Implicit Interventions to Promote Healthier Food Choices from Menus

By

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Summary

Unhealthy diets and associated negative health outcomes (e.g., obesity, heart disease, some cancers) are problematic. Because of the limited long-term success of explicit healthy-eating interventions (e.g., weight-loss diets, sugar tax regulations), recent attempts to promote healthier eating have focused on implicit interventions, which are based upon the autonomy-preserving principles of nudging. However, research on implicit interventions, particularly in food menu contexts, is limited and inconclusive. This is particularly the case for placement interventions, which aim to increase healthier choices by positioning healthy foods in optimal locations. Therefore, this thesis aimed to investigate the effectiveness of implicit interventions, particularly placement interventions, to promote healthier food choices from menus.

The thesis consists of a systematic review and five empirical studies. The systematic review (Study 1), which evaluated the literature on implicit healthy-eating interventions in food menus, found that placement and default interventions were consistently effective at promoting healthier eating. Priming/cueing, ratio and naming interventions also showed promise but require further research, while signage interventions were generally ineffective.

Studies 2 and 3 tested three variations of a healthy-eating placement intervention in two different settings. Specifically, presentation of healthy foods in the top, middle, and bottom sections of a physical (Study 2) and online (Study 3) snack menu were compared. The placement of healthy snacks made no difference to healthy choices from the physical menu. However, healthy snacks were chosen more from the top section, in comparison to the middle or bottom sections, of the online menu.

Studies 4-6 sought to further compare presentation of healthy foods in the top, middle, and bottom sections, using longer online menus offering mains, sides and desserts. This was examined for fast-food (Study 4), Chinese (Study 5), and mixed Australian (Study 6)

cuisines. The number of healthy food choices from the fast-food and Chinese menus did not vary between conditions. However, participants made more healthy choices from the mixed Australian menu when healthy options were presented in either the top or bottom sections of the menu, rather than the middle.

Dietary restraint was measured in all five empirical studies to explore whether placement effects might be stronger for restrained than unrestrained eaters. However, dietary restraint had no effect on the efficacy of the interventions. Therefore, the observed positive placement effects in Studies 3 and 6 may occur regardless of dietary restraint.

Overall, the thesis contributes to our understanding of how best to promote healthier eating, broadly supporting the use of nudging and implicit interventions in specific menu contexts. The thesis suggests that placing healthy foods in the top section of a menu may increase healthier choices from online snack menus, and that placing healthy foods in both the top and the bottom sections may increase healthier meal choices from longer online menus, depending on the type of cuisine. If supplemented with further research, these findings could give way to important practical applications for general public health improvements, which could eventually lead to reduced instances of diet-related illness. They could also provide valuable insight for food businesses looking to promote healthier eating.

Declaration

I certify that this thesis:

1. does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any university
2. and the research within will not be submitted for any other future degree or diploma without the permission of Flinders University; and
3. 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.

Indah Gynell

Signed:  Date: 04/09/2022

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Gynell, I., Kemps, E., & Prichard, I. (2022). The effectiveness of implicit interventions in food menus to promote healthier eating behaviours: A systematic review. *Appetite, 105997*. https://doi.org/10.1016/j.appet.2022.105997

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Gynell, I., Kemps, E., Prichard, I., & Tiggemann, M. (2022). *A placement intervention for healthier food choices from online menus*. [Manuscript submitted for publication].

CHAPTER 1: GENERAL INTRODUCTION

Chapter overview

The overarching objective of this thesis is to understand ways in which we might promote healthier eating. In doing so, it focuses on the food environment, and whether implicit changes to this environment by way of nudging might promote healthier food choices. This introduction chapter aims to outline the theoretical concept of nudging and to provide an overview of implicit interventions (which are based upon the principles of nudging) in the context of promoting healthier eating behaviours. Relevant research on implicit interventions is summarised, with a particular focus on placement interventions. In conclusion, the primary aims of the thesis and an orientation to the following chapters are provided.

The Rising Prevalence of Junk-Food Consumption and Associated Health Issues

Worldwide, low nutrient, poor-quality diets (e.g., diets high in processed foods, saturated fats, and refined sugars) are concerningly prevalent (Australian Bureau of Statistics, 2018; Ng et al., 2014; Roberto, 2020). While the causes of poor-quality diets are multi-faceted and complex, research suggests that unhealthy food environments play a considerable role in exacerbating the issue (Cummins & Macintyre, 2006; Drewnowski, 2004; Roberto, 2020). Unhealthy food environments are contexts in which unhealthy foods are easily accessible and widely available to consumers, and healthy options are scarce (Hallum et al., 2020). Unhealthy food environments can be physical (e.g., shopping centre food courts; Turner et al., 2020), or online (e.g., food delivery apps and online ordering systems; Bates et al., 2020).

Research has consistently linked unhealthy food environments and unhealthy diets to increased negative physical health conditions such as diabetes (Roglic, 2016), obesity (Brownell & Horgen, 2004), cardiovascular disease, stroke (World Health Organisation,

2022), and some cancers (e.g., stomach (Key et al., 2007) and colorectal (Cena & Calder, 2020) cancer;). Unhealthy diets have also been linked to mental health issues such as stress, anxiety (Baskin et al., 2015; Bonnet et al., 2005), depression (Jacka et al., 2013; Rosenheck, 2008), and poor emotional functioning (e.g., frequent feelings of fear and anger; Kulkarni et al., 2015). In addition to these individual-level impacts, unhealthy diets are also problematic at an organisational and community level, with strained healthcare systems struggling to organise and coordinate treatments for diet- and lifestyle-related health conditions (Albashir, 2020; Wang et al., 2012). Funding these treatments is also a serious issue, with costs to healthcare systems worldwide rising in conjunction with increasing obesity rates and associated health conditions (e.g., cardiovascular disease and type 2 diabetes; Einarson et al., 2018; Olm et al., 2019; Omer, 2020). Furthermore, diet-related illness has been linked to indirect economic costs by decreasing workforce productivity (Lehnert et al., 2013).

Previous Attempts to Combat Unhealthy Eating Behaviours

In light of the negative consequences associated with consistently unhealthy diets, it is evident that interventions to promote healthier dietary behaviours are essential. Traditionally, interventions to promote healthier eating have involved explicit strategies, some of which restrict or limit certain foods, and some of which are based on information provision. Common explicit interventions include commercial weight-loss diets (Pillitteri et al., 2008), government policies or regulations such as sugar taxes (Stafford, 2012) or restrictions on the advertising of unhealthy foods (Hendry et al., 2013). Other explicit interventions include the use graphic images to demonstrate the potential negative consequences of an unhealthy diet (similar to the confronting images often seen on cigarette boxes; Dixon et al., 2015) and school education programmes aimed at teaching children the importance of healthy eating (Battjes-Fries et al., 2015; Chaudhary et al., 2020).

Some explicit interventions have prompted short-term positive change. Thomas et al. (2008) found that commercial weight-loss diets lowered participants' body weight and boosted their emotional wellbeing in the early stages, while Battjes-Fries et al. (2015) found that a school-based education programme to promote healthy eating had a small, positive, short-term effect on students' willingness to try healthy foods. However, no long-term benefits were observed in either of these studies. As such, while there may be signs of positive outcomes from some explicit interventions, this has not translated to lasting change. Further to this, explicit interventions can cause negative consequences. For instance, due to their restrictive and isolating nature, explicit interventions can trigger reactance, whereby individuals defy the intervention by engaging in counter-intuitive behaviours (e.g., bingeing on unhealthy foods; Dowd, 2002; Junghans et al., 2015). Furthermore, many consumers, particularly those from disadvantaged backgrounds, have difficulty accurately interpreting nutrition labels and ingredient lists (Michou et al., 2019; Grech et al., 2017). This is problematic, as many explicit interventions (e.g., weight-loss diets) require consumers to base their food choices on calorie content, or avoid specific ingredients (Rosenbaum et al., 2018). The high cost and time requirements associated with diet programmes have also been described as unsustainable and unrealistic (Thomas et al., 2008). Lastly, explicit interventions such as sugar tax regulations and graphic images are not always well-received by business owners in the food and hospitality industry, as they often discourage consumers from making purchases, thereby negatively impacting profits (Carins & Bogomolova, 2021).

Nudging and Implicit Interventions in the Context of Healthier Eating

In response to the important limitations associated with explicit interventions, attention is now turning to implicit interventions to promote healthier eating (Carins & Bogomolova, 2021; St Quinton & Brunton, 2017; Thomas et al., 2008). In contrast to explicit interventions, implicit interventions are inconspicuous and simple, and are typically based

upon the principles of nudging. Nudges gently guide individuals towards certain choices or behaviours, without compromising their autonomy (Sunstein, 2014; Thaler & Sunstein, 2008). Some examples of nudges include increasing the number of signs directing people to staircases (e.g., in a shopping centre) to encourage taking the stairs, placing a doormat at the front door of a house to encourage visitors to clean their shoes, or increasing the size of recycling bins (relative to general waste bins) to encourage recycling (Wee et al., 2021). Importantly, nudges do not forbid particular choices or behaviours, nor do they rely on economic incentives. Notably, due to the subtle nature of these interventions, individuals who are exposed to them are also unlikely to be consciously aware that their behaviour is being manipulated. In line with this, research (Hollands et al., 2016) suggests that, by design, nudges capitalise on our subconscious tendencies. Therefore, they work particularly well in the food and eating domain, given that eating often occurs mindlessly (Wansink, 2016). They are also inexpensive (e.g., compared to signing up to a weight-loss programme or purchasing a diet plan; Dayan & Bar-Hillel, 2011), making them widely accepted by consumers (Junghans et al., 2015). Furthermore, because implicit interventions are not designed to be interactive or tailored to individual consumers, once developed and implemented, they are generally low maintenance, making them attractive to policymakers and business owners who wish to conserve resources (Hollands et al., 2017). Being both broadly effective while simultaneously widely accepted by consumers and policymakers are important feature of nudging-based interventions. Some moderately effective explicit interventions, such as eliminating junk food in schools, are not well-liked (Diepeveen et al., 2013); however, nudges and related implicit interventions may provide a satisfactory middle ground.

As Hollands et al. (2017) outline in their typology of interventions in proximal physical micro-environments (TIPPME; a tool used to classify and define health-focused implicit interventions), implicit interventions that utilise nudging principles to promote

healthier eating generally involve changing aspects of physical micro-environments (e.g., supermarkets, cafés, restaurants, and bars). Such changes often involve making healthy foods more salient (e.g., by placing them at eye-level on a supermarket shelf; Foster et al., 2014), or by using appealing language to describe them (e.g., 'hearth-baked melange of assorted flavourful seasoned vegetables nestled on quinoa' instead of 'grilled assorted vegetables with quinoa'; Feldman et al., 2011; Olstad et al., 2014). They may also increase the accessibility of healthy foods by minimising the effort required to acquire them. Some examples include making healthy food options the default choice (Giesen et al., 2013), or increasing the number of healthy options available (Reynolds et al., 2021). In this way, implicit interventions allow individuals to maintain their freedom of choice, thereby minimising the likelihood of resistance from both consumers (Junghans et al., 2015) and business owners in the food and hospitality industry (Carins & Bogomolova, 2021).

Previous Research on Implicit Interventions

While the body of research on implicit interventions to promote healthier eating has grown in recent years, there remains a lack of comprehensive and diverse literature. For instance, certain implicit interventions have been studied quite extensively, but only in specific populations and contexts (e.g., default interventions have primarily been tested with children and young adults in school or college settings; Ferrante et al., 2022; Loeb et al., 2017; Loeb et al., 2018; Radnitz et al., 2018). Furthermore, comparisons between different variations of the same intervention (e.g., comparing the presentation of healthy foods in different sections of a menu or buffet table, or comparing different types of appealing names to describe a food dish) are few and far between.

Despite this lack of research, implicit interventions have demonstrated potential as useful tools in the healthy-eating promotion domain. For example, Broers et al.'s (2019) implicit naming intervention, which involved adding the phrase 'suggestion of the chef' to

the name of a healthy food item at a restaurant, increased choices of this item relative to when a standard name was used. Tonkin et al.'s (2019) and Otterbring and Shams' (2019) implicit priming interventions also successfully increased healthy food choices. They primed participants to subconsciously favour healthy options by presenting visual cues (e.g., an image of a fruit and vegetable basket; Tonkin et al.) prior to a food choice task, resulting in increased visual attention towards healthy foods (Otterbring & Shams), and more healthy food choices from a menu (Otterbring & Shams; Tonkin et al.). In addition, Knowles et al.'s (2019) proximity intervention, which involved placing a bowl of fruit physically closer to participants than a bowl of chocolate, thereby making the chocolate more effortful than the fruit to obtain, increased fruit consumption. Furthermore, placement interventions, which increase the salience of certain foods by placing them in the most prominent and visible locations (Bucher et al., 2016) have been found to increase the selection of healthy foods from a vending machine (Rosi et al., 2017), healthy food consumption from a menu (Flores et al., 2019), and visual attention towards healthy foods at a salad buffet (Puurtinen et al., 2021). These positive outcomes across varied settings have led to placement interventions gaining recognition as an exciting prospect for use in future healthy-eating initiatives. For instance, Bucher et al. (2016) and Hollands et al.'s (2019) systematic reviews concluded that interventions which involve manipulating the order in which food options are presented are promising approaches in terms of shaping consumer behaviours, and warrant further investigation.

Previous Research on Placement Interventions in Food Menu Settings

Evidently, implicit interventions, particularly placement interventions, show promise as effective alternatives to traditional explicit interventions. However, while there is a considerable body of empirical literature focusing on placement interventions, there are clear and consistent limitations throughout this literature. For example, many studies on placement

interventions have been conducted in artificial laboratory settings (e.g., Keegan et al., 2019; Romero & Biswas, 2016), or used hypothetical (as opposed to real) food choices (e.g., Flores et al., 2019; Bergman et al., 2021). In addition to these limitations, studies on placement interventions in menu contexts have also revealed inconsistent findings. For instance, while it is generally accepted that items placed at eye-level on supermarket shelves and near checkouts at grocery stores are favoured by consumers (Foster et al., 2014; Sigurdsson et al., 2014; Van Gestel et al., 2017), there is no clear consensus as to where healthy foods should be placed on a menu in order to maximise healthy choices. Some studies suggest that consumers favour food items when they are placed at the top of a menu, while other research suggests that the middle is preferred, or that placement has no effect on choice at all. For example, Feldman et al. (2011) found that placing healthy food items in the top section of a menu (i.e., first) increased their choices relative to when they were placed elsewhere on the menu. In line with Feldman et al., Deek et al. (2022) found that when participants saw a healthy dish (e.g., a salad) as the first option (i.e., on the top left of the page) on an online menu, they made more healthy food choices than when they saw an unhealthy dish first (e.g., a pizza).

Kim et al. (2019), who did not differentiate between healthy and unhealthy foods, found that when menu items were listed horizontally, consumers preferred middle items, yet when menu items were listed vertically, consumers preferred top and bottom items. However, not all research using vertical menus (e.g., Bergman et al., 2021; Choi et al., 2010; Wyse et al., 2019) reflects these findings. In contrast to Kim et al., Wyse et al. found that placing healthy foods first and last on an online school ordering system made no difference to the number of healthy food choices made by students. Similarly, Bergman et al. found that placing healthy foods either at the top and bottom of each menu panel, at the top of the right-hand panel, or scattered randomly throughout an online menu made no difference to healthy

choices. Furthermore, Choi et al. claimed that foods displayed in the middle of menus are favoured by consumers. In their field experiment, consumers paid the most visual attention to, and were most likely to purchase, food items placed in the middle of a menu.

While many of the aforementioned findings are promising (i.e., Choi et al., 2010; Deek et al., 2022; Feldman et al., 2011; Kim et al., 2019), there is a clear lack of consistency across studies on placement interventions in menu settings. This is problematic, given the established links between restaurant and fast-food dining (where menus are typically used) and unhealthy dietary behaviours such as consistent overconsumption (Bowman & Vinyard, 2004; Cohen & Story, 2014). As such, there is a need for further research on placement interventions and their application in the context of promoting healthier food choices from menus, both in physical and online settings. Online menus are a particularly important avenue for future research, given the exponential growth of the online food industry in recent years, particularly during the COVID-19 pandemic (Amist et al., 2021; Brewer & Sebby, 2021). Online ordering systems have also been linked to automatic and mindless food purchases (which are typically unhealthy; Abell., 2019; Hofmann et al., 2009).

Aims of the thesis

The overarching aim of the present thesis was to investigate the efficacy of implicit interventions to promote healthier eating behaviours in food menu contexts, with a specific focus on placement interventions. Within this overarching aim, individual studies had their own specific aims. These individual aims were to: (1) evaluate the literature on implicit interventions to promote healthier eating behaviours in the context of food menus (Study 1, Chapter 2), (2) compare different variations of a placement intervention to promote healthier snack choices from physical and online menus (Studies 2 and 3, Chapter 3), and (3) compare different variations of a placement intervention to promote healthier main, side and dessert choices from online menus offering different types of cuisines (Studies 4-6, Chapter 4).

Overview of the thesis

Chapter 2 presents the results of a systematic review (Study 1), which sought to evaluate the efficacy of implicit interventions commonly used to promote healthier eating behaviours in the context of food menus. The implicit interventions that were evaluated in the review can be categorised into six types: (1) placement, (2) default, (3) priming/cueing, (4) ratio, (5) naming, and (6) signage interventions. The systematic review intended to further our understanding of how best to apply implicit interventions in the healthy eating-promotion domain. In Chapter 3, Studies 2 and 3 aimed to directly compare three variations of a placement intervention (i.e., placing healthy foods in either the top, middle, or bottom section of a menu) against one another, to determine which could most effectively promote healthier snack choices. These comparisons were made using physical (Study 2) and online (Study 3) single-page menus. The findings from the first two experimental studies guided the focus of the subsequent three studies, which are described in Chapter 4. These final three studies aimed to compare the same three variations of a placement intervention as in Studies 2 and 3, using longer online menus offering mains, sides, and desserts. Studies 4-6 also used different cuisines to explore whether the efficacy of placement interventions would vary depending on the type of food offered. Specifically, Study 4 used fast-food cuisine, Study 5 used Chinese cuisine, and Study 6 used mixed Australian cuisine, which consisted of food dishes from mixed origins (e.g., American burgers and English scones). Finally, Chapter 5 presents a general discussion of the key findings from each study, and discusses practical implications, limitations, and avenues for future research.

All of the chapters in the present thesis (excluding Chapters 1 and 5) are formatted as manuscripts for publication. Chapters 2 and 3 are each published as individual articles in the journal *Appetite*, and Chapter 4 is currently a submission being processed in the *Journal of*

Experimental Psychology: Applied. Some repetition is therefore present in the Introduction and Method sections of Chapters 2-4.

