ESTIMATE checklist: Questions to consider when justifying the choice of analysis method, describing the analysis, and interpreting the results[1]

| Section / topic | Recommendation | Thesis section |
|---|---|---|
| Estimates | Describe the choice of parameter estimates resulting from the model appropriately and completely, including<br>• Whether each variable corresponds to an effects-coded level, a dummy-coded level, or a continuous change in levels<br>• Whether each variable corresponds to a main effect or interaction effect<br>• Whether continuous variables are linear or have an alternative functional form | 4.3.2. |
| Stochastic | Describe the stochastic properties of the analysis, including<br>• The statistical distributions of parameter estimates<br>• The distribution of parameter estimates across the sample (preference heterogeneity)<br>• The variance of the estimation function, including systematic differences in variance across observations (scale heterogeneity) | 4.4.3. |
| Trade-offs | Describe the trade-offs that can be inferred from the model, including<br>• The magnitude and direction of the attribute-level coefficients<br>• The relative importance of each attribute over the range of levels included in the experiment<br>• The rate at which respondents are willing to trade off among the attributes (marginal rate of substitution) | 4.4.3. |
| Interpretation | Provide interpretation of the results taking into account the properties of the statistical model, including<br>• Conclusions that can be drawn directly from the results<br>• Applicability of the sample, including subgroups or segments, to the population of interest<br>• Limitations of the results | 4.5.1. |
| Method | Describe the reasons for selecting the statistical analysis method used in the analysis, including<br>• Why the method is appropriate for analyzing the data generated by the experiment<br>• Why the method is appropriate for addressing the underlying research question<br>• Why the method was selected over alternative methods | 4.1.3.,<br>4.1.4.,<br>4.2.3. |
| Assumptions | Describe the assumptions of the model and the implications of the assumptions for interpreting the results,<br>including<br>• Assumptions about the error distribution<br>• Assumptions about the independence of observations<br>• Assumptions about the functional form of the value function | 4.3.2. |
| Transparent | Describe the study in a sufficiently transparent way to warrant replication, including descriptions of<br>• The data setup, including handling missing data<br>• The estimation function, including the value function and the statistical analysis method<br>• The software used for estimation | 4.3.1,<br>4.3.2. |
| Evaluation | Provide an evaluation of the appropriateness of the statistical analysis method to answering the research question,<br>including<br>• The goodness of fit of the model<br>• Sensitivity analysis of the model specification<br>• Consistency of results estimated using different methods | 4.4.2.,<br>4.4.3. |

1 Adapted from Hauber et al.[301]

***Completed PRISMA checklist for Study 3 (Chapter 5)***

PRISMA Statement: Preferred Reporting Items for Systematic Reviews and Meta-Analyses[1]

| **Section / topic** | **Item no** | **Checklist item** | **Thesis section** |
|---|---|---|---|
| **Title** | | | |
| Title | 1 | Identify the report as a systematic review, meta-analysis, or both. | n/a |
| **Abstract** | | | |
| Structured summary | 2 | Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number. | n/a |
| **Introduction** | | | |
| Rationale | 3 | Describe the rationale for the review in the context of what is already known. | 5.1. |
| Objectives | 4 | Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS). | 5.1.3. |
| **Methods** | | | |
| Protocol and registration | 5 | Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number. | 5.2. |
| Eligibility criteria | 6 | Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale. | 5.2.1. |
| Information sources | 7 | Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched. | 5.2.1. |
| Search | 8 | Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated. | 5.2.1., Appendix 8 |
| Study selection | 9 | State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis). | 5.2.1. |
| Data collection process | 10 | Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators. | 5.2.1., 5.2.2. |
| Data items | 11 | List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made. | 5.2.4. |
| Risk of bias in individual studies | 12 | Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis. | 5.2.3. |
| Summary measures | 13 | State the principal summary measures (e.g., risk ratio, difference in means). | 5.2.5. |
| Synthesis of results | 14 | Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., $I^2$) for each meta-analysis. | 5.2.5. |

[1] Adapted from Moher et al.[332]

PRISMA Statement: Preferred Reporting Items for Systematic Reviews and Meta-Analyses

| **Section / topic** | **Item no** | **Checklist item** | **Thesis section** |
|---|---|---|---|
| Risk of bias across studies | 15 | Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies). | 5.4.5. |
| Additional analyses | 16 | Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified. | 5.2.5. |
| **Results** | | | |
| Study selection | 17 | Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram. | 5.3. |
| Study characteristics | 18 | For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations. | Table 5.1 |
| Risk of bias within studies | 19 | Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12). | 5.3. |
| Results of individual studies | 20 | For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot. | 5.3.1., 5.3.2., 5.3.3. |
| Synthesis of results | 21 | Present results of each meta-analysis done, including confidence intervals and measures of consistency. | n/a |
| Risk of bias across studies | 22 | Present results of any assessment of risk of bias across studies (see Item 15). | n/a |
| Additional analysis | 23 | Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]). | 5.3.4., 5.3.5. |
| **Discussion** | | | |
| Summary of evidence | 24 | Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers). | 5.4. |
| Limitations | 25 | Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias). | 5.4.5. |
| Conclusions | 26 | Provide a general interpretation of the results in the context of other evidence, and implications for future research. | 5.5. |
| **Funding** | | | |
| Funding | 27 | Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review. | n/a |

## Appendix 5: Data Collection Tools

### *Study 1: Complete survey questions in online format*

### WELCOME

Welcome to the study **'What influences parents provision of foods to children at home?'**

Parents play an important role in their child's health and nutrition. It can be hard to provide a healthy diet with the availability of different food, busy lives, TV adverts and children's pester power. We want to know more about what parents think about the foods they provide to their child at home.

If you are a **parent of a 3-7 year old** we need your help, to simply complete a **once-off online survey**. It involves answering a series of questions about the foods your child eats, and your thoughts and opinions about providing foods to your child at home, and some general information about yourself. Your responses will be anonymous.

Ready to get started? Make sure you have **set aside 30 minutes** to complete the survey as you will need to do this in one sitting.
Unfortunately, if you close the survey before you are finished you won't be able to go back to where you were up to.
If you have the time now click 'next' to continue.

### INFORMATION SHEET

**<u>This page provides important information about this study. Please read this information before continuing.</u>**

**WHAT INFLUENCES PARENTS PROVISION OF FOODS TO CHILDREN AT HOME?**

Parents play an important role in their child's health and nutrition. It can be hard to provide a healthy diet with the availability of different food, busy lives, TV adverts and children's pester power. We want to know more about what parents think about the foods they provide to their child at home.

We want you to take part in the study. Before you decide whether you take part, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully. Ask us if there is anything that is not clear or if you would like more information.

1. **What is the study purpose?** We want to know more about what influences what food parents provide to their child at home.

2. **What does taking part in the study involve?** Taking part in this study is voluntary and will involve:

- Providing informed consent to take part in the study by commencing the survey,

- Completing a once-off 30minute online survey about the foods your child eats, and your thoughts and opinions about providingfoods to your child at home, and some general information about yourself. If you have multiple children aged 3-7 years, you will be asked to complete the survey just thinking about one child of your choosing

- You will be asked to report your child's height and weight

3. **What are the possible disadvantages and risks of taking part?** There are no foreseeable discomforts, disadvantages or risks for taking part in this study. Some of the questions relate to sensitive personal

information, however, remember that your responses will remain anonymous. If you feel uncomfortable at any stage when answering questions you will have the option to withdraw from the study, at any point while completing the survey, without affecting your position now or in the future. Once you submit your survey, however, we are unable to remove your response as it will be impossible to identify your individual data. Incomplete questionnaires will not be used.

4. **What are the possible benefits of taking part?** While there may not be immediate benefits, you will be providing a valuable contribution to the scientific knowledge in this area. This will help future research and public health nutrition to better support parents and improve children's nutrition.

5. **What if I want to speak to someone about a problem?** If you wish to raise a problem or issue in relation to this study, in the first instance you should contact Ms Brittany Johnson or Dr Rebecca Golley (See 'Contact for further information' for contact details).

6. **Will my taking part in this project be kept confidential?** Any information collected from you will be used solely for the purpose of conducting this study in accordance with the National Statement on Ethical Conduct in Human Research. All records containing personal information will remain confidential and no information, which could lead to identification of any individual, will be released, unless required by law. Data will be stored in a locked filing cabinet at the University of South Australia, City East Campus for a period of 5 years. At the end of this period your records will be confidentially destroyed. Electronic data will be stored under password protection only accessible by the research team. Your information will not be disclosed to any third party without your permission and your child will not be able to be identified in any reports or publications arising from this study. All records will be anonymous; therefore we will not be able to provide you with a copy of your record. The researcher will take every care to remove responses from any identifying material as early as possible. Likewise individuals' responses will be kept confidential by the researcher and not be identified in the reporting of the research. However the researcher cannot guarantee the confidentiality or anonymity of material transferred by email or the internet.

7. **What will happen to the results of the research project?** At the completion of the study a summary of overall group results will be provided via email (if you chose to provide an address for this purpose). The results from this study will be published in scientific journals and may be used as comparative data in future research projects for which ethics approval will be sought.

8. **Who is organising and funding the research?** This research is being funded by the University of South Australia.

9. **Who has ethically reviewed the project?** This project has been approved by the University of South Australia's Human Research Ethics Committee. If you have any ethical concerns about the project or any questions about the rights of your child as a participant, please contact Executive Officer of this Committee, Tel: +61 8 8302 3118; Email: vicki.allen@unisa.edu.au

10. **Contact for further information** Please screenshot this webpage if you would like to keep this information sheet for your records. For further information please contact Ms Brittany Johnson, University of South Australia, email brittany.johnson@mymail.unisa.edu.au or Dr Rebecca Golley, University of South Australia, Ph 08 8302 2507, email rebecca.golley@unisa.edu.au

**Thank you for supporting this project.**

**If you are happy to continue click 'Next'**

# CONSENT

**Human Research Ethics Committee**

**CONSENT**

This project has been approved by the University of South Australia's Human Research Ethics Committee. If you have any ethical concerns about the project or questions about your rights as a participant please contact the Executive Officer of this Committee, Tel: +61 8 8302 3118; Email: vicki.allen@unisa.edu.au

**SECTION 1: CONTACT AND PROJECT DETAILS**

Researcher's Full Name: Ms Brittany Johnson

Contact Details: University of South Australia, brittany.johnson@mymail.unisa.edu.au

Supervisor's Full Name: Dr Rebecca Golley

Contact Details: University of South Australia, City East Campus, Ph 08 8302 2507, email

rebecca.golley@unisa.edu.au Protocol Number: 0000033798

Project Title: What influences parents provision of foods to children at home?

**SECTION 2: CERTIFICATION**

Participant Certification

In completing this survey, I confirm that:

- I have read the Participant Information Sheet and I understand the nature and purpose of the research project. I understand andagree to take part.
- I understand the purpose of the research project and my involvement in it.
- I understand that I may withdraw from the research project at any stage and that this will not affect my status now or in the future.
- I understand that while information gained during the study may be published, I will not be identified and my personal results willremain confidential, unless required by law.

Do you consent to take part in this study?

- ◯ I consent to take part in this study
- ◯ I do not consent to take part in this study

[Eligibility screening and socio-demographic items]

Have you previously completed the 'What influences parents provision of foods to children at home?' survey (e.g. in 2015)?

- Yes
- No

Are you male or female?

- Male
- Female

How old are you? (enter age in years)

Which state or territory do you live in:

- ACT
- NT
- QLD
- SA
- TAS
- VIC
- WA
- NSW

How many children (aged 0-18 years) do you have living at home?

- 1
- 2
- 3
- 4
- more than 4

**If you have more than one child aged 3-7 years old, please choose one child to keep in mind throughout this survey.**

What is the date of birth of the child you have nominated for this study?

If your child's birth year is outside of the years listed in the drop down box, please DO NOT continue with the questionnaire.

| | Day | Month | Year |
|---|---|---|---|
| Date of birth | | | |

Is the child you have nominated for this study male or female?

- Male
- Female

What is your relationship to the child you have nominated for this study?

- Mother
- Father
- Caregiver (residing with the child)
- Other (please specify)

Does your child have any special dietary requirements recommended by a doctor or dietitian?

- No
- Yes. Please specify (what the requirements are and why)

[Short Food Survey]

In the following questions you will be asked about what your child usually eats. In terms of "usually", it may be helpful to think about what your child has eaten *over the last week*. To prompt your answers think about all meals, snacks and drinks as well as foods that are eaten at home and away from home.

**Please read each question carefully as questions will ask:**

• 'How many serves' – referring to **how much** your child usually consumes, or;

• 'How often' – referring to whether your child eats a food **always, usually, sometimes or never.**

**Please note that questions relating to serves will be asked in two ways:**

• 'Weekday' – referring to number of serves usually eaten on a **Monday-Friday,** or; • 'Weekend day' – referring to number of serves usually eaten on a **Saturday or Sunday** **Please continue to the next page to answer these questions.**

*Remember, if you have multiple children, please keep in mind just the child you have nominated for this study.*

Please indicate how many serves of breads, cereals, rice, pasta or noodles your child would usually eat?

*A serve is equivalent to:*

*1 slice of bread OR*

*½ medium bread roll OR*

*½ cup cooked rice, pasta or noodles OR*

*½ cup cooked porridge OR*

*2/3 cup breakfast cereal flakes OR*

*¼ cup muesli*

| | |
|---|---|
| Number of serves on a **weekday** | ☐ |
| Number of serves on a **weekend day** | ☐ |

How often is the bread your child eats wholegrain/wholemeal?

*Including high fibre white bread, wholegrain made from white flour with added seeds/grains, wholemeal bread, rye bread, wholemeal/wholegrain made from wholemeal flour with added seeds/grains*

- ◯ Always
- ◯ Usually
- ◯ Sometimes
- ◯ Never
- ◯ Doesn't eat bread

Please indicate how many serves of vegetables your child would usually eat?

*A serve is equivalent to:*

*½ cup (75g) cooked vegetables OR*

*1 cup salad vegetables OR*

*1 potato (5cm diameter)/ ½ cup mashed potato (hot chips NOT included) OR*

*½ cup (75g) cooked/canned beans/peas/lentils*

| | |
|---|---|
| Number of serves on a **weekday** | |
| Number of serves on a **weekend day** | |

Please indicate how many serves of fruit your child would usually eat?

*A serve is equivalent to:*

*1 medium piece e.g. apple/banana/orange/pear OR*

*2 small pieces e.g. apricots/plums/kiwi fruit OR*

*1 cup fruit salad/canned fruit OR*

*Dried fruit – 4 apricot halves/ 1 ½ tablespoons sultanas OR*

*½ cup <u>100%</u> fruit juice ONLY*

| | |
|---|---|
| Number of serves on a **weekday** | |
| Number of serves on a **weekend day** | |

Please indicate how many serves of milk, yoghurt or cheese your child would usually eat?

*A serve is equivalent to:*

*1 cup (250ml) fresh/long-life/flavoured milk OR*

*1 cup (250ml) soy milk OR*

*40g of cheese/ 2 prepacked slices OR*

*1 small carton (200g) yoghurt OR*

*1 cup (250ml) custard (ice cream NOT included) OR*

*½ cup evaporated milk*

| | |
|---|---|
| Number of serves on a **weekday** | |
| Number of serves on a **weekend day** | |

What type of milk does your child usually have?

- Whole/full cream (4%)
- Reduced fat (1-2%)
- Skim (less than 1%)
- Regular soy
- Reduced fat soy
- Doesn't have cow's milk or other milk
- Other (please specify)

Please indicate how many serves of meat, pork, fish, poultry, eggs, legumes or nuts your child would usually eat?

*A serve is equivalent to:*

*65-100g cooked meats e.g. ½ cup lean mince (sausages NOT included) OR*

*2 small chops/ 2 slices roast meat OR*

*½ chicken breast / 2 drumsticks OR*

*80-120g fish e.g. 1 large fish fillet / ½ cup canned tuna drained OR*

*2 eggs OR*

*1 cup cooked or canned legumes/beans such as lentils, chick peas or split peas*

*1/3 cup peanuts/ almonds OR*

*2 tablespoons peanut butter*

| | |
|---|---|
| Number of serves on a **weekday** | |
| Number of serves on **weekend day** | |

**You are a quarter of the way through! Thank you for starting the survey, your thoughts are really important.**

How often is the beverage your child drinks water?

*Include tap, bottled or rain water*

- Almost always (most of the time water)
- Usually (more than half the time is water)
- Sometimes (less than half the time is water)
- Never/ doesn't drink water (no water)

What types of spread does your child usually have?

*For example: on bread, biscuits or crackers*

- ◯ Butter
- ◯ Table margarine (e.g. Country Gold Dairy Blend, Devondale Spread)
- ◯ Unsaturated margarine (e.g. Flora, MeadowLea, Olive Grove, Bertolli, Gold N Canola, Logical)
- ◯ Doesn't have spread
- ◯ Other (please specify)

How often does your child have meat that is trimmed before cooking?

*For example: removing the chicken skin or all visible fat removed from beef, lamb and pork before cooking*

- ◯ Always
- ◯ Usually
- ◯ Sometimes
- ◯ Rarely/ never
- ◯ Doesn't eat meat

The following questions refer to the variety in your child's diet.

**Please read each question carefully as questions will ask:**

- 'How many different types' – referring to how many different types of food your child has eaten in the past 2 or 7 days

**Please read the following examples.** If your child eats…

- Canned fruit for dessert, a banana the next day at breakfast, and cut up fruit at recess – this equals 3 different types in the past 48 hours.

**Please continue to the next page to answer these questions**

How many different types of fruit has your child eaten in the past 48 hours (2 days)?

*For example: one banana + one apple = 2 different types of fruit*

- ◯ Nil
- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5 +

How many different types of vegetables has your child eaten in the past 48 hours (2 days)?

*For example: lettuce in a sandwich + peas, carrots and corn at dinner = 4 different types of vegetables*

- Nil
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8+

How many different types of dairy foods has your child eaten in the past 48 hours (2 days)?

*Include only milk, flavoured milk, cheese, yoghurt and custard. DO NOT include ice-cream.*

- Nil
- 1
- 2
- 3
- 4
- 5

Which of the following foods has your child eaten over the past 7 days:

*Choose as many answers as applicable*

- [ ] Beef
- [ ] Lamb
- [ ] Pork
- [ ] Veal
- [ ] Chicken
- [ ] Turkey
- [ ] Processed meats (e.g. bacon, devon, fritz, ham, salami)
- [ ] Fish
- [ ] Eggs
- [ ] Nuts
- [ ] Tofu
- [ ] Baked beans
- [ ] Lentils
- [ ] None of the above
- [ ] Other (please specify)

Which of the following foods has your child eaten over the past 7 days:

*Choose as many answers as applicable*

- [ ] Bread (brown, flat bread, mixed grain, pita bread, rolls, rye, white, wholegrain)
- [ ] Breakfast cereal other than muesli or porridge
- [ ] Oats/ muesli/ porridge
- [ ] Pasta, noodles, or couscous
- [ ] Pearl barley or other grains
- [ ] Polenta, taco shells or tortilla
- [ ] Rice (brown or white)
- [ ] None of the above
- [ ] Other (please specify)

You will be asked questions about what your child usually eats. In terms of "usually", it may be helpful to think back about what your child has eaten *over the last week*. To prompt your answers think about all meals, snacks and drinks as well as foods that are eaten at home and away from home.

**Read each question carefully as questions will ask:**

- 'How often' – referring to whether your child eats a food daily, weekly, monthly or never, **or**;
- 'How many serves' – referring to how much your child usually consumes, **or**;
- 'How many times' – referring to how many times each day, week or month they usually eat the food.
-

**Please read the following examples**. If your child eats……

- porridge for breakfast and has Corn Flakes as a snack after school – this equals 2 times daily.
- a banana at breakfast, cut up fruit at recess, and canned fruit for dessert – this equals 3 times daily.
- a pie after sport every Saturday morning – this equals 1 time each week.
- spaghetti for dinner once a week and rice once a week – this equals 2 times weekly.
- chicken in a sandwich for lunch every school day and you have BBQ chicken for dinner one night each week – this equals 6 timesweekly.
- take away pizza once one week and fish and chips once another week – this equals 2 times monthly.

**Please continue to the next page to answer these questions**

How often does your child usually eat meat products?

*Include sausages, frankfurters, devon, fritz, ham, salami, hot dogs, hamburgers and chicken nuggets*

- ◯ Each day
- ◯ Each week
- ◯ Each month
- ◯ Doesn't eat meat products

How many times does your child usually eat meat products?

*Include sausages, frankfurters, devon, fritz, ham, salami, hot dogs, hamburgers and chicken nuggets*

How often does your child usually have soft drink, cordial, or sports drinks?

*Include regular and diet/low joule varieties*

- ◯ Each day
- ◯ Each week
- ◯ Each month
- ◯ Doesn't drink soft drink, cordial or sports drinks

How many times does your child usually have soft drink, cordial, or sports drinks?

*Include regular and diet/low joule varieties*

How often does your child usually have fruit juice drinks?

*Include fruit boxes, poppers or any fruit drink with added water or sugar. DO NOT include 100% fruit juice*

- Each day
- Each week
- Each month
- Doesn't drink fruit juice drinks

How many times does your child usually have fruit juice drinks?

*Include fruit boxes, poppers or any fruit drink with added water or sugar. DO NOT include 100% fruit juice*

How often does your child usually have meals or snacks from take away food stores?

*This includes places like McDonalds, Hungry Jacks, Pizza Hut, KFC, Red Rooster, Fish/Chicken Shop or local take away food places and foods such as burgers, pizza, hot dogs, battered chicken or fish and chips*

- Each day
- Each week
- Each month
- Doesn't eat meals and snacks from take away food stores

How many times does your child usually have meals or snacks from take away food stores?

*This includes places like McDonalds, Hungry Jacks, Pizza Hut, KFC, Red Rooster, Fish/Chicken Shop or local take away food places and foods such as burgers, pizza, hot dogs, battered chicken or fish and chips*

**You are halfway through! Not that much further!**

How often does your child usually eat oven baked potato gems/ chips/ hashbrowns, hot chips/ French fries, wedges or fried potatoes?

- Each day
- Each week
- Each month
- Doesn't eat any of the foods listed above

How many times does your child usually eat oven baked potato gems/ chips/ hashbrowns, hot chips/ French fries, wedges or fried potatoes?

[ ]

How often does your child usually eat savoury snacks such as crisps, pretzels or plain/ flavoured crackers?

- ◯ Each day
- ◯ Each week
- ◯ Each month
- ◯ Doesn't eat any of the foods listed above

How many times does your child usually eat savoury snacks such as crisps, pretzels or plain/ flavoured crackers?

[ ]

How often does your child usually have sweet biscuits/ cakes/ buns/ muffins/ donuts?

*Include both home-made and bought*

- ◯ Each day
- ◯ Each week
- ◯ Each month
- ◯ Doesn't eat any of the foods listed above

How many times does your child usually have sweet biscuits/ cakes/ buns/ muffins/ donuts?