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CHAPTER 2: STUDY 1

The effectiveness of implicit interventions in food menus to promote healthier eating behaviours: A systematic review

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Abstract

Unhealthy eating and related chronic illness are serious public health concerns. Initial attempts to discourage unhealthy eating using explicit techniques have been largely unsuccessful. However, emerging implicit interventions have started to show promise. Common implicit interventions in food-choice contexts include placement, priming/cueing, defaults, naming, ratios, and signage. The present review aimed to evaluate the effectiveness of these interventions in promoting healthier eating behaviours in the context of food menus. Five electronic databases were searched. Included studies were conducted in a menu setting, used implicit interventions which were unlikely to be noticed by consumers, had a healthy-eating promotion focus, and were experimental or pre/post designs. A total of 19 papers comprising 23 individual studies were included. Overall, four of six implicit interventions effectively promoted healthier eating behaviours in one or more studies, with placement and default interventions the most promising. Priming/cueing and ratio interventions showed potential but require further investigation. Naming and signage interventions were largely unsuccessful, although this could be because they have not yet been explored in a variety of menu settings with a health-eating promotion focus. If existing findings can be extended to additional menu settings and demographics in future studies, implicit interventions could provide affordable and accessible tools to promote healthier eating.

Introduction

Poor diets rich in highly processed, fatty, and sugary foods have been consistently linked to overweight, obesity and chronic lifestyle-related diseases such as cardiovascular disease, stroke, and diabetes (Wyatt et al., 2006; World Health Organisation, 2021). Although public health campaigns aimed at promoting healthy eating have been widespread, food environments around the world are still largely unhealthy (Ni Mhurchu et al., 2013). As such, worldwide children, adolescents, and adults are failing to comply with dietary recommendations and guidelines (Banfield et al., 2016; Hendrie et al., 2017). In Australia alone, one third of the population's daily energy intake comes from discretionary foods high in salt, fat, and sugar, and low in nutrients (Australian Bureau of Statistics, 2018). Globally, dietary quality is consistently deteriorating (Ronto et al., 2018), including in low- and middle-income regions such as Asia and Africa, where once nutrient-rich diets are now typically calorie-dense and high in cheap oils, added sugar and harmful fats (Bhurosy & Jeewon, 2014).

To date, the majority of interventions aimed at improving dietary behaviours have utilized explicit techniques such as marketing campaigns and community-based education programs (Walls et al., 2011). However, many of these explicit techniques have been linked to resistance and counter-reactance (Dowd, 2002), and, as such, have been unsuccessful in creating long-term positive behaviour change (Carins & Bogomolova, 2021; de Ridder et al., 2017). Therefore, the logical next step is to consider alternative approaches. Fittingly, implicit interventions, which are subtle and indirect, and therefore unlikely to cause resistance, have been gaining interest in the field of eating behaviour research. Implicit interventions utilise natural human tendencies to guide individuals towards certain behaviours or choices, without compromising autonomy. Therefore, they allow feelings of freedom and independence to be preserved, and resistance is largely avoided. Due to their

unobtrusive nature, these interventions are generally well-accepted by consumers, especially when used to promote health (Junghans et al., 2015).

Several types of implicit interventions have been used in healthy-eating promotion contexts (i.e., contexts in which people are encouraged to improve their health by making healthy dietary choices; Mattei & Alfonso, 2020; Graça et al., 2018). These implicit interventions include, but are not limited to, placement, priming/cueing, defaults, naming, ratios, and signage (Kraak et al., 2017). Placement interventions typically involve placing healthy items in optimal locations to increase the popularity of these items by maximising their visibility, thereby improving salience (e.g., at eye-level on a supermarket shelf; Christenfeld, 1995). Priming/cueing interventions often work by activating healthy eating goals or associations which prompt individuals to subconsciously favour healthy foods when they are offered (e.g., showing a fruit and vegetable advertisement before a snack is to be selected; Forwood et al., 2015). Other primes/cues are presented simultaneously with choice options (e.g., an image cue embedded in the middle of a menu; Otterbring & Shams, 2019) and are designed to shift the consumers' focus towards the healthy items. Making the healthy option the default option can also increase the likelihood of healthy options being chosen (e.g., parents having to request a second lunch option to opt out of a healthy default meal when making selections for their children; Loeb et al., 2017). Using descriptive or appealing names for healthy items (e.g., 'decked out chicken sandwich' instead of 'roast chicken sandwich'; Olstad et al., 2014) may draw attention to these items. Ratio interventions typically maximise the availability of healthy foods by increasing the ratio of healthy options in relation to unhealthy ones (e.g., Boo et al., 2008). Signage interventions involve tactics such as increasing the size of menu signs used to display healthy options (e.g., Olstad et al.), and are intended to make healthy options more noticeable.

Previous systematic reviews (e.g., Wilson et al., 2016; Arno & Thomas, 2016; Cadario & Chandon, 2020) have examined the effectiveness of implicit strategies to promote healthy eating behaviours in settings such as cafeterias, supermarkets, buffets, grocery stores and laboratories. However, to date, no reviews have investigated and synthesised the evidence in relation to implicit interventions to promote healthier eating specifically in the context of food menus. This is important, as establishments which typically use menus (such as fast-food restaurants) have been linked to poor dietary choices. For instance, Bowman and Vinyard (2004) found that frequent fast-food eaters had lower intakes of nutritious foods like fruits, and much higher intakes of energy, saturated fat, and added sugars in comparison to those who did not eat fast food. Food menus have also become increasingly popular in online ordering apps such as UberEats. As food ordering apps and online menus have been linked to the consumption of unhealthy foods (Bates et al., 2020), this highlights the importance of exploring interventions to promote healthy food choices in menu contexts.

There are also important social implications associated with using implicit interventions to promote healthy food choices in physical menu contexts, such as dine-in restaurants. Implicit interventions allow consumers to enjoy the social benefits of eating out (e.g., increased connection with others), unlike restrictive explicit interventions which often result in isolation (Thomas et al., 2008; Carins & Bogomolova, 2021). Furthermore, because humans naturally emulate the behaviours of others, when seeing other consumers selecting healthy foods, they tend to follow suit (Prinsen et al., 2013). Therefore, the positive effects of implicit interventions may extend beyond the individual, resulting in broader societal benefits (Higgs, 2015). These benefits could extend to nutrition-focused food businesses, which may grow in popularity as a result of healthy eating becoming more common (Kraak et al., 2014).

In addition, a closer focus on implicit interventions that are truly subtle and inconspicuous is needed. To date, no health-focused reviews have exclusively explored

implicit interventions that are not directly obvious to consumers. Indeed, previous reviews by Wilson et al., (2016), Arno and Thomas (2016), Kim and Magnini (2016) and Cadario and Chandon (2020) all included studies where easily noticeable, rather direct interventions (such as calorie labels, nutrition labels and logos such as green stickers or smiley faces) were used. Ozdemir and Caliskan (2015) did focus exclusively on inconspicuous implicit interventions used in menus, but with a focus on raising revenue and improving the customer experience as opposed to promoting healthy choices.

Furthermore, while implicit interventions can also include computerized psychomotor and cognitive tasks (Veling & Lawrence, 2019) such as the Go/No-go task (Veling et al., 2017), we focused exclusively on implicit environmental interventions (i.e., those that change the food environment itself, as opposed to individual behavioural tendencies; Veling & Lawrence, 2019). This is because implicit environmental interventions are most suitable for use in food businesses such as restaurants and cafés, given their simple and cost-effective nature. Accordingly, the present review adds to the literature by providing a more specific focus on purer implicit interventions that can be used to promote healthy eating behaviours in everyday food choice settings.

Notably, the literature on implicit interventions and food choices has grown substantially in recent times, particularly in the past five years, after several of the aforementioned reviews (e.g., Arno & Thomas, 2016; Wilson et al., 2016; Kim & Magnini, 2016; Ozdemir & Caliskan, 2015) were published. Therefore, the present review provides an important opportunity for evaluating new studies, many of which show potential in shaping how we promote healthier eating. The overall aim of the present review was to evaluate the effectiveness of implicit interventions in promoting healthier eating behaviours in the context of food menus, and, if they are, which implicit interventions are most effective.

Method

The review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al., 2021). It was registered with the Open Science Framework (OSF) on 21st April 2020 (OSF registration DOI: 10.17605/OSF.IO/SJTUC).

Search strategy

The initial search strategy was developed from reference lists of existing systematic reviews and meta-analyses on related topics, and in consultation with an academic librarian. The Problem, Intervention, Comparison, Outcome, Setting (PICOS) approach (Liberati et al., 2009) was used to frame the scope of the review (Appendix A provides the PICOS table). The final search strategy included key terms, synonyms, combinations of words and plurals related to implicit interventions, nudging, healthy food choices, healthy food consumption, and menus. The initial search was conducted on 17th May 2020 from five electronic databases: PsycInfo, PsycArticles, Web of Science, Medline, and Scopus. A final search was conducted on 2nd December 2021, to ensure that any papers published after the initial search date were identified. This final search used exactly the same search strategy as the initial search, except that the date range for the final search was set from May 2020 (the date of the initial search). Appendix B provides the complete search strategy.

Eligibility criteria

In order to be eligible for inclusion in the review, studies needed to: (1) be aimed at promoting healthy eating behaviour and/or reducing unhealthy eating behaviour, (2) use pictorial or written food menu/s, (3) use an implicit intervention (i.e., an intervention that is not intended to convey information to, or to be perceived by, the individual exposed to the intervention), (4) be experimental studies, pre/post designs, or intervention studies (5) have a primary outcome measure of food selection or consumption (including calorie or kilojoule

intake), (6) be published in the English language, and (7) be full-text papers (i.e., no grey literature) published in peer-reviewed journals. No limits were placed on publication date.

Population

Only studies which recruited a generic population (i.e., not individuals with overweight or obesity or those with a specific illness such as diabetes) were included. Individuals with overweight or obesity were excluded due to consistent differences in satiety, appetite, and dietary restraint ratings (Dykes et al., 2004). Using only generic populations also allowed for clearer comparisons between studies. Studies involving non-human participants (i.e., animal studies) were excluded.

Inclusion screening

All retrieved papers were uploaded to Covidence, an online screening and data extraction tool. Following the removal of duplicates, two independent reviewers screened the titles and abstracts of all papers for eligibility. Full-text screening of papers that met eligibility criteria was then undertaken. Reviewers discussed any uncertainties or disagreements to reach a resolution. A third reviewer was consulted when necessary. Additional studies were located through forward and backward citation searching. These additional studies were also reviewed at the title and abstract level, followed by the full-text screen if they met the criteria.

Data extraction and synthesis

Data extraction was completed by the first author using a template developed specifically for this review. This template included: study design, sample, setting, intervention, and key findings. Following extraction, data were synthesised using a narrative approach (i.e., a textual method; Popay et al., 2006) which was agreed upon by researchers prior to data extraction and stipulated in the Open Science Framework registration. Due to

variations in outcome measures and effect sizes, a meta-analysis was not appropriate (Boland et al., 2017).

Quality assessment of included studies

Two independent reviewers used the Mixed Methods Assessment Tool (MMAT; Hong et al., 2018) to assess individual study quality. The MMAT appraises the methodological quality of three domains: qualitative, quantitative, and mixed methods. Quantitative studies are subdivided into sub-domains: randomised controlled (i.e., studies in which participants are allocated to intervention/control groups by randomisation) and non-randomised (i.e., non-randomised controlled trials, or studies in which the intervention is defined and assessed, but not randomly assigned, by researchers; Hong et al., 2018). The MMAT enables overall scores to be calculated from the number of criteria that are met. These overall scores range from 25% or 1 star (one criterion met) to 100% or 4 stars (four criteria met). For mixed methods studies, overall scores are based on the weakest component of the study (e.g., if the qualitative component scored 2 stars and the quantitative component scored 4 stars, the study would score 2 stars overall).

Results

Study selection

Together, the database searches identified a total of 13,144 papers, following the removal of 9,165 duplicates. Title and abstract screening revealed that 13,075 of these were ineligible and 69 full-text papers were then screened. Overall, 10 papers met the inclusion criteria. Forward and backward citation searching identified an additional two eligible papers. The final search identified seven additional papers. This provided a total of 19 papers deemed suitable for review, according to pre-determined eligibility criteria. Figure 1 shows the reasons for exclusion and a more detailed summary of each step of the study selection process.

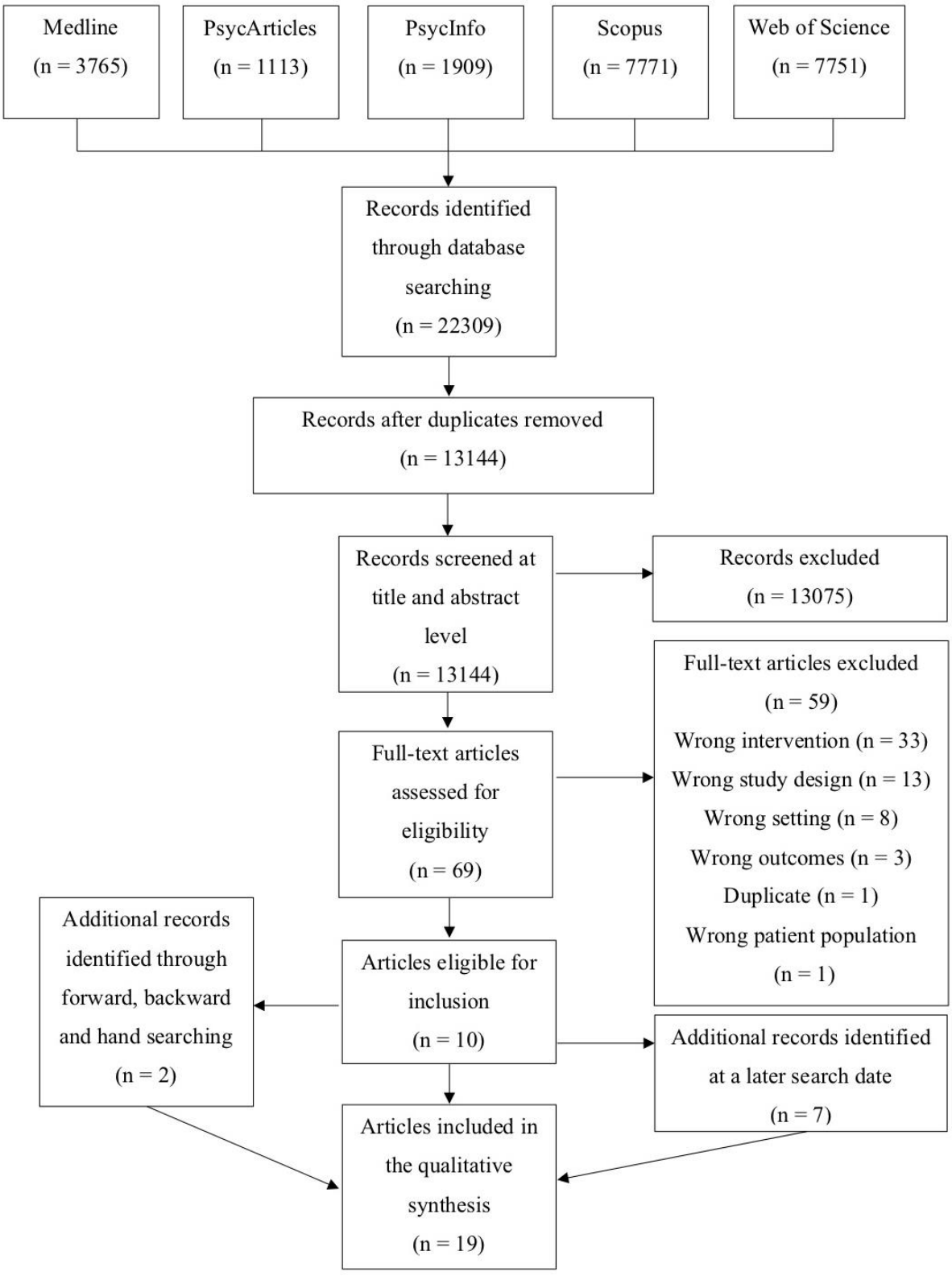

Figure 1. PRISMA flow diagram illustrating the study selection process for the systematic review

Study characteristics

Of the 19 papers included, four (Romero & Biswas, 2016; Flores et al., 2019; Dalyrymple et al., 2020; Gynell et al., 2021) were comprised of two separate experiments. Therefore, 23 individual studies were included. Twenty-one (91.30%) of these used an experimental design, one (4.35%) used a pre-post intervention design, and one (4.35%) used a mixed methods design. The most frequent study settings were laboratories (*n* = 7) and online platforms (*n* = 6). Other study settings included university dining centres/restaurants (*n* = 3), primary schools (*n* = 2), theme park restaurants (*n* = 2), assisted living centres (*n* = 1), worksite cafeterias (*n* = 1) and a recreation centre (*n* = 1). Sample sizes generally ranged between 100 and 500 (*n* = 15), with some studies using larger samples, between 1400 and 21000 (*n* = 3), or smaller samples, between 15 and 100 (*n* = 5). The mean age of participants in most studies that reported age (*n* = 11) was between 18 and 40 years. In papers where parents or carers made food choices on behalf of their children (Loeb et al., 2017; Loeb et al., 2018; Dalrymple et al., 2020), parents' ages ranged from 23 to 62 years. Most commonly, studies used a relatively even number of female and male participants (*n* = 9), while others used exclusively females (*n* = 6) or mostly females (*n* = 2). Some did not report gender (*n* = 5), and one study (Reynolds et al., 2021) used mostly male participants. In the studies that reported mean body mass index (BMI), the average ranged from 23 to 27 kg/m^2 (*n* = 8). Several studies explored multiple interventions but reported the effects of these interventions separately.

Definitions of healthy foods varied throughout, although healthy foods were most commonly defined as those with a low calorie or fat content (*n* = 9). Other studies defined healthy foods as those classified as healthy by government nutrition guidelines (*n* = 4), those consistently rated as healthy in pilot studies using subjective rating systems (*n* = 4), or those with a high nutrient content (*n* = 1). Healthiness of actual food choice (*n* = 10), and

healthiness of hypothetical food choice (n = 8) were the most commonly used outcome variables. Other outcome variables included calorie content of hypothetical food choice (n = 3), calorie content of actual food choice (n = 4), amount of healthy food consumed (n = 3), and healthiness of food choice opted by parents for their children (n = 2). Most studies were conducted in the United States or Canada (n = 14). Other countries included Australia (n = 5), Belgium (n = 1), Malaysia, (n = 1), Scandinavia (country not specified; n = 1) and the United Kingdom (n = 1). Only five studies reported socio-economic or financial status. Loeb et al. (2017) and Loeb et al. (2018) used low-income samples. Wyse et al.'s sample consisted of six schools, five of which were located in a disadvantaged area. Olstad et al.'s (2014) participants were high-socio-economic individuals from a wealthy district, and Ferrante et al. also used a high-income sample. See Table 1 for included studies' characteristics.

Table 1

Characteristics of Included Studies

Author(s), Year, Country of origin	**Study design**	**Sample**	**Setting**	**Intervention**	**Key findings**	**Quality rating**
Bergman, Tian, Moreo & Raab, 2021, United States	Experimental	*n* = 471, age range = 18- 24 years, 41.2 % female, 57.7% male, 1.1% other. BMI distributions = 4.9% underweight, 56.6% normal weight, 24.2% overweight, 14.4% obese	Online (Qualtrics)	Placement intervention: Healthy items placed either at the top and bottom of each menu panel, at the top of the right-hand panel, or scattered randomly throughout a 12-item, double panel menu.	No significant effect of placement condition on calorie content of choice. Participants selected more high calorie items, regardless of where they were placed on the menu.	****
Boo, Chan & Fatimah, 2008, Malaysia	Between subjects experimental	274 females aged 19-24 years (mean age = 21.66)	Dining simulation at a university	Ratio intervention: One-quarter healthy and three-quarters unhealthy menu options versus one-half healthy and one-half unhealthy menu options	Small to medium (odds ratio = 2.25) effect of number of healthy items on healthiness of food choice. Participants who received a menu with one-half healthy	**

					options (as opposed to one-quarter) made more healthy food choices	
Broers, Van den Broucke, Taverne & Luminet, 2019, Study 1, Belgium	Experimental	15 university restaurant customers	Field study (university sandwich restaurants)	Naming intervention: During intervention periods, the phrase "suggestion of the chef" was added to the name of one healthy menu item, while a standard name describing just the ingredients of the dish was used during non-intervention periods	The healthy menu item was significantly more popular when the naming intervention was implemented, in comparison to when a standard name was used. This was a large effect.	****
Colby, Li & Chapman, 2020, Study 3, United States	Experimental	*n* = 351	Online (Amazon Mechanical Turk)	Default intervention: A menu with either a healthy or an unhealthy default was presented to participants, with the information that an alternative option could be requested at no extra cost	A strong, significant effect of default condition on hypothetical food choice. Over 91% of participants who saw a menu with a healthy default opted to stick with the healthy choice	***

Dalrymple, Radnitz, Loeb & Keller, 2020, Study 1, United States	Experimental with repeated measures	1704 children and/or their parents/carers visiting theme parks (information regarding who placed each order (children and/or parents) not collected)	Field study (theme park restaurants)	Default intervention: Lower-energy-dense default, standard default, and free array children's menus each presented to consumers for 1 week at a time	Lower-energy-dense meals as defaults increased the likelihood of lower-energy-dense selections, and also decreased the likelihood that customers would opt to view standard main meal options, in comparison to standard default and free array menus	****
Dalrymple, Radnitz, Loeb & Keller, 2020, Study 2, United States	Experimental with repeated measures	753 children and/or their parents/carers visiting theme parks (information regarding who placed each order (children and/or parents) not collected)	Field study (theme park restaurants)	Default intervention: Lower-energy-dense default side dish, standard default side dish, and free array children's menus each presented to consumers for 1 week at a time	Lower-energy-dense side dishes as defaults increased the likelihood of lower-energy-dense selections and decreased the likelihood that customers would opt to view standard side dish options, in comparison to standard default and free array menus	*****

Feldman, Mahadevan, Su, Brusca, & Ruzsilla, 2011, United States	Experimental	150 residents at assisted living centres, aged 60+ years, 78% female, 22% male, mean BMI = 26	Field study (assisted living centres providing communal dining services)	Placement and naming interventions: Some healthy dishes placed in visual 'hotspots' (the top section of the menu). Descriptive language used in the names of some healthy dishes	No significant effect of descriptive language on food choice. A medium effect (odds ratio = 3.31) of placement on healthiness of food choice. Participants chose more healthy foods when healthy items were placed in the top section of the menu (as opposed to randomly scattered across the page)	***
Ferrante, Johnson, Miller & Bellows, 2022, United States	Experimental	48 children (and their families) aged 4-8 years (mean age = 6.2 (SD = 1.3), 47.9% female, 52.1% male, high median income, BMI distributions = 54.2% normal	Restaurant simulation at a university campus	Default intervention: A purely healthy (optimal) default (i.e., an extra-large serve of carrot sticks), a mostly healthy default (i.e., a large serve of carrots with a small serve of fries) or a mostly unhealthy default	Defaults significantly influenced choice, in that the majority of children stuck with the default they received. However, there was no significant effect of default condition on consumption. Children who received the mostly	****

		weight, 27.1% overweight, 10.4% obese		(i.e., a large serve of fries with a small serve of carrots).	unhealthy default menu did consume significantly more unhealthy food than those who received the mostly healthy default menu, although this effect disappeared after controlling for weight and age.	
Flores, Reimann, Castano & Lopez, 2019, Study 2, United States	Experimental	*n* = 160, mean age = 37.6, 48% female, 52% male, mean BMI = 26.8	Online (Amazon Mechanical Turk)	Placement intervention: Healthy dessert presented first (i.e., on the far left) versus last (i.e., on the far right), or unhealthy dessert presented first (versus last) on a seven-item, online menu	Large effect (*d* = 1.11). Placing an unhealthy dessert first (as opposed to last) reduced hypothetical calories consumed and increased healthy choices	*****
Flores, Reimann, Castano & Lopez, 2019,	Experimental	*n* = 180, mean age = 36.4, 48% female, 52% male, mean BMI = 26.5	Online (Amazon Mechanical Turk)	Placement intervention: Healthy main meal presented first (i.e., on the far left) versus last (i.e., on the far right), or unhealthy main	Large effect (*d* = 1.27). Placing an unhealthy main meal first (as opposed to last) reduced hypothetical	*****

Study 3, United States				presented first (versus last) on a seven-item, online menu	calories consumed and increased healthy choices	
Gynell, Kemps, Prichard & Tiggemann, 2022, Study 1, Australia	Experimental	172 female university students, mean BMI = 24.65 (5.68)	University laboratory	Placement intervention: Four healthy snack food items placed in either the top, middle, or bottom section of a single page, 12-item menu	No significant effect of item placement on food choice. Participants chose more healthy snacks than unhealthy snacks, regardless of where they were placed on the menu	****
Gynell, Kemps, Prichard & Tiggemann, 2022, Study 2, Australia	Experimental	182 female university students aged 17- 75 years (mean age = 23.52 (9.70), mean BMI = 24.04 (5.73)	Online (Qualtrics)	Placement intervention: Four healthy snack food items placed in either the top, middle, or bottom section of a 12-item menu online menu	A significant main effect of condition on food choice (Nagelkerke $R^2 = 0.07$). Participants chose more healthy snacks when they were placed first on the menu, in comparison to when they were placed in the middle or at the end of the menu	*****
Keegan, Kemps, Prichard, Polivy,	Experimental	143 female university students	University laboratory	Placement and priming/cueing intervention:	A significant main effect of condition on food choice	***

Herman & Tiggemann, 2019, Australia		aged 17-35 years (mean age = 22.72), mean BMI = 23.35		Healthy salad presented either in the middle of unhealthy foods, beside unhealthy foods, or 5 cm to the right of unhealthy foods	(Nagelkerke R^2 = 0.09). Participants were most likely to choose the healthy food option when it was presented separately from (as opposed to in the middle of) the unhealthy foods	
Loeb, Radnitz, Keller, Schwartz, Marcus, Pierson, Shannon & DeLaurentis, 2017, Study 1, United States	Experimental	62 parents/carers of school children. Parents' age range = 23-62 years, BMI range = 19.83-49.74, 95% female, 5% male. Children's age range = 3-8 years, low median income, BMI range = 12.77-22.06, 44% female, 56% male	Laboratory	Priming/cueing and default interventions: Priming with a parent empowerment video versus a neutral food safety video, and either a healthy default menu, or a less healthy, 'standard' default menu	No significant effect of prime condition on food choice or consumption. A small to moderate effect (R^2 = .41) of default condition on choice and consumption. Parents who received a healthy default menu chose more healthy options for their children, and therefore their children consumed a greater amount of healthy breakfast food (Nagelkerke R^2 = .70)	****

Loeb, Radnitz, Keller, Schwart, Zucker, Marcus, Pierson, Shannon, DeLaurentis, 2018, United States	Experimental	127 first grade children (and their parents/carers), mean age = 6.73 years, 48% female, 52% male, low median income, mean BMI for age percentile = 64.50	Field study (elementary schools)	Default intervention: Optimal (nutritionally healthier) or suboptimal (standard, less healthy) default school lunch menu	Default condition had a strong effect (statistics not reported) on the proportion of parents opting to receive the healthy menu option. Parents who were given a healthy default menu selected a greater proportion of healthy foods for their children	***
Olstad, Goonewardene, McCargar & Raine, 2014, Canada	Mixed methods/ pre-post intervention	1441 recreation centre customers, 40% female, 60% male, high socio-economic status, 26.5% overweight/obese, 73.5% normal/underweight	Field study (an outdoor recreation centre canteen)	Naming and signage interventions: Descriptive names to appeal to children used for healthy items. Larger menu signs used for menu sections displaying healthy items	No significant effect of naming or signage interventions on food choice	*****
Otterbring & Shams, 2019,	Experimental	121 females	University laboratory	Priming/cueing intervention: Overweight female face,	Moderate ($V = 0.31$) effect of condition on healthiness	**

Scandinavia (country not specified)				normal weight female face, or no image in the centre of a food menu	of food choice. The overweight face cue condition resulted in significantly more healthy food choices	
Radnitz, Loeb, Keller, Boutelle, Schwartz, Todd & Marcus, 2018, United States	Experimental	*n* = 129, aged 18-19 years, 60% female, 40% male, mean BMI for females = 24.66, mean BMI for males = 27.18	Dining hall simulations on university campuses	Default intervention: An optimal (healthy, nutrient dense, low calorie) default lunch choice versus a suboptimal (unhealthy, nutrient-poor, high calorie) default lunch choice	A large effect (Partial η^2 = .77) of condition on number of healthy choices. Participants who received a healthy default menu made more healthy lunch choices. No significant effect (Partial η^2 = .04) of condition on food consumption	*****
Reynolds, Ventsel, Kosīte, Rigby Dames, Brocklebank, Masterton, Pechey, Pilling, Pechey,	Stepped-wedge experimental	20, 327 customers at worksite cafeterias, mean age = 39 (SD = 12), 15% female, 85% male	Field study (worksite cafeterias in supermarket distribution centres)	Ratio intervention: A baseline period of no intervention versus a ratio intervention period during which some higher energy menu options were replaced with lower energy menu	A significant effect of ratio intervention on calories purchased. The mean number of calories purchased per day, per cafeteria decreased from the baseline period to the	****

Hollands & Marteau, 2021, United Kingdom				options, thus decreasing the proportion of high-energy options from 58% to 50%.	intervention period. Effect sizes not reported	
Romero & Biswas, 2016, Study 1a, United States	Experimental	*n* = 48, mean age = 37, 50% female, 50% male	Online (Amazon Mechanical Turk)	Placement intervention: Healthy menu item displayed to the left (versus the right) of an unhealthy menu item	Placing a healthy item to the left of an unhealthy item resulted in more healthy food choices. Effect sizes not reported	***
Romero & Biswas, 2016, Study 1b, United States	Experimental	*n* = 93, mean age = 22, 57% female, 43% male	University laboratory	Placement intervention: Healthy menu item displayed to the left (versus the right) of an unhealthy menu item	Placing a healthy item to the left of an unhealthy item resulted in more healthy food choices. Effect sizes not reported	***
Tonkin, Kemps, Prichard, Polivy, Herman & Tiggemann, 2019, Australia	Experimental	210 female university students aged 18-35 years (mean age = 21.57), mean BMI = 23.27	University laboratory	Priming/cueing intervention: Healthy food cue (an image of a basket of fruit and vegetables) either on the front cover or inside the menu, versus a neutral cue (picture of a fork) both inside and on the cover of the menu	Large main effect (η^2 = .171) of cueing condition on food choice. Those who saw the healthy cue on the cover chose more healthy items than both those in the control condition (*d* = 1.05) and those who saw the	****

					healthy cue inside the menu (d = .78)	
Wyse, Gabrielyan, Wolfenden, Yoong, Swigert, Delaney, Lecathelinais, Ooi, Pinfold & Just, 2019, Australia	Pre/post intervention	1938 users of an online school lunch ordering system (kindergarten to Grade 6 students, parents/carers of these students). Five of six included schools located in a disadvantaged area	Field study (primary schools using online menus for canteen orders)	Placement intervention: Healthy items placed first and last on the menu versus no changes made to the menu	No significant difference in the number of healthy food choices from pre- to post-intervention	***

The effectiveness of implicit interventions to promote healthy eating

In the present review, placement (n = 10), defaults (n = 7) and priming/cueing (n = 4) were the most common interventions. Other interventions included naming (n = 3), ratios (n = 2), and signage (n = 1). To provide an overall picture of which of these implicit interventions were most effective in promoting healthy eating, studies were categorized based on which intervention/s were implemented. The following sub-sections provide an overview of the general effectiveness of each intervention.

Placement interventions. Seven papers (Romero & Biswas, 2016; Flores et al., 2019; Wyse et al., 2019; Feldman et al., 2011; Keegan et al., 2019; Gynell et al., 2021; Bergman et al., 2021) consisting of ten individual studies used placement interventions to promote healthy eating using pictorial (Romero & Biswas; Flores et al.; Keegan et al.; Gynell et al.) and written (Wyse et al.; Feldman et al.; Bergman et al.) menus. Studies investigating placement interventions were a mix of online (Romero & Biswas (Study 1a); Flores et al. (Studies 2 and 3); Gynell et al. (Study 2); Bergman et al.), laboratory (Keegan et al.; Romero & Biswas (Study 1b); Gynell et al. (Study 1)) and field (Feldman et al.; Wyse et al.) studies. These studies varied the placement of healthy foods from left to right (Romero & Biswas, 2016; Flores et al., 2019), top to bottom (Wyse et al., 2019; Feldman et al., 2011; Gynell et al., 2021; Bergman et al.), or beside, in the middle of, or separately from unhealthy foods (Keegan et al., 2019). In seven of these studies, the intervention effectively promoted the desired behaviour, but in slightly different ways. Romero and Biswas (2016) found that placing a *healthy* item to the left of an unhealthy item increased healthy food choices. In contrast, Flores et al. (2019) found that placing *unhealthy* dessert (Study 2) and main dishes (Study 3) first (i.e., on the left) (as opposed to last (i.e., on the right)) on a menu reduced the number of hypothetical calories consumed and increased healthier choices. Keegan et al. (2019) found that a healthy menu option was more popular when presented five centimetres

to the right (in comparison to in the middle) of unhealthy foods, while Feldman et al. (2011) increased the popularity of healthy dishes by placing them in the top section of a menu. Gynell et al. (2021) found that healthy foods that were placed in the top section of a menu were more popular than healthy foods placed in the middle or bottom sections of an online menu (Study 2), but not a physical menu (Study 1). Wyse et al. (2019), the only placement study in which parents may have chosen food on behalf of their children (the proportion of children who made their own choices was not specified), found that placing healthy food items first and last on online school canteen menus did not increase the popularity of these items. Similarly, Bergman et al. (2021) found that placing low calorie menu options either in the top and bottom sections, or in the top right corner of a menu did not increase low calorie food choices amongst young adults.

Default interventions. Defaults, which make healthy menus or foods the pre-set choices (Thaler & Sunstein, 2008), increased healthy food choices in all seven studies which implemented this intervention (Radnitz et al., 2018; Loeb et al., 2017; Loeb et al., 2018; Dalrymple et al., 2020 (Studies 1 and 2); Colby et al., 2020; Ferrante et al., 2022). However, in two of the three studies that reported consumption (Ferrante et al.; Radnitz et al.; Loeb et al., 2017), defaults did not increase the amount of healthy food consumed. Default interventions were used in both pictorial (Radnitz et al.; Loeb et al., 2017) and written (Dalrymple et al.; Ferrante et al.) menus.

Most default studies (except for Radnitz et al. and Colby et al.) involved parents making food choices on behalf of, or together with their children. In a college dining hall setting using young adults, Radnitz et al. (2018) found that offering a nutrient dense, lower calorie meal as a default choice resulted in a greater proportion of healthy choices (but no difference in grams of food consumed) than offering a less nutrient dense, high calorie default. Similarly, Ferrante et al. found that offering a purely healthy default side (i.e., an

extra-large serve of carrots) or a mostly healthy default side (i.e., large serve of carrots with small serve of fries) increased healthy food choices in comparison to a mostly unhealthy default (i.e., large serve of fries with small serve of carrots). However, while children who received mostly healthy defaults did consume less unhealthy foods than children who received mostly unhealthy defaults, this effect was non-significant after controlling for age and weight. In contrast, Loeb et al. (2017) did see increases in healthy food consumption. In their laboratory study, Loeb et al. presented parents of school children with either a healthy menu as a default, or a less healthy, 'standard' menu as a default when selecting their children's breakfasts. To view the alternative menu, parents had to opt out of the menu they received by actively requesting a second menu. As a result, children whose parents received a healthy default menu received a greater proportion of healthy breakfast foods, resulting in greater consumption of these foods, in comparison to children whose parents did not see the healthy menu as the default. Similar effects were seen with lunch menus. Loeb et al. (2018) provided either a healthy or an unhealthy default lunch menu to parents of elementary school children, that could be opted out of on request. They found that no parents in the unhealthy default condition requested to see the healthier lunch menu, and only one parent in the healthy default condition requested to see the unhealthy menu. Therefore, healthy default menus resulted in a greater proportion of healthy lunch choices. Dalrymple et al. (2020), who presented parents at a theme-park restaurant with either a lower-energy default, a standard default, or a free array (i.e., no default) children's menu, found that the low-energy default increased the likelihood of lower-energy-dense food selections. Similar findings were evident in the context of online menus and hypothetical food choices. Colby et al. (2020), who presented participants in an online restaurant simulation scenario with either a healthy or an unhealthy default menu, found that those who received the healthy default menu were significantly more likely to make a healthy food choice. However, they also revealed a

'dodge effect', such that participants were less likely to return to a restaurant where they had been presented with a healthy default, than one where they had been presented with an unhealthy default. Thus, while defaults may promote healthy choices initially, this may not necessarily translate to long-term positive behaviour change.