*Include both home-made and bought*

[ ]

How often does your child usually eat savoury pastries?

*This includes pies, pastries, sausage rolls, Kransky Dogs and frankfurters wrapped in pastry*

- ◯ Each day
- ◯ Each week
- ◯ Each month
- ◯ Doesn't eat savoury pastries

How many times does your child usually eat savoury pastries?

*This includes pies, pastries, sausage rolls, Kransky Dogs and frankfurters wrapped in pastry*

[ ]

How often does your child usually eat snack type bars?

*This includes muesli bars, fruit bars and breakfast cereal bars*

- ◯ Each day
- ◯ Each week
- ◯ Each month
- ◯ Doesn't eat snack type bars

How many times does your child usually eat snack type bars?

*This includes muesli bars, fruit bars and breakfast cereal bars*

How often does your child usually have chocolate or lollies?

*Includes all types of chocolate and both hard and soft lollies*

- ◯ Each day
- ◯ Each week
- ◯ Each month
- ◯ Doesn't eat chocolate and lollies

How many times does your child usually have chocolate or lollies?

*Includes all types of chocolate and both hard and soft lollies*

How often does your child usually have ice-cream or ice-blocks?

*This includes ice-blocks, ice-cream in a bowl or ice-creams on a stick*

- ◯ Each day
- ◯ Each week
- ◯ Each month
- ◯ Doesn't eat ice-creams or ice-blocks

How many times does your child usually have ice-cream or ice-blocks?

*This includes ice-blocks, ice-cream in a bowl or ice-creams on a stick*

[Parental Food Attitude Questionnaire]

**You are on the home stretch now! Thank you for involvement in the survey, your thoughts are really important. Not much to go.**

The next series of questions will be asking you about your thoughts and opinions (so there are no right or wrong answers) about providing **'extras' foods and drinks** to your child from within the home.

*Remember, if you have multiple children,* ***please keep in mind just the child you have nominated for this study.***

'Extras' foods and drinks can be referred to as sometimes foods or treats/junk food.

When we talk about **'extras'** we are including:

- Soft drink (regular, diet/low joule), fruit drinks, sweetened flavoured water, energy drinks, sports drinks
- Pies, pastries, sausage rolls
- Ice cream, chocolate, lollies
- Doughnuts, pastries, cakes, biscuits, muffins bought and home-made
- Savoury snack biscuits (e.g. jatz, shapes), chips
- Fried potato chips, hash browns, wedges – including oven baked
- Fast food and takeaway (e.g. McDonalds, KFC, pizza, burgers, fish and chips, Chinese, Indian etc)
- Processed meats (e.g. sausages, fritz/devon, chicken nuggets, hot dogs)

Please keep **all of these foods** in mind when answering the following questions. Remember that your answers are **anonymous** so please answer honestly.

Considering the extras you provide to your child from within the home, choose if you think this is lower to higher than the following statements.

*'Extras from within the home' refers to all home made or brought extras provided within the home, as well as those packed from the home e.g. lunchboxes and picnics.*

| | Lower | Slightly lower | Same | Slightly higher | Higher | I don't know what the dietary guidelines are |
|---|---|---|---|---|---|---|
| Compared with the recommendations in the Australian Dietary Guidelines, the amount of extras I provide to my child is... | ○ | ○ | ○ | ○ | ○ | ○ |

Considering the extras you provide to your child from within the home, select if you think this is lower to higher than the following statements.

| | Lower | Slightly lower | Same | Slightly higher | Higher |
|---|---|---|---|---|---|
| Compared with how active my child is the amount of extras I provide to my child is… | ◯ | ◯ | ◯ | ◯ | ◯ |
| Compared with how healthy my child's overall diet is the amount of extras I provide to my child is… | ◯ | ◯ | ◯ | ◯ | ◯ |
| Compared with that of other children the same age as my child the amount of extras I provide to my child is… | ◯ | ◯ | ◯ | ◯ | ◯ |
| Compared with that of other children the same size (weight and height) as my child the amount of extras I provide to my child is… | ◯ | ◯ | ◯ | ◯ | ◯ |

For 3-7 year old children (i.e. similar age and size to your child), in general, how serious a concern do you think the following are:

| | Not serious at all (can be ignored) | Somewhat serious | Moderately serious | Serious | Very serious (life threatening) |
|---|---|---|---|---|---|
| being overweight | ◯ | ◯ | ◯ | ◯ | ◯ |
| tooth decay | ◯ | ◯ | ◯ | ◯ | ◯ |
| behavioural issues | ◯ | ◯ | ◯ | ◯ | ◯ |
| too much energy (calories), saturated fat, added sugar and salt | ◯ | ◯ | ◯ | ◯ | ◯ |

How much do you agree or disagree with the following statements. If I limit the extras I provide to my child, I think that I can reduce their chances of…

| | Strongly agree | Agree | Neither agree nor disagree | Disagree | Strongly disagree |
|---|---|---|---|---|---|
| …becoming overweight in the next 2-3 years | ◯ | ◯ | ◯ | ◯ | ◯ |
| …developing tooth decay | ◯ | ◯ | ◯ | ◯ | ◯ |
| …having behavioural issues | ◯ | ◯ | ◯ | ◯ | ◯ |
| …eating too much energy (calories), saturated fat, added sugar and salt | ◯ | ◯ | ◯ | ◯ | ◯ |

How true are the following statements for you? If I limit my provision of extras from within the home…

| | Not at all true | Somewhat true | Mostly true | Exactly true |
|---|---|---|---|---|
| …I'll be seen as a 'good' parent for doing what's best for my child's health | ○ | ○ | ○ | ○ |
| …my child will throw a tantrum or pester me for extras | ○ | ○ | ○ | ○ |
| …my child will be healthy (i.e. weight, teeth) | ○ | ○ | ○ | ○ |
| ...I'll save money on food shopping | ○ | ○ | ○ | ○ |
| …I'll have to spend more time preparing meals and snacks | ○ | ○ | ○ | ○ |
| ...my child will continue healthy eating habits into adulthood | ○ | ○ | ○ | ○ |
| …my child will eat more fruit and vegetables | ○ | ○ | ○ | ○ |
| …I will also need to change my own intake of extras | ○ | ○ | ○ | ○ |
| …my child will miss out on having treats | ○ | ○ | ○ | ○ |
| …it will affect what we do in family time (i.e. movie nights, baking, celebrations etc) | ○ | ○ | ○ | ○ |
| …I'll be seen to be environmentally-friendly | ○ | ○ | ○ | ○ |
| …others may think I am restricting my child's enjoyment of food | ○ | ○ | ○ | ○ |
| …my child will overeat extras when they are available | ○ | ○ | ○ | ○ |
| ...my child will miss out on eating what their friends eat | ○ | ○ | ○ | ○ |

How confident are you that you can limit the extras you provide to your child from within the home over the next month? I am...

- ○ Not at all confident
- ○ Somewhat confident
- ○ Moderately confident
- ○ Extremely confident

In the next month, I intend to start or continue to limit the extras I provide to my child from within the home. I...

- ○ Don't intend at all
- ○ Somewhat intend
- ○ Moderately intend
- ○ Strongly intend

Some situations can make it hard to maintain certain behaviours. How confident are you, that you could limit providing extras to your child from within the home, even if…

| | Not at all confident | Somewhat confident | Moderately confident | Extremely confident |
|---|---|---|---|---|
| …your child is requesting/ demanding/ fussing/ pestering you for extras | ◯ | ◯ | ◯ | ◯ |
| …your child is resistant to limiting extras | ◯ | ◯ | ◯ | ◯ |
| …you are tired | ◯ | ◯ | ◯ | ◯ |
| …you are having a very busy day | ◯ | ◯ | ◯ | ◯ |
| …your partner is undermining you | ◯ | ◯ | ◯ | ◯ |
| …you have other financial pressures | ◯ | ◯ | ◯ | ◯ |
| …it is school/child care holidays | ◯ | ◯ | ◯ | ◯ |
| …you consume extras around your child | ◯ | ◯ | ◯ | ◯ |
| …it takes you a long time to make it habit | ◯ | ◯ | ◯ | ◯ |
| …your child sees food marketing on television | ◯ | ◯ | ◯ | ◯ |
| …your parents/relatives continue to bring extras into your home | ◯ | ◯ | ◯ | ◯ |
| …you are having family time (i.e. movie night, baking, celebrations etc) | ◯ | ◯ | ◯ | ◯ |
| ...your child has a strong liking for extras | ◯ | ◯ | ◯ | ◯ |

Some parents would like to limit the extras they provide. How true are the following statements for you? I already have strategies for how to limit extras…

| | Not at all true | Somewhat true | Moderately true | Exactly true |
|---|---|---|---|---|
| …at home on **weekdays** | ◯ | ◯ | ◯ | ◯ |
| ...at home on **weekend** days | ◯ | ◯ | ◯ | ◯ |
| ...when packing lunch for childcare / kindergarten / school | ◯ | ◯ | ◯ | ◯ |
| …when buying takeaway meals and snacks for eating at home | ◯ | ◯ | ◯ | ◯ |
| …at home when we have visitors | ◯ | ◯ | ◯ | ◯ |
| …at home when celebrating a birthday or other special occasion | ◯ | ◯ | ◯ | ◯ |
| ...when other people bring food to my home | ◯ | ◯ | ◯ | ◯ |

Some parents would like to limit the extras they provide. How true are the following statements for you?
I already have strategies for…

| | Not at all true | Somewhat true | Moderately true | Exactly true |
|---|---|---|---|---|
| …how to manage when my child asks for extras | ◯ | ◯ | ◯ | ◯ |
| …how to deal with certain situations in order to stick to my intentions (e.g. where I know only extras may be available, when I'm in a hurry, school holidays) | ◯ | ◯ | ◯ | ◯ |
| …how to manage when friends undermine my plans to limit extras | ◯ | ◯ | ◯ | ◯ |
| …how to manage when relatives (e.g. grandparents) undermine my plans to limit extras | ◯ | ◯ | ◯ | ◯ |
| …how to deal with set-backs when I provide extras outside of my intentions | ◯ | ◯ | ◯ | ◯ |

Sometimes we don't always stick to our intentions. Imagine you have increased the extras you provide to your child for some time.
How confident are you about re-limiting the extras you provide to your child after...

| | Not at all confident | Somewhat confident | Moderately confident | Extremely confident |
|---|---|---|---|---|
| …2 days (e.g. after a special occasion) | ◯ | ◯ | ◯ | ◯ |
| …2 to 6 weeks (e.g. after school holidays, Christmas period etc) | ◯ | ◯ | ◯ | ◯ |
| … weeks to months (e.g. after a period of change in family routine) | ◯ | ◯ | ◯ | ◯ |

[Socio-demographic items]

**You are so close now!!**

These last few questions are really important for us to find out a little more about who this research can support. Thank you again for your contribution! Almost there!

Does the child you have nominated for this study currently attend the following? (select all that apply)

- ☐ Child care / Early Learning Centre
- ☐ Family day care
- ☐ Kindergarten
- ☐ Primary school
- ☐ Not applicable

How tall (height) is the child you have nominated for this study? (enter in centremetres)

What does the child you have nominated for this study weigh? (enter in kilograms)

How confident are you these measurements for your child are accurate?

| | Not at all confident | Somewhat confident | Confident | Extremely confident |
|---|---|---|---|---|
| Height | ○ | ○ | ○ | ○ |
| Weight | ○ | ○ | ○ | ○ |

Has your child been measured within the past 6 months, by yourself, or a health care practitioner (e.g. child health nurse, doctor)?

- ○ Yes
- ○ No

Are you:

- ○ Single / never married
- ○ Married
- ○ Living as married
- ○ Separated /divorced
- ○ Widowed

What is the highest level of education that you have completed?

- ◯ Did not go to school
- ◯ Primary school
- ◯ Some high school
- ◯ Completed high school
- ◯ Tech or trade qualification (including TAFE)
- ◯ Tertiary degree (e.g. university)
- ◯ Post graduate degree

Are you currently:

- ◯ Employed full time
- ◯ Employed part time
- ◯ Unemployed
- ◯ Full time home maker
- ◯ Retired
- ◯ Student
- ◯ Disabled or too ill to work
- ◯ Volunteering / unpaid work

What is your approximate average household income annually (before tax, including all wages, salary, pensions and government assistance)?

- ◯ Less than $20,800
- ◯ $20,800 to $36, 399
- ◯ $36,400 to $51,999
- ◯ $52,000 to $77,999
- ◯ $78,000 to 103,999
- ◯ $104,000 to $114,399
- ◯ $114,400 and over
- ◯ I'd prefer not to answer

What is your current postcode?

[ ]

What is your current weight? (enter in kilograms)

[ ]

What is your height? (enter in centremetres or feet and inches)

The following 5 items are about what advice you think experts are giving us.

Do you think the Australian Dietary Guidelines recommend that people should be eating more, the same amount, or less of these foods?

| | More | Same | Less | Not sure |
|---|---|---|---|---|
| Vegetables and legumes/beans | ◯ | ◯ | ◯ | ◯ |
| Sugary foods | ◯ | ◯ | ◯ | ◯ |
| Meat | ◯ | ◯ | ◯ | ◯ |
| Carb (carbohydrate) rich foods (breads and cererals) | ◯ | ◯ | ◯ | ◯ |
| Fatty foods | ◯ | ◯ | ◯ | ◯ |
| High fibre foods | ◯ | ◯ | ◯ | ◯ |
| Fruit | ◯ | ◯ | ◯ | ◯ |
| Salty foods | ◯ | ◯ | ◯ | ◯ |
| Dairy foods | ◯ | ◯ | ◯ | ◯ |

How many servings of fruit and vegetables a day do you think experts recommend people eat?

*Examples of one serve are a medium piece of fruit or 1 cup of salad vegetables*

| | |
|---|---|
| Fruit | |
| Vegetable | |

Which fat do experts say is the most important for people to cut down on?

◯ Monounsaturated fat

◯ Polyunsaturated fat

◯ Saturated fat

◯ Not sure

What version of dairy foods do experts say people (over 2 years old) should eat?

◯ Full fat

◯ Low fat

◯ Both full fat and lower fat

◯ None, dairy foods should be cut out

◯ Not sure

How many servings of extras foods (food and drinks high in saturated fat, added sugar or salt) a day do you think experts recommend 3-7 year old children of average height and activity should eat?

*Examples of one serve are:*

*½ snack size packet salty crackers or crisps, OR*

*1 slice plain cake, OR*

*5–6 small lollies, OR*

*1 can regular soft drink*

- ◯ Up to 1/2 serve
- ◯ Up to 1 serve
- ◯ Up to 2 serves
- ◯ Up to 3 serves
- ◯ Not sure

Which of the following occasions did your child have in the past week? (tick all that apply)

- ☐ Play date (i.e. social occasion involving child playing with their friends)
- ☐ Catching up with friends as a family (e.g. at home, others home, park)
- ☐ Catching up with extended family / relatives (e.g. at home, others home, park)
- ☐ Eating out with friends as a family (e.g. at a restaurant, cafe, takeaway outlet)
- ☐ Eating out with extended family / relatives (e.g. at a restaurant, cafe, takeaway outlet)
- ☐ School event or outing (e.g. sports day, fundraiser, field trip)
- ☐ Birthday celebration
- ☐ Other celebration (e.g. cultural day, milestone, anniversary)
- ☐ Extra curricular activity (informal, competition)
- ☐ Family holiday
- ☐ Outing with grandparents (e.g. cinema, picnic, shopping, going to a cafe)
- ☐ Other social occasion (please specify the occasion)

## THANK YOU

**Thank you for completing the survey!**

You will now be redirected to new page where you will be able to provide contact details to receive a summary of the study findings and information about future research.

If the page does not automatically redirect when selecting 'submit and go to next', please copy and paste the weblink: https://www.surveymonkey.com/r/studyfindings

Before you submit the survey, if you have any comments regarding this survey, please type them in the box below. This will help us to improve our future surveys.

***Complete survey questions and discrete choice experiment in online format***

**Block 1a - Welcome and Consent**

## PARENT FOOD CHOICE STUDY

## WELCOME

Thank you for your interest in taking part in this survey.

The survey will take approximately 30 minutes to complete.
You will not be able to close and re-enter the survey so please make sure you have enough time. If not please bookmark this webpage to complete when you have 30 minutes available.

This research is being conducted by Flinders University in collaboration with University of South Australia and CSIRO. This study has been approved by the Flinders University Social and Behavioural Research Ethics Committee.

Please do not use the 'back' and 'forward' buttons in your browser. Please use the buttons at the bottom of each screen. Tip: This survey works best on a computer or tablet.

To continue to the participant information sheet for more information about the survey click the arrow to the next screen.

## PARENT INFORMATION SHEET

Please read this explanatory statement in full before deciding whether or not to participate in this research. If you have any questions please contact us on the phone number or email address listed below.

### What is this research about?

We want to find out what things are most important to parents' when choosing what foods or drinks to give to their children. This project is supported by Flinders University Nutrition and Dietetics within the College of Nursing and Health Sciences.

### What will I be asked to do?

You will be asked about food or drink items you might choose to offer your 3 to 7 year old child for a snack on a weekend. After completing the study, you will be asked a few questions about yourself and your child. The study is a once-off survey, all online and participation is entirely voluntary.

### What benefit will I gain from being involved in this study?

You will also be providing a valuable contribution to the scientific knowledge in this area. This will help future research and public health nutrition to be tailored to parents needs and better support parents to improve children's nutrition. You will also have the option to register your interest to receive information via email about future research you may be eligible for.

**Will I be identifiable by being involved in this study?**

We do not need your name. Whilst participation will be anonymous and no identifying information will be published, provision of an email address following completion of the survey will mean that the researchers will be aware who has participated. All information and results obtained in this study will be stored in a secure way, with access restricted to relevant researchers.

**Are there any risks or discomforts if I am involved?**

There are no anticipated risks. Some of the questions relate to personal information, however, remember that your responses will remain anonymous. If you feel uncomfortable at any stage when answering questions, you can decide to withdraw from the study by closing the survey. If you feel uncomfortable and want to access support services please visit the websites listed below. If you have any concerns regarding risks or discomforts, please raise them with the researcher.

Raising Children Network is a national website aimed at helping families care for their children, it contains information about child development and parenting. Please visit raisingchildren.net.au/articles/parents__families

Family Relationships Online provides all families (whether together or separated) with access to information about family relationships, ranging from building better relationships to dispute resolution. Please visit familyrelationships.gov.au

**How do I agree to participate?**

Participation is voluntary. You are free to withdraw from the survey at any time without effect or consequences. A consent statement is on the next webpage. If you agree to participate please read the consent statement and click 'I agree to participate'.

**What will happen with the results of the project?**

On completion of the survey, a summary of overall group results will be available from the study Facebook page (www.facebook.com/ParentFoodChoice) from March 2019. The results from this study will be published in scientific journals, but individual participants will not be identifiable.

**Recognition of contribution and time**

On completion of the survey, you will have the option to enter your email address in the draw to win one of 10 supermarket vouchers (valued at $30 each) to thank you for your time. Your email address will be collected separately to your responses and erased once vouchers have been distributed.

Thank you for taking the time to read this information sheet.

**Researcher(s)**

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Institute for Choice, Business School
University of South Australia

Dr Gilly Hendrie
Health and Biosecurity
CSIRO

*This research project has been approved by the Flinders University Social and Behavioural Research Ethics Committee (Project number: 8043). For more information regarding ethical approval of the project only, the Executive Officer of the Committee can be contacted by telephone on (08) 8201 3116, by fax on (08) 8201 2035, or by email to [human.researchethics@flinders.edu.au](mailto:human.researchethics@flinders.edu.au)*

Please screenshot this webpage if you would like to keep this information sheet for your records. If you are happy to continue please click the arrow to the next screen.

**Participant Certification**

In completing this survey, I confirm that:

1. I have read the Participant Information Sheet provided on the prior webpage.
2. I understand the purpose of the research project and my involvement in it.
3. I am aware that I should retain a copy of the Information Sheet and Consent Form for future reference.
4. I have had the opportunity to discuss taking part in this research with a family member or friend, if I wish.
5. I understand that:
   - I may not directly benefit from taking part in this research.
   - I am free to withdraw from the project at any time and am free to decline to answer particular questions.
   - While the information gained in this study will be published as explained, I will not be identified, and individual information will remain confidential.
   - Whether I participate or not, or withdraw after starting the survey, will have no effect or consequences to me.

Do you consent to take part in this study?

○ I DO consent to take part in this study

○ I DO NOT consent to take part in this study

[Eligibility screening and socio-demographic items]

**Block 1b - Introduction screening**

Please take as much time as you need to answer the questions.

Most questions will only require you to check a box. A few questions ask you to type in a response. All your answers to the questions are strictly anonymous and will be used for research purposes only.

Please do not use the ‘back’ and ‘forward’ buttons in your browser. Please use the yellow buttons at the bottom of each screen.

The survey begins with a few questions to make sure you are eligible for the survey.

Do you have a child or children aged 3 to 7 years old?

- Yes
- No

If you have more than one child aged 3 to 7 years old, please choose one child to keep in mind throughout this survey.
Please enter your child’s first name below.
(This name will be included in questions later in the survey as a reminder)

**Block 1c - Introduction screening**

Do you prepare most of ${q://QID9/ChoiceTextEntryValue}’s meals and snacks?

- Yes
- No

Do you live in Australia?

- Yes
- No

Please enter your current postcode.

How old are you? (enter age in years)

[Discrete Choice Experiment items including quasi-revealed preference]

**Block 1d - DCE Introduction**

The next questions ask you about snacks you might provide to your child.

A snack is any food or drink that could be provided at a snack eating occasion, which is the time between main meal eating occasions (e.g. breakfast, lunch, dinner). Sometimes these snack occasions are called other names depending on the time of day such as morning tea, recess, and supper.

Please imagine you are preparing a snack for your child **on a typical Saturday mid-morning**.
What are some common examples of snacks you would give to you child?
*Hint: Try thinking back to last Saturday morning, did you give your child a snack(s)*

Please imagine you are preparing a snack for your child **when you have friends visiting on a Saturday mid-morning**.
What are some common examples of snacks you would give to you child?
*Hint: Try thinking back to last time you had visitors Saturday morning, did you give your child a snack(s)*

The next question asks you about things that could make it difficult for your child to eat a healthy diet.

For each item, please select whether this makes it very difficult, a little difficult or does not make it difficult at all for ${q://QID9/ChoiceTextEntryValue} to eat a healthy diet.

| | Makes it very difficult | Makes it a little difficult | Does not make it difficult at all |
|---|---|---|---|
| Resistance from my child | | | |
| The availability of healthy food | | | |
| The influence of food advertising | | | |
| A busy lifestyle | | | |
| The high cost of healthy foods | | | |
| The influence of my child's peers | | | |
| Not knowing how to get my child to eat healthy foods | | | |
| Significant family members (e.g. co-parent) undermining my provision | | | |
| My ability to set rules and stick to them | | | |
| The effort required to provide healthy food | | | |
| Not knowing what foods to provide or allow | | | |
| Expectations from my friends about what foods to provide | | | |
| Grandparents undermining my provision | | | |

Thank you for your responses so far.