Priming/Cueing interventions. Three studies (Tonkin et al., 2019; Otterbring & Shams, 2019; Loeb et al., 2017) used priming/cueing interventions and all were laboratory experiments. Two of these studies, both of which used a simple image cue, successfully increased healthy food choices. Specifically, Tonkin et al. (2019) found that presenting a healthy food cue (i.e., a basket of fruit and vegetables) on the front cover of a pictorial menu increased healthy choices in comparison to when this cue was presented inside the menu, or not presented at all. Otterbring and Shams (2019) found that placing an image of an overweight female face in the middle of a pictorial menu increased the proportion of healthy choices, in comparison to a normal weight face or no cue. Otterbring and Shams also measured visual attention (towards healthy versus unhealthy items) as a potential mediator of the relationship between condition and food choice but found no significant effect. Loeb et al. (2017) used video primes, whereby parents were shown either an empowering 15-minute video about improving their child's health, or a video of equal length containing neutral content about food safety, prior to selecting their child's breakfast from a written menu. Priming condition did not have a significant effect on the proportion of healthy breakfast choices made by parents, or the grams of healthy food consumed by children.

Ratio interventions. The ratio of healthy to unhealthy menu options was manipulated in two studies. In a restaurant role-play scenario using female university students, Boo et al. (2008) found that participants who received a menu on which half the options were healthy made significantly more healthy food choices than participants who received a menu on which only a quarter of the options were healthy. Boo et al. did not specify whether their

menu was written or pictorial. In their field study on worksite cafeterias, Reynolds et al. (2021) found that decreasing the proportion of high-energy options on a menu from 58% to 50% (by replacing these high-energy foods with lower-energy alternatives) decreased the mean number of calories purchased per day, per cafeteria. This was in comparison to a baseline period, during which no interventions were implemented. The significant effect of ratio intervention on food choice was, however, driven by just three of the nineteen participating cafeterias. Thus, ratio effects may not necessarily be universal, but may depend on factors such as consumer demographics.

Naming interventions. Three field studies tested descriptive naming interventions to promote healthier food choices. Feldman et al.'s (2011) study took place in an assisted living residence dining centre, Broers et al.'s (2019) study took place in a university sandwich restaurant, and Olstad et al.'s (2014) study was conducted in an outdoor recreation centre. Feldman et al. and Broers et al. used written menus, while Olstad et al. used a pictorial menu. Naming interventions were ineffective in two (Feldman et al.; Olstad et al.) of these three studies. Feldman et al., who used descriptive language such as 'gently steamed succulent sea scallops', found that this intervention did not increase the proportion of healthy meal choices. Furthermore, participants indicated that they somewhat disliked certain descriptive names, particularly those containing the word 'organic'. Similarly, Olstad et al. found that descriptive names to appeal to children (e.g., 'wonderful waterberry slushie') did not increase the number of healthy items sold from pre- to post-intervention. In contrast, Broers et al. (2019) found that adding the phrase 'suggestion of the chef' to the name of a healthy soup option increased the popularity of this option, in comparison to when a standard name that simply listed the ingredients of the dish was used.

Signage interventions. In combination with the naming intervention outlined above, Olstad et al. (2014) also investigated signage interventions. Specifically, they doubled the

size of their pictorial menu signs displaying healthy options, while leaving menu signs displaying unhealthy options unchanged. This intervention did not increase the number of healthy items sold from pre- to post-intervention.

Quality assessment. Of the 23 included studies, the most common quality rating (n = 8) was 4 stars according to the Mixed Method Appraisal Tool (MMAT) criteria. See Table 2 for the quality rating of each included study. Several studies scored 5 stars (n = 6) or 3 stars (n = 7), while a small number scored 2 stars (Otterbring & Shams, 2019; Boo et al., 2008), indicating low quality. Otterbring and Shams excluded over 5% of participants' data (for scoring too far from the mean), which, according to Higgins et al. (2016), led to an unacceptable complete data value. They also failed to disclose baseline characteristics between groups. Boo et al. did not disclose exclusions, and assessor blinding and adherence to the restaurant role-play scenario were unclear or inadequate. Neither Otterbring and Shams (2019) nor Boo et al. (2008) specified how their randomisation sequence was generated.

Table 2

MMAT Quality Ratings for Included Studies

	Criteria from the Mixed Methods Appraisal Tool																						
Studies	1.1	1.2	1.3	1.4	1.5	2.1	2.2	2.3	2.4	2.5	3.1	3.2	3.3	3.4	3.5	4.1	4.2	4.3	4.5	5.1	5.2	5.3	5.4	5.5
Bergman et al., 2021						1	0	1	1	1														
Boo et al., 2008											0	0	1	0	1									
Broers et al., 2019											1	1	0	1	1									
Colby et al., 2020											0	1	1	0	1									
Dalrymple et al., 2020, Study 1											1	1	1	1	0									
Dalrymple et al., 2020, Study 2											1	1	1	1	1									
Feldman et al., 2011						0	1	1	1	1														
Ferrante et al., 2022											0	1	1	1	1									

Flores et al., 2019, Study 2											1	1	1	1	1
Flores et al., 2019, Study 3											1	1	1	1	1
Gynell et al., 2021, Study 1						0	1	1	1	1					
Gynell et al., 2021, Study 2						1	1	1	1	1					
Keegan et al., 2019						0	0	1	1	1					
Loeb et al., 2017, Study 1						0	1	1	1	1					
Loeb et al., 2018						0	0	1	1	1					
Olstad et al., 2014	1	1	1	1	1						1	1	1	1	1
Otterbring & Shams, 2019						0	0	0	1	1					
Radnitz et al., 2018						1	1	1	1	1					

Reynolds et al., 2021	1	0	1	1	1
Romero & Biswas, 2016, Study 1a	1	0	0	1	1
Romero & Biswas, 2016, Study 1b	1	0	0	1	1
Tonkin et al., 2019	0	1	1	1	1
Wyse et al., 2019	0	0	1	1	1

Effect sizes. Placement interventions ranged from having no effect (Wyse et al., 2019; Gynell et al., 2021 (Study 1); Bergman et al., 2021) to moderate (Feldman et al., 2011; Keegan et al., 2011; Gynell et al., 2021 (Study 2)) or large (Flores et al., 2019 (Studies 2 and 3)) effects on food choice or hypothetical food consumption. Priming/cueing interventions had no effect (Loeb et al., 2017) to a moderate (Otterbring & Shams, 2019) or large (Tonkin et al., 2019) effect on food choice, while defaults had a large effect on food choice (Radnitz et al.; Loeb et al., 2017; Loeb et al., 2018; Colby et al., 2020), but a small (Loeb et al., 2017) to no effect (Radnitz et al.; Ferrante et al., 2022) on consumption. The effect of ratio condition on food choice was small to medium (Boo et al., 2008). Naming interventions ranged from having no effect (Olstad et al., 2014) to a large effect (Broers et al., 2019) on food choice. Signage interventions had no significant effect (Olstad et al.).

Summary

In summary, four of the six implicit interventions investigated in the included papers effectively promoted healthier eating behaviours in one or more studies. While there were inconsistencies regarding where healthy foods should be placed on a menu, placement interventions were particularly effective, positively influencing food choice or consumption in seven of ten studies. Although not as widely researched, default, ratio and priming/cueing interventions were generally successful. Naming was effective in one of two studies, while signage was not effective at all. These findings suggest that some implicit interventions could potentially be used to promote healthier eating behaviours in a variety of menu settings.

Discussion

The present review aimed to ascertain the overall effectiveness of implicit (i.e., subtle, indirect) interventions to promote healthier eating behaviours in the context of food menus. Furthermore, it aimed to determine which implicit interventions are the most effective. The review identified several relevant experimental studies, as well as a small number of pre-post

intervention studies and a mixed methods study. The included papers suggest that implicit interventions are effective more often than not. In general, guiding consumers in certain directions, whilst allowing them to maintain their autonomy, may be an effective approach to maximise healthy food choices and promote the consumption of healthy foods. However, this is dependent not only on the type of intervention, but also the population and context in which the intervention is implemented.

Placement interventions, which typically involve placing healthy food items in certain locations on a menu, were the most widely researched among the included studies. Placement interventions were largely effective in promoting healthier eating behaviours in both online and physical settings, and for a range of food items such as main meals, snacks, side dishes, and desserts. Interestingly, placement was ineffective in an online school lunch ordering system (Wyse et al., 2019). While Wyse et al. did not specify whether choices were made by parents or children, if children did choose for themselves, this finding could indicate that placement interventions may be most effective for adult consumers. Additionally, Gynell et al. (Study 1, 2021) found that a placement intervention did not increase healthy choices when a single-page, physical menu was used. However, placing healthy items at the top of a menu increased their popularity in an online context (Study 2), where participants needed to scroll down to view the full menu. Similarly, Bergman et al. (2020), whose placement intervention was also unsuccessful, used single-page menus that presented all items simultaneously. This suggests that some placement interventions may be most effective when consumers have to turn a page or scroll down to view the full set of options.

Default interventions were consistently effective in promoting healthy food selections, but not always healthy food consumption (Ferrante et al., 2020; Radnitz et al., 2018). While this warrants further investigation, selecting a healthy meal (even if not all of it is consumed) is still a healthier alternative to selecting a nutrient-poor, high calorie option.

Priming/Cueing was effective in promoting healthy choices in two (Tonkin et al., 2019; Otterbring & Shams, 2019) of three laboratory experiments. However, a video prime intervention did not increase healthy food choices (made by parents for their children) or children's' healthy food consumption in a study on parents' choices of their children's breakfast (Loeb et al., 2017). Perhaps this is because Loeb et al.'s video was presented well before any food choices were made (and in a different room), while Tonkin et al. and Otterbring and Shams' image cues were embedded in the actual menus. As such, the effects of the video may have diminished in the time that it took to relocate and seat participants, then have them read and choose from a menu. Tonkin et al. and Otterbring and Shams' image cues were also simple and easy for participants to look at, whereas watching and comprehending Loeb et al.'s 15-minute video may have been cognitively demanding, leaving less capacity for carefully considering food choices. Furthermore, as food selections in Loeb et al.'s (2017) study were made by parents on behalf of their children, unhealthy choices may have been made regardless of priming condition to avoid food refusal or conflict. However, for most default studies that surveyed parents, these factors did not seem to impact food choice. In fact, parents in default studies consistently chose more healthy foods for their children when they received healthy default menus (Loeb et al., 2017; Loeb et al., 2018; Dalrymple et al., 2020).

Ratio interventions were not widely researched in the context of menus, yet were able to increase healthy meal selections in a mock restaurant study (Boo et al., 2008) and in a field study on worksite cafeterias (Reynold et al., 2021). Naming interventions were ineffective in two field studies, in both younger (i.e., children and adolescents) (Olstad et al., 2014) and older (i.e., 60+ years) adults (Feldman et al., 2011). However, Broers et al.'s naming intervention did increase the popularity of a healthy dish in a university restaurant. Lastly, Olstad et al.'s signage intervention (i.e., larger menu signs for healthy items) that was used in

conjunction with their naming intervention did not increase healthy food sales at an outdoor recreation centre.

Evidently, some interventions were more effective than others. One explanation for this is that the interventions which were most successful (i.e., placement and default interventions) have been more extensively researched in the context of food menus than those which were unsuccessful. As such, naming and signage interventions may have potential, just not in the particular menu contexts in which they have been predominantly studied so far. For example, naming interventions were mostly ineffective in field studies, including in a recreation centre canteen (Olstad et al., 2014) and a communal dining centre (Feldman et al., 2011). However, a non-menu study (Grabenhorst et al., 2013) found that descriptive names (e.g., 'low fat fruit') increased healthy choices in an online food choice task where single items were presented sequentially. This could indicate that naming interventions may work better in online menus, as there are typically fewer distractions (e.g., other diners), allowing consumers to focus more closely on reading and interpreting names and descriptions of dishes. Furthermore, certain populations were more receptive to some implicit interventions than others. For instance, placement interventions were generally effective amongst adult populations, yet failed to deliver similar results for younger age groups (i.e., kindergarten to grade 6 (11-12 years) (Wyse et al., 2019). Perhaps this could be because children are generally less health conscious than adults (Hill, 2002) and may therefore ignore healthy options altogether (or instruct their parent to ignore them) no matter what their location is. Accordingly, implicit interventions to promote healthier eating behaviours in younger age groups may be more effective if aimed exclusively at parents, whose children may emulate their eating habits (Savage et al., 2007). Loeb et al.'s (2017) findings that defaults aimed at parents effectively promoted healthy food choices are consistent with this notion. Further to this, as the included studies on default interventions focused almost exclusively on food

choices for younger samples (i.e., college and school students), future investigations into the effectiveness of defaults for adults are needed.

Furthermore, the present review used exclusively implicit environmental interventions, as opposed to implicit interventions that modify individual behavioural tendencies, such as cognitive and psychomotor tasks (Veling & Lawrence, 2019). It is possible that implicit interventions involving these tasks may be better suited to populations for whom implicit environmental interventions are not consistently effective. Therefore, future studies could also explore computerised cognitive tasks such as the Go/No-go task (Veling et al., 2017), both in comparison to, and together with, implicit environmental interventions.

In the included studies, there were no specific settings that were consistently linked to successful interventions. In particular, Dalrymple et al. (2020) effectively promoted healthy food choices in a field study at a theme park restaurant, while Olstad et al. (2014) found no significant effects in a similar setting. Likewise, while Loeb et al.'s (2018) default intervention elicited a strong effect on food choice in elementary schools, Wyse et al. (2019) reported no significant effects in a similar setting.

Some studies (Loeb et al., 2018; Loeb et al., 2017) recruited low-income samples, in which only default interventions were consistently effective. This suggests that implicit interventions do have the potential to benefit financially disadvantaged populations, dependent on the type of intervention used. As such, it may be most important for future interventions to focus primarily on targeting appropriate populations and demographics, rather than specific settings. Future studies could also directly compare the efficacy of implicit interventions between different demographics, particularly socio-economic and weight-status groups. These are important to study, given that financially disadvantaged

groups and those struggling to maintain a healthy weight are likely most in need of dietary intervention (Grech et al., 2017).

Our findings are generally consistent with those of earlier meta-analyses and systematic reviews exploring other nudges in food choice settings not limited to menus. In particular, our results support both Arno and Thomas' (2016) meta-analysis and Vecchio and Cavallo's (2019) systematic review. These reviews found that nudges (i.e., implicit nudges such as placement and defaults, and also more explicit nudges like calorie labelling and plate/container sizing) were generally effective in increasing healthier eating behaviours in settings such as canteens, grocery stores, supermarkets and homes. Our review extends Arno and Thomas' and Vecchio and Cavallo's findings regarding implicit nudges to menus. Our review also supports Cadario and Chandon's (2020) meta-analysis of nudging interventions in field experiments, which were also not limited to menus and included settings such as grocery stores and cafeterias. Cadario and Chandon's findings suggest that nudges which are implemented at the consumption stage (e.g., changing portion sizes) effectively promote healthier eating behaviours. While the aforementioned review and meta-analyses (Arno & Thomas; Vecchio & Cavallo; Cadario & Chandon) focused on interventions that were not exclusive to menus, our findings fit with these earlier reviews by highlighting the notion that changes to the food environment do not need to be obtrusive to effectively shape health behaviours.

Our findings were, however, inconsistent with some aspects of Ozdemir and Caliskan's (2015) review on the influence of menu design on consumer choices (i.e., choices in general, as opposed to healthy versus unhealthy food choices). Ozdemir and Caliskan revealed that naming interventions effectively promoted food items (of an unspecified health status) by increasing positive perceptions of these items. In contrast, the present review found that descriptive names were ineffective in promoting healthy choices from menus more often

than not. A potential explanation for this inconsistency is that, as promoting healthy eating was not Ozdemir and Caliskan's key focus, several included studies that were not aimed at promoting health used descriptive names to emphasize taste. However, as healthy-eating promotion was central in the present review, naming interventions tended to be health oriented (e.g., 'organic grilled turkey' or 'low-fat cheese sauce'; Feldman et al., 2011). As research suggests that consumers tend to value taste over health (Malone & Lusk, 2017; Forwood et al., 2013), this may explain why the taste-focused naming interventions in Ozdemir and Caliskan's review were effective, while health-focused naming interventions in ours were not. Therefore, future studies could explore the use of naming interventions that highlight the taste attributes of healthier foods. Alternatively, they could combine health and taste-focused labels (e.g., "delicious and nutritious") which other recent research has shown increases visits to a healthy recipe page online (Garaus & Lalicic, 2021).

The present review has several practical implications. First, the finding that placement interventions effectively promoted healthy foods suggests that, for adult populations, menu placement interventions may be useful tools for encouraging healthy eating in restaurants, dining halls and online food ordering systems. It is unclear, however, which placement interventions are most effective. For instance, placing healthy items on the right was effective for Flores et al. (2019) and Keegan et al. (2019), while Romero and Biswas (2016) promoted healthy items by placing them to the left. Similarly, Wyse et al. (2019) and Bergman et al. (2021) saw no increase in the popularity of healthy foods that were placed in the top and bottom menu sections, yet Gynell et al. (Study 2, 2021) increased healthy choices by placing healthy items at the top of an online menu. As such, future research could directly compare placement interventions to determine which are most effective. Second, the finding that default interventions were generally successful suggests that these interventions could also be effective healthy-eating promotion tools. Nevertheless, future studies should explore the

dodge effect (i.e., consumers avoiding establishments with healthy defaults), and focus more closely on consumption, as it seems that healthy default choices may not always translate to healthy food consumption. Implicit interventions are also likely to be accepted, or even embraced, by food-retail and hospitality industries. This is because, while explicit interventions (e.g., sugar taxes or advertising regulations; Finkelstein et al., 2004) often discourage ordering food or dining out altogether, most implicit interventions simply encourage consumers to make healthier choices without discouraging purchases. Therefore, they are more consistent with profit-related business objectives (Veling & Lawrence, 2019). Implicit interventions are also cheap, simple and quick to implement (Dayan & Bar-Hillel, 2011) making them appealing to policy makers and industry leaders. Lastly, because their freedom is preserved and they are not penalised for certain choices, consumers largely approve of implicit interventions (Junghans et al., 2015).

A limitation of the studies included in the present review is that definitions of healthy foods varied across studies, limiting the comparability of some findings. In addition, the majority of the included studies were conducted in high-income countries. Therefore, our findings are not necessarily relevant to all groups, particularly individuals from low-income or disadvantaged areas. Furthermore, due to inconsistencies in the reporting of data across the included studies, a quantitative analysis was not feasible. Relatedly, publication bias, which could have influenced our conclusions, could not be tested for.

While not all eligible study designs were equally represented in our review, those which were most prevalent (i.e., experimental designs) are ranked higher in the hierarchy of evidence for evaluating health interventions (Evans, 2003) than other less prevalent designs (e.g., pre/post interventions). This indicates that the majority of the included studies utilised the most effective and appropriate research methods available. Individually, the majority of the studies included in our review were of high quality. Only two studies (Boo et al., 2008;

Otterbring & Shams, 2019), which explored two different interventions in two different settings, were of a particularly low quality. In the included randomised-controlled experiments, which ranged from low to high quality, few researchers reported how randomisation sequences were generated. Many also failed to specify whether sample characteristics were comparable between groups at baseline. Only six of the 23 included studies did not report effect sizes, and, of those that did, significant effects ranged from small/moderate to large. Large effects were seen in studies on placement, default, and priming/cueing interventions. Interestingly, studies in which implicit interventions did not effectively influence food choice were of a generally high quality. As such, rather than replicating existing studies on naming and signage interventions, future research could explore these interventions in different settings and samples, to determine whether they have potential in other contexts.

In conclusion, this systematic review synthesized evidence from existing research and found that placement and default interventions appear to be, at present, the most effective implicit interventions to promote healthier eating behaviours in menu contexts. Priming/cueing, ratio and naming interventions show some potential but require further investigation due to limited existing research. Different approaches within interventions (e.g., different types of placement interventions) should also be compared. If future research consistently supports implicit interventions, they could be valuable tools for governments, healthcare systems, and food purveyors looking to promote healthier eating behaviours. Eventually, this could result in widespread positive health outcomes.

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Appendix A

PICOS table used to frame the scope of the review

P	**Patient, Population, or Problem**	General population (all ages)
I	**Intervention (or exposure)**	Intervention to promote healthy dietary choices in the context of food menus
C	**Comparison (or control)**	The intervention may be compared to a control or another intervention. Alternatively, it could be a pre/post comparison of a single intervention.
O	**Outcomes of interest**	Increase in healthy food choices or consumption or decrease in unhealthy food choices or consumption. Could also include food intake, calories or kilojoules.
S	**Study designs**	Experimental designs and pre/post designs.

Appendix B

Complete search strategy for each of the five databases

Medline

Healthy eating and food choice/consumption component	1. exp Eating Behavior/ OR exp Food Preferences/ OR exp Health Behavior/ OR exp Health Promotion/ OR exp Diets/ 2. ((health* OR nutri* OR unhealth*) AND (food* OR meal* OR dessert* OR snack* OR choice* OR preference* OR purchas* OR choose OR chose* OR select* OR reduc* OR increas* OR encourag* OR less* OR lower* OR more OR improv* OR promot* OR outcome* OR consum* OR eat* OR option*)).ti,ab. 3. ((intake OR consum*) AND (calorie* OR energy OR kilojoule* OR food* OR nutri*)).ti,ab. 4. 1 OR 2 OR 3
Implicit intervention component	5. (nudg* OR change* OR alter* OR intervention* OR avail* OR convenien* OR environment* OR proxim* OR distanc* OR reposition* OR position* OR visib* OR accessib* OR range* OR assortment* OR arrangement* OR array* OR display* OR salien* OR close* OR near* OR adjacent OR far* OR primacy OR recency).ti,ab. 6. ((technique* OR intervention*) AND (implicit OR subtle)).ti,ab. 7. (spatial AND (manipulat* OR influenc* OR intervention* OR arrangement* OR technique*)).ti,ab.

	8. 5 OR 6 OR 7
Menu component	9. (menu* OR restaurant* OR cafe* OR canteen* OR bistro* OR eater* OR diner* OR “coffee shop*”).ti,ab. 10. 4 AND 8 AND 9
Limits	English language Peer-reviewed

PsycArticles

Healthy eating and food choice/consumption component	1. (“eating behavio?r*” OR “food preference*” OR “health behavio?r*” OR “health promotion*” OR diet*).ti,ab. 2. ((health* OR nutri* OR unhealth*) AND (food* OR meal* OR dessert* OR snack* OR choice* OR preference* OR purchas* OR choose OR chose* OR select* OR reduc* OR increas* OR encourag* OR less* OR lower* OR more OR improv* OR promot* OR outcome* OR consum* OR eat* OR option*)).ti,ab. 3. ((intake OR consum*) AND (calorie* OR energy OR kilojoule* OR food* OR nutri*)).ti,ab. 4. 1 OR 2 OR 3
Implicit intervention component	5. (nudg* OR change* OR alter* OR intervention* OR avail* OR convenien* OR environment* OR proxim* OR distanc* OR reposition* OR position* OR visib* OR accessib* OR range* OR assortment* OR arrangement* OR array* OR display* OR salien* OR close* OR near* OR adjacent OR far* OR primacy OR recency).ti,ab. 6. ((technique* OR intervention*) AND (implicit OR subtle)).ti,ab. 7. (spatial AND (manipulat* OR influenc* OR intervention* OR arrangement* OR technique*)).ti,ab. 8. 5 OR 6 OR 7

Menu component	9. (menu* OR restaurant* OR cafe* OR canteen* OR bistro* OR eater* OR diner* OR "coffee shop*").ti,ab. 10. 4 AND 8 AND 9
Limits	English language Peer-reviewed

PsycInfo

Healthy eating and food choice/consumption component	1. exp Eating Behavior/ OR exp Food Preferences/ OR exp Health Behavior/ OR exp Health Promotion/ OR exp Diets/ 2. ((health* OR nutri* OR unhealth*) AND (food* OR meal* OR dessert* OR snack* OR choice* OR preference* OR purchas* OR choose OR chose* OR select* OR reduc* OR increas* OR encourag* OR less* OR lower* OR more OR improv* OR promot* OR outcome* OR consum* OR eat* OR option*)).ti,ab. 3. ((intake OR consum*) AND (calorie* OR energy OR kilojoule* OR food* OR nutri*)).ti,ab. 4. 1 OR 2 OR 3
Implicit intervention component	5. (nudg* OR change* OR alter* OR intervention* OR avail* OR convenien* OR environment* OR proxim* OR distanc* OR reposition* OR position* OR visib* OR accessib* OR range* OR assortment* OR arrangement* OR array* OR display* OR salien* OR close* OR near* OR adjacent OR far* OR primacy OR recency).ti,ab. 6. ((technique* OR intervention*) AND (implicit OR subtle)).ti,ab. 7. (spatial AND (manipulat* OR influenc* OR intervention* OR arrangement* OR technique*)).ti,ab. 8. 5 OR 6 OR 7

Menu component	9. (menu* OR restaurant* OR cafe* OR canteen* OR bistro* OR eater* OR diner* OR "coffee shop*").ti,ab. 10. 4 AND 8 AND 9
Limits	English language Peer-reviewed

Scopus

Healthy eating and food choice/consumption component	1. TITLE-ABS ((health* OR nutri* OR unhealth*) AND (food* OR meal* OR dessert* OR snack* OR choice* OR preference* OR purchas* OR choose OR chose* OR select* OR reduc* OR increas* OR encourag* OR less* OR lower* OR more OR improv* OR promot* OR outcome* OR consum* OR eat* OR option*)) 2. TITLE-ABS ((intake OR consum*) AND (calorie* OR energy OR kilojoule* OR food* OR nutri*)) 3. 1 OR 2
Implicit intervention component	4. TITLE-ABS (nudg* OR change* OR alter* OR intervention* OR avail* OR convenien* OR environment* OR proxim* OR distanc* OR reposition* OR position* OR visib* OR accessib* OR range* OR assortment* OR arrangement* OR array* OR display* OR salien* OR close* OR near* OR adjacent OR far* OR primacy OR recency) 5. TITLE-ABS ((technique* OR intervention*) AND (implicit OR subtle)) 6. TITLE-ABS (spatial AND (manipulat* OR influenc* OR intervention* OR arrangement* OR technique*)) 7. 4 OR 5 OR 6
Menu component	8. TITLE-ABS (menu* OR restaurant* OR cafe* OR canteen* OR bistro* OR eater* OR diner* OR “coffee shop*”) 9. 3 AND 7 AND 8

Limits	English language Peer-reviewed

Web of Science

Healthy eating and food choice/consumption component	1. TS=("eating behavio$r*" OR "food preference*" OR "health hehavio$r*" OR "health promotion*" OR "diet*") 2. TS=((health* OR nutri* OR unhealth*) AND (food* OR meal* OR dessert* OR snack* OR choice* OR preference* OR purchas* OR choose OR chose* OR select* OR reduc* OR increas* OR encourag* OR less* OR lower* OR more OR improv* OR promot* OR outcome* OR consum* OR eat* OR option*)) 3. TS=((intake OR consum*) AND (calorie* OR energy OR kilojoule* OR food* OR nutri*)) 4. 1 OR 2 OR 3
Implicit intervention component	5. TS=(nudg* OR change* OR alter* OR intervention* OR avail* OR convenien* OR environment* OR proxim* OR distanc* OR reposition* OR position* OR visib* OR accessib* OR range* OR assortment* OR arrangement* OR array* OR display* OR salien* OR close* OR near* OR adjacent OR far* OR primacy OR recency) 6. TS=((technique* OR intervention*) AND (implicit OR subtle)) 7. TS=(spatial AND (manipulat* OR influenc* OR intervention* OR arrangement* OR technique*)) 8. 5 OR 6 OR 7

Menu component	9. TS=(menu* OR restaurant* OR cafe* OR canteen* OR bistro* OR eater* OR diner* OR “coffee shop*”) 10. 4 AND 8 AND 9
Limits	English language Peer-reviewed

CHAPTER 3: STUDIES 2 AND 3

The effect of item placement on snack food choices from physical and online menus

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Statement of co-authorship: Indah Gynell and Eva Kemps designed the studies and wrote the protocol. Data were collected and statistical analyses were undertaken by Indah Gynell, under the supervision of Eva Kemps. Indah Gynell wrote the first draft of the manuscript. Indah Gynell, Eva Kemps, Ivanka Prichard and Marika Tiggemann edited subsequent drafts of the manuscript, and have approved the final manuscript.

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Preamble

The systematic review reported in Chapter 2 revealed promising findings, specifically that implicit interventions have the potential to shape our eating behaviours in a positive way. Despite this, several gaps in the literature were identified, predominantly relating to inconsistent and conflicting research findings. For instance, while placement interventions were broadly effective, some studies found that placing healthier foods at the top of a menu increased healthy food choices (Feldman et al., 2011), whereas others found that healthy options placed last on a menu were consumed the most (Flores et al., 2019). Evidently, further research directly comparing different variations within interventions is needed. The present chapter describes two experimental studies which aimed to address this need by directly comparing the presentation of healthy items in the top, middle, and bottom sections of snack menus, to determine which approach(es) could most effectively promote healthier food choices. This was achieved using two different presentation formats, a physical (Study 2) and an online (Study 3) menu.

Abstract

Previous attempts to promote healthy eating using explicit techniques have not been consistently successful. We therefore investigated an implicit strategy (item placement techniques) to encourage healthy food choices in the context of snack menus. Two experimental studies compared presentation of healthy items in the top, middle, and bottom sections of a snack menu. Study 2 compared these presentations in a physical paper-based menu, while Study 3 used an online menu. Menus consisted of 8 unhealthy and 4 healthy items, arranged in three rows of four in Study 2, and one column of 12 in Study 3. In each study, participants selected one food item from one of the three experimental menus, before completing the Revised Restraint Scale (to determine dietary restraint status). In Study 2 (n = 172), item placement condition did not predict healthiness of food choice. In Study 3 (n = 182), healthy items were most popular from the first section of the menu, in comparison to the middle or last sections. Dietary restraint did not moderate the effect of item placement condition on food choice. In line with nudging principles, our results suggest that item placement techniques could be a potentially powerful tool in promoting healthy choices from online snack menus.

Introduction

Recent spikes in unhealthy eating behaviour throughout Western society have been linked to increased negative physical and mental health outcomes (World Health Organisation, 2020; Wyatt et al., 2006), for example, obesity (Brownell & Horgen, 2004) and depression (Rosenheck, 2008). Governments and healthcare systems are under increasing pressure to fund and facilitate treatments and interventions to combat these issues (Wang et al., 2012). Therefore, it is vital that we explore the most effective ways to promote healthy eating (Burton et al., 2006).

Previous attempts to reduce dietary and lifestyle-related diseases by minimising unhealthy eating have utilised explicit techniques such as dieting and public health campaigns. However, these attempts have not been consistently successful (Walls et al., 2011). One reason is that many explicit techniques (e.g., commercial weight-loss diets) cause individuals to feel restricted, frustrated or isolated (Thomas et al., 2008). Explicit interventions can also cause resistance and counter-reactance, whereby individuals refuse to comply, or they engage in counter-intuitive behaviour (Dowd, 2002).

As explicit techniques have generally failed to effectively promote healthier food choices, there is increasing interest in more implicit techniques. Implicit techniques are subtle, indirect approaches which guide individuals (often subconsciously) toward certain choices or behaviours (Sunstein, 2014). Many promising implicit techniques are based on the principle of nudging. Nudges allow individuals to preserve their feelings of freedom and independence, whilst being gently steered in a certain direction (Junghans et al., 2015). A speed bump on the road is an example of a nudge that many of us encounter in everyday life. Seeing a speed bump up ahead signals to us that it is time to slow down; however, we are free to continue speeding over the bump if we wish, although doing so will be somewhat uncomfortable. Nudges, whilst they can be used to promote particular behaviour, still allow

individuals to go their own way and remain in charge of their own decisions. For this reason, nudges are unlikely to be resisted and have the potential to transform the ways in which we promote healthy dietary and lifestyle choices. For example, Junghans et al. (2015) revealed that an overwhelming majority of both male and female consumers from a wide variety of socio-economic and educational backgrounds held favourable opinions about nudging. None of their 20 participants, whose beliefs and opinions about nudging were assessed through in-depth interviews, were opposed to the general concept, especially when considering it in relation to health issues. Finally, as well as being consistently appealing to consumers, nudging is also extremely cost effective and often simple to implement in comparison to alternative interventions (Dayan & Bar-Hillel, 2011).

Most nudges used in food choice settings utilise people's inclinations to favour objects that are easily accessible or available, or placed in certain locations. One promising type of nudge is referred to as item placement techniques, which involve manipulating the spatial placement of certain food items in order to promote these items (Bowen & Morris, 1995). Item placement techniques are said to influence food choices due to people's natural gaze-motion and memory tendencies (Bowen & Morris).

To date, studies on menu item placement and food choice have revealed mixed findings. For example, Dayan and Bar-Hillel (2011) found that consumers favoured both extreme ends (i.e., both the top and the bottom) of a menu, suggesting items viewed first and last may be most salient and best remembered. However, Feldman et al. (2011) showed that only menu items placed at the top of a page are preferred. They suggested that after viewing these items first, consumers have less cognitive energy available for reading the rest of the menu. Conversely, in Choi et al.'s (2010) examination of gaze patterns when reading from food menus, consumers were not only more inclined to focus their eyes first on the centre of the menu, but also stated that they tend to select items from this area. This favouring of the

middle and avoiding the edges is referred to as edge aversion (Huber, 1983). Similarly, Christenfeld (1995) found that items on the top and bottom of supermarket shelves were avoided by consumers in favour of middle items. These tendencies toward middle items have also been demonstrated in non-food-related settings (e.g., multiple-choice tests; Attali & Bar-Hillel, 2003)).

Interestingly, there are no obvious features that differentiate the studies supporting top, middle or bottom item placement. For example, in studies that used single-page menus, some show preferences for middle items (Choi et al., 2010; Gallup, 1987), while others found preferences for top (Dayan & Bar-Hillel, 2011; Feldman et al., 2011) or bottom (Dayan & Bar-Hillel, 2011) items. Likewise, some studies offering extensive numbers of items (> 25 items), showed preferences for middle items (Christenfeld, 1995); however, others showed preferences for top and bottom items (Dayan & Bar-Hillel, 2011).

Of note, studies to date have presented healthy food items intermixed with unhealthy ones, rather than separated into their own menu sections. As a result, only food choices in general, rather than healthy versus unhealthy food choices, have been explored in the context of item placement. This highlights the need to directly compare item placement techniques as a tool to encourage healthy eating.

Thus, the aim of the present research was to compare presentation of healthy items in the top, middle, and bottom sections of a menu against one another, to determine which could most effectively promote healthy snack food choices. Study 2 compared these presentations in the context of a physical snack menu, as typically seen in cafés, restaurants, and fast-food outlets (Pang & Hammond, 2013). Study 3 compared these presentations in the context of an online menu; these have become increasingly popular in recent times (Stephens et al., 2020), particularly with the widespread use of food delivery systems during the COVID-19 pandemic (Hobbs, 2020). Item placement may impact food choice differently in physical and

online menus, as physical menus typically present food options simultaneously (Study 2), whereas online menus tend to present items in a more sequential manner (Study 3; Jones & Mifll, 2001). Because of the mixed state of the literature on item placement techniques, no specific predictions were made regarding which placement condition would most effectively promote healthy food choices.

We further measured dietary restraint as a potential moderator of the effect of item placement on food choice. Some studies have shown the effect of nudges on food choice/consumption to be more pronounced for restrained (i.e., individuals who chronically restrict their food intake to lose weight or avoid gaining weight) than unrestrained eaters (e.g., Papies & Hamstra, 2010; Tonkin et al., 2019), however, others have not (e.g., Keegan et al., 2019; Rotenberg et al., 2005). While dietary restraint has not yet been explored in the context of item placement techniques, we predicted that the impact of item placement on healthy food choice would be greater for restrained than unrestrained eaters.

Study 2

Method

Participants

The sample consisted of 172 female students from Flinders University, South Australia. An a priori power analysis determined that for Chi-square and regression analyses, a minimum sample of 172 would provide adequate statistical power to detect a moderate sized effect at .95 power with an alpha level of .05 (Faul et al., 2007). In line with Colby et al. (2020), our benchmark for a moderate sized odds ratio (*ExpB*) was 1.25. Participants were recruited for a study on menu choices through the University's online research participation system. People were eligible to participate if they were female, English speakers, with no food allergies or intolerances and who liked most foods. Recruitment was restricted to female participants due to dieting behaviours being consistently more prevalent in women than in men (Lemon et al., 2009). To equalise hunger levels, participants were instructed to refrain from eating or drinking anything except water for two hours prior to their participation. In recognition of their time commitment, 96 participants received course credit and 76 received a $5 monetary reimbursement.

Design

The study used a 3 (item placement: top, middle, bottom) x 2 (dietary restraint status: restrained eaters, unrestrained eaters) between-subjects design. Participants were randomly allocated to an item placement condition subject to equal Ns. The outcome measure was food choice (healthy, unhealthy).