The following questions will show you a scenario, where you will need to select one of three options: Snack A, Snack B, or Neither. Choose the option that most closely matches what you would think about when choosing snacks to give the child you selected earlier in the survey (i.e. the child you have selected for this study).

- There are many things we think about when choosing what foods or drinks we give to our children. We have listed some common things which will vary in the options. When making your choice please consider only these things: **Cost of snack**, **Time to prepare**, **Your child's likely response**, **Significant family members**, **Family friends**, **Type of food**.
- We have explained what we mean by these things, please click on this link to open it in a new tab of your web browser so you can read it as needed throughout the survey.
- When answering the questions you will need to weigh up these things between Snack A and Snack B (see example question below).
- Although there are probably other things that might change what you choose to give your child, imagine these other things stay the same between options.

**Example of what the questions will look like:**

Please imagine it is a typical Saturday morning. It is mid-morning and you are preparing a snack to give to your child.

Please indicate which option you most prefer to provide to your child.
Assume they are all available options.

Scenario 1 out of 5

| | Snack A | Snack B |
|---|---|---|
| Cost of snack | Cheaper | More expensive |
| Time to prepare | More time consuming | Quick |
| Your child's likely response | Accepting | Resistant |
| Significant family members (e.g. co-parent) | Unsupportive | Supportive |
| Family friends | Supportive | Unsupportive |
| Type of food | Sometimes foods | Everyday foods |

- Snack A
- Snack B
- Neither

Ready to get started? Remember that your answers are **anonymous** so please answer honestly. **There are no right or wrong answers**, just choose which option you would choose in the scenario.

Click the arrow to continue to the next screen.

[Participants were then randomised to either control or experimental condition first]

**Block 2a - DCE Control Part 1** [one of 4 blocks]

Please imagine it is a typical Saturday morning and you are at home with your family. It is mid-morning and you are preparing a snack to give to your child.

Please indicate which option you most prefer to provide to your child. Assume they are all available options.

Scenario 1 out of 5

| | **Snack A** | **Snack B** |
|---|---|---|
| Type of food | Everyday foods | Everyday foods |
| Family friends | Supportive | Unsupportive |
| Significant family members (e.g. co-parent) | Unsupportive | Supportive |
| Cost of snack | Cheaper | Cheaper |
| Time to prepare | Instant | Instant |
| Your child's likely response | Accepting | Accepting |

- Snack A
- Snack B
- Neither

Please imagine it is a typical Saturday morning and you are at home with your family. It is mid-morning and you are preparing a snack to give to your child.

Please indicate which option you most prefer to provide to your child. Assume they are all available options.

Scenario 2 out of 5

| | **Snack A** | **Snack B** |
|---|---|---|
| Your child's likely response | Accepting | Resistant |
| Type of food | Sometimes foods | Everyday foods |
| Time to prepare | Quick | More time consuming |
| Cost of snack | Cheaper | More expensive |
| Family friends | Unsupportive | Supportive |
| Significant family members (e.g. co-parent) | Supportive | Unsupportive |

- Snack A
- Snack B
- Neither

Please imagine it is a typical Saturday morning and you are at home with your family. It is mid-morning and you are preparing a snack to give to your child.

Please indicate which option you most prefer to provide to
your child. Assume they are all available options.

Scenario 3 out of 5

| | **Snack A** | **Snack B** |
|---|---|---|
| Family friends | Supportive | Unsupportive |
| Time to prepare | More time consuming | Instant |
| Significant family members (e.g. co-parent) | Supportive | Unsupportive |
| Your child's likely response | Resistant | Resistant |
| Type of food | Everyday foods | Sometimes foods |
| Cost of snack | Cheaper | More expensive |

- Snack A
- Snack B
- Neither

Please imagine it is a typical Saturday morning and you are at home with your family. It is mid-morning and you are preparing a snack to give to your child.

Please indicate which option you most prefer to provide to
your child. Assume they are all available options.

Scenario 4 out of 5

| | **Snack A** | **Snack B** |
|---|---|---|
| Your child's likely response | Accepting | Resistant |
| Type of food | Sometimes foods | Sometimes foods |
| Family friends | Supportive | Unsupportive |
| Cost of snack | More expensive | More expensive |
| Time to prepare | Instant | More time consuming |
| Significant family members (e.g. co-parent) | Unsupportive | Supportive |

- Snack A
- Snack B
- Neither

Please imagine it is a typical Saturday morning and you are at home with your family. It is mid-morning and you are preparing a snack to give to your child.

Please indicate which option you most prefer to provide to
your child. Assume they are all available options.

Scenario 5 out of 5

| | **Snack A** | **Snack B** |
|---|---|---|
| Significant family members (e.g. co-parent) | Supportive | Unsupportive |
| Type of food | Sometimes foods | Sometimes foods |
| Cost of snack | More expensive | Cheaper |
| Your child's likely response | Resistant | Accepting |
| Time to prepare | Quick | Quick |
| Family friends | Unsupportive | Unsupportive |

- ○ Snack A
- ○ Snack B
- ○ Neither

**Block 4 - Break Activity** [Distraction task]

Which is your more preferred dream holiday?

Summer beaches

○

Winter snow

○

**Block 6b - DCE Experimental Part 2** [one of 4 blocks]

Weekends are a common time to catch up with friends as a family.
Please imagine you have a friend, their partner and child visiting/over to your home on a typical Saturday morning. It is mid-morning and you are preparing a snack to give your child.

Please indicate which option you most prefer to provide to your child.
Assume they are all available options.

Scenario 1 out of 5

| | **Snack A** | **Snack B** |
|---|---|---|
| Time to prepare | Quick | Quick |
| Your child's likely response | Resistant | Accepting |
| Significant family members (e.g. co-parent) | Supportive | Supportive |
| Cost of snack | Cheaper | Cheaper |
| Family friends | Supportive | Supportive |
| Type of food | Sometimes foods | Sometimes foods |

- Snack A
- Snack B
- Neither

Weekends are a common time to catch up with friends as a family.
Please imagine you have a friend, their partner and child visiting/over to your home on a typical Saturday morning. It is mid-morning and you are preparing a snack to give your child.

Please indicate which option you most prefer to provide to your child. Assume they are all available options.

Scenario 2 out of 5

| | **Snack A** | **Snack B** |
|---|---|---|
| Time to prepare | Quick | Quick |
| Cost of snack | More expensive | More expensive |
| Your child's likely response | Resistant | Resistant |
| Family friends | Unsupportive | Supportive |
| Type of food | Everyday foods | Sometimes foods |
| Significant family members (e.g. co-parent) | Unsupportive | Supportive |

- Snack A
- Snack B
- Neither

Weekends are a common time to catch up with friends as a family.

Please imagine you have a friend, their partner and child visiting/over to your home on a typical Saturday morning. It is mid-morning and you are preparing a snack to give your child.

Please indicate which option you most prefer to provide to your child. Assume they are all available options.

Scenario 3 out of 5

| | **Snack A** | **Snack B** |
|---|---|---|
| Time to prepare | Instant | Quick |
| Significant family members (e.g. co-parent) | Unsupportive | Unsupportive |
| Your child's likely response | Resistant | Accepting |
| Family friends | Unsupportive | Supportive |
| Cost of snack | Cheaper | More expensive |
| Type of food | Everyday foods | Everyday foods |

- Snack A
- Snack B
- Neither

Weekends are a common time to catch up with friends as a family.

Please imagine you have a friend, their partner and child visiting/over to your home on a typical Saturday morning. It is mid-morning and you are preparing a snack to give your child.

Please indicate which option you most prefer to provide to your child. Assume they are all available options.

Scenario 4 out of 5

| | **Snack A** | **Snack B** |
|---|---|---|
| Time to prepare | More time consuming | Quick |
| Significant family members (e.g. co-parent) | Unsupportive | Unsupportive |
| Family friends | Unsupportive | Unsupportive |
| Cost of snack | More expensive | Cheaper |
| Type of food | Sometimes foods | Everyday foods |
| Your child's likely response | Accepting | Accepting |

- Snack A
- Snack B
- Neither

Weekends are a common time to catch up with friends as a family.

Please imagine you have a friend, their partner and child visiting/over to your home on a typical Saturday morning. It is mid-morning and you are preparing a snack to give your child.

Please indicate which option you most prefer to provide to your child. Assume they are all available options.

Scenario 5 out of 5

| | **Snack A** | **Snack B** |
|---|---|---|
| Family friends | Supportive | Supportive |
| Time to prepare | More time consuming | Quick |
| Significant family members (e.g. co-parent) | Supportive | Supportive |
| Type of food | Everyday foods | Everyday foods |
| Your child's likely response | Accepting | Resistant |
| Cost of snack | More expensive | Cheaper |

- Snack A
- Snack B
- Neither

**Block 7 - Questions**

**You are on the home stretch now! Thank you for your involvement in the survey, your thoughts are really important! Not much to go.**

How would you describe the foods and drinks you would usually provide to your child at snack times? Please select the most appropriate response for each item.

Cost of snack:

| Cheaper | More expensive |
|---|---|
| O | O |

Time to prepare:

| Instant | Quick | More time consuming |
|---|---|---|
| O | O | O |

Type of food:

| Everyday foods | Sometimes foods |
|---|---|
| O | O |

How would you describe the general response from your child, significant family members and friends to the food and drinks you would usually provide to your child at snack times?

${q://QID9/ChoiceTextEntryValue}'s likely response:

| Accepting | Resistant |
|---|---|
| O | O |

Significant family members (e.g. co-parent):

| Supportive | Unsupportive |
|---|---|
| O | O |

Family friends:

| Supportive | Unsupportive |
|---|---|
| O | O |

The next question relates to ${q://QID9/ChoiceTextEntryValue}

Please read the general statements below and select for every statement how much it describes your child.

| | Extremely untrue of your child | Slightly true of your child | Partially true / partially untrue of your child | Quite true of your child | Extremely true of your child |
|---|---|---|---|---|---|
| This child has lots of energy, is easily excited, and often goes fast on the playground. This child enjoys meeting new people and going to new places. | ○ | ○ | ○ | ○ | ○ |
| This child often shows their frustration or discomfort, and easily becomes sad when not able to finish a project. This child is often afraid of the dark, and when upset may be difficult to calm down. | ○ | ○ | ○ | ○ | ○ |
| This child likes to listen to rhymes and songs. When working on a project this child can concentrate deeply, and carefully follows rules and instructions. When something changes, this child quickly notices. | ○ | ○ | ○ | ○ | ○ |

Which of the following occasions did your child have in the past week? (If your child did not have the occasion please enter '0')

For each occasion please enter in the most relevant response, e.g. if your child attended a birthday celebration at a restaurant with extended family, enter a 1 in 'Birthday celebration'.

| | Please enter the number of times your child had each occasion |
|---|---|
| Play date (i.e. social occasion involving child playing with their friends) | |
| Catching up with friends as a family (e.g. at home, others home, park) | |
| Catching up with extended family / relatives (e.g. at home, others, home, park) | |
| Eating out with friends as a family (e.g. at a restaurant, cafe, takeaway outlet) | |
| Eating out with extended family / relatives (e.g. at a restaurant, cafe, takeaway outlet) | |
| School event or outing (e.g. sports day, fundraiser, field trip) | |
| Birthday celebration | |
| Other celebration (e.g. cultural day, milestone, anniversary) | |
| Extra curricular activity (informal, competition) | |
| Family holiday | |
| Outing with grandparents (e.g. cinema, picnic, shopping, going to a cafe) | |
| Other social occasion (please specify the occasion) | |

The next series of questions are relating to your feelings about being a parent.

Please read each item carefully and rate whether you feel it applies to you, by selecting a number from 1 (strongly agree) to 6 (strongly disagree) on the scale.

| | Strongly agree | Agree | Mildly agree | Mildly disagree | Disagree | Strongly disagree |
|---|---|---|---|---|---|---|
| The problems of taking care of a child are easy to solve once you know how your actions affect your child, an understanding I have acquired. | | | | | | |
| Even though being a parent could be rewarding, I am frustrated now while my child is at his/her present age. | | | | | | |
| I go to bed the same way I wake up in the morning feeling I have not accomplished a whole lot. | | | | | | |
| I do not know why it is, but sometimes when I'm supposed to be in control, I feel more like the one being manipulated. | | | | | | |
| My mother/father was better prepared to be a good mother/father than I am. | | | | | | |
| I would make a fine model for a new mother/father to follow in order to learn what she would need to know in order to be a good parent. | | | | | | |

The next series of questions are relating to your feelings about being a parent.

Please read each item carefully and rate whether you feel it applies to you, by selecting a number from 1 (strongly agree) to 6 (strongly disagree) on the scale.

| | Strongly agree | Agree | Mildly agree | Mildly disagree | Disagree | Strongly disagree |
|---|---|---|---|---|---|---|
| Being a parent is manageable and any problems are easily solved. | | | | | | |
| A difficult problem in being a parent is not knowing whether you're doing a good job or a bad one. | | | | | | |
| Sometimes I feel like I'm not getting anything done. | | | | | | |
| I meet my own personal expectations for expertise in caring for my child. | | | | | | |
| If anyone can find the answer to what is troubling my child, I am the one. | | | | | | |

The next series of questions are relating to your feelings about being a parent.

Please read each item carefully and rate whether you feel it applies to you, by selecting a number from 1 (strongly agree) to 6 (strongly disagree) on the scale.

| | Strongly agree | Agree | Mildly agree | Mildly disagree | Disagree | Strongly disagree |
|---|---|---|---|---|---|---|
| My talents and interests are in other areas, not in being a parent. | ○ | ○ | ○ | ○ | ○ | ○ |
| Considering how long I've been a mother/father, I feel thoroughly familiar with this role. | ○ | ○ | ○ | ○ | ○ | ○ |
| If being a mother/father were only more interesting, I would be motivated to do a better job as a parent. | ○ | ○ | ○ | ○ | ○ | ○ |
| I honestly believe that I have all the skills necessary to be a good mother/father to my child. | ○ | ○ | ○ | ○ | ○ | ○ |
| Being a parent makes me tense and anxious. | ○ | ○ | ○ | ○ | ○ | ○ |

The next questions relate to yourself.

These last few questions are important for us to find out a little more about who this research can support.

What is your gender?

- ○ Male
- ○ Female
- ○ Self ascribed, please specify ____________

What is the highest level of education that you have completed?

- ○ Didn't go to school
- ○ Primary school
- ○ Some high school
- ○ Completed high school
- ○ Tech or trade qualification (e.g. TAFE)
- ○ Tertiary degree
- ○ Post graduate degree

Are you currently:

- ○ Employed full time
- ○ Employed part time
- ○ Unemployed
- ○ Non-paid home duties
- ○ Retired
- ○ Student
- ○ Disabled or too ill to work
- ○ Volunteering / unpaid work

What is your current weight in kilograms? (move the slider until you find your weight)

| | 0 | 20 | 40 | 60 | 80 | 100 | 120 | 140 | 160 | 180 | 200 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Weight | | | | | | | | | | | |

What is your height in centimetres? (move the slider until you find your height)

| | 0 | 20 | 40 | 60 | 80 | 100 | 120 | 140 | 160 | 180 | 200 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Height | | | | | | | | | | | |

Which of the following best describes your household?

- Couple family with a child
- Couple family with children
- One parent family with a child
- One parent family with children
- Other family type (please specify) ____

What is your ancestry? (provide up to two ancestries only)

- English
- Irish
- Scottish
- Italian
- German
- Chinese
- Australian
- Other background (please specify) ____

The next questions refer to ${q://QID9/ChoiceTextEntryValue} (the child you have nominated for this study)

What is ${q://QID9/ChoiceTextEntryValue}'s date of birth? (DD/MM/YYYY)

____

What is ${q://QID9/ChoiceTextEntryValue}'s gender?

- Male
- Female
- Self ascribed, please specify ____

How tall (height) is ${q://QID9/ChoiceTextEntryValue} in centimetres? (move the slider until you find the correct height)

| | 0 | 19 | 38 | 57 | 76 | 95 | 114 | 133 | 152 | 171 | 190 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Child's height | | | | | | | | | | | |

What does ${q://QID9/ChoiceTextEntryValue} weigh in kilograms? (move the slider until you find the correct weight)

| | 0 | 11 | 21 | 32 | 42 | 53 | 63 | 74 | 84 | 95 | 105 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Child's weight | | | | | | | | | | | |

How confident are you these measurements for your child are accurate?

| | Not at all confident | Somewhat confident | Confident | Extremely confident |
|---|---|---|---|---|
| Height | ○ | ○ | ○ | ○ |
| Weight | ○ | ○ | ○ | ○ |

Has your child been measured within the past 6 months, by yourself, or a health care practitioner (e.g. child health nurse, doctor)?

- Yes
- No

Before you submit the survey, if you have any comments or opinions regarding this survey, please type in the box below. This will help us to improve our future surveys.

This is the end of the survey, thank you very much for participating.

Once you click the arrow you will be directed to separate survey where you can provide your contact details to receive information about future research studies and to enter the draw to win one of 10 supermarket vouchers (valued at $30 each).

Powered by Qualtrics

[Glossary linked from Discrete Choice Experiment introduction]

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INSPIRING ACHIEVEMENT

## Parent Food Choice Study

What do we mean by each of these things that will vary between the options?

### Snack

A snack is any food or drink that could be provided at a snack eating occasion, which is the time between main meal eating occasions (e.g. breakfast, lunch, dinner). Sometimes these snack occasions are called other names depending on the time of day such as morning tea, recess, and supper.

### Cost of snack

This refers to how much the snack costs, and can vary from **cheaper** to **more expensive**. When considering the cost think about what you would think of as a: cheap and expensive snack as a reference point.

### Time to prepare

This refers to how long it will take to prepare the snack. This will vary from **instant** which would be almost instant or ready to eat (such as taken straight from the fridge or pantry), **quick** so a few minutes (such as chopping, toasting or plating), or **more time consuming** which would be around 5 minutes or more (such as cooking, preparing multiple components).

### Your child's likely response

This refers to your child's likely response to the option. Think about past experiences and how your child has responded to the food options you provide.

For example, if it is a food your child does not prefer or may not feel like they might have been **resistant** to eating it. Whereas if it is a liked or preferred type of food they may have been **accepting**. In the questions options will vary between your child being **accepting** or **resistant** with the option if chosen.

### Significant family members

This refers to partners or co-parents. The opinion or role of these significant family members may vary between options from **supportive** (or consistent with you) to **unsupportive** (or undermining), depending on their values for food provision.

For example, they would be considered as **supportive** if their values/opinions for food provision would align with yours for the certain scenario. If not, we would call this **unsupportive**. The support from significant family members is likely to change in different scenarios and between types of food.

## Family friends

This refers to your (or your partners) friends with kids that you would spend time with as a family. As with family members the opinion or role of these family friends may vary between options from **supportive** (or consistent with you) to **unsupportive** (or undermining), depending on their values for food provision.

For example, they would be considered as **supportive** if their values/opinions for food provision would align with yours for the certain scenario. If not, we would call this **unsupportive**. The support from family friends is likely to change in different scenarios and between types of food.

## Type of food

This refers to the category of food rather than individual foods. Commonly foods are grouped as **everyday foods** or **sometimes foods**.

**Everyday foods** are the foods and drinks that we commonly refer to as the 'five food group' or 'staple/core' foods that we include in our meals and snacks every day. These foods come from the fruit, vegetable, dairy or alternatives, grain foods, and meat or alternatives food groups.

**Sometimes foods** are the foods and drinks that we commonly refer to as 'extras', 'treats' or 'junk food'. They tended to be choices that are higher in saturated fat, added sugars and/or salt, and are often high in energy (calories) but low in micro-nutrients. Some examples include crisps, pastries, pizza, cake, sweet or savoury biscuits, chocolate, muesli bars, and sugary drinks.