Materials

Snack menus. Stimuli consisted of three coloured, pictorial, single page 'snack' menus, one for each of the item placement conditions. Each menu contained the same four healthy and eight unhealthy snack options. A greater proportion of unhealthy than healthy

items reflects what is typically offered in most snack menus (e.g., those seen in corner stores or canteens). In each menu, the food items were arranged in three rows of four. One menu presented the healthy food items on the top row, one presented the healthy food items in the middle row, and one presented the healthy food items on the bottom row (see Figure 1). Menus were printed on an A4 piece of paper and laminated.

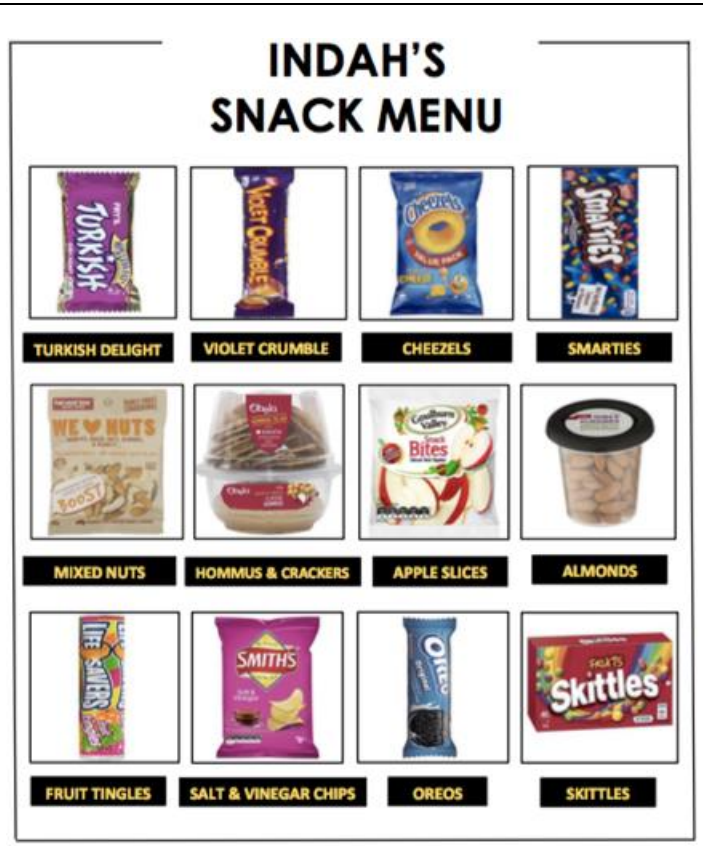
Healthy items on top	Healthy items in the middle	Healthy items on the bottom
		

Figure 1. Menus for each of the three item placement conditions

The food options were taken from an initial pool of 40 food items from the Victorian Government Healthy Eating Advisory Service's FoodChecker (Nutrition Australia & Victoria State Government, 2016). This classification system uses a traffic light method to categorise foods into groups based on their fat, salt, sugar and nutrient content; foods in the 'green' category have a high nutritional value and should be consumed regularly; foods in the 'red' category have very little nutritional value and should be limited or avoided. Half of the initial selection of 40 snack items were healthy (green), and half unhealthy (red). Female volunteers (N = 20) aged between 18 and 30 years were then shown photographs of the snack items sourced from the website of an Australian supermarket chain (Coles Australia) in a PowerPoint slideshow. They were asked to record the name of the snack shown in each picture (as it was important that the food items be recognised by most people), and to rate the perceived healthiness of the 40 items on a 9-point rating scale which ranged from 'not at all healthy' to 'extremely healthy,'. The items included in our studies were correctly recognised by 95-100% of participants. Based on the data from this pilot study, the 4 items rated 'most healthy' and the 8 items rated 'most unhealthy' were selected. A paired samples *t*-test showed that the four healthy items had a significantly higher mean healthiness rating ($M = 7.10$, $SD = 0.85$) than the eight unhealthy items ($M = 1.33$, $SD = 0.33$), $t(19) = 27.75$, $p < .001$.

Snack choice. Participants were asked to select a snack item from their menu. In order to make the study more relevant to real-life situations and encourage genuine choices, they were then provided with their item of choice. Snack items were similar in size (e.g., participants were given a bag of four Oreo cookies as opposed to an entire pack, to standardise portion sizes), and ranged in price from approximately AU$1.00 to AU$3.00.

Post-choice questionnaire. Participants were asked to briefly describe why they chose their particular snack item to determine the most common reasons for choices, and to

probe for suspicion of the experimental manipulation. Participants also rated how much they liked each of the food items on the menu on a 9-point scale ranging from 1 ‘dislike extremely’ to 9 ‘like extremely’.

Dietary restraint. The Revised Restraint Scale (Herman & Polivy, 1980) was used to assess dietary restraint. This ten-item, self-report scale measures weight fluctuation (e.g., “In a typical week, how much does your weight (in kg) fluctuate?”) and dieting-related concerns and thoughts (e.g., “Do you give too much time and thought to food?”). Participants indicate their response from a set of four to five options (e.g., “never, rarely, sometimes, often, always”). Total scores range from 0 to 35, with higher scores indicating greater eating restraint. Participants who score 15 or more are considered restrained eaters; those who score 14 or below are considered unrestrained eaters.

Allison et al. (1992) showed that compared to other well-known dietary restraint scales (e.g., the Three-Factor Eating Questionnaire and Dutch Eating Behavior Questionnaire), the Revised Restraint Scale has the highest test-retest reliability (r = .95). They also found that the Revised Restraint Scale has adequate internal consistency (Cronbach’s α = .82), and correlates minimally with social desirability scales, suggesting high discriminant validity. Additionally, Polivy et al. (1988) demonstrated excellent test-retest reliability for the Revised Restraint Scale (r = .93), using intervals of one week. In the current sample, the internal consistency of the Revised Restraint Scale was adequate (α = .81).

Procedure

The study was conducted in the Flinders University Food Research Laboratory. Up to two participants were tested at a time, in separate cubicles. All questionnaires were administered using Qualtrics survey software. After providing informed consent, participants completed a short demographics questionnaire, including the length of time since they had

last consumed any food or drink other than water, and a rating of their current hunger level on a 100 mm visual analogue scale ranging from ‘not at all hungry’ to ‘extremely hungry’. They were then presented with the laminated A4 snack menu, with healthy items either in the top, middle, or bottom row, depending on their condition. Participants were asked to peruse the menu and then fill in a form to indicate which snack they would like. While the researcher fetched their chosen snack, participants completed the reason for choice question. They were then provided with their snack and completed the liking rating scales and the Revised Restraint Scale. Finally, the researcher measured the participant’s height and weight from which BMI (kg/m^2) was calculated. Testing sessions lasted approximately 15 minutes.

Results

Sample Characteristics and Food Choices

Table 1 displays the sample characteristics for each placement condition. All participants reported that they had refrained from eating for approximately two hours before testing. The mean hunger rating across all three conditions sat just below the midpoint of the scale ($M = 43.60$, $SD = 24.28$).

Table 1

Means (and Standard Deviations) of Study 2 Sample Characteristics by Item Placement Condition

	Top (*n* = 58)	Middle (*n* = 57)	Bottom (*n* = 57)
Body Mass Index (kg/m^2)	26.01 (7.49)	24.39 (4.74)	23.55 (4.80)
Time since eating or drinking (minutes)	129.83(85.29)	157.46 (132.92)	146.14 (102.46)
Hunger (rated from 0 – 100)	40.72 (21.59)	43.21 (24.74)	49.56 (25.06)
Revised Restraint Scale score	16.09 (6.20)	16.00 (5.41)	14.56 (6.39)

Hommus and crackers (25.6 %) and apple slices (20.9%) were the most frequently selected items. Based on the subsequent liking ratings, apple slices (*M* = 6.74, *SD* = 2.01) and Oreos (*M* = 6.22, *SD* = 2.34) were the food items participants liked the most, while Turkish Delights (*M* = 3.70, *SD* = 2.86) and Violet Crumbles (*M* = 4.16, *SD* = 2.45) were liked the least. Taste (34.3%) and health (27.9%) were the most common reasons for choosing a particular snack. No participants indicated any awareness of the study aim or manipulation.

Effect of Item Placement Condition on Food Choice

Table 2 shows the percentages of healthy snack food choices for each item placement condition. Overall, healthy items were chosen more frequently than unhealthy ones. Although a slightly greater proportion of individuals in the middle condition chose a healthy item than those in the top and bottom conditions, the difference between conditions was not significant, $\chi^2(2) = 1.45$, $p = .485$.

Table 2

Number (and Percentage) for Food Item Choice (Healthy, Unhealthy) by Item Placement Condition (Top, Middle, Bottom) in Study 2

	Item Choice	
Item placement condition	Healthy	Unhealthy
Top	34 (58.6%)	24 (41.4%)
Middle	38 (66.7%)	19 (33.3%)
Bottom	32 (56.1%)	25 (43.9%)
Total	104 (60.5%)	68 (39.5%)

Dietary Restraint as a Potential Moderator of the Effect of Item Placement Condition on Food Choice

A binomial logistic regression was performed to investigate whether dietary restraint moderated the effect of condition on food choice. The item placement condition variable was dummy coded with the top condition as the reference category, such that two new dummy variables, which compared the top against the middle group, and the top against the bottom group were created. Food item choice, the dependent variable, was coded as 0 = unhealthy, 1 = healthy. The moderator variable, dietary restraint status, was coded as 1 = restrained, 2 = unrestrained.

In Step 1 of the logistic regression, item placement condition and dietary restraint were entered. Together, these variables did not predict food choice, $\chi^2(3) = 1.54$, $p = .674$ (Nagelkerke pseudo $R^2 = .01$). In Step 2, adding the item placement condition by dietary restraint product term did not significantly enhance the prediction of food item choice, $\chi^2(2) =$

1.72, $p = .424$ (Nagelkerke pseudo $R^2 = .03$). Thus, dietary restraint did not moderate the effect of condition on food choice.[1]

Predictors of Food Choice

A second binomial logistic regression was performed to investigate other general predictors of food choice (i.e., liking, row of choice, hunger, BMI and dietary restraint) alongside item placement condition. Row of choice, which was dummy coded, refers to the row (top, middle or bottom) from which the item was chosen, regardless of its healthiness. See Table 3 for inferential and descriptive statistics.

[1] Running the regression with the bottom condition as the reference group revealed the same pattern of results, such that there was no variation in healthy choices between the middle and bottom conditions, and no significant interaction with dietary restraint.

Table 3

Inferential and Descriptive Statistics for the Main Effects of Condition, Mean Liking Rating (of Healthy and Unhealthy Items), Row of Choice, Hunger, BMI and Dietary Restraint for Food Item Choice (Healthy or Unhealthy) in Study 2

Predictor	***b***	***SE***	***Wald***	***p***	**Odds Ratio**	**95% CI**
Top condition (versus middle)	.33	.48	.48	.489	1.40	.54 – 3.60
Top condition (versus bottom)	.13	.47	.08	.777	1.14	.46 – 2.87
Mean liking of healthy items	.56	.12	20.94	.000	1.75	1.38 – 2.22
Mean liking of unhealthy items	-.50	.13	14.84	.000	.60	.47 - .78
Row of choice (top versus middle)	-.67	.48	1.96	.161	.51	.20 – 1.31
Row of choice (top versus bottom)	-.40	.47	.71	.398	.67	.26 – 1.70
Hunger rating	.003	.01	.13	.724	1.00	.99 – 1.02
Body Mass Index (kg/m^2)	.04	.04	1.31	.253	1.04	.97 – 1.12
Dietary restraint	.07	.42	.03	.871	1.07	.47 – 2.43

Notes. $df = 1$ for all variables and interactions. $N = 172$.

Together, all variables (item placement condition, liking, row of choice, hunger, BMI and dietary restraint) significantly predicted food choice, $\chi^2(9) = 42.35$, $p < .001$ (Nagelkerke

pseudo $R^2 = .30$). However, as can be seen in Table 3, only mean liking of healthy and unhealthy items offered unique prediction.

Discussion

Item placement on a physical menu did not affect the proportion of healthy (relative to unhealthy) snack food choices. Participants in the top condition were no more likely to choose a healthy item than an unhealthy one, in comparison to both the middle and bottom conditions. Similarly, those in the middle condition were no more likely to choose a healthy item than those in the bottom condition. In addition, the effect of condition on food choice did not vary depending on dietary restraint status. While condition, row of choice, liking, and participant characteristics together predicted food choice, liking was the only independent predictor. Unsurprisingly, what seemed to be driving choice here was the extent to which participants liked the food items.

The findings of Study 2 are not consistent with previous literature supporting the use of item placement techniques as a means to promote the selection of certain food items from physical menus, although it needs to be noted that the literature is itself inconsistent (Choi et al., 2010; Dayan & Bar-Hillel, 2011; Feldman et al., 2011). In Study 3, we turned to the investigation of item placement in the digital context of an online menu. In addition to investigating an increasingly common menu presentation, this afforded the opportunity for greater anonymity, thereby minimising potential effects of social desirability and demand characteristics.

Study 3

Method

Participants

The sample consisted of 182 students from Flinders University, South Australia. Eligibility criteria and methods of participant recruitment were the same as in Study 2.

Design, Materials and Procedure

Design, materials and procedure were the same as for Study 2, except that the menus were presented online with the same twelve food items arranged in a single column, and participants completed the study at home in their own time. One menu presented the four healthy food items first, one presented them in the middle, and one presented them last (see Figure 2). Qualtrics online survey software randomly allocated participants to one of three conditions. Participants selected a snack by clicking on the image of their chosen item. As the study was conducted fully on-line (during COVID-19), participants were not able to be given their chosen snack for consumption, and height and weight were self-reported.

Healthy items first	Healthy items in the middle	Healthy items last
		

Figure 2. Menus for each of the three item placement conditions. *Note.* When presented on the Qualtrics screen, the full menu was not visible without scrolling down the page.

Results

Sample Characteristics and Food Choices

Table 4 shows the sample characteristics for each condition. The mean hunger rating across all three conditions sat just below the midpoint of the scale (M = 41.60, SD = 24.31). Hommus and crackers (15.4%), Cheezels (13.7%), and salt and vinegar chips (13.7%) were the most frequently selected items. As in Study 2, apple slices (M = 6.27, SD = 2.01) and Oreos (M = 6.26, SD = 2.33) were the food items participants liked the most, while Turkish Delights (M = 4.05, SD = 2.73) and Violet Crumbles (M = 4.45, SD = 2.41) were liked the least. Taste (41.8%) and health (18.1%) were again the most common reasons for choosing a particular item. As in Study 2, no participants indicated any awareness of the manipulation.

Table 4

Means (and Standard Deviations) of Study 3 Sample Characteristics by Item Placement Condition

	Top (n = 61)	Middle (n = 60)	Bottom (n = 61)
Age (in years)	25.00 (11.29)	22.95 (8.39)	22.61 (9.16)
Body Mass Index (kg/m^2)	23.69 (4.95)	25.07 (6.89)	23.38 (5.13)
Time since eating or drinking (minutes)	129.51 (99.10)	129.08 (44.14)	130.46 (85.73)
Hunger (rated from 0 – 100)	43.56 (24.52)	40.55 (24.68)	40.67 (24.03)
Revised Restraint Scale score	15.02 (6.46)	15.53 (5.33)	15.41 (6.68)

Effect of Item Placement Condition on Food Choice

Table 5 shows the percentages of healthy choices for each experimental condition. Overall, unhealthy items were chosen more frequently than healthy ones. In addition, there was a significant effect of item placement condition on food choice, $\chi^2(2) = 9.34$, $p = .009$. Specifically, post hoc comparisons using a Bonferroni correction indicated that a significantly greater proportion of individuals chose a healthy item when they were placed first on the menu (55.7%) in comparison to when they were placed in the middle (31.7%) or at the end (32.8%) of the menu (determined using an alpha value of .05).

Table 5

Number (and Percentage) for Food Item Choice (Healthy, Unhealthy) by Item Placement Condition (Top, Middle, Bottom) in Study 3

	Item Choice	
Item placement condition	Healthy	Unhealthy
Top section	34 (55.7%)	27 (44.3%)
Middle section	19 (31.7%)	41 (68.3%)
Bottom section	20 (32.8%)	41 (67.2%)
Total	73 (40.1%)	109 (59.9%)

Dietary Restraint as a Potential Moderator of the Effect of Item Placement Condition on Food Choice

Results from a binomial logistic regression show that together, item placement condition and dietary restraint significantly predicted food choice, $\chi^2(3) = 10.07$, $p = .018$ (Nagelkerke pseudo $R^2 = .07$). Individually, condition predicted food choice, but dietary restraint did not, $b = .28$, $SE = .31$, $Wald(1) = .80$, $p = .372$, $ExpB = 1.32$. Nor did dietary

restraint moderate the effect of condition on food choice, $\chi^2(2) = 1.29$, $p = .526$ (Nagelkerke pseudo $R^2 = .08$).

Predictors of Food Choice

A final binomial logistic regression showed that collectively, item placement condition, liking, section of choice (which, similar to row of choice in Study 2, referred to the section (top, middle or bottom) from which the item was chosen), hunger, BMI, and dietary restraint were significant predictors of food choice, $\chi^2(9) = 54.07$, $p < .001$ (Nagelkerke pseudo $R^2 = .35$). As individual predictors, item placement condition and mean liking of the snack food items significantly predicted choice. As shown in Table 6, the odds of choosing a healthy item in the top condition were approximately 30 percent greater than the odds of choosing a healthy item in the middle condition, and approximately 40 percent greater than the odds of choosing a healthy item in the bottom condition. Notably, section of choice was not a significant predictor, indicating that participants did not simply favour items from the top section regardless of whether they were healthy or unhealthy.

Table 6

Inferential and Descriptive Statistics for the Main Effects of Condition, Mean Liking Rating (of Healthy and Unhealthy Items), Section of Choice, Hunger, BMI and Dietary Restraint for Food Item Choice (Healthy or Unhealthy) in Study 3

Predictor	***b***	***SE***	***Wald***	***p***	**Odds Ratio**	**95% CI**
Top condition (versus middle)	-1.23	.46	7.16	.007	.29	.12 - .72
Top condition (versus bottom)	-.94	.44	4.64	.031	.39	.17 - .92
Mean liking of healthy items	.65	.13	26.15	.000	1.91	1.49 – 2.45
Mean liking of unhealthy items	-.32	.13	6.15	.013	.72	.56 - .93
Section of choice (top versus middle)	-.05	.45	.01	.918	.96	.40 – 2.30
Section of choice (top versus bottom)	-.18	.44	.16	.687	.84	.35 – 1.99
Hunger rating	-.001	.01	.01	.934	1.00	.99 – 1.01
Body Mass Index (kg/m^2)	-.07	.04	3.51	.061	.93	.86 - .1.00
Dietary restraint	.20	.38	.28	.596	1.23	.58 – 2.60

Notes. *df* = 1 for all variables and interactions. *N* = 182.