**Appendix 6: Study 1 Supplementary Files**

***Preparation of variables for structural equation modelling***

Table A6.1: Testing model difference for one factor models parallel vs congeneric[1]

| Construct | DF | $X^2$ | P |
|---|---|---|---|
| Risk perception 1 | 2 | 17.836 | <0.001 |
| Risk perception 2 | 2 | 6.942 | 0.031 |
| Risk perception 3 | 6 | 81.084 | <0.001 |
| Risk perception 4 | 2 | 60.583 | <0.001 |
| Positive outcome expectancies | 6 | 111.350 | <0.001 |
| Negative outcome expectancies | 8 | 48.940 | <0.001 |
| Maintenance self-efficacy 1 | 10 | 86.576 | <0.001 |
| Maintenance self-efficacy 2 | 2 | 2.667 | 0.264 |
| Maintenance self-efficacy 3 | 2 | 2.814 | 0.245 |
| Action planning | 6 | 128.792 | <0.001 |
| Coping planning 1 | 2 | 9.337 | 0.009 |
| Coping planning 2 | 2 | 14.069 | 0.001 |
| Recovery self-efficacy | 4 | 43.988 | <0.001 |

Abbreviations: $X^2$: chi-squared; DF: degrees of freedom
[1] Outputs are for the parallel model assuming the congeneric model to be correct

Table A6.2: Descriptive statistics of Parental Food Attitude Questionnaire composite constructs using rescaled factor score weights (n=495)

| | | | | | Skewness | | Kurtosis | |
|---|---|---|---|---|---|---|---|---|
| | Minimum | Maximum | Mean | SD | Statistic | SE | Statistic | SE |
| Risk perception 1 | 1.00 | 5.00 | 3.38 | 0.97 | 0.147 | 0.110 | -0.557 | 0.219 |
| Risk perception 2 | 1.00 | 5.00 | 3.81 | 0.97 | -0.451 | 0.110 | -0.352 | 0.219 |
| Risk perception 3 | 1.00 | 5.00 | 3.58 | 0.77 | -1.143 | 0.110 | 1.799 | 0.219 |
| Risk perception 4 | 1.00 | 5.00 | 4.00 | 0.88 | -0.913 | 0.110 | 0.937 | 0.219 |
| Positive outcome expectancies | 1.00 | 4.00 | 2.90 | 0.67 | -0.292 | 0.110 | -0.531 | 0.219 |
| Negative outcome expectancies | 1.00 | 4.00 | 3.30 | 0.53 | -1.000 | 0.110 | 1.275 | 0.219 |
| Maintenance self-efficacy 1 | 1.00 | 4.00 | 2.83 | 0.74 | -0.256 | 0.110 | -0.695 | 0.219 |
| Maintenance self-efficacy 2 | 1.00 | 4.00 | 3.16 | 0.84 | -0.650 | 0.110 | -0.499 | 0.219 |
| Maintenance self-efficacy 3 | 1.00 | 4.00 | 2.61 | 0.92 | -0.155 | 0.110 | -0.872 | 0.219 |
| Action planning | 1.00 | 4.00 | 3.08 | 0.79 | -0.610 | 0.110 | -0.385 | 0.219 |
| Coping planning 1 | 1.00 | 4.00 | 2.34 | 0.89 | 0.162 | 0.110 | -0.791 | 0.219 |
| Coping planning 2 | 1.00 | 4.00 | 2.66 | 0.84 | -0.135 | 0.110 | -0.725 | 0.219 |
| Recovery self-efficacy | 1.00 | 4.00 | 3.17 | 0.78 | -0.616 | 0.110 | -0.448 | 0.219 |

Abbreviations: SD: standard deviation; SE: standard error

Table A6.3: Parameter values for composite latent variables using factor weight scores, rescaled and recoded to whole numbers

| **Latent Variable** | **SD of Composite** | **Reliability of Composite**[1] | **Factor Loading** | **Error Variance** |
|---|---|---|---|---|
| Risk perception 1 | 1.039 | 0.835 | 0.950 | 0.178 |
| Risk perception 2 | 0.979 | 0.899 | 0.929 | 0.097 |
| Risk perception 3 | 0.793 | 0.856 | 0.733 | 0.090 |
| Risk perception 4 | 0.926 | 0.875 | 0.866 | 0.107 |
| Positive outcome expectancies | 0.727 | 0.777 | 0.641 | 0.118 |
| Negative outcome expectancies | 0.629 | 0.714 | 0.531 | 0.113 |
| Maintenance self-efficacy 1 | 0.805 | 0.868 | 0.750 | 0.086 |
| Maintenance self-efficacy 2 | 0.857 | 0.942 | 0.831 | 0.043 |
| Maintenance self-efficacy 3 | 0.945 | 0.932 | 0.913 | 0.061 |
| Action planning | 0.860 | 0.901 | 0.816 | 0.073 |
| Coping planning 1 | 0.923 | 0.886 | 0.869 | 0.097 |
| Coping planning 2 | 0.881 | 0.813 | 0.795 | 0.145 |
| Recovery self-efficacy | 0.820 | 0.912 | 0.783 | 0.059 |

Abbreviations: SD: standard deviation
[1] Calculated as coefficient H as items were congeneric

Table A6.4: Predictor variables for input into the structural equation model

| **Construct** | **Variable type** | **Initial** | | **Reliability**[1] | **Mean (SD)** |
|---|---|---|---|---|---|
| | | **Number of items** | **Response scale** | | |
| Risk perception 1 | Exogenous | 2 | 1-5 | 0.835 | 3.37 (1.04) |
| Risk perception 2 | Exogenous | 2 | 1-5 | 0.899 | 3.77 (0.98) |
| Risk perception 3 | Exogenous | 4 | 1-5 | 0.856 | 3.58 (0.79) |
| Risk perception 4 | Exogenous | 2 | 1-5 | 0.875 | 3.96 (0.93) |
| Positive outcome expectancies | Exogenous | 4 | 1-4 | 0.717 | 2.96 (0.73) |
| Negative outcome expectancies | Exogenous | 5 | 1-4 | 0.710 | 3.32 (0.63) |
| Action self-efficacy | Exogenous | 1 | 1-4 | n/a | 2.87 (0.96) |
| Intention | Mediating | 1 | 1-4 | n/a | 2.64 (1.03) |
| Maintenance self-efficacy 1 | Mediating | 6 | 1-4 | 0.858 | 2.85 (0.81) |
| Maintenance self-efficacy 2 | Mediating | 2 | 1-4 | 0.940 | 3.17 (0.86) |
| Maintenance self-efficacy 3 | Mediating | 2 | 1-4 | 0.931 | 2.61 (0.95) |
| Action planning | Mediating | 4 | 1-4 | 0.851 | 3.10 (0.86) |
| Coping planning 1 | Mediating | 2 | 1-4 | 0.858 | 2.37 (0.92) |
| Coping planning 2 | Mediating | 2 | 1-4 | 0.797 | 2.61 (0.88) |
| Recovery self-efficacy | Mediating | 3 | 1-4 | 0.880 | 3.17 (0.82) |

Abbreviations: SD: standard deviation
[1] Coefficient H as items were congeneric

### ***Sensitivity analysis: Low socio-economic status parent ratings for reflective motivation***

Table A6.5: Low socio-economic status parent ratings of HAPA motivational phase questionnaire items

| Item | Response frequency (%)[1] | | | | |
|---|---|---|---|---|---|
| | Unfavourable response[2] | | | Favourable response[3] | |
| | 1 | 2 | 3 | 4 | 5 |
| **Absolute risk perception^** | | | | | |
| *comparison with dietary guidelines[4]* | *6 (8.5)* | ***25 (35.2)*** | *22 (31.0)* | *8 (11.3)* | *10 (14.1)* |
| child's activity levels | 1 (1.1) | 16 (16.8) | **44 (46.3)** | 15 (15.8) | 19 (20.0) |
| child's overall diet | 3 (3.2) | 17 (17.9) | **33 (34.7)** | 22 (23.2) | 20 (21.1) |
| other children the same age | 2 (2.1) | 6 (6.3) | 20 (21.1) | 30 (31.6) | **37 (38.9)** |
| other children the same size | 2 (2.1) | 3 (3.2) | **34 (35.8)** | 27 (28.4) | 29 (30.5) |
| **General severity assessment** | | | | | |
| being overweight | 10 (10.5) | 16 (16.8) | 16 (16.8) | **37 (38.9)** | 16 (16.8) |
| tooth decay | 1 (1.1) | 7 (7.4) | 12 (12.6) | **67 (70.5)** | 8 (8.4) |
| behavioural issues | 3 (3.2) | 9 (9.5) | 22 (23.2) | **53 (55.8)** | 8 (8.4) |
| too much energy and associated nutrients | 2 (2.1) | 11 (11.6) | 19 (20.0) | **51 (53.7)** | 12 (12.6) |
| **Absolute risk perception for my child^** | | | | | |
| becoming overweight | 2 (2.1) | 6 (6.3) | 19 (20.0) | **42 (44.2)** | 26 (27.4) |
| developing tooth decay | 3 (3.2) | 1 (1.1) | 6 (6.3) | **51 (53.7)** | 34 (35.8) |
| *having behavioural issues* | *5 (5.3)* | *7 (7.4)* | *16 (16.8)* | ***43 (45.3)*** | *24 (25.3)* |
| *eating too much energy and associated nutrients* | *3 (3.2)* | *3 (3.2)* | *43 (45.3)* | ***46 (48.4)*** | *0 (0)* |
| | **Unfavourable response** | | **Favourable response** | | |
| | **1** | **2** | **3** | **4** | |
| **Positive outcome expectancies** | | | | | |
| *'good' parent* | *9 (9.5)* | ***36 (37.9)*** | ***36 (37.9)*** | *14 (14.7)* | |
| be healthy | 1 (1.1) | 17 (17.9) | **41 (43.2)** | 36 (37.9) | |
| *save money on food shopping* | *24 (25.3)* | ***26 (27.4)*** | *25 (26.3)* | *20 (21.1)* | |
| healthy eating habits | 2 (2.1) | 17 (17.9) | **49 (51.6)** | 27 (28.4) | |
| eat more fruit and vegetables | 9 (9.5) | 23 (24.2) | **36 (37.9)** | 27 (28.4) | |
| environmentally-friendly | 33 (34.7) | **38 (40.0)** | 16 (16.8) | 8 (8.4) | |
| **Negative outcome expectancies^** | | | | | |
| throw a tantrum or pester | 10 (10.5) | 14 (14.7) | **43 (45.3)** | 28 (29.5) | |
| *spend more time* | *10 (10.5)* | *29 (30.5)* | ***30 (31.6)*** | *26 (27.4)* | |
| *adjust my own intake of unhealthy foods* | ***28 (29.5)*** | *25 (26.3)* | *23 (24.2)* | *19 (20.0)* | |
| miss out on having treats | 2 (2.1) | 6 (6.3) | 35 (36.8) | **52 (54.7)** | |
| affect family time | 5 (5.3) | 4 (4.2) | 35 (36.8) | **51 (53.7)** | |
| *restricting enjoyment of food* | *9 (9.5)* | *15 (15.8)* | *33 (34.7)* | ***38 (40.0)*** | |
| overeat unhealthy foods when available | 11 (11.6) | 11 (11.6) | **49 (51.6)** | 24 (25.3) | |
| miss out on eating what their friends eat | 5 (5.3) | 7 (7.4) | **47 (49.5)** | 36 (37.9) | |
| **Action self-efficacy** | 6 (6.3) | **38 (40.0)** | 20 (21.1) | 31 (32.6) | |
| **Intention** | 14 (14.7) | 29 (30.5) | **31 (32.6)** | 21 (22.1) | |

[1] For ease of interpretation responses are presented based on item scoring, with relevant items (^) reverse scored. Note: scales varied from 4 to 5 items. Results are presented as percentage of responding parents residing in the low Socio Economic Index For Areas tertile (n=95). **Bold** text indicates the highest frequency response. *Greyed italics* text indicates items removed in confirmatory factor analysis.
[2] Unfavourable response related to higher provision of unhealthy foods.
[3] Favourable response towards limiting unhealthy foods.
[4] Missing n=24 responses (I don't know the guidelines).

Table A6.6: Low socio-economic status parent ratings of HAPA volitional phase questionnaire items

| Item | Response frequency (%)[1] | | | |
|---|---|---|---|---|
| | Unfavourable response[2] | | Favourable response[3] | |
| | 1 | 2 | 3 | 4 |
| **Maintenance self-efficacy** | | | | |
| child is pestering for unhealthy foods | 7 (7.4) | 22 (23.2) | 27 (28.4) | **39 (41.1)** |
| child is resistant to limiting unhealthy foods | 4 (4.2) | 23 (24.2) | 30 (31.6) | **38 (40.0)** |
| you are tired | 11 (11.6) | 29 (30.5) | **40 (42.1)** | 15 (15.8) |
| having a very busy day | 10 (10.5) | **32 (33.7)** | **31 (32.6)** | 22 (23.2) |
| partner is undermining you | 17 (17.9) | 26 (27.4) | **30 (31.6)** | 22 (23.2) |
| financial pressures | 11 (11.6) | 22 (23.2) | 30 (31.6) | **32 (33.7)** |
| school/child care holidays | 12 (12.6) | 22 (23.2) | **33 (34.7)** | 28 (29.5) |
| *consume unhealthy foods around your child* | *24 (25.3)* | ***31 (32.6)*** | *22 (23.2)* | *18 (18.9)* |
| takes a long time to make it habit | 7 (7.4) | 28 (29.5) | **39 (41.1)** | 21 (22.1) |
| food marketing on television | 7 (7.4) | 19 (20.0) | 28 (29.5) | **41 (43.2)** |
| *parents/relatives continue to bring unhealthy foods* | *27 (28.4)* | ***33 (34.7)*** | *21 (22.1)* | *14 (14.7)* |
| family time | 15 (15.8) | **37 (38.9)** | 26 (27.4) | 17 (17.9) |
| *child has a strong likely for unhealthy foods* | *8 (8.4)* | *32 (33.7)* | ***29 (30.5)*** | *26 (27.4)* |
| **Action planning usual routine** | | | | |
| weekdays | 9 (9.5) | 17 (17.9) | **34 (35.8)** | **35 (36.8)** |
| weekend days | 8 (8.4) | 26 (27.4) | **32 (33.7)** | 29 (30.5) |
| packing lunchbox | 4 (4.2) | 14 (14.7) | 22 (23.2) | **55 (57.9)** |
| takeaway meals and snacks | 13 (13.7) | 27 (28.4) | **36 (37.9)** | 19 (20.0) |
| *visitors* | *10 (10.5)* | ***45 (47.4)*** | *26 (27.4)* | *14 (14.7)* |
| *celebrating a special occasion* | *26 (27.4)* | ***44 (46.3)*** | *17 (17.9)* | *8 (8.4)* |
| *people bring food to my home* | *30 (31.6)* | ***38 (40.0)*** | *19 (20.0)* | *8 (8.4)* |
| **Coping planning** | | | | |
| *my child asks for unhealthy foods* | *9 (9.5)* | *20 (21.1)* | *31 (32.6)* | ***35 (36.8)*** |
| certain situations | 9 (9.5) | **32 (33.7)** | **31 (32.6)** | 23 (24.2) |
| friends undermine my plans | 23 (24.2) | **32 (33.7)** | 26 (27.4) | 14 (14.7) |
| relatives undermine my plans | 29 (30.5) | **33 (34.7)** | 24 (25.3) | 9 (9.5) |
| set-backs when unhealthy foods have been provided | 14 (14.7) | **36 (37.9)** | 30 (31.6) | 15 (15.8) |
| **Recovery self-efficacy** | | | | |
| small relapse (2 days) | 4 (4.2) | 23 (24.2) | 28 (29.5) | **40 (42.1)** |
| moderate relapse (2-6 weeks) | 5 (5.3) | 21 (22.1) | 33 (34.7) | **36 (37.9)** |
| large relapse (weeks-months) | 6 (6.3) | 22 (23.2) | 32 (33.7) | **35 (36.8)** |

[1] For ease of interpretation responses are presented based on item scoring, nil items reverse scored. Results are presented as percentage of responding parents residing in the low Socio Economic Index For Areas tertile (n=95). **Bold** text indicates the highest frequency response. *Greyed italics* text indicates items removed in confirmatory factor analysis.
[2] Unfavourable response related to higher provision of unhealthy foods.
[3] Favourable response towards limiting unhealthy foods.

### *Selected outputs from exploratory factor analysis*

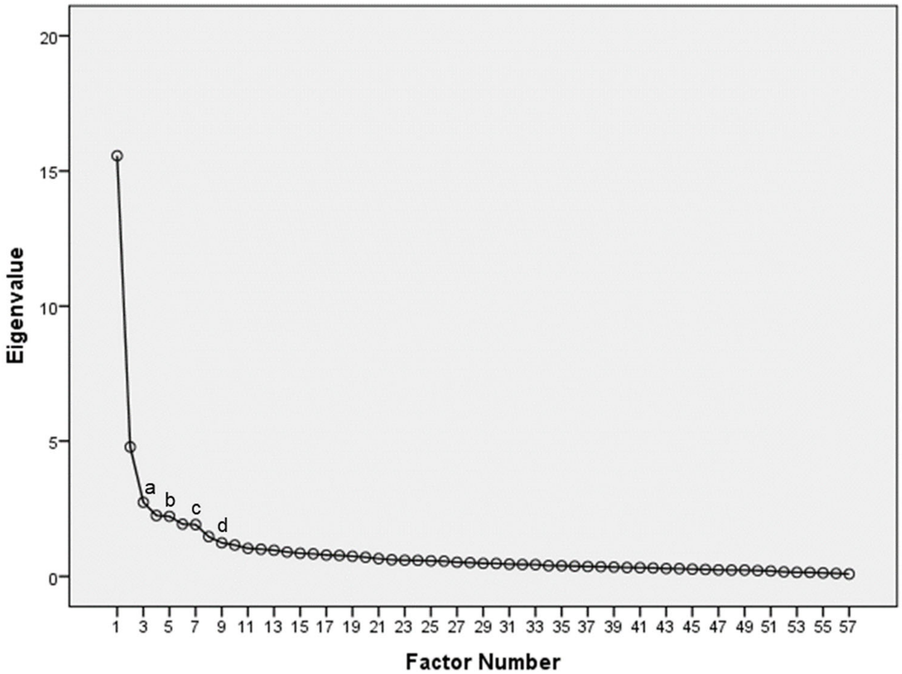



Figure A6.1: Scree plot of motivational items (57 sub-items)

Kaiser-Meyer-Olkin 0.924, Bartlett's Test of Sphericity $p<0.001$
[a] 3 factors: cumulative variance 40.5%, eigenvalues 2.74 to 15.56
[b] 5 factors: cumulative variance 48.3%, eigenvalues 2.22 to 15.56
[c] 7 factors: cumulative variance 55.1%, eigenvalues 1.91 to 15.56
[d] 9 factors: cumulative variance 59.8%, eigenvalues 1.24 to 15.56

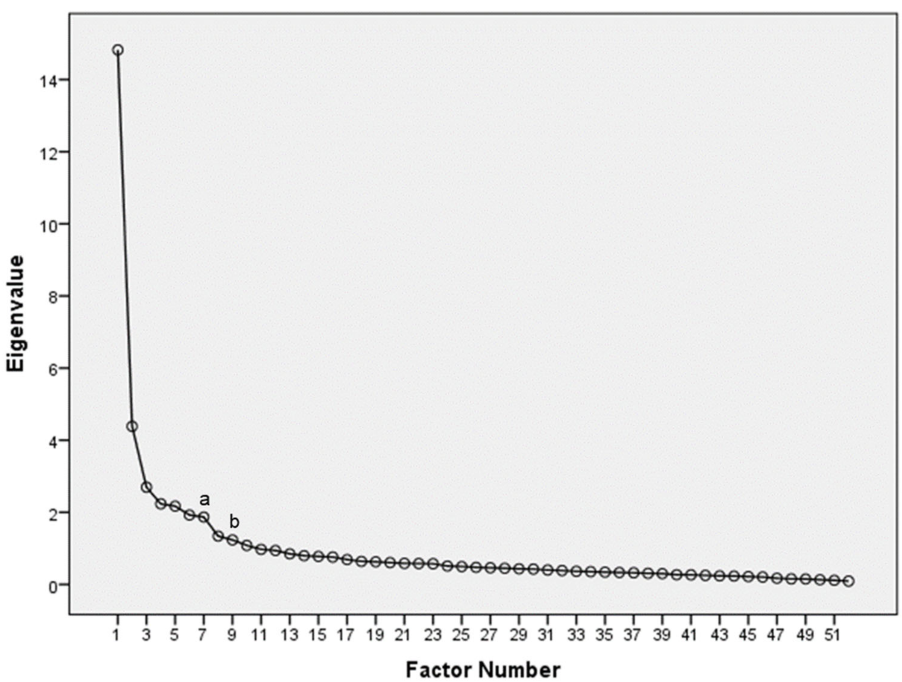



Figure A6.2: Scree plot of remaining motivational items (52 sub-items)

Action self-efficacy, intention and 3 sub-items removed. Kaiser-Meyer-Olkin 0.923, Bartlett's Test of Sphericity $p<0.001$
[a] 7 factors: cumulative variance 57.9%, eigenvalues 1.87 to 14.82
[b] 9 factors: cumulative variance 62.8%, eigenvalues 1.23 to 14.82

Table A6.7: Seven factor solution pattern matrix[1] for parents' motivational constructs

| Construct | Factor loadings | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| **Risk perception (absolute)** | | | | | | | |
| comparison with dietary guidelines | **.649** | | .147 | | | -.206 | -.121 |
| child's activity levels | **.760** | | | | | | |
| child's overall diet | **.783** | | | | | | |
| other children the same age | **.831** | | | | | .140 | .128 |
| other children the same size | **.841** | | | -.103 | | | |
| **Risk perception (general severity)** | | | | | | | |
| being overweight | | **-.754** | | | | | |
| tooth decay | | **-.776** | | | | | |
| behavioural issues | | **-.795** | | | | | |
| too much energy and associated nutrients | | **-.771** | | | | | |
| **Risk perception (for child)** | | | | | | | |
| becoming overweight | | | **.678** | .108 | | | |
| developing tooth decay | | | **.596** | | | -.113 | |
| having behavioural issues | | .119 | **.538** | | | -.137 | -.130 |
| **Positive outcome expectancies** | | | | | | | |
| be healthy | | | **.568** | | | .108 | |
| healthy eating habits | | | **.498** | | | | |
| eat more fruit and vegetables | | .101 | **.586** | | | .110 | |
| environmentally-friendly | | | **.381** | -.184 | | | |
| **Negative outcome expectancies** | | | | | | | |
| adjust my own intake of unhealthy foods | | | **-.430** | .185 | | | |
| **Negative outcome expectancies** | | | | | | | |
| throw a tantrum or pester | .185 | | | **.408** | .286 | .108 | |
| spend more time | .117 | | -.258 | **.352** | | | |
| miss out on having treats | | | | **.500** | .132 | | |
| affect family time | .128 | | .123 | **.443** | .110 | | |
| restricting enjoyment of food | -.111 | | -.172 | **.599** | | | |
| overeat unhealthy foods when available | | | | **.540** | | | |
| miss out on eating what their friends eat | | | | **.724** | -.156 | | |
| **Maintenance self-efficacy** | | | | | | | |
| child is pestering for unhealthy foods | | | | | **.778** | .166 | |
| child is resistant to limiting unhealthy foods | | | | | **.837** | .143 | |
| you are tired | | | | | **.721** | | |
| having a very busy day | | | | | **.692** | | |
| partner is undermining you | | | | | **.545** | | -.175 |
| financial pressures | | | | | **.744** | | |
| school/child care holidays | | | | | **.628** | -.141 | -.111 |
| consume unhealthy foods around your child | | | -.154 | | **.432** | -.277 | -.154 |
| takes a long time to make it habit | | | | | **.625** | | -.135 |
| food marketing on television | | | | | **.676** | | |
| family time | | | | | **.416** | -.264 | -.277 |
| child has a strong likely for unhealthy foods | | | | | **.722** | | |
| **Coping planning** | | | | | | | |
| my child asks for unhealthy foods | | | | | **.422** | .369 | -.279 |
| **Recovery self-efficacy** | | | | | | | |
| small relapse (2 days) | | | | | **.619** | .361 | |
| moderate relapse (2-6 weeks) | | | | | **.561** | .349 | |
| large relapse (weeks-months) | | | | | **.516** | .266 | |
| **Action planning** | | | | | | | |
| weekdays | .140 | | .112 | | .194 | **.471** | -.325 |
| packing lunchbox | | | .104 | | | **.439** | -.285 |

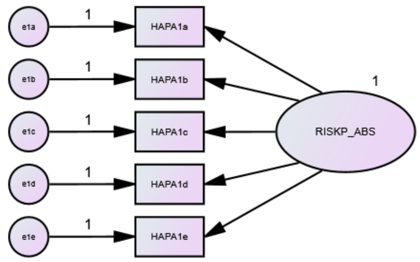
Table A6.7: Seven factor solution pattern matrix[1] for parents' motivational constructs (cont.)

| **Construct** | **Factor loadings** | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| **Maintenance self-efficacy** | | | | | | | |
| parents/relatives continue to bring unhealthy foods | | | | | .252 | -.329 | **-.470** |
| **Action planning** | | | | | | | |
| weekend days | .145 | | | | .145 | .406 | **-.418** |
| takeaway meals and snacks | .116 | | | | | .310 | **-.488** |
| visitors | | | | | | .175 | **-.732** |
| celebrating a special occasion | | | | | | | **-.731** |
| people bring food to my home | | | | | | | **-.771** |
| **Coping planning** | | | | | | | |
| certain situations | | | | | .304 | .189 | **-.483** |
| friends undermine my plans | | | | | .115 | | **-.708** |
| relatives undermine my plans | | | | | | | **-.736** |
| set-backs when unhealthy foods have been provided | | | | | .271 | .127 | **-.566** |
| Eigenvalue | 2.70 | 1.87 | 5.38 | 2.17 | 14.82 | 1.92 | 2.24 |
| % variance explained | 5.19 | 3.59 | 8.43 | 4.17 | 28.51 | 3.70 | 4.30 |
| Cronbach's alpha | .625 | .849 | .625 | .730 | .938 | .785 | .906 |

[1] Extracted by Principal Axis Factoring, rotated by Oblimin with Kaiser Normalization (converged in 11 iterations), factor loadings <0.1 supressed; cumulative variance 57.9%.
Note cross-loading items were examined in confirmatory factor analysis.

***Nine factor solution confirmatory factor analysis outputs for one-factor model***

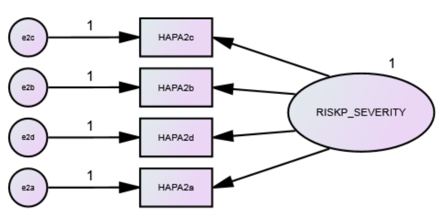
Table A6.8: Factor 1 absolute risk perception confirmatory factor analysis output




| Iterations | Items | Modification | Model fit statistics |
|---|---|---|---|
| V0 | 5 items<br>HAPA 1a, 1b, 1c, 1d, 1e | Nil | $X^2$ 180.756, df 5, $p$<0.001<br>TLI 0.758<br>CFI 0.879<br>RMSEA 0.267, PCLOSE 0.000<br>SRMR 0.0683 |
| V0.1 | 5 items<br>HAPA 1a, 1b, 1c, 1d, 1e | Covariance added between e1b and e1c (MI 64.907, Par Change 0.194) | $X^2$ 96.188, df 4, $p$<0.001<br>TLI 0.841<br>CFI 0.937<br>RMSEA 0.216, PCLOSE 0.000<br>SRMR 0.0707 |
| V1 | 4 items<br>HAPA 1b, 1c, 1d, 1e | Removed 1a (SMC 0.449) – comparison to dietary guidelines | $X^2$ 114.553, df 2, $p$<0.001<br>TLI 0.707<br>CFI 0.902<br>RMSEA 0.338, PCLOSE 0.000<br>SRMR 0.0721 |
| V1.1 | 4 items<br>HAPA 1b, 1c, 1d, 1e | Covariance added between e1b and e1c (MI 103.083, Par Change 0.275) | $X^2$ 0.552, df 1, $p$=0.458<br>TLI 1.002<br>CFI 1.000<br>RMSEA 0.000, PCLOSE 0.676<br>SRMR 0.0026 |
| **V1.1.1** | **2 items<br>HAPA 1b, 1c<br><br>2 items<br>HAPA 1d, 1e** | **Reformatted as per V1.1** | **$X^2$ 0.552, df 1, $p$=0.458<br>TLI 1.002<br>CFI 1.000<br>RMSEA 0.000, PCLOSE 0.676<br>SRMR 0.0026<br><br>Discriminant validity<br>Covariances constrained to 1<br>$X^2$ 114.001, df 1, $p$=0.000** |

$X^2$: chi-squared; df: degrees of freedom; TLI: Tucker Lewis Index; CFI: Comparative Fit Index; RMSEA: Root Mean Squared Error of Approximation; PCLOSE: the p-value for testing the null hypothesis than RMSEA is <0.05; SRMR: Standardised Root Mean-square Residual

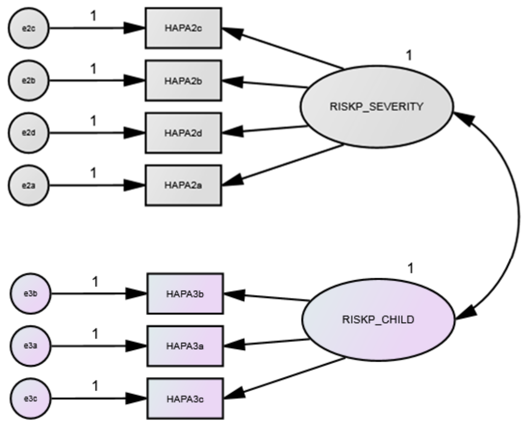
Table A6.9: Factor 2 risk perception severity confirmatory factor analysis output




| Iterations | Items | Modification | Model fit statistics |
|---|---|---|---|
| **V0** | **4 items<br>HAPA 2c, 2b, 2d, 2a** | **Nil** | **$X^2$ 10.194, df 2, $p$=0.006<br>TLI 0.971<br>CFI 0.990<br>RMSEA 0.091, PCLOSE 0.081<br>SRMR 0.0179** |

$X^2$: chi-squared; df: degrees of freedom; TLI: Tucker Lewis Index; CFI: Comparative Fit Index; RMSEA: Root Mean Squared Error of Approximation; PCLOSE: the p-value for testing the null hypothesis than RMSEA is <0.05; SRMR: Standardised Root Mean-square Residual

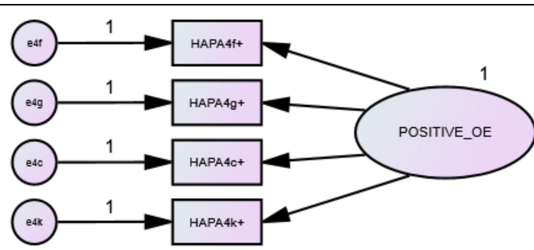
Table A6.10: Factor 3 risk perception for child confirmatory factor analysis output




| Iterations | Items | Modification | Model fit statistics |
|---|---|---|---|
| V0 | 3 items<br>HAPA 3b, 3a, 3c | Nil<br>Run in model with risk perception severity to meet required degrees of freedom | $X^2$ 71.126, df 13, $p$<0.001<br>TLI 0.930<br>CFI 0.957<br>RMSEA 0.095, PCLOSE 0.000<br>SRMR 0.0454 |
| **V1** | **2 items**<br>**HAPA 3b, 3a** | **Removed 3c (SMC 0.384) – behavioural issues** | **$X^2$ 30.066, df 8, $p$<0.001**<br>**TLI 0.964**<br>**CFI 0.981**<br>**RMSEA 0.075, PCLOSE 0.066**<br>**SRMR 0.0216**<br><br>**Discriminant validity**<br>**Covariances constrained to 1**<br>**$X^2$ 236.973, df 1, $p$=0.000** |

$X^2$: chi-squared; df: degrees of freedom; TLI: Tucker Lewis Index; CFI: Comparative Fit Index; RMSEA: Root Mean Squared Error of Approximation; PCLOSE: the p-value for testing the null hypothesis than RMSEA is <0.05; SRMR: Standardised Root Mean-square Residual

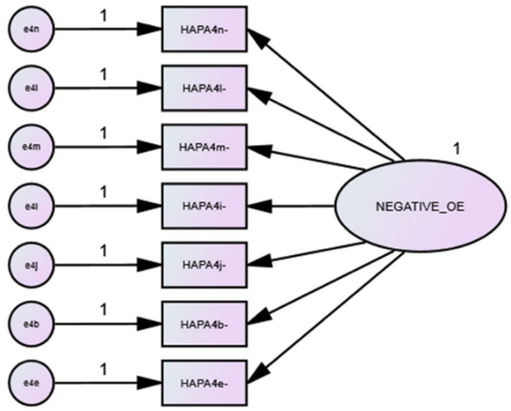
Table A6.11: Factor 4 positive outcome expectancies confirmatory factor analysis output




| Iterations | Items | Modification | Model fit statistics |
|---|---|---|---|
| **V0** | **4 items**<br>**HAPA 4f, 4g, 4c, 4k** | **Nil** | **$X^2$ 2.563, df 2, $p$=0.278**<br>**TLI 0.996**<br>**CFI 0.999**<br>**RMSEA 0.024, PCLOSE 0.623**<br>**SRMR 0.0146** |

$X^2$: chi-squared; df: degrees of freedom; TLI: Tucker Lewis Index; CFI: Comparative Fit Index; RMSEA: Root Mean Squared Error of Approximation; PCLOSE: the p-value for testing the null hypothesis than RMSEA is <0.05; SRMR: Standardised Root Mean-square Residual

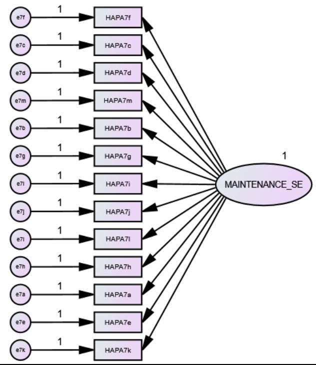
Table A6.12: Factor 5 negative outcome expectancies confirmatory factor analysis output




| Iterations | Items | Modification | Model fit statistics |
|---|---|---|---|
| V0 | 7 items<br>HAPA 4n, 4l, 4m, 4i, 4j, 4b, 4e | Nil | $X^2$ 57.543, df 14, *p*<0.001<br>TLI 0.886<br>CFI 0.924<br>RMSEA 0.079, PCLOSE 0.011<br>SRMR 0.0454 |
| V1 | 6 items<br>HAPA 4n, 4l, 4m, 4i, 4j, 4b | Removed 4e (SMC 0.155) – spend more time preparing meals | $X^2$ 45.672, df 9, *p*<0.001<br>TLI 0.880<br>CFI 0.928<br>RMSEA 0.091, PCLOSE 0.005<br>SRMR 0.0465 |
| **V2** | **5 items**<br>**HAPA 4n, 4m, 4i, 4j, 4b** | **Removed 4l (SMC 0.258) – others will think I'm restricting child's enjoyment** | $X^2$ **16.639, df 5, *p*=0.005**<br>**TLI 0.940**<br>**CFI 0.970**<br>**RMSEA 0.069, PCLOSE 0.167**<br>**SRMR 0.0311** |
| V3 | 4 items<br>HAPA 4n, 4m, 4i, 4b | Removed 4j (SMC 0.318) – impact family time | $X^2$ 11.469, df 2, *p*=0.003<br>TLI 0.894<br>CFI 0.965<br>RMSEA 0.098, PCLOSE 0.055<br>SRMR 0.0206 |

$X^2$: chi-squared; df: degrees of freedom; TLI: Tucker Lewis Index; CFI: Comparative Fit Index; RMSEA: Root Mean Squared Error of Approximation; PCLOSE: the p-value for testing the null hypothesis than RMSEA is <0.05; SRMR: Standardised Root Mean-square Residual

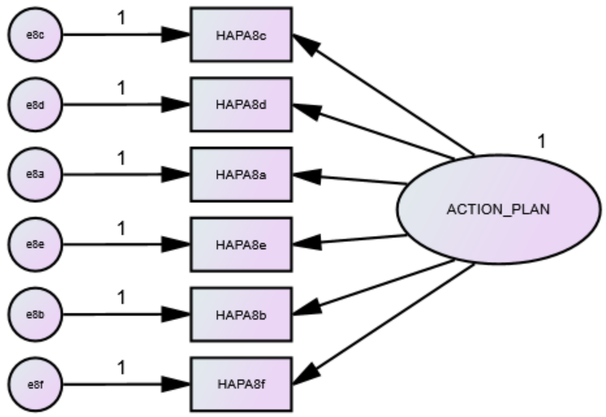
Table A6.13: Factor 6 maintenance self-efficacy confirmatory factor analysis output




| Iterations | Items | Modification | Model fit statistics |
|---|---|---|---|
| V0 | 13 items<br>HAPA 7f, 7c, 7d, 7m, 7b, 7g, 7i, 7j, 7l, 7h, 7a, 7e, 7k | Nil | $X^2$ 826.767, df 65, *p*<0.001<br>TLI 0.782<br>CFI 0.818<br>RMSEA 0.154, PCLOSE 0.000<br>SRMR 0.0619 |
| V1 | 12 items<br>HAPA 7f, 7c, 7d, 7m, 7b, 7g, 7i, 7j, 7l, 7h, 7a, 7e | Removed 7k (SMC 0.231) – relatives continue to bring extras | $X^2$ 734.76, df 54, *p*<0.001<br>TLI 0.791<br>CFI 0.829<br>RMSEA 0.160, PCLOSE 0.000<br>SRMR 0.0557 |
| V2 | 11 items<br>HAPA 7f, 7c, 7d, 7m, 7b, 7g, 7i, 7j, 7l, 7a, 7e | Removed 7h (SMC 0.227) – consume extras around my child | $X^2$ 680.387, df 44, *p*<0.001<br>TLI 0.792<br>CFI 0.834<br>RMSEA 0.171, PCLOSE 0.000<br>SRMR 0.0534 |
| V2.1 | 11 items<br>HAPA 7f, 7c, 7d, 7m, 7b, 7g, 7i, 7j, 7l, 7a, 7e | Covariance added between e7b and e7a (MI 254.662, Par Change 0.186) | $X^2$ 374.285, df 43, *p*<0.001<br>TLI 0.889<br>CFI 0.913<br>RMSEA 0.125, PCLOSE 0.000<br>SRMR 0.0435 |
| V2.2 | 11 items<br>HAPA 7f, 7c, 7d, 7m, 7b, 7g, 7i, 7j, 7l, 7a, 7e | Covariance added between e7c and e7d (MI 237.812, Par Change 0.232) | $X^2$ 91.342, df 42, *p*<0.001<br>TLI 0.983<br>CFI 0.987<br>RMSEA 0.049, PCLOSE 0.538<br>SRMR 0.0275 |
| V2.2.1 (maintenance self-efficacy 1) | 7 items<br>HAPA 7f, 7m, 7g, 7i, 7j, 7l, 7e | Reformatted as per v2.2 | $X^2$ 29.304, df 14, *p*=0.010<br>TLI 0.985<br>CFI 0.990<br>RMSEA 0.047, PCLOSE 0.545<br>SRMR 0.0329 |
| V2.2.1 (maintenance self-efficacy 2 and 3) | 2 items<br>HAPA 7a, 7b<br><br>2 items<br>HAPA 7c, 7d | Reformatted as per v2.2 | $X^2$ 2.450, df 1, *p*=0.118<br>TLI 0.995<br>CFI 0.999<br>RMSEA 0.054, PCLOSE 0.329<br>SRMR 0.0028 |
| V2.3 (maintenance self-efficacy 1) | 6 items<br>HAPA 7f, 7g, 7i, 7j, 7l, 7e | Removed 7m – child has a strong liking for extras – as doesn't not align with theoretical interpretation of factor | $X^2$ 11.098, df 9, *p*=0.269<br>TLI 0.997<br>CFI 0.998<br>RMSEA 0.022, PCLOSE 0.888<br>SRMR 0.0322 |
| **V2.3** | **6 items**<br>**HAPA 7f, 7g, 7i, 7j, 7l, 7e**<br>**2 items**<br>**HAPA 7a, 7b**<br>**2 items**<br>**HAPA 7c, 7d** | | **$X^2$ 78.920, df 34, *p*<0.001**<br>**TLI 0.983**<br>**CFI 0.987**<br>**RMSEA 0.052, PCLOSE 0.402**<br>**SRMR 0.0322**<br>**Discriminant validity**<br>**Covariances constrained to 1**<br>**$X^2$ 559.893, df 1, *p*=0.000** |

$X^2$: chi-squared; df: degrees of freedom; TLI: Tucker Lewis Index; CFI: Comparative Fit Index; RMSEA: Root Mean Squared Error of Approximation; PCLOSE: the p-value for testing the null hypothesis than RMSEA is <0.05; SRMR: Standardised Root Mean-square Residual

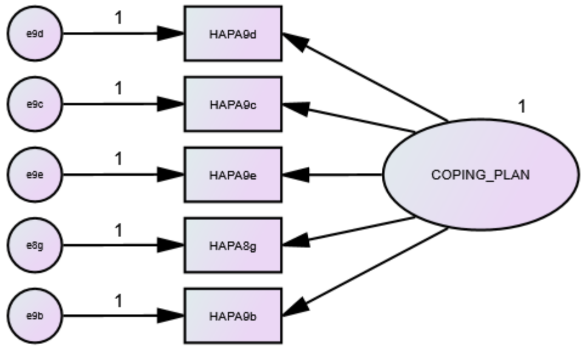
Table A6.14: Factor 7 action planning confirmatory factor analysis output




| Iterations | Items | Modification | Model fit statistics |
|---|---|---|---|
| V0 | 6 items<br>HAPA 8c, 8d, 8a, 8e, 8b, 8f | Nil | $X^2$ 257.180, df 9, $p$<0.001<br>TLI 0.731<br>CFI 0.839<br>RMSEA 0.236, PCLOSE 0.000<br>SRMR 0.0816 |
| V1 | 5 items<br>HAPA 8c, 8d, 8a, 8e, 8b | Removed 8f (SMC 0.312) – celebrating a birthday | $X^2$ 90.582, df 5, $p$<0.001<br>TLI 0.860<br>CFI 0.930<br>RMSEA 0.186, PCLOSE 0.000<br>SRMR 0.0535 |
| **V2** | **4 items**<br>**HAPA 8c, 8d, 8a, 8b** | **Removed 8e (SMC 0.409) – when we have visitors** | $X^2$ **35.104, df 2, $p$<0.001**<br>**TLI 0.896**<br>**CFI 0.965**<br>**RMSEA 0.183, PCLOSE 0.000**<br>**SRMR 0.0361** |
| V2.1 | 4 items<br>HAPA 8c, 8d, 8a, 8b | Covariance added between e8d and e8c (MI 14.299, Par Change 0.082)<br><br>Not supported by theory | $X^2$ 19.456, df 1, $p$<0.001<br>TLI 0.884<br>CFI 0.981<br>RMSEA 0.193, PCLOSE 0.000<br>SRMR 0.0221 |
| Checking for cross loading items V0 | 7 items<br>HAPA 8c, 8d, 8a, 8e, 8b, 8f, 8g | Added 8g cross loading in EFA | $X^2$ 413.310, df 14, $p$<0.001<br>TLI 0.684<br>CFI 0.789<br>RMSEA 0.240, PCLOSE 0.000<br>SRMR 0.0912 |
| Checking for cross loading items V1 | 6 items<br>HAPA 8c, 8d, 8a, 8e, 8b, 8f | Removed 8g (0.430) – when people bring food to my home | Note same as for Action planning V0 |

$X^2$: chi-squared; df: degrees of freedom; TLI: Tucker Lewis Index; CFI: Comparative Fit Index; RMSEA: Root Mean Squared Error of Approximation; PCLOSE: the p-value for testing the null hypothesis than RMSEA is <0.05; SRMR: Standardised Root Mean-square Residual

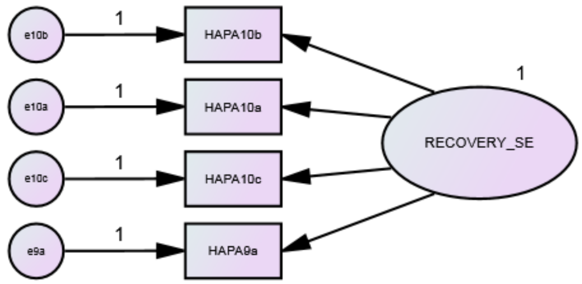
Table A6.15: Factor 8 coping planning confirmatory factor analysis output




| Iterations | Items | Modification | Model fit statistics |
|---|---|---|---|
| V0 | 5 items<br>HAPA 9d, 9c, 9e, 8g, 9b | Nil | $X^2$ 61.247, df 5, *p*=0.000<br>TLI 0.912<br>CFI 0.956<br>RMSEA 0.151, PCLOSE 0.00<br>SRMR 0.0383 |
| V0.1 | 5 items<br>HAPA 9d, 9c, 9e, 8g, 9b | Covariance added between e9e and e9b (MI 43.419, Par Change 0.124) | $X^2$ 11.324, df 4, *p*=0.023<br>TLI 0.986<br>CFI 0.994<br>RMSEA 0.061, PCLOSE 0.278<br>SRMR 0.0182 |
| V1 | 4 items<br>HAPA 9d, 9c, 9e, 9b | Removed 8g (SMC 0.430) – plans for when others bring food to my home | $X^2$ 57.480, df 2, *p*=0.000<br>TLI 0.840<br>CFI 0.947<br>RMSEA 0.237, PCLOSE 0.000<br>SRMR 0.0460 |
| V1.1 | 4 items<br>HAPA 9d, 9c, 9e, 9b | Covariance added between e9e and e9b (MI 46.544, Par Change 0.131) | $X^2$ 1.195, df 1, *p*=0.274<br>TLI 0.999<br>CFI 1.000<br>RMSEA 0.020, PCLOSE 0.521<br>SRMR 0.0050 |
| **V1.1.1** | **2 items**<br>**HAPA 9d, 9c**<br><br>**2 items**<br>**HAPA 9e, 9b** | **Reformatted to V1.1** | $X^2$ **1.195, df 1, *p*=0.274**<br>**TLI 0.999**<br>**CFI 1.000**<br>**RMSEA 0.020, PCLOSE 0.521**<br>**SRMR 0.0460**<br><br>**Discriminant validity**<br>**Covariances constrained to 1**<br>$X^2$ **56.285, df 1, *p*=0.000** |
| Checking for cross loading items V0 | 8 items<br>HAPA 9d, 9c, 9e, 8g, 9b, 7k, 8e, 8f | Added 7k, 8e, 8f cross loading in EFA | $X^2$ 328.018, df 20, *p*=0.000<br>TLI 0.805<br>CFI 0.861<br>RMSEA 0.177, PCLOSE 0.000<br>SRMR 0.0650 |
| Checking for cross loading items V1 | 7 items<br>HAPA 9d, 9c, 9e, 8g, 9b, 8e, 8f | Removed 7k (SMC 0.314) – maintenance self-efficacy parents bring food to home | $X^2$ 279.474, df 14, *p*=0.000<br>TLI 0.802<br>CFI 0.868<br>RMSEA 0.196, PCLOSE 0.000<br>SRMR 0.0670 |
| Checking for cross loading items V2 | 6 items<br>HAPA 9d, 9c, 9e, 8g, 9b, 8e | Removed 8f (SMC 0.497) – action planning celebrating a birthday | $X^2$ 140.114, df 9, *p*=0.000<br>TLI 0.864<br>CFI 0.918<br>RMSEA 0.172, PCLOSE 0.000<br>SRMR 0.0524 |
| Checking for cross loading items V3 | 5 items<br>HAPA 9d, 9c, 9e, 8g, 9b | Removed 8e (SMC 0.455) – action planning having visitors over | Note same as for Coping planning V0 |

$X^2$: chi-squared; df: degrees of freedom; TLI: Tucker Lewis Index; CFI: Comparative Fit Index; RMSEA: Root Mean Squared Error of Approximation; PCLOSE: the p-value for testing the null hypothesis than RMSEA is <0.05; SRMR: Standardised Root Mean-square Residual