Discussion

In the online menu used in Study 3, the proportion of healthy items chosen varied depending on the experimental condition. Participants who saw healthy items first were more likely to choose a healthy item than an unhealthy one, in comparison to participants who viewed the healthy items in the middle or last sections. Condition also predicted food choice independently of other factors including liking, section of choice, BMI, hunger, and dietary restraint, increasing confidence in the potential for item placement techniques to encourage healthy food choices in their own right. The effect of condition on food choice again did not vary depending on dietary restraint status.

General Discussion

The present studies aimed to compare three key item placement techniques against one another to determine the most effective way to promote healthy food choices. This was achieved by presenting participants with a physical menu with healthy items either on the top, middle or bottom row (Study 2), or an online menu with similar configurations (Study 3). In each case, dietary restraint was explored as a potential moderator of the relationship between condition and food choice.

We found that item placement condition did not predict healthy food choices from a physical menu (Study 2), but did so from an online menu (Study 3), such that participants who saw healthy items first chose a greater proportion of healthy items than those who viewed them further down the menu. Contrary to prediction, the effect of condition on food choice did not vary depending on dietary restraint status in either study. Liking of food items predicted food choice in both studies, indicating that, unsurprisingly, participants generally selected food items that they liked.

The present findings indicate that item placement techniques can successfully promote healthy choices, when certain menu formats are used. Specifically, the online menu,

but not the physical menu, resulted in a greater proportion of healthy food choices from the top condition. Although Study 2 did not support previous findings that food items at the top of menus are most popular (Dayan & Bar-Hillel, 2011; Feldman et al., 2011), Study 3 did, and extended them to an online context. Consistent with Dayan and Bar-Hillel and Feldman et al., the Study 3 findings suggest that primacy effects (i.e., the idea that items which are viewed first are most salient and best remembered) appear to occur for healthy items in the context of online food menus.

Items placed in the middle of our experimental menus, regardless of healthiness, were not particularly popular. This contradicts research supporting the idea that people avoid the edges and favour the middle when making selections from choice sets (Attali & Bar-Hillel, 2003; Choi et al., 2010; Christenfeld, 1995). Potential explanations for this difference include different study methodologies and objectives, the use of food versus non-food choice sets, and the food setting. Specifically, Choi et al. (2010) focused primarily on gaze patterns and did not measure food choice. Instead, participants indicated that they usually choose menu items from the section where their eyes focus first, which was primarily the middle. Alternatively, Attali and Bar-Hillel (2003), whose study supported the concept of edge aversion, used non-food related choice options. This suggests that people may memorise non-food-related items differently from food-related items (Corsini et al., 1969). Finally, Christenfeld (1995), who found preferences for middle items, presented choice options on supermarket shelves. In this setting, middle items are at eye-level; by contrast, people have to look up to see items on the top shelves or look down to see those on the bottom shelves.

The discrepancy in the effect of condition on food choice between the two studies here could be attributed to a number of factors, predominantly relating to the overall layout of the menus. In Study 2, menu items were presented in an array, while in Study 3, they were presented in a single column. Therefore, participants in Study 2 could see all items at once,

while participants in Study 3 needed to scroll down to see all the menu items. Thus, like in a real online menu, the top section of the menu would have been viewed first in Study 3. This fits with Feldman et al. (2011) and Bowen and Morris' (1995) suggestion that gaze-motion tendencies play a role in driving preferences for items in top locations. However, future studies could utilise eye-tracking technology to determine which menu locations are focused on the most. Additionally, Feldman et al. (2011) suggested that menu items that are read or viewed first receive the majority of consumers' cognitive energy. Thus, it is likely that the top items of the online menu in Study 3 would have been the most cognitively processed, enhancing their salience and memorability.

Interestingly, although the menu items were identical in both studies, overall, healthy items were considerably more popular in Study 2 (60.5%) than in Study 3 (40.1%). Furthermore, more participants in Study 2 (27.9%) based their food choice on health than in Study 3 (18.1%) where taste was far more popular. This could be because online menus and ordering systems (as used in Study 3) are generally associated with the consumption of unhealthy snack foods (Bates et al., 2020). In addition, Study 3 was conducted during the COVID-19 pandemic. COVID-19-related interventions such as lockdowns, physical distancing and self-isolation have been associated with comfort eating and impulsive eating behaviours (Clemmensen et al., 2020). More generally, the greater overall preference for unhealthy foods in Study 3 could be attributed to reduced social desirability and demand effects. Participants in the laboratory-based Study 2 knew that the researcher would be aware of their chosen food item, as it was subsequently given to them to consume. However, in Study 3, there was no contact with the researcher as food choices were made entirely online.

Furthermore, dual processing theories (Hofmann et al., 2009) suggest that ordering food from digital platforms may trigger automatic decision-making behaviours, as digital devices such as laptops, iPads and smartphones are associated with automatic gratification

and spontaneous or impulsive behaviours (Abell, 2019). These associations could have influenced the impact of condition on food choice in Study 3, due to the dependence of nudges on natural human tendencies and automatic processes (Bowen & Morris, 1995). Specifically, participants may have been more susceptible to being nudged in the context of online menus, due to associations between computer screens and spontaneous or impulsive behaviours.

In both studies, liking of food items predicted food choice. Participants who liked healthy items generally selected healthy items, whereas those who liked unhealthy items generally selected unhealthy ones. This supports previous findings that liking drives food choices and consumption (Jones et al., 2010). Interestingly, liking of healthy items was a stronger predictor of choice than liking of unhealthy items. We speculate that this may reflect an increased prevalence of the 'healthy eater' identity (Strachan & Brawley, 2009) in recent times. Individuals with healthy eater identities are both more likely to like healthy foods and engage in more healthy eating behaviours (e.g., avoiding foods of low nutritional value) (Strachan & Brawley).

Importantly, the row (Study 2) or section (Study 3) of chosen items did not predict food choice. This indicates that participants in Study 3 did not simply choose items from the top of the menu regardless of their healthiness. Rather, they preferred items at the top only when these were healthy. This finding suggests that to promote certain food choices in online settings, we must consider the placement of healthy items in relation to unhealthy ones.

Dietary restraint was not a moderator of the effect of condition on food choice. Thus, the positive effects of top item placement of healthy food items in online menus appear to apply across the board. This is consistent with some nudging studies (e.g., Keegan et al., 2019), but contradicts others which have found that implicit strategies to promote healthy food choices are more effective for restrained eaters (e.g., Papies & Hamstra, 2010; Tonkin et

al., 2019). In contrast to the present studies, these previous studies presented the nudge before the food options for choice: a poster for a low-calorie recipe at the entrance of a butcher's store (Papies & Hamstra), and a basket of fruit and vegetables on the cover of a café-style menu (Tonkin et al.). This would have afforded restrained eaters the time to activate their dieting goal before making their food selections. By contrast, in the present studies, and in that of Keegan et al., the nudge was presented at the same time as the food options.

The present studies have some practical implications. First, in Study 3, the top item placement approach resulted in approximately 30-40% greater odds of choosing a healthy item in comparison to the middle and bottom conditions. While these figures may appear relatively small, if added up over time on a population level, consistent healthier choices could result in general health benefits such as better nutrient intake and physical wellbeing (Rozin et al., 2011). Second, the findings of Study 3 offer valuable suggestions for food purveyors who use online platforms such as UberEATS. In particular, they could increase healthier food choices by placing healthy items in the top sections of their menus. Third, in contrast to explicit interventions, nudges such as item placement techniques are more likely to be accepted by food purveyors. This is because they are less likely to impact profits, as consumers are gently guided towards healthier options rather than discouraged from making a purchase altogether. Nudges are also widely approved of by consumers, particularly in the context of health promotion (Junghans et al., 2015).

Like all studies, the present research has some limitations, which may point to future research directions. First, participation was restricted to women to facilitate the investigation of dietary restraint as a potential moderating variable. However, women are generally more likely to select healthy items than men (Wardle et al., 2004), which could have skewed the results. To generalise the present findings, future research should examine the effect of item placement on food choices in all genders. Second, although snack foods are commonly

purchased through online ordering systems (Bates et al., 2020), consumers may generally buy these in bulk rather than as individual items. In contrast, restaurant menus provide a context where customers often order a single dish. Thus, future studies could usefully investigate item placement techniques in both paper and online restaurant menus. Finally, the packaging of the various food items varied in size and colour, which could have made certain items more noticeable. While variations in packaging are a feature of real-world snack menus, future studies could circumvent this issue by using unpackaged foods such as meals on plates.

In conclusion, we found that in online menus, the placement of healthy snacks predicted food choice over and above section of choice and liking of food items. In online contexts, item placement techniques appear to be potentially powerful tools in promoting healthy food choices, with both restrained and unrestrained eaters preferring healthy items placed in the top section of the menu. More generally, the present studies offer valuable suggestions for promoting healthy food choices, particularly for businesses utilising online ordering platforms. Over time and with consistent use, item placement techniques could have the potential to provide health benefits at a population level.

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CHAPTER 4: STUDIES 4, 5 AND 6

A placement intervention for healthier food choices from online menus

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Statement of co-authorship: Indah Gynell, Eva Kemps and Ivanka Prichard designed the studies and wrote the protocol. Data was collected and statistical analyses were undertaken by Indah Gynell, under the supervision of Eva Kemps. Indah Gynell wrote the first draft of the manuscript. Indah Gynell, Eva Kemps, Ivanka Prichard and Marika Tiggemann edited subsequent drafts of the manuscript, and have approved the final manuscript.

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Preamble

The findings of the experimental studies reported in Chapter 3 revealed that, in the context of online menus, healthy foods were most popular from the top section of the menu, relative to the middle or bottom sections. This is an important finding, which highlights the potential for placement interventions to contribute usefully to future healthy-eating initiatives. However, while the findings outlined in Chapter 3 are promising, the menus in Studies 2 and 3 were single-page, and only offered snack food items. Therefore, the Chapter 3 findings are not necessarily generalisable to longer online menus, such as those commonly used in restaurant settings or online food ordering platforms. This is an important next step, as settings where multiple choices are offered have been linked to an increase in unhealthy consumption behaviours (Lin et al., 1998).

Accordingly, Studies 4-6 aimed to further investigate the effects of placement interventions on food choices using three-page online menus that offered main, side and dessert dishes. In line with the finding that the placement intervention in Study 3 was effective in the context of online menus, and in response to the growing popularity of online food-ordering systems, Studies 4-6 utilised online contexts. To further increase the external validity of our findings, we also used three different cuisines across the three experimental studies. In Study 4, we used fast-food cuisine, in Study 5 Chinese cuisine, and in Study 6 modern mixed Australian cuisine.

Abstract

In response to growing concern about poor-quality diets and related chronic health conditions, we investigated the effectiveness of an implicit intervention to promote healthy food choices, namely item placement. Three experimental studies compared presentation of healthy dishes in the top, middle, and bottom sections of an online menu, using three different cuisines. Study 4 examined fast-food cuisine, Study 5 Chinese cuisine, and Study 6 mixed Australian cuisine. Menus consisted of 8 unhealthy and 4 healthy main, side and dessert dishes (36 dishes in total) presented in one column on three separate pages. Participants were asked to select one main, one side, and one dessert. They then completed the Revised Restraint Scale to determine dietary restraint status and the Consumer Nutrition Knowledge Scale to assess nutrition knowledge. There was no difference between conditions in the number of healthy food choices from the fast-food menu (Study 4; n = 185) or Chinese menu (Study 5; n = 184). However, participants who saw healthy foods in the top or bottom sections of the mixed Australian menu (Study 6; n = 186) made more healthy choices than participants who saw healthy foods in the middle section, regardless of dietary restraint or nutrition knowledge. Our findings suggest that item placement may be a useful strategy for encouraging healthier choices from online menus, depending on the type of cuisine.

Introduction

Poor quality, highly processed and nutrient-deficient diets have been consistently linked to chronic conditions such as diabetes (Walsh et al., 2021), heart disease (Mente et al., 2009) and some cancers (Key et al., 2004). As these are serious, life-threatening conditions (World Health Organization, 2020), it is crucial to investigate how best to promote healthier eating behaviours (Burton et al., 2006). To date, unhealthy eating behaviours have been largely targeted using explicit interventions. These include educational programs, policy changes, and public health campaigns (Walls et al., 2011). However, research suggests that such interventions are often ineffective at promoting healthy eating (de Ridder et al., 2017). For example, policies such as taxation of unhealthy foods provoke resistance amongst consumers and business owners (Bowen et al., 2015), while restrictive strategies such as weight-loss diets can cause feelings of isolation and resentment, limiting their long-term success (Thomas et al., 2008). For these reasons, more implicit interventions have been gaining traction.

Implicit interventions, like nudging (Thaler & Sunstein, 2008), prompt certain behaviours or choices without compromising autonomy or independence (Junghans et al., 2015). Unlike explicit interventions, implicit interventions are unlikely to provoke resistance or resentment, as feelings of freedom are preserved (Junghans et al.). In addition, most implicit interventions are cheap and simple to implement (Dayan & Bar-Hillel, 2011), making them feasible and practical. As such, they have the potential to positively impact future health promotion initiatives. In the context of food choice, implicit interventions often capitalise on humans' natural tendencies to favour the easiest or most salient options, such as those foods pre-selected as the default choice on an online food ordering system (e.g., Colby et al., 2020) or given enticing names (e.g., Olstad et al., 2014). Another way to make healthy food options more accessible or salient than others is to alter the placement of certain food

items (e.g., on a menu, a buffet table, or a supermarket shelf) in relation to others. For example, Foster et al. (2014) increased healthy food choices at a supermarket by placing healthy items at eye level in the middle of the shelf, while Romero and Biswas (2016) increased healthy food choices by placing healthy items to the left of unhealthy items on a menu.

While research on the impact of item placement on food choices from menus has progressed considerably in recent years, findings have been mixed. For instance, Dayan and Bar-Hillel (2011) found that food items placed in the top and bottom sections of a menu were chosen nearly twice as often as those placed in the middle section amongst consumers at a café. Similarly, Feldman et al. (2011) successfully increased healthy food choices amongst older adults by placing healthy dishes in the top section of dinner menus at assisted living residences. Contrastingly, Wyse et al. (2019) found that placing healthy items at the top and bottom of a school lunch menu did not increase healthy choices. Likewise, Bergman et al.'s (2021) placement interventions in the context of an online lunch menu did not increase healthy choices amongst young adults. Adding to these varied findings, Choi et al.'s (2010) participants paid more visual attention to items placed in the middle of a restaurant menu, than items placed at the top or bottom. The majority of their respondents, who were customers at Korean restaurants, also indicated that when dining out they tend to order items from the middle either often or very often. More recently, Gynell et al. (2022) compared the healthiness of food choices from a snack menu presenting healthy items in either the top, middle or bottom menu sections across two experiments: one in a physical setting, and one in an online setting. They found that university students selected more healthy snack foods when they were placed at the top of an online menu, but not a physical menu. They suggested that the format of the online menu whereby participants could scroll down the page to view the full list may have strengthened the effect of the placement intervention in the online

setting. However, placement effects are yet to be investigated in the context of full meal choices from online platforms.

Research on placement interventions in the context of meals (e.g., mains, sides, and desserts) is particularly important, as consumers tend to indulge when ordering from menus that offer multiple choices (Cohen & Story, 2014). Such indulgence has been linked to problematic dietary behaviours, including over-consumption and nutrient-poor food choices (Lin et al., 1998). Furthermore, the online food industry has grown exponentially in the past few years, with many restaurants now utilising online food ordering platforms such as UberEats® (Amist et al., 2021). More recently, the COVID-19 pandemic has further accelerated the popularity of such platforms, enabling businesses and consumers to adhere to lockdowns and social distancing regulations (Brewer & Sebby, 2021). Online ordering systems and digital platforms are also associated with unhealthy and impulsive behaviours (Bates et al., 2020; Abell, 2019). Therefore, in line with Gynell et al.'s (2022) finding that item placement was more effective using an online menu, the present investigations utilised online contexts.

The present research tested three variations of a placement intervention using online menus offering main, side and dessert dishes. Specifically, we compared the presentation of healthy dishes in the top, middle or bottom sections of a menu to determine which would most effectively promote healthy food choices. To increase the external validity of our findings, we compared the variations of the placement intervention across three experimental studies, using three different cuisines. In Study 4, we used fast-food cuisine, which is one of the most popular cuisines ordered via online platforms (e.g., UberEATS® and Deliveroo®) in Australia (Cameron et al., 2022; Partridge et al., 2020). Study 5 used Chinese cuisine, which is also commonly ordered online (Sun, 2019), and is rapidly gaining popularity amongst Australian consumers (Ma & Hsiao, 2020). Lastly, Study 6 used a modern mixed Australian

cuisine consisting of food dishes from mixed origins (e.g., Indian curry, British fish and chips, French croissants). Based on the findings of Gynell et al. (2022), we predicted that participants in the present studies would make more healthy food choices when the healthy dishes were placed in the top sections of the menu pages, in comparison to the middle or bottom sections.

We also measured dietary restraint as a potential moderator of the effect of item placement on healthy food choices. Some research (e.g., Deek et al., 2022; Kemps et al., 2016; Papies & Hamstra, 2010; Tonkin et al., 2019) suggests that the effects of nudges may be stronger for restrained eaters than for unrestrained eaters. However, dietary restraint has had no impact on the efficacy of nudging interventions in other studies (e.g., Gynell et al., 2021; Keegan et al., 2019; Rotenberg et al., 2005). Therefore, measuring dietary restraint was simply explorative, and no specific hypotheses were made. We further measured nutrition knowledge to examine whether an increased understanding of nutrition would be associated with an increase in healthy food choices, as some previous studies have demonstrated (Kandiah & Jones, 2002; Pirouznia, 2001).

Study 4: The effect of item placement on food choices from a fast-food menu

Method

Participants

The sample consisted of 184 students (women (N = 141), men (N = 40) and non-binary individuals (N = 4)) from Flinders University, South Australia. An a priori power analysis determined that for regression and ANOVA analyses, a sample of this size would provide adequate statistical power to detect a moderate sized effect at .80 power with an alpha level of .05 (Cohen, 1988). In line with Colby et al. (2020), our benchmark for a moderate sized odds ratio (*ExpB*) was 1.25, and in line with (Lakens, 2013), our benchmark for a moderate sized Eta squared (η^2) value was 0.05. Participants were recruited for a study

on menu choices through the University's online research participation system. Participants were eligible to take part if they were English speakers, with no food allergies or intolerances who were not pescatarian, vegetarian or vegan, and who liked most foods. To equalise hunger levels, participants were instructed to refrain from eating or drinking anything except water for two hours prior to participation. In compensation for their time, participants received either course credit or a $5 gift voucher.