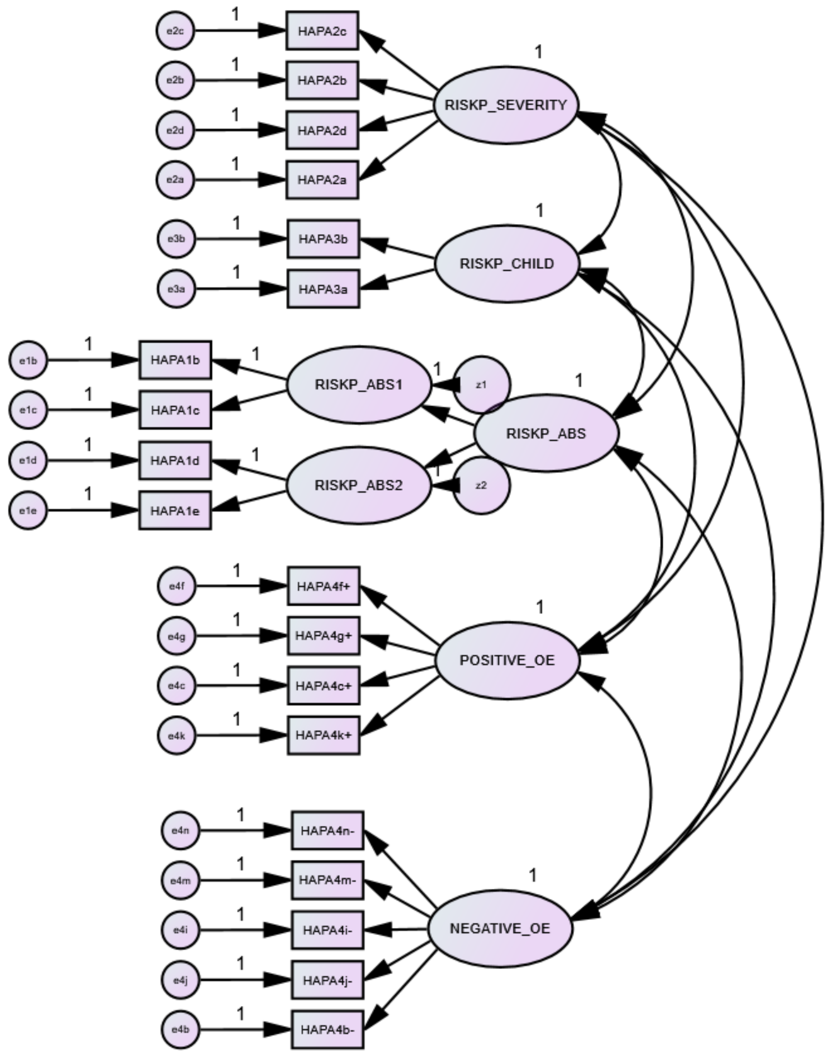
Table A6.16: Factor 9 recovery self-efficacy confirmatory factor analysis output




| Iterations | Items | Modification | Model fit statistics |
|---|---|---|---|
| V0 | 4 items<br>HAPA 10b, 10a, 10c, 9a | Nil | $X^2$ 38.491, df 2, $p$=0.000<br>TLI 0.901<br>CFI 0.967<br>RMSEA 0.192, PCLOSE 0.000<br>SRMR 0.0427 |
| **V1** | **3 items<br>HAPA 10b, 10a, 10c** | **Removed 9a (SMC 0.336) – how to manage when child asks for extras<br>Run in model with maintenance self-efficacy to meet required degrees of freedom** | **$X^2$ 230.753, df 64, $p$=0.000<br>TLI 0.956<br>CFI 0.964<br>RMSEA 0.073, PCLOSE 0.000<br>SRMR 0.0573<br><br>Discriminant validity<br>Covariances constrained to 1<br>$X^2$ 236.973, df 1, $p$=0.000** |
| Checking for cross loading items V0 | 6 items<br>HAPA 10b, 10a, 10c, 9a, 7b, 7a | Added 7b, 7a cross loading in EFA | $X^2$ 554.934, df 9, $p$=0.000<br>TLI 0.594<br>CFI 0.756<br>RMSEA 0.350, PCLOSE 0.000<br>SRMR 0.1202 |
| Checking for cross loading items V0.1 | 6 items<br>HAPA 10b, 10a, 10c, 9a, 7b, 7a | Covariance added between 10b and 10c (MI 154.049, Par Change 0.398) | $X^2$ 227.281, df 8, $p$=0.000<br>TLI 0.817<br>CFI 0.902<br>RMSEA 0.236, PCLOSE 0.000<br>SRMR 0.0953 |
| Checking for cross loading items V0.2 | 6 items<br>HAPA 10b, 10a, 10c, 9a, 7b, 7a | Covariance added between 10a and 10b (MI 93.512, Par Change 0.329) | $X^2$ 123.167, df 7, $p$=0.000<br>TLI 0.889<br>CFI 0.948<br>RMSEA 0.183, PCLOSE 0.000<br>SRMR 0.0721 |

$X^2$: chi-squared; df: degrees of freedom; TLI: Tucker Lewis Index; CFI: Comparative Fit Index; RMSEA: Root Mean Squared Error of Approximation; PCLOSE: the p-value for testing the null hypothesis than RMSEA is <0.05; SRMR: Standardised Root Mean-square Residual

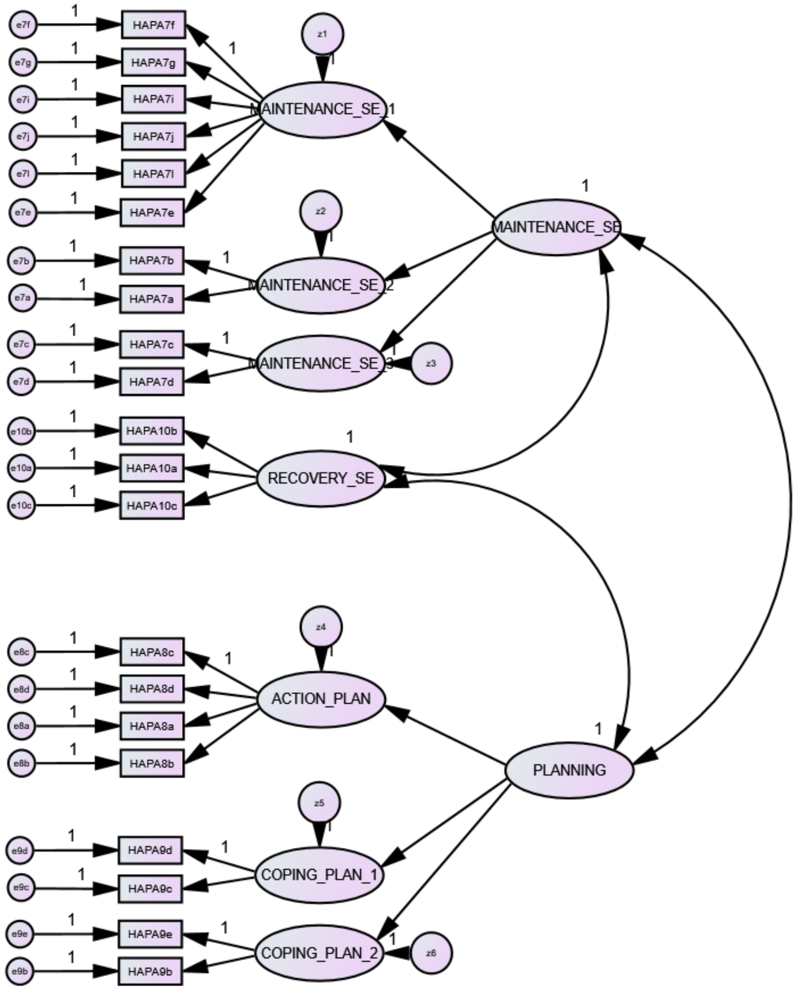
Table A6.17: Final motivational phase confirmatory factor analysis output




| Iterations | Items | Modification | Model fit statistics |
|---|---|---|---|
| V1 | RiskP_Severity – HAPA 2c, 2b, 2d, 2a<br>RiskP_Child – HAPA 3b, 3a<br><br>*Risk perception absolute*<br>RiskP_Absolute_1 – HAPA 1b, 1c<br>RiskP_Absolute_2 – HAPA 1d, 1e<br><br>Positive outcome expectancies – HAPA 4f, 4g, 4c, 4k<br><br>Negative outcome expectancies – HAPA 4n, 4m, 4i, 4j, 4b | Second order CFA | $X^2$ 258.114, df 140, $p$=0.000<br>TLI 0.957<br>CFI 0.965<br>RMSEA 0.041, PCLOSE 0.966<br>SRMR 0.0477 |

$X^2$: chi-squared; df: degrees of freedom; TLI: Tucker Lewis Index; CFI: Comparative Fit Index; RMSEA: Root Mean Squared Error of Approximation; PCLOSE: the p-value for testing the null hypothesis than RMSEA is <0.05; SRMR: Standardised Root Mean-square Residual

Table A6.18: Final volitional phase confirmatory factor analysis output




| Iterations | Items | Modification | Model fit statistics |
|---|---|---|---|
| V1 | *Maintenance self-efficacy*<br>Maintenance_SE_1 –<br>HAPA 7f, 7g, 7i, 7j, 7l, 7e<br>Maintenance_SE_2 –<br>HAPA 7a, 7b<br>Maintenance_SE_3 –<br>HAPA 7c, 7d<br><br>Recovery_SE –<br>HAPA 10a, 10b, 10c<br><br>*Planning*<br>Action_Plan –<br>HAPA 8c, 8d, 8a 8b<br>Coping_Plan_1 –<br>HAPA 9d, 9c<br>Coping_Plan_2 –<br>HAPA 9e, 9b | Second order CFA | $X^2$ 475.452, df 180, $p$=0.000<br>TLI 0.953<br>CFI 0.960<br>RMSEA 0.058, PCLOSE 0.023<br>SRMR 0.0568 |

$X^2$: chi-squared; df: degrees of freedom; TLI: Tucker Lewis Index; CFI: Comparative Fit Index; RMSEA: Root Mean Squared Error of Approximation; PCLOSE: the p-value for testing the null hypothesis than RMSEA is <0.05; SRMR: Standardised Root Mean-square Residual

### ***Outputs from structural equation modelling***

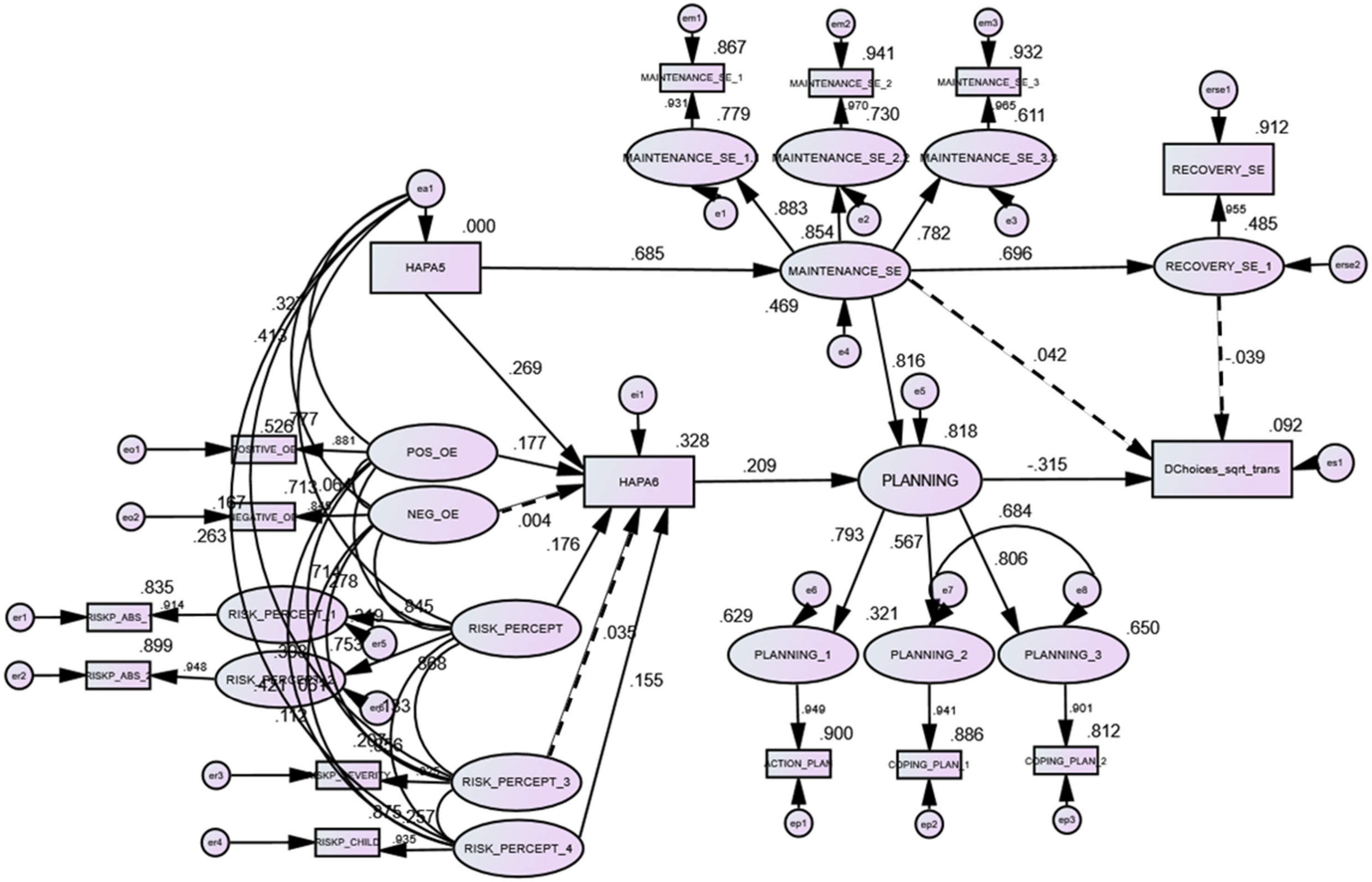



Figure A6.3: Final Health Action Process Approach confirmatory structural equation model (n=495)

Model fit: $X^2$ 210.033, df 83, $p$<0.001; CFI 0.956; TLI 0.936; RMSEA 0.056, PCLOSE 0.153; SRMR 0.0601

Model explains 9.2% of the variance in mean unhealthy food serves.
Composite latent constructs created by factor weight score method; serves of unhealthy foods variable was transformed.
Path coefficients are presented as standardised regression weights, rectangles represent measured constructs; ellipses represent latent constructs; solid line indicates statistically significant relationship ($p$<0.05); dashed line indicates non-significant relationship
Legend: ex#: error term; Dchoices_sqrt_trans: unhealthy food serves, square root transformed; HAPA5: action self-efficacy; HAPA6: intention; POS_OE: positive outcome expectancies; NEG_OE: negative outcome expectancies; MAINTENANCE_SE: maintenance self-efficacy; RECOVERY_SE: recovery self-efficacy; RISK_PERCEPT: risk perception

Table A6.19. Indirect effects within the final Health Action Process Approach confirmatory structural equation model (n=495)

| **Indirect pathway** | **Standardised indirect regression weight** | **Two tailed significance**[1] |
|---|---|---|
| Risk perception 1&2 → Planning | .037 | 0.002 |
| Risk perception 1&2 → Mean unhealthy food serves | -.012 | 0.091 |
| Risk perception 3 → Planning | .007 | 0.390 |
| Risk perception 3 → Mean unhealthy food serves | -.002 | 0.331 |
| Risk perception 4 → Planning | .032 | 0.002 |
| Risk perception 4 → Mean unhealthy food serves | -.010 | 0.123 |
| Positive outcome expectancies → Planning | .037 | 0.002 |
| Positive outcome expectancies → Mean unhealthy food serves | -.012 | 0.102 |
| Negative outcome expectancies → Planning | .001 | 0.916 |
| Negative outcome expectancies → Mean unhealthy food serves | .000 | 0.735 |
| Action self-efficacy → Planning | .615 | 0.006 |
| Action self-efficacy → Recovery self-efficacy | .477 | 0.004 |
| Action self-efficacy → Mean unhealthy food serves | -.184 | 0.004 |
| Intention → Mean unhealthy food serves | -.066 | 0.123 |
| Maintenance self-efficacy → Mean unhealthy food serves | -.285 | 0.101 |

[1] Test of significance of indirect effects via bootstrapping (500 bootstrap samples), bias-corrected confidence intervals 95%CI

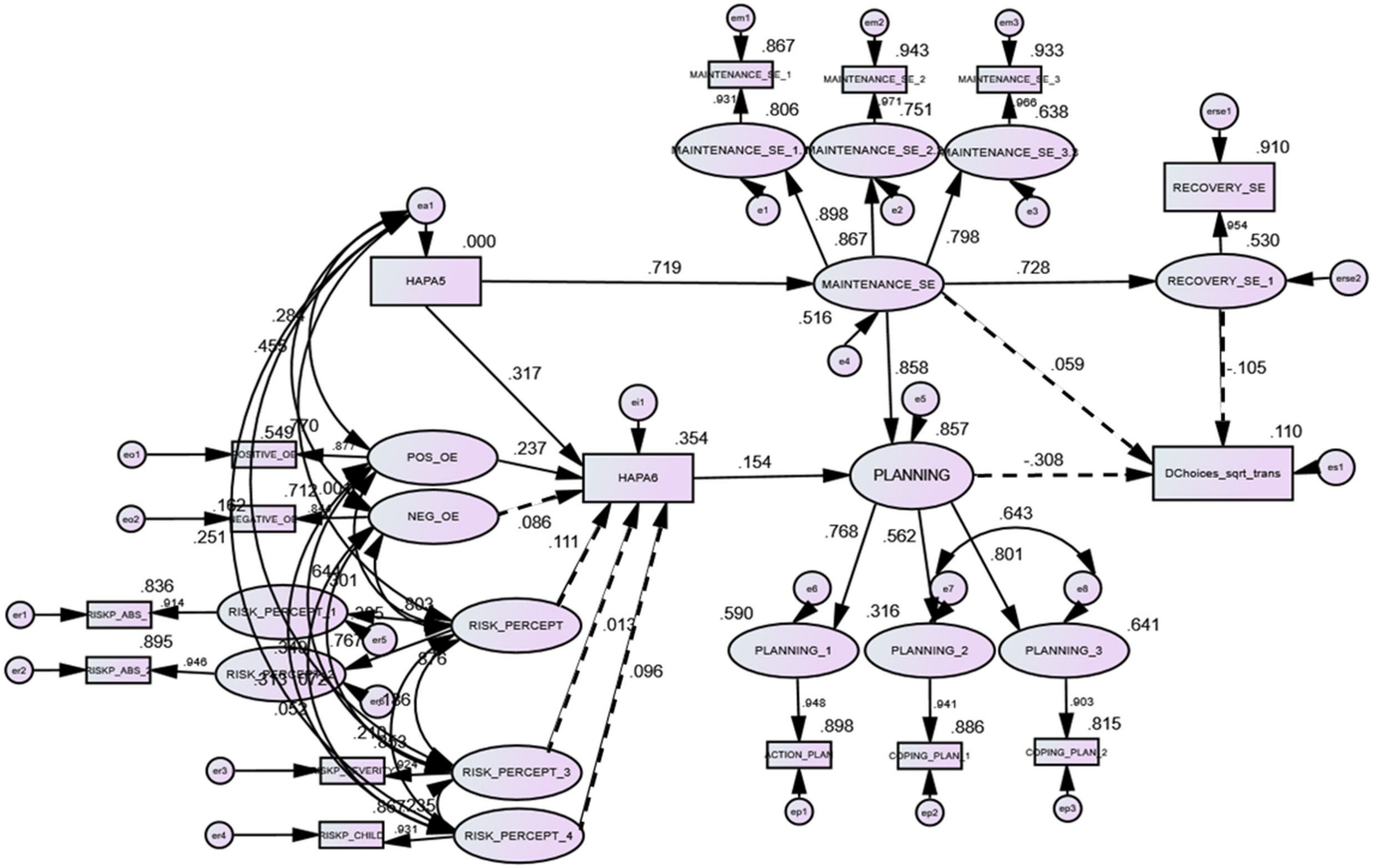


Figure A6.4: Sensitivity analysis of final Health Action Process Approach confirmatory structural equation model excluding participants with any missing data (n=339)

Model fit: $X^2$ 160.233, df 83, $p$<0.001; CFI 0.962; TLI 0.945; RMSEA 0.052, PCLOSE 0.355; SRMR 0.0606

Model explains 11.0% of the variance in mean unhealthy food serves.

Composite latent constructs created by factor weight score method; serves of unhealthy foods variable was transformed.

Path coefficients are presented as standardised regression weights, rectangles represent measured constructs; ellipses represent latent constructs; solid line indicates statistically significant relationship ($p$<0.05); dashed line indicates non-significant relationship

Legend: ex#: error term; Dchoices_sqrt_trans: unhealthy food serves, square root transformed; HAPA5: action self-efficacy; HAPA6: intention; POS_OE: positive outcome expectancies; NEG_OE: negative outcome expectancies; MAINTENANCE_SE: maintenance self-efficacy; RECOVERY_SE: recovery self-efficacy; RISK_PERCEPT: risk perception

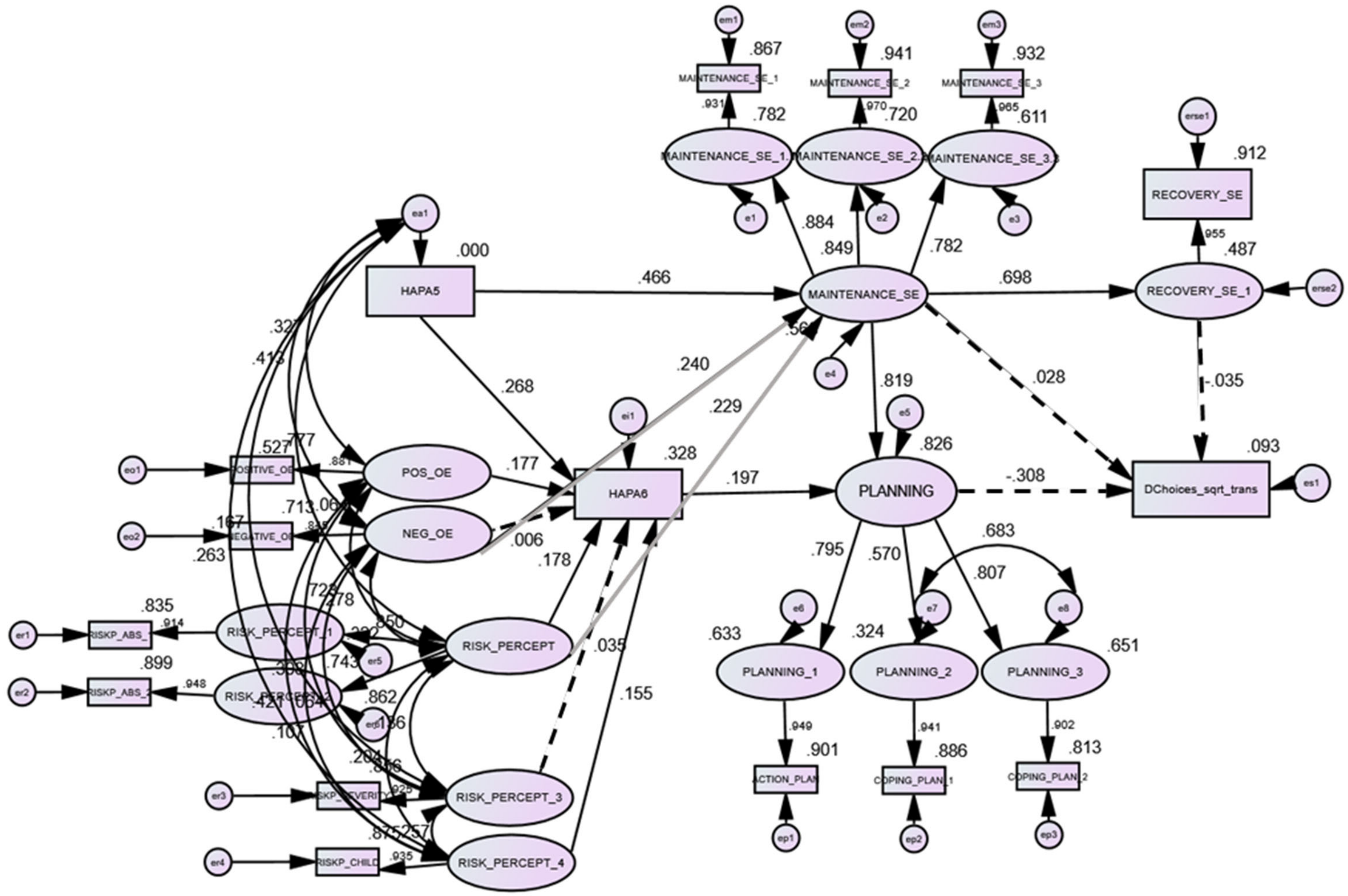


Figure A6.5: Exploratory structural equation modelling data driven alternative model 1 (n=495)

Model fit: $X^2$ 155.070, df 81, $p$<0.001; CFI 0.974; TLI 0.962; RMSEA 0.043, PCLOSE 0.866; SRMR 0.0363

Model explains 9.3% of the variance in mean unhealthy food serves.

Composite latent constructs created by factor weight score method; serves of unhealthy foods variable was transformed. Paths added from negative outcome expectancies and risk perception 1&2 to maintenance self-efficacy (displayed as grey line), based on modification indices and several high standardised residual covariances.

Path coefficients are presented as standardised regression weights, rectangles represent measured constructs; ellipses represent latent constructs; solid line indicates statistically significant relationship ($p$<0.05); dashed line indicates non-significant relationship

Legend: ex#: error term; Dchoices_sqrt_trans: unhealthy food serves, square root transformed; HAPA5: action self-efficacy; HAPA6: intention; POS_OE: positive outcome expectancies; NEG_OE: negative outcome expectancies; MAINTENANCE_SE: maintenance self-efficacy; RECOVERY_SE: recovery self-efficacy; RISK_PERCEPT: risk perception

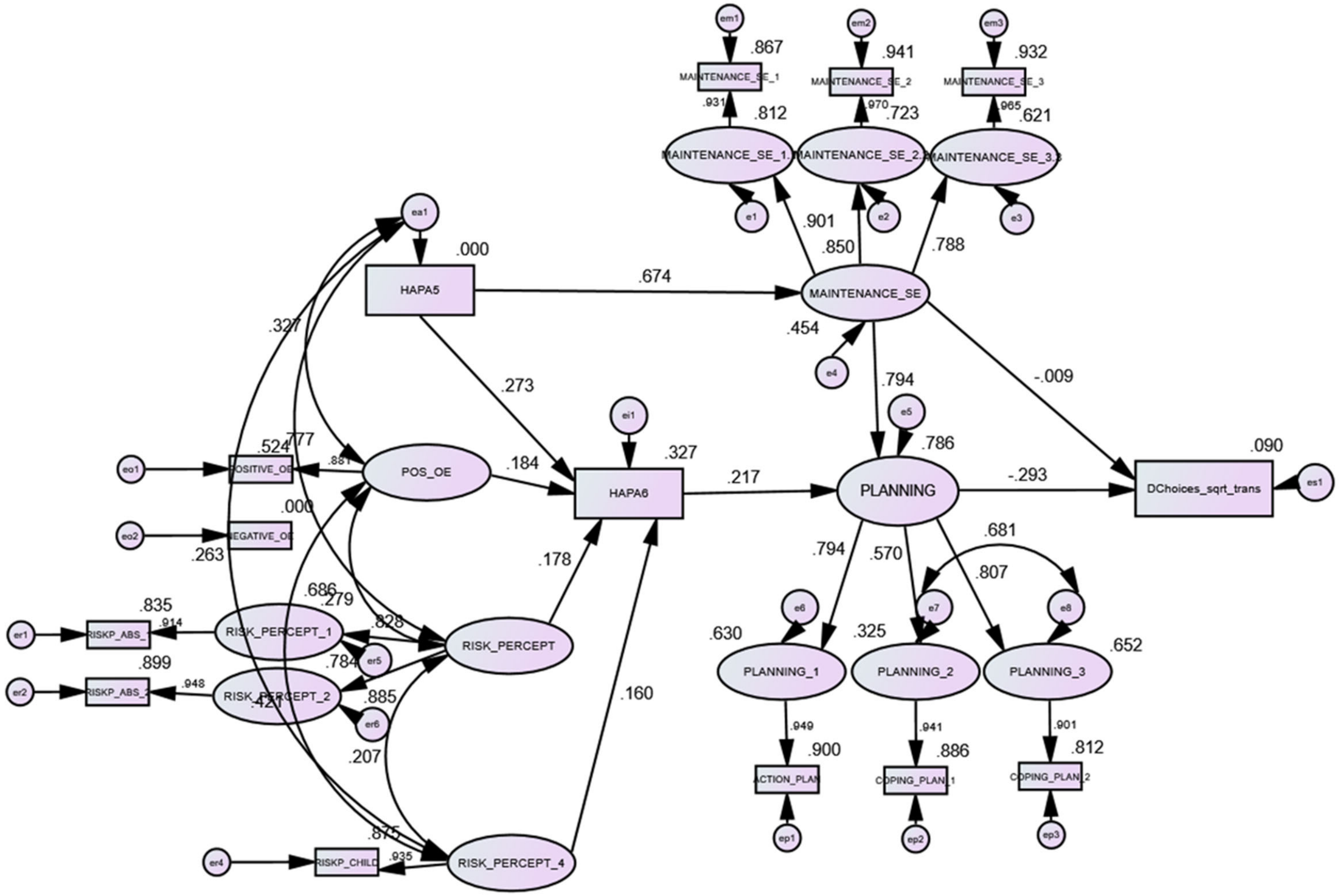



Figure A6.6: Exploratory structural equation modelling data driven alternative model 2 (n=495)

Model fit: $X^2$ 860.136, df 68, $p$<0.001; TLI 0.590; CFI 0.694; RMSEA 0.154, PCLOSE 0.000; SRMR 0.1057 (note significantly worse fit)
Model explains 9.0% of the variance in mean unhealthy food serves.
Composite latent constructs created by factor weight score method; serves of unhealthy foods variable was transformed. Negative outcome expectancies, risk perception 3 and recovery self-efficacy constructs removed, based on small, non-significant path coefficients.
Path coefficients are presented as standardised regression weights, rectangles represent measured constructs; ellipses represent latent constructs; solid line indicates statistically significant relationship ($p$<0.05); dashed line indicates non-significant relationship
Legend: ex#: error term; Dchoices_sqrt_trans: unhealthy food serves, square root transformed; HAPA5: action self-efficacy; HAPA6: intention; POS_OE: positive outcome expectancies; NEG_OE: negative outcome expectancies; MAINTENANCE_SE: maintenance self-efficacy; RECOVERY_SE: recovery self-efficacy; RISK_PERCEPT: risk perception

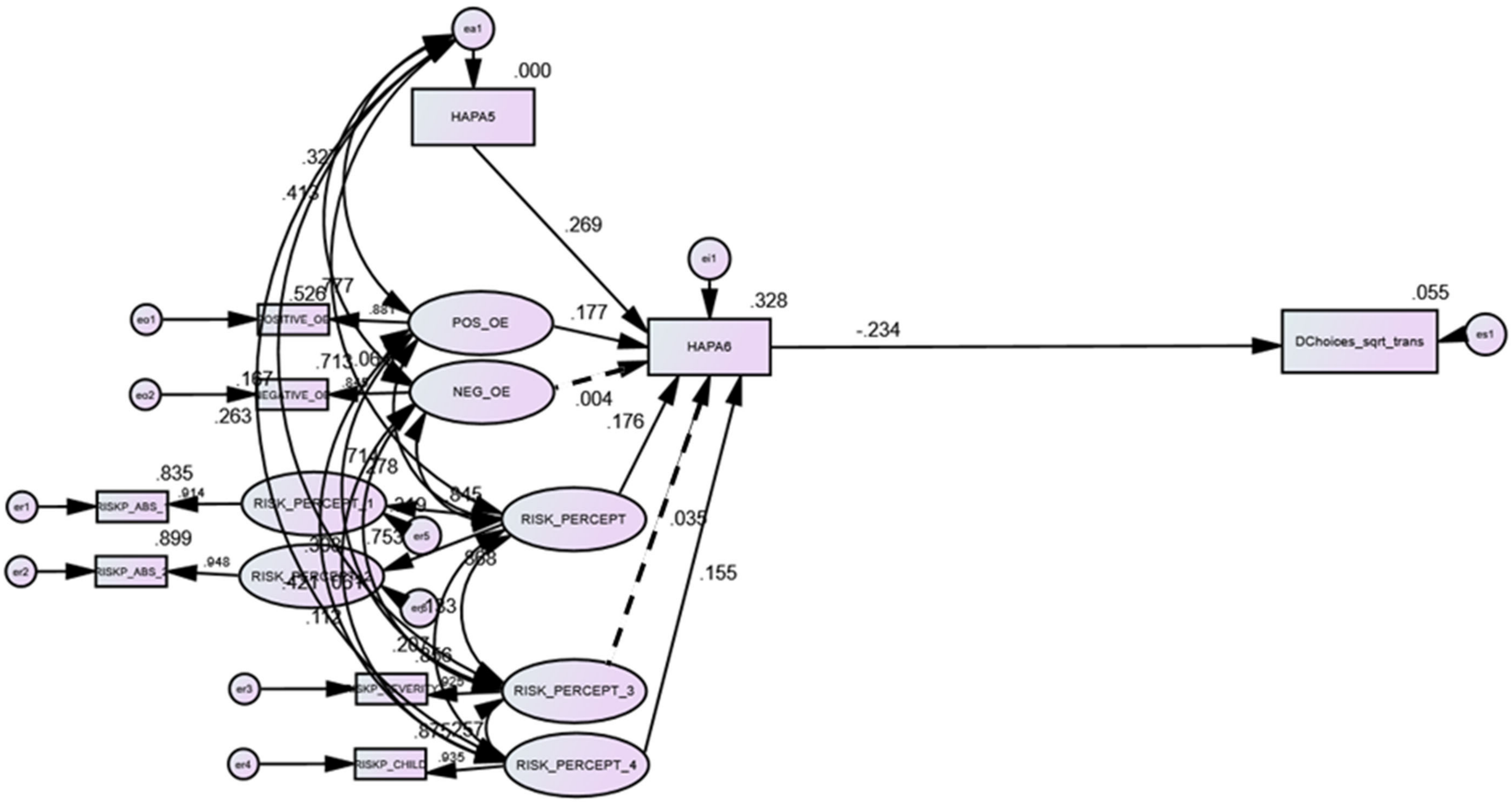



Figure A6.7: Exploratory structural equation modelling alternative theoretical model (n=495)

Model of fit: $X^2$ 55.294, df 12, *p*<0.001; TLI 0.847; CFI 0.949; RMSEA 0.085, PCLOSE 0.005; SRMR 0.0496

Model explains 5.5% of the variance in mean unhealthy food serves.

Composite latent constructs created by factor weight score method; serves of unhealthy foods variable was transformed. Alternative theoretical model similar to the Theory of Planned Behavior.

Path coefficients are presented as: unstandardized regression coefficient (standard error), standardised regression coefficient; rectangles represent measured constructs; ellipses represent latent constructs; solid line indicates statistically significant relationship (*p*<0.05); dashed line indicates non-significant relationship

Legend: ex#: error term; Dchoices_sqrt_trans: unhealthy food serves, square root transformed; HAPA5: action self-efficacy; HAPA6: intention; POS_OE: positive outcome expectancies; NEG_OE: negative outcome expectancies; RISK_PERCEPT: risk perception

Types of social occasions in childhood

Data collection in 2017 for Study 1 (Chapter 3) included an additional item not related to parental motivation, but related to social occasions to gain information to inform the design of Study 2 (Chapter 4). The item asked parents *'Which of the following occasions did your child have in the past week?'*, response options were as per Table A6.20, where parents were asked to tick all that apply. Responses were coded as '1' if the occasion was ticked or '0' if not. This item did not capture the number of each occasion, for example, if a child had two play dates in the past week this was not captured only the presence of a play date. Special occasions including birthday celebrations and other celebrations were included as response options so they could be separated from social occasions.

Sample characteristics are presented in Table 3.7a and 3.7b in Chapter 3 (Study 1). Children in this sample had on average three types of social occasions in the week prior to completing the survey, this ranged from zero to eight. The most frequently selected types of social occasions were catching up with friends as a family (64%) or extended family (52%) and play date (i.e. child with peer; 52%).

Table A6.20: Types of social occasions children (n=328) had in the week prior to the survey[a]

| | Percentage (count) |
|---|---|
| **Social occasions** | |
| Catching up with friends as a family | 64.3 (211) |
| Catching up with extended family | 52.1 (171) |
| Play date | 52.1 (171) |
| Eating out with friends as a family | 38.4 (126) |
| Outing with grandparents | 29.0 (95) |
| Eating out with extended family | 21.3 (70) |
| Extra curricular activity | 18.3 (60) |
| Family holiday | 17.7 (58) |
| School event / outing | 15.2 (50) |
| Other social occasions | 2.1 (7) |
| **Special occasions** | |
| Birthday celebration | 26.4 (87) |
| Other celebration | 17.4 (57) |

## Appendix 7: Study 2 Supplementary Files

### *Discrete choice experiment design*

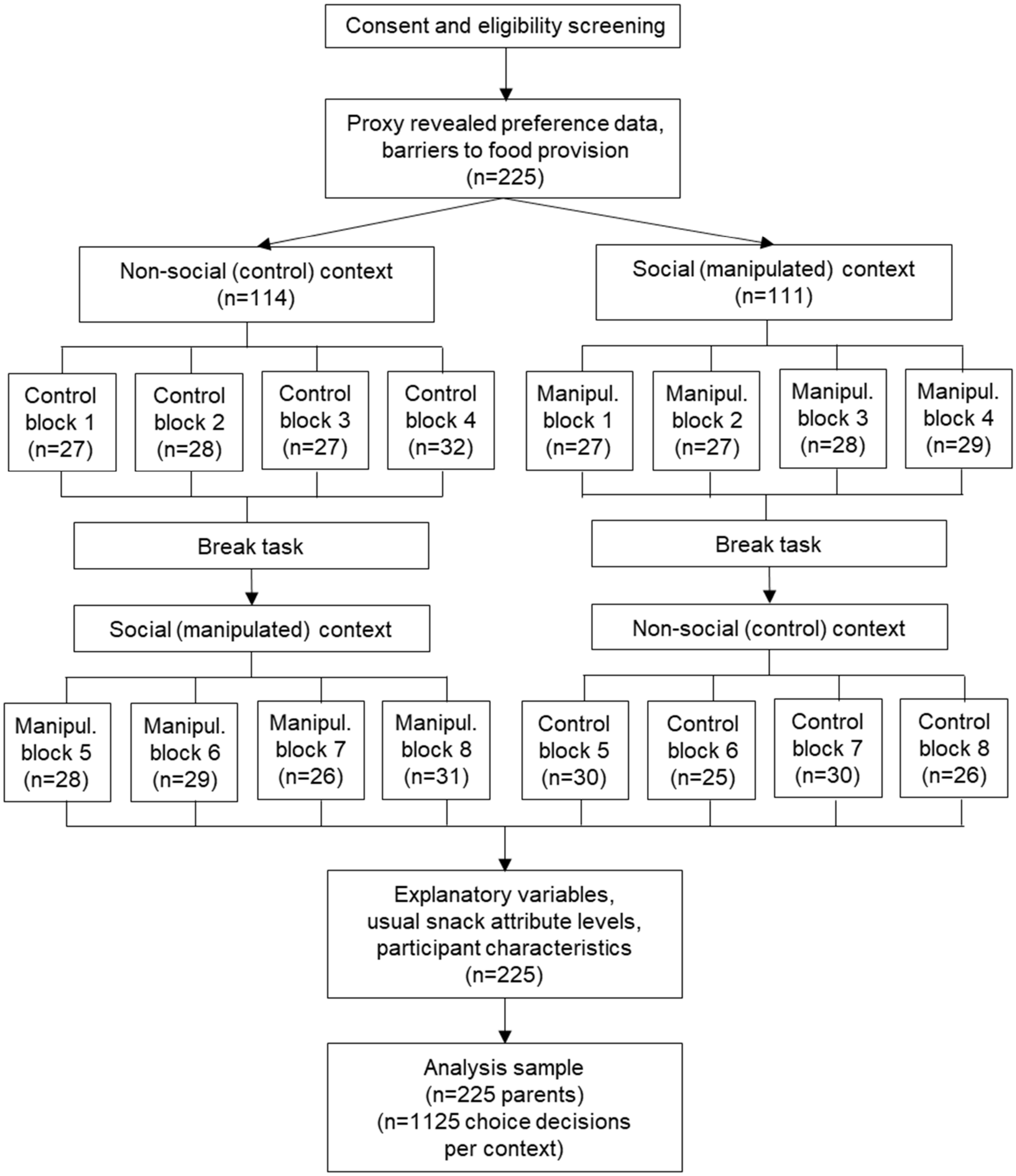



Figure 7.1: Flow chart of discrete choice experiment blocks[1] and randomisation of final sample

[1] Numbers represent the number of participants, each choice block contained five choice tasks.

***Primary analyses relative importance score***

Table A7.2: Control condition attribute relative importance score

| | **Hauber et al. 2016 method** | | | **Partial log-likelihood analysis method** | | | |
|---|---|---|---|---|---|---|---|
| **Attribute** | **Difference in preference weights** | **Order of impact** | **Attribute excluded from analysis** | **Log-likelihood** | **Partial effect (change in log-likelihood)** | **Relative effect (% sum of change in log-likelihood)** | **Order of impact** |
| | | | None (full model) | -756.18044 | | | |
| Cost of snack | 0.333 | 5 | Cost of snack | -759.52716 | -3.34672 | 1.062 | 5 |
| Time to prepare | 0.211 | 6 | Time to prepare | -757.08339 | -0.90295 | 0.287 | 6 |
| Child's likely response | 1.624 | 2 | Child's likely response | -871.84690 | -115.66646 | 36.709 | 2 |
| Co-parent support | 0.998 | 3 | Co-parent support | -797.91406 | -41.73362 | 13.245 | 3 |
| Friend support | 0.448 | 4 | Friend support | -763.78640 | -7.60596 | 2.414 | 4 |
| Type of food | 1.944 | 1 | Type of food | -902.01083 | -145.83039 | 46.283 | 1 |

Table A7.3: Experimental condition attribute relative importance score

| | **Hauber et al. 2016 method** | | | **Partial log-likelihood analysis method** | | | |
|---|---|---|---|---|---|---|---|
| **Attribute** | **Difference in preference weights** | **Order of impact** | **Attribute excluded from analysis** | **Log-likelihood** | **Partial effect (change in log-likelihood)** | **Relative effect (% sum of change in log-likelihood)** | **Order of impact** |
| | | | None (full model) | -827.28808 | | | |
| Cost of snack | 0.320 | 5 | Cost of snack | -830.93801 | -3.649202 | 1.346 | 5 |
| Time to prepare | 0.162 | 6 | Time to prepare | -827.77141 | -0.482602 | 0.178 | 6 |
| Child's likely response | 1.506 | 1 | Child's likely response | -934.81239 | -107.523582 | 39.656 | 1 |
| Co-parent support | 1.077 | 3 | Co-parent support | -877.44151 | -50.152702 | 18.497 | 3 |
| Friend support | 0.794 | 4 | Friend support | -854.37217 | -27.083362 | 9.989 | 4 |
| Type of food | 1.384 | 2 | Type of food | -909.53481 | -82.246002 | 30.334 | 2 |

***Descriptive characteristics by sub-groups of participants***

Table A7.4: Descriptive characteristics of parents and children, by SEIFA subgroups

| Parent characteristic | Lower SEIFA (n=91) | Higher SEIFA (n=133) | Child characteristic | Lower SEIFA (n=91) | Higher SEIFA (n=133) |
|---|---|---|---|---|---|
| Age, years (mean, SD) | 34.3 (3.9) | 36.1 (3.5) | Age, years (mean, SD) | 5.2 (1.3) | 5.2 (1.4) |
| Gender (%, count) | | | Gender (%, count) | | |
| Male | 1.1 (1) | - | Male | 47.3 (43) | 51.1 (68) |
| Female | 98.9 (90) | 100 (133) | Female | 52.7 (48) | 48.9 (65) |
| Weight status[1] (%, count) | | | Weight status (%, count) | | |
| Underweight | 4.5 (4) | - | Underweight | 16.5 (15) | 12.2 (16) |
| Healthy weight | 26.5 (26) | 46.9 (60) | Healthy weight | 51.6 (47) | 58.8 (77) |
| Overweight | 33.0 (29) | 33.6 (43) | Overweight | 15.4 (14) | 15.3 (20) |
| Obesity | 33.0 (29) | 19.5 (25) | Obesity | 16.5 (15) | 13.7 (18) |
| Family structure (%, count) | | | Weight and/or height measured in past 6 months (%, count) | 70.3 (64) | 75.9 (101) |
| Couple with a child | 13.2 (12) | 13.5 (18) | | | |
| Couple with children | 79.1 (72) | 82.7 (110) | | | |
| One parent family with a child | 1.1 (1) | 0.8 (1) | Frequency of social occasions in past week (median, IQR) | 5 (3) | 5 (5) |
| One parent family with children | 2.2 (2) | 1.5 (2) | | | |
| Other family type | 4.4 (4) | 1.5 (2) | Frequency of select celebratory occasions in past week (median, IQR) | 0 (1) | 0 (1) |
| SEIFA[2] Index of Relative Advantage and Disadvantage, quintiles (%, count) | | | Child temperament, 5 point scale (mean, SD) | | |
| 1 | 36.3 (33) | - | | | |
| 2 | 36.3 (33) | - | Surgency/extraversion | 3.7 (1.2) | 3.6 (1.2) |
| 3 | 12.1 (11) | 21.1 (28) | Negative affectivity | 2.5 (1.2) | 2.4 (1.1) |
| 4 | - | 43.6 (58) | Effortful control | 3.8 (1.1) | 3.5 (1.2) |
| 5 | - | 35.3 (47) | | | |
| Parent education (%, count) | | | State | | |
| | | | SA | 37.4 (34) | 39.8 (53) |
| Completed high school or less | 6.6 (6) | 6.8 (9) | QLD | 20.9 (19) | 12.0 (16) |
| | | | NSW | 16.5 (15) | 13.5 (18) |
| Tech or trade | 27.5 (25) | 16.5 (22) | VIC | 8.8 (8) | 15.8 (21) |
| Tertiary degree | 34.1 (31) | 36.1 (48) | WA | 8.8 (8) | 6.8 (9) |
| Postgraduate degree | 31.9 (29) | 40.6 (54) | TAS | 7.7 (7) | 4.5 (6) |
| Parent employment (%, count) | | | ACT | - | 4.5 (6) |
| | | | NT | - | 3 (4) |
| Employed full time | 15.4 (14) | 19.5 (26) | | | |
| Employed part time | 48.4 (44) | 54.1 (72) | | | |
| Not working / homemaker | 36.3 (33) | 26.3 (35) | | | |
| Parental self-efficacy[3] (mean, SD) | | | | | |
| Efficacy scale | 30.2 (5.0) | 31.6 (5.1) | | | |
| Satisfaction scale | 36.0 (6.8) | 36.4 (7.8) | | | |

[1] missing anthropometric responses for parents (lower SEIFA n=3; higher SEIFA n=5) and for children (higher SEIFA n=2)

[2] SEIFA, Socio-Economic Indexes for Areas. Missing SEIFA (n=1)

[3] Parenting self-efficacy scores calculated from 6-point likert scale, possible range for efficacy scale is 7 to 42 and satisfaction 9 to 54.

Table A7.5: Descriptive characteristics of parents and children, by child weight status subgroups

| Parent characteristic | Healthy weight range (n=124) | Overweight / obesity (n=68) | Child characteristic | Healthy weight range (n=124) | Overweight / obesity (n=68) |
|---|---|---|---|---|---|
| Age, years (mean, SD) | 35.2 (3.7) | 35.5 (4.0) | Age, years (mean, SD) | 5.2 (1.3) | 5.2 (1.4) |
| Gender (%, count) | | | Gender (%, count) | | |
| Male | 0.8 (1) | - | Male | 54.8 (68) | 36.8 (25) |
| Female | 99.2 (123) | 100 (68) | Female | 45.2 (56) | 63.2 (43) |
| Weight status[1] (%, count) | | | Weight status (%, count) | | |
| Underweight | 0.8 (1) | 3.1 (2) | Underweight | - | - |
| Healthy weight | 39.3 (48) | 37.5 (24) | Healthy weight | 100 (124) | - |
| Overweight | 33.6 (41) | 29.7 (19) | Overweight | - | 50.0 (34) |
| Obesity | 26.2 (32) | 29.7 (19) | Obesity | - | 50.0 (34) |
| Family structure (%, count) | | | Weight and/or height measured in past 6 months (%, count) | 81.5 (101) | 61.8 (42) |
| Couple with a child | 12.1 (15) | 11.8 (8) | | | |
| Couple with children | 81.5 (101) | 83.8 (57) | | | |
| One parent family with a child | 1.6 (2) | - | Frequency of social occasions in past week (median, IQR) | 5 (4) | 5 (6) |
| One parent family with children | 2.4 (3) | 1.5 (1) | | | |
| Other family type | 2.4 (3) | 2.9 (2) | Frequency of select celebratory occasions in past week (median, IQR) | 0 (1) | 0 (1) |
| SEIFA[2] Index of Relative Advantage and Disadvantage, quintiles (%, count) | | | Child temperament, 5 point scale (mean, SD) | | |
| 1 | 16.1 (20) | 16.2 (11) | | | |
| 2 | 10.5 (13) | 14.7 (10) | Surgency/extraversion | 3.7 (1.2) | 3.5 (1.2) |
| 3 | 24.2 (30) | 23.5 (16) | Negative affectivity | 2.5 (1.1) | 2.1 (1.0) |
| 4 | 26.6 (33) | 22.1 (15) | Effortful control | 3.6 (1.2) | 3.7 (1.2) |
| 5 | 22.6 (28) | 22.1 (15) | | | |
| Parent education (%, count) | | | State | | |
| | | | SA | 41.9 (52) | 38.8 (26) |
| Completed high school or less | 8.9 (11) | 2.9 (2) | QLD | 12.1 (15) | 16.4 (11) |
| | | | NSW | 16.9 (21) | 10.4 (7) |
| Tech or trade | 19.4 (24) | 23.5 (16) | VIC | 13.7 (17) | 13.4 (9) |
| Tertiary degree | 36.3 (45) | 35.3 (24) | WA | 5.6 (7) | 9.0 (6) |
| Postgraduate degree | 35.5 (44) | 38.2 (26) | TAS | 6.5 (8) | 4.5 (3) |
| Parent employment (%, count) | | | ACT | 1.6 (2) | 4.5 (3) |
| | | | NT | 1.6 (2) | 3.0 (2) |
| Employed full time | 12.9 (16) | 26.5 (18) | | | |
| Employed part time | 52.4 (65) | 51.5 (35) | | | |
| Not working / homemaker | 34.7 (43) | 22.1 (15) | | | |
| Parental self-efficacy[3] (mean, SD) | | | | | |
| Efficacy scale | 30.8 (5.0) | 31.5 (5.8) | | | |
| Satisfaction scale | 36.3 (6.3) | 36.4 (9.1) | | | |

[1] missing anthropometric responses for parents (n=8) and for children (n=2)
[2] SEIFA, Socio-Economic Indexes for Areas. Missing SEIFA (n=1)
[3] Parenting self-efficacy scores calculated from 6-point likert scale, possible range for efficacy scale is 7 to 42 and satisfaction 9 to 54.

**Appendix 8: Study 3 Supplementary Files**

***Example search strategy: Final terms for search in Epub Ahead of Print***

*Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily and Ovid MEDLINE(R) 1946 to Present*
*Nil refinement of search fields*

1 (child* and (preschool or pre school or "primary school" or junior school)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
2 exp Child/
3 1 or 2
4 (parent or parent$1 or care giver or caregiver or guardian or family or families or step parent$1 or mother$1 or father$1 or step mother or step father or grandparent$1 or grandfather or grandmother).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
5 grandparents/ or parents/ or fathers/ or mothers/ or single parent/
6 4 or 5
7 3 and 6
8 (discretionary food or discretionary choices or treats or extras or non core food or sometimes food$1 or energy dense or nutrient poor or EDNP or empty calor$3 or high kilojoule or high energy or junk food or sofas or unhealthy food or soft drinks or sugar sweetened beverage$1 or SSB or soda or sugary drink or sweet or fast food or takeaway food or take away food or saturated fat or added sugar or salt or sodium or energy intake or calorie intake).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
9 (controlled clinical trial or randomised controlled trial or randomized controlled trial or random allocation or double blind method or single blind method or placebo or intervention stud* or evaluation stud* or comparative study or follow up stud* or prospective stud* or cross-over stud* or clinical trial or latin square or time series or trial or random or RCT or matched or population* or control or comparison or comparative stud* or matched pairs or outcome stud* or quasi or pseudo or non randomi* or prospective or experimental or intervention or evaluation or cross over).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
10 exp clinical trial/ or exp controlled clinical trial/ or comparative study/ or evaluation studies/
11 9 or 10
12 (nutrition and (education or training or information or knowledge)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
13 ((behaviour or behavior) and change).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
14 (program or programme or intervention$1 or prevention or weight management).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
15 12 or 13 or 14
16 7 and 8 and 11 and 15
17 limit 16 to (english language and humans and ("preschool child (2 to 5 years)" or "child (6 to 12 years)"))

***Sensitivity analysis: use of Behaviour Change Techniques in published and unpublished parent-focused intervention content***

Table A8.1: Use of Behaviour Change Techniques in published and unpublished parent-focussed intervention content

| Study | Total | Primarily group program | | | | | Primarily individual | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **Raynor 2012 – Int. 1** Weak | **Golley 2011** Strong | **Raynor 2012 – Int. 2a** | **Elder 2014** Moderate | **Raynor 2012 – Int. 2b** | **Taylor 2015** Strong | **Fletcher 2013** Strong | **Duncanson 2013** Moderate |
| **Effect size**[1] | | -0.4 to -0.6 | -0.3 | -0.3 | -0.2 to -0.3 | 0.1 | -0.1 to -0.4 | -0.2 | 0.6 to 0.3 |
| **1.1 Goal setting (behaviour)** | **7** | X | X | X | X | X | X | X | |
| **1.2 Problem solving** | **6** | X | X | X | X | | X | X | |
| 1.4 Action planning | 4 | X | X | X | | | | X | |
| **1.5 Review behaviour goal(s)** | **6** | X | X | X | X | | X | X | |
| 1.6 Discrepancy between current behaviour and goal | 2 | | X | | | | X | | |
| 1.8 Behavioural contract | 2 | | X | | | | | X | |
| 2.2 Feedback on behaviour | 3 | X | | X | | | | X | |
| **2.3 Self-monitoring of behaviour** | **5** | X | X | X | | X | | X | |
| 3.1 Social support (unspecified) | 4 | | X | | X | | X | X | |
| **4.1 Instruction on how to perform the behaviour** | **5** | | X | | X | | X | X | X |
| 4.2 Information about antecedents | 4 | X | X | X | | | | X | |
| **5.1 Information about health consequences** | **5** | X | X | X | X | | | X | |
| 5.2 Salience of consequences | 2 | X | | X | | | | | |
| 5.3 Information about social and environmental consequences | 3 | | | | X | | X | X | |
| 6.1 Demonstration of the behaviour | 0 | | | | | | | | |
| 6.2 Social comparison | 4 | X | X | X | | | | X | |
| 7.1 Prompts / cues | 1 | | | | | | | X | |
| 8.1 Behavioural practice / rehearsal | 4 | X | X | X | | | X | | |
| 8.2 Behavioural substitution | 2 | | X | | | | | X | |
| 8.3 Habit formation | 1 | | X | | | | | | |
| 8.7 Graded tasks | 4 | X | | X | | | X | X | |
| 9.1 Credible source | 1 | | X | | | | | | |
| 9.2 Pros and cons | 1 | | | | | | X | | |
| 10.1 Material incentive (behaviour) | 1 | | | | X | | | | |
| 10.2 Material reward (behaviour) | 1 | | | | X | | | | |
| 10.3 Non-specific reward | 4 | X | | X | X | X | | | |
| 10.4 Social reward | 2 | | | | X | | | X | |
| 12.1 Restructuring the physical environment | 4 | X | X | X | | | | X | |
| 12.2 Restructuring the social environment | 3 | X | | X | | | | X | |
| **12.3 Avoidance / reducing exposure to cues for the behaviour** | **5** | X | X | X | | | X | X | |
| 12.5 Adding objects to the environment | 2 | | | | | | X | X | |
| **13.1 Identification of self as role model** | **5** | X | X | X | | X | | X | |
| Total number of BCTs in published content | | 4 | 9 | 4 | 5 | 4 | 4 | 13 | 1 |
| Total number of BCTs in unpublished content | | 13 | 10 | 13 | 6 | 13 | 8 | 9 | 0 |
| **Overall total number of BCTs** | | **17** | **19** | **17** | **11** | **17** | **10** | **22** | **1** |

Abbreviations: BCT: Behaviour Change Technique

**Appendix 9: Study 4 Supplementary Files**

Table A9.1: Proposed lower priority behaviour change enablers for general population and families from lower socio-economic backgrounds

| **COM-B** ***TDF*** | **Behaviour change enablers** (What needs to happen for the behaviour to occur?) | **Rationale and supporting evidence** | **Change needed** |
|---|---|---|---|
| Psychological capability *Knowledge Cognitive and interpersonal skills Memory, attention and decision making processes Behavioural regulation* | Learning which foods are unhealthy sweet and savoury snacks | Considered essential knowledge but not sufficient to enable behaviour change.<br>Risks of not including this target behaviour is that the foods of interest are not reduced – e.g. muesli bars, plain biscuits, rice crackers and other savoury snacks.<br>Overlap with skills to identify unhealthy snacks, therefore superseded, and lower priority.<br>Petrunoff 2012; Curtis 2017; Smit 2017; Pescud 2014 | Yes |
| | Learning how to choose between different snack options / alternative snacks to purchase in place of unhealthy snacks | Insufficient evidence available to determine need.<br>Overlaps with physical opportunity regarding prompts to reduce unhealthy snack purchases.<br>Priority area for future research to understand parents' current skills and strategies for choosing snack options.<br>Petrunoff 2012 | Unclear |
| | Remembering to purchase less unhealthy sweet and savoury snacks and/or to purchase alternative healthy snacks* when at the supermarket | Insufficient evidence available to determine need.<br>Difficult area to measure with divisions of reflective versus automatic processes. Could be addressed by skills training to enhance memory or through environmental changes to prompt/cue purchasing changes. Overlaps with physical opportunity regarding prompts to reduce unhealthy snack purchases.<br>Priority area for future research to understand parents' memory abilities and strategies to support favourable snack purchasing. | Unclear |
| | Learning how to create 'if-then' rules to prompt purchasing less unhealthy sweet and savoury snacks or to start purchasing alternative snack purchases | Insufficient evidence available to determine need.<br>Behaviour change research highlights the importance of 'if-then' plans (i.e. implementation intentions), but unclear whether parents need to develop skills in this area or to apply plans.<br>Overlaps with goals within reflective motivation.<br>Priority area for future research to understand parents' current behavioural regulation strategies.<br>Fisher 2015 | General: unclear<br>Low SEP: mixed |
| | Having better strategies for monitoring unhealthy sweet and savoury snack purchases to be able to reduce unhealthy snacks | Insufficient evidence available to determine need.<br>Past research has often focussed on identifying barriers rather than examining strategies or enablers to support desired behaviours.<br>Priority area for future research to understand parents' current behavioural regulation strategies.<br>Petrunoff 2012 | Unclear |

Table A9.1: Proposed lower priority behaviour change enablers for general population and families from lower socio-economic backgrounds (cont.)

| **COM-B**<br>***TDF*** | **Behaviour change enablers**<br>(What needs to happen for the behaviour to occur?) | **Rationale and supporting evidence** | **Change needed** |
|---|---|---|---|
| Social opportunity<br>*Social influences* | Having other parents purchase less unhealthy sweet and savoury snacks or purchase alternative healthy snacks | Peer parent influences were identified as lower importance for low SES families from discrete choice experiment subgroup analysis (5/6 lower vs 4/6 higher SEIFA) (Study 2). To address this enabler, it would require a two-wave approach. First, it would require enhancing parents who are perhaps already actioners or intenders to reduce purchasing, for then pre-intenders or intenders to engage in behaviour change (second-wave). For example, it could be achieved by two-waves of the proposed intervention, recruitment based on intention status, to create changes in social norms or more immediate influences. It could also be addressed through peer support behaviour change intervention approaches.<br>Research gap to explore importance in low SES families, currently not raised in qualitative research, lower ranking in self-reported barriers.<br>Petrunoff 2012; Peters 2014 | General: yes<br>Low SEP: unclear |
| Reflective motivation<br>*Beliefs about consequences*<br>*Goals* | Believing there are more positives than negatives to reducing unhealthy sweet and savoury snack purchasing and consumption | Lower intervention priority as favourable and unfavourable ratings in PFAQ, likely captured in intention formation.<br>More evidence to support focus on positive outcome expectancies. Limited research in low SES families, would benefit from further research to determine tailored need.<br>Lower priority for generic intervention content.<br>Peters 2014; Russell 2014; Martin-Biggers 2015; Petrunoff 2012; Van de Gaar 2017 | General: no / mixed<br>Low SEP: mixed |
| | Having clear goals or plans to reduce unhealthy sweet and savoury snack home food availability, over other competing goals (e.g. psychosocial)<br>(decision balance) | Considered lower priority for purchasing intervention versus provision intervention. By changing food availability bypassing some of this decision balance (e.g. if not purchasing confectionary cannot be given as a 'treat').<br>Lack of research specific to purchasing goals, and limited evidence for low SES families (one study). Unpublished work from our team looking at parents' food provision goals highlighted both nutritional and psychosocial goals (Golley, unpublished).<br>Martin-Biggers 2015; Russell 2014; Schuster 2019; Slater 2010 | Yes |
| Automatic motivation<br>*Emotion* | Feeling less cravings for unhealthy sweet and savoury snacks | Insufficient evidence available to determine need.<br>Priority area for future research to understand the emotional drivers of unhealthy snack purchasing. | Unclear |
| | Enjoying purchasing alternative healthy snacks* | Insufficient evidence available to determine need.<br>Priority area for future research to understand the emotional response to healthy snack purchasing. | Unclear |

Abbreviations: COM-B: Sources of behaviour within the Capability, Opportunity, Motivation and Behaviour model; SEP: socio-economic position; TDF: Theoretical Domains Framework

Table A9.2: Behaviour Change Technique labels grouped by the 16 hierarchal clusters[1]

| | |
|---|---|
| **1. Goals and planning** | |
| 1.1. Goal setting (behaviour) * | |
| 1.2. Problem solving * | |
| 1.3. Goal setting (outcome) | |
| 1.4. Action planning * | |
| 1.5. Review behaviour goal(s) * | |
| 1.6. Discrepancy between current behaviour and goal * | |
| 1.7. Review outcome goal(s) | |
| 1.8. Behavioural contract | |
| 1.9. Commitment | |
| **2. Feedback and monitoring** | |
| 2.1. Monitoring of behaviour by others without feedback | |
| 2.2. Feedback on behaviour | |
| 2.3. Self-monitoring of behaviour * | |
| 2.4. Self-monitoring of outcome(s) of behaviour * | |
| 2.5. Monitoring of outcome(s) of behaviour without feedback | |
| 2.6. Biofeedback | |
| 2.7. Feedback on outcome(s) of behaviour | |
| **3. Social support** | |
| 3.1. Social support (unspecified) * | |
| 3.2. Social support (practical) | |
| 3.3. Social support (emotional) | |
| **4. Shaping knowledge** | |
| 4.1. Instruction on how to perform the behaviour * | |
| 4.2. Information about antecedents * | |
| 4.3. Re-attribution | |
| 4.4. Behavioural experiments | |
| **5. Natural consequences** | |
| 5.1. Information about health consequences * | |
| 5.2. Salience of consequences | |
| 5.3. Information about social and environmental consequences * | |
| 5.4. Monitoring of emotional consequences | |
| 5.5. Anticipated regret | |
| 5.6. Information about emotional consequences | |
| **6. Comparison of behaviour** | |
| 6.1. Demonstration of the behaviour * | |
| 6.2. Social comparison * | |
| 6.3. Information about others' approval | |
| **7. Associations** | |
| 7.1. Prompts/cues * | |
| 7.2. Cue signalling reward | |
| 7.3. Reduce prompts/cues | |
| 7.4. Remove access to the reward | |
| 7.5. Remove aversive stimulus | |
| 7.6. Satiation | |
| 7.7. Exposure | |
| 7.8. Associative learning | |
| **8. Repetition and substitution** | |
| 8.1. Behavioural practice/rehearsal * | |
| 8.2. Behaviour substitution | |
| 8.3. Habit formation | |
| 8.4. Habit reversal | |
| 8.5. Overcorrection | |
| 8.6. Generalisation of target behaviour | |
| 8.7. Graded tasks * | |
| **9. Comparison of outcomes** | |
| 9.1. Credible source * | |
| 9.2. Pros and cons * | |
| 9.3. Comparative imagining of future outcomes | |
| **10. Reward and threat** | |
| 10.1. Material incentive (behaviour) | |
| 10.2. Material reward (behaviour) | |
| 10.3. Non-specific reward | |
| 10.4. Social reward | |
| 10.5. Social incentive | |
| 10.6. Non-specific incentive * | |
| 10.7. Self-incentive | |
| 10.8. Incentive (outcome) | |
| 10.9. Self-reward | |
| 10.10. Reward (outcome) | |
| 10.11. Future punishment | |
| **11. Regulation** | |
| 11.1. Pharmacological support | |
| 11.2. Reduce negative emotions | |
| 11.3. Conserving mental resources | |
| 11.4. Paradoxical instructions | |
| **12. Antecedents** | |
| 12.1. Restructuring the physical environment * | |
| 12.2. Restructuring the social environment | |
| 12.3. Avoidance/reducing exposure to cues for the behaviour * | |
| 12.4. Distraction | |
| 12.5. Adding objects to the environment * | |
| 12.6. Body changes | |
| **13. Identity** | |
| 13.1. Identification of self as role model * | |
| 13.2. Framing/reframing | |
| 13.3. Incompatible beliefs | |
| 13.4. Valued self-identify | |
| 13.5. Identity associated with changed behaviour | |
| **14. Scheduled consequences** | |
| 14.1. Behaviour cost | |
| 14.2. Punishment | |
| 14.3. Remove reward | |
| 14.4. Reward approximation | |
| 14.5. Rewarding completion | |
| 14.6. Situation-specific reward | |
| 14.7. Reward incompatible behaviour | |
| 14.8. Reward alternative behaviour | |
| 14.9. Reduce reward frequency | |
| 14.10. Remove punishment | |
| **15. Self-belief** | |
| 15.1. Verbal persuasion about capability | |
| 15.2. Mental rehearsal of successful performance | |
| 15.3. Focus on past success | |
| 15.4. Self-talk | |
| **16. Covert learning** | |
| 16.1. Imaginary punishment | |
| 16.2. Imaginary reward | |
| 16.3. Vicarious consequences | |

[1] Replicated from the Behaviour Change Technique taxonomy V1 by Michie et al.[166] (The Behavior Change Technique Taxonomy (v1) of 93 Hierarchically Clustered Techniques: Building an International Consensus for the Reporting of Behavior Change Interventions, Annals of Behavioral Medicine, 2013, Vol.46, Iss.1, p.81–95), by permission of Oxford University Press
Black text indicates technique included in proposed intervention content in Study 4 (Chapter 6), hence grey text indicates not included.
* Indicates technique was identified in past parent-focussed interventions in Study 3 (Chapter 5).