Design

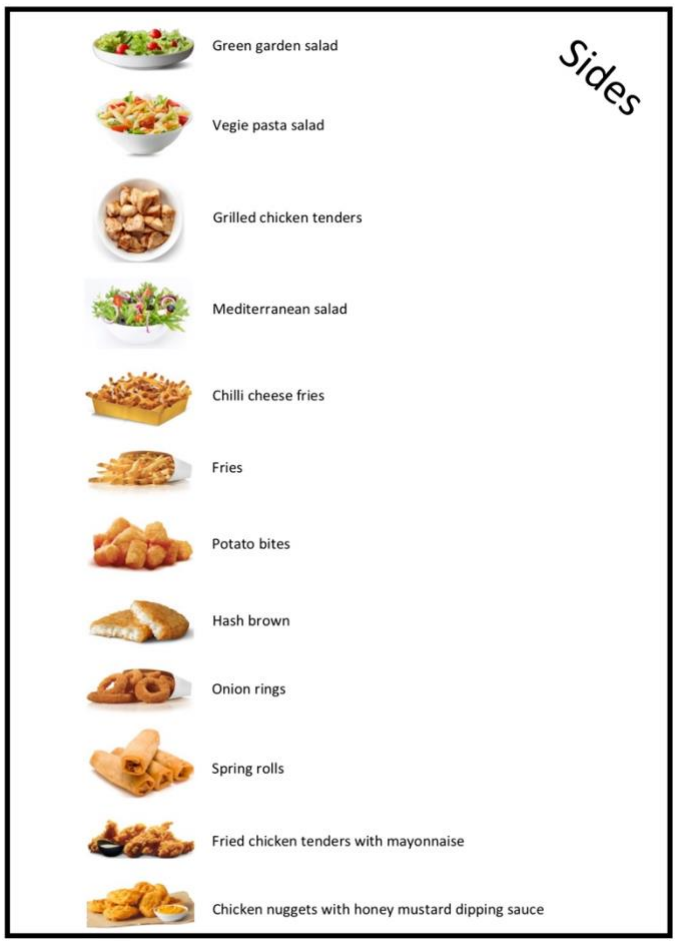
The study used a 3 (placement condition: top, middle, bottom) x 2 (dietary restraint status: restrained eaters, unrestrained eaters) between-subjects design. Participants were randomly allocated to a placement condition. The dependent variables were the number of healthy food choices overall (out of 3), and the number of healthy and unhealthy main, side, and dessert choices.

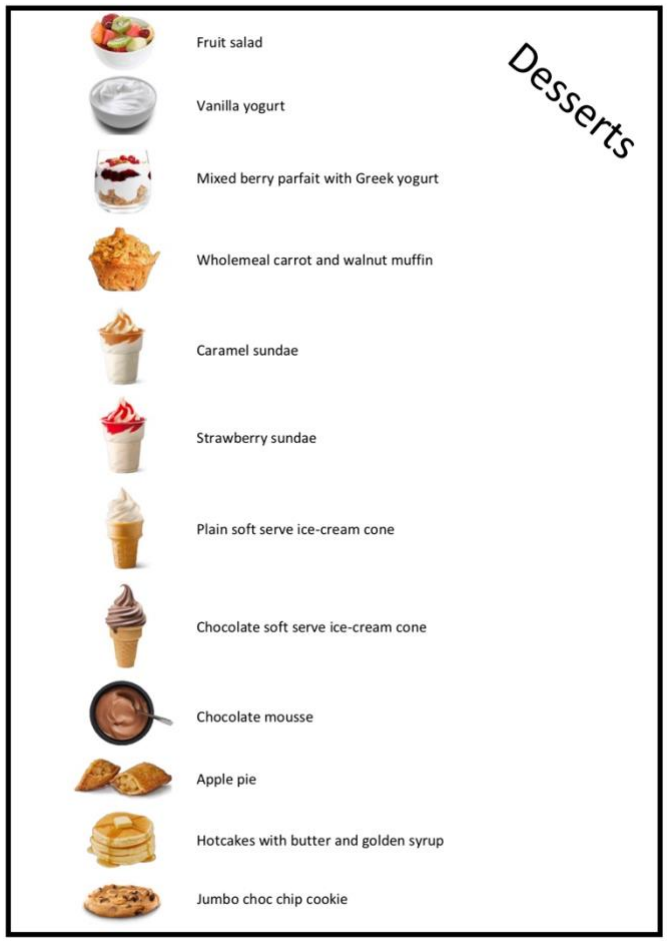
Materials

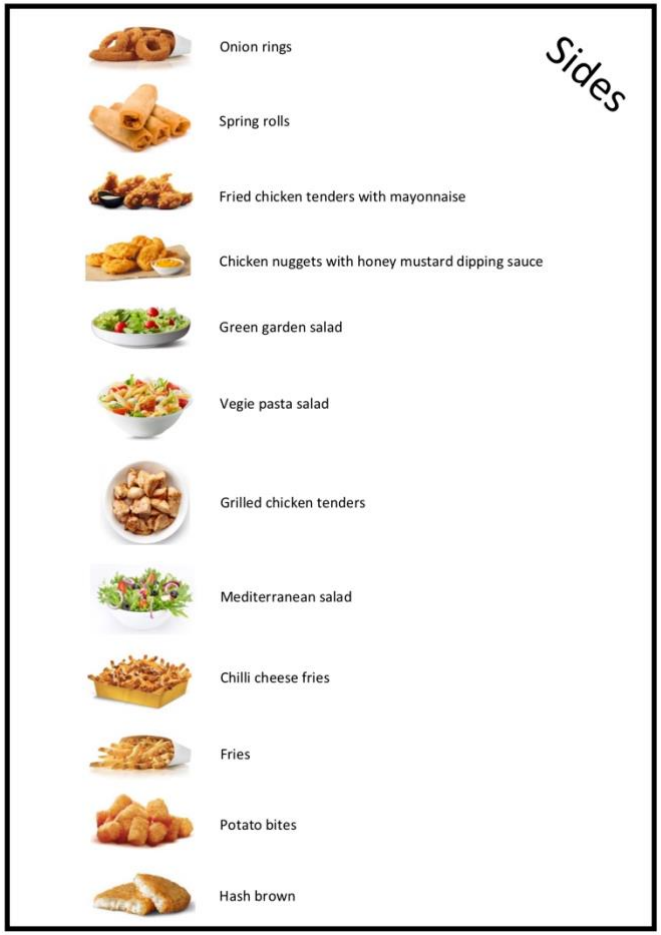
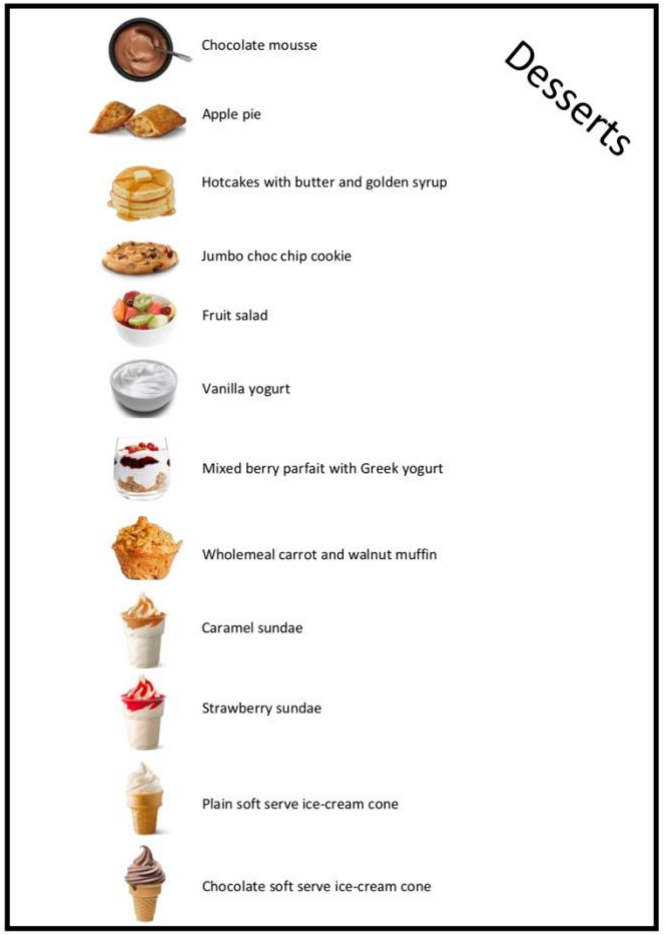
Menu. Three different versions of a coloured, pictorial menu were used (one for each placement condition). Each version of the menu contained the same four healthy and eight unhealthy main, side and dessert options, which consisted of dishes typically seen on Australian fast-food menus (see Figure 1). Mains, sides, and desserts were presented on separate pages. On each page, the dishes were arranged in a single column of 12 items. One version of the menu presented the four healthy dishes on each page first, one version presented them in the middle, and one presented them last. Participants were asked to choose one main, one side, and one dessert by clicking on the images of their chosen dishes.

Panel A. Menu for the top placement condition

Mains with healthy dishes on top	Sides with healthy dishes on top	Desserts with healthy dishes on top





	Mains with healthy dishes in the middle	Sides with healthy dishes in the middle	Desserts with healthy dishes in the middle
Panel B. Menu for the middle placement condition			

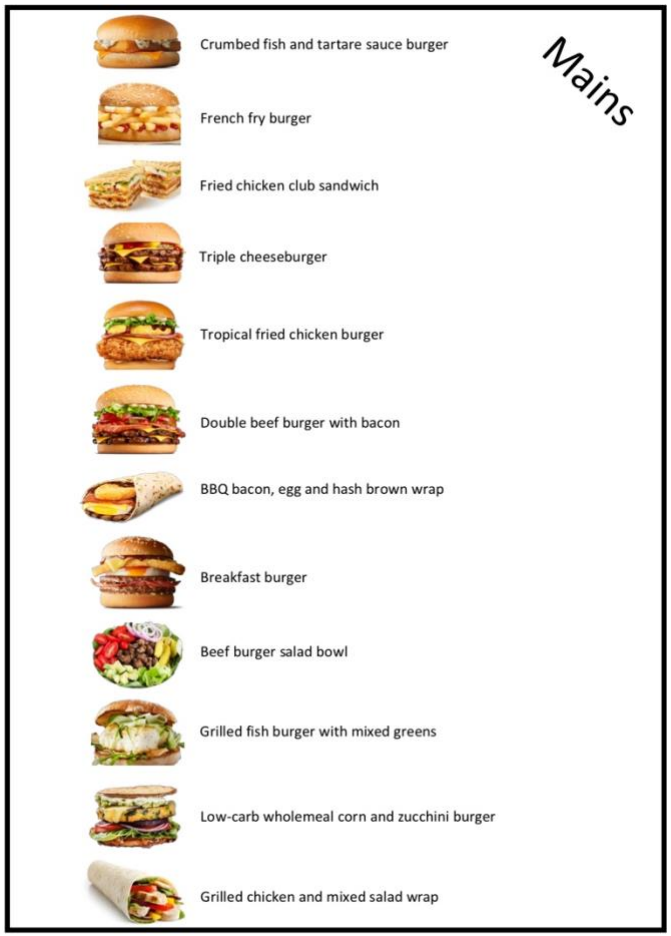
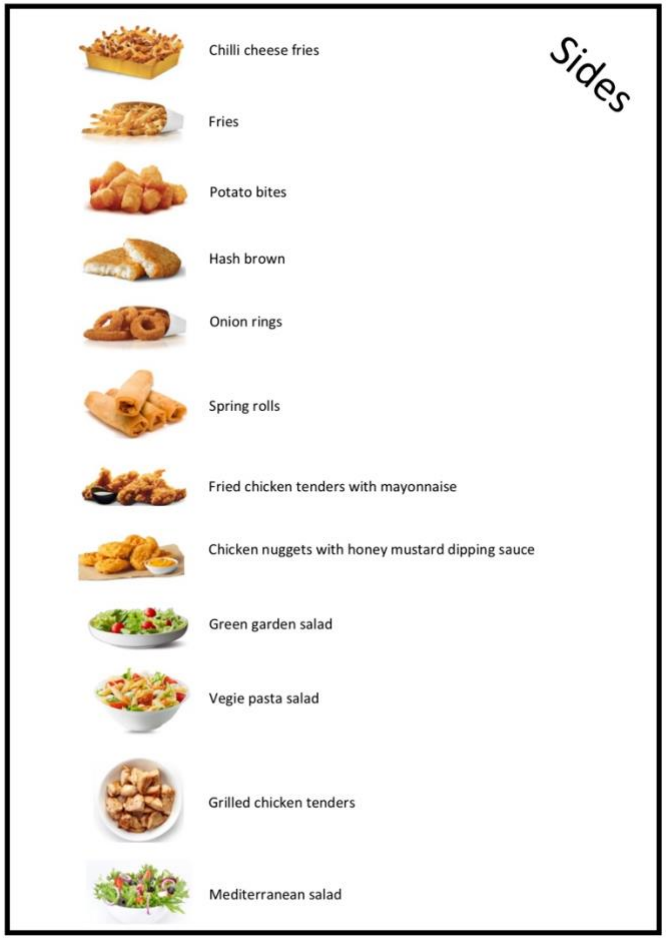
	Mains with healthy dishes on the bottom	Sides with healthy dishes on the bottom	Desserts with healthy dishes on the bottom
Panel C. Menu for the bottom placement condition			

Figure 1. Menus for each of the three placement conditions in Study 4.

The fast-food dishes were taken from an initial pool of 62 dishes based on menu items from existing Australian fast-food outlets. Objective nutritional information was provided by the Victorian Government Healthy Eating Advisory Service's FoodChecker (Nutrition Australia & Victoria State Government, 2016). The FoodChecker uses a traffic light system where foods are categorised into three groups: green, amber, and red, based on their fat, salt, sugar, and nutrient content. Foods in the 'green' category are the healthiest options and should be eaten regularly, foods in the 'amber' category can be eaten in moderation, and foods in the 'red' category are the least healthy options and should be limited or avoided. In line with these ratings, this initial pool included 30 healthy 'green' dishes and 32 unhealthy 'red' dishes. These selections were confirmed by a pilot study to ensure that people's subjective perceptions of healthiness aligned with these objective selections. The pilot study was conducted online using Qualtrics survey software. Volunteers (N = 22) aged between 17 and 65 years rated photographs of the dishes on perceived healthiness, how well the name of the dish described the image, and their familiarity with the dishes. Ratings were made on 9-point scales ranging from 'not at all healthy' to 'extremely healthy', 'not at all well' to 'extremely well', and 'not at all familiar' to 'extremely familiar', respectively. Based on the data from this pilot study, four 'healthy' dishes and eight 'unhealthy' dishes from each menu category were selected. A series of paired samples t-tests showed that together, the final 12 healthy main, side and dessert dishes had a significantly higher mean healthiness rating (M = 6.69, SD = 0.76) than the final 24 unhealthy main, side and dessert dishes (M = 1.98, SD = 0.75), $t(21) = 21.07$, $p = < .001$. In addition, the extent to which the names of the dishes described the images did not vary significantly between the 12 healthy (M = 8.34, SD = 0.93) and the 24 unhealthy (M = 8.48, SD = 0.80) dishes, $t(21) = -1.10$, $p = .255$. Nor were there significant differences in the familiarity ratings of the 12 healthy (M = 7.18, SD = 1.20) and the 24 unhealthy (M = 6.59, SD = 2.12) dishes, $t(21) = 1.93$, $p = .067$.

Post-choice questionnaire. Participants were asked to briefly describe why they chose their particular dishes to determine the most common reasons for choices, and to probe for suspicion of the experimental manipulation. Participants also rated how much they liked each of the dishes on a 9-point scale ranging from 1 'dislike extremely' to 9 'like extremely'.

Dietary restraint. The Revised Restraint Scale (Herman & Polivy, 1980) was used to assess dietary restraint. This ten-item, self-report scale measures weight fluctuation (e.g., "What is the maximum amount of weight (in kg) that you have ever lost within a month?") and dieting-related concerns and thoughts (e.g., "Do you have feelings of guilt after overeating?"). Participants indicate their response from a set of four to five options (e.g., "never, rarely, sometimes, often, always"). Total scores range from 0 to 35, with higher scores indicating greater dietary restraint. Participants who score 15 or more are considered restrained eaters; those who score 14 or below are considered unrestrained eaters. In the current sample, the internal consistency of the Revised Restraint Scale was good ($\alpha = .82$).

Nutrition knowledge. The validated Consumer Nutrition Knowledge Scale (CoNKS) (Dickson-Spillmann et al., 2011) was used to assess participants' knowledge about nutrition. The scale comprises 20 items relating to calorie content (e.g., 'If cream is whipped it contains less calories than in its liquid form'), healthiness (e.g., 'Brown sugar is much healthier than white sugar'), and nutrient value (e.g., 'Lentils contain only few useful nutrients, therefore their health benefit is not great'). Participants indicate their response by selecting either 'true', 'false' or 'don't know'. Total scores range from 0-20, with higher scores indicating better nutrition knowledge. The scale has good construct validity and internal consistency (Cronbach's $\alpha = .73$) (Dickson-Spillmann et al., 2011). In the current sample, the internal consistency of the Consumer Nutrition Knowledge Scale was adequate ($\alpha = .71$).

Procedure

The present study was conducted online using Qualtrics survey software. After providing informed consent, participants completed a short demographics questionnaire, including the length of time since they had last consumed any food or drink other than water, and a rating of their current hunger level on a 100 mm visual analogue scale ranging from 'not at all hungry' to 'extremely hungry'. Participants were then told to imagine that they were on an online food ordering platform and had selected a fast-food restaurant to order from. They were further told that they would see a menu consisting of main, side, and dessert dishes, and should select one dish from each category. Next, they were presented with the menu (one page at a time), with healthy dishes in the top, middle, or bottom sections, depending on their condition. After choosing their dishes, participants were asked if they would like to make any changes to their order. Those who wished to make changes were shown the menu (from the same condition) again and were able to make new choices. In this way, the study was similar to real-world food ordering platforms, which allow consumers to change their mind. Participants then completed the reason for choice question, the Revised Restraint Scale and the Consumer Nutrition Knowledge Scale. Participants were subsequently asked to rate how often they typically consume fast-food on a 7-point scale ranging from 'never' to 'more than once per day'. Finally, participants reported their height and weight from which BMI (kg/m^2) was calculated. The questionnaire took approximately 15 minutes to complete.

Results

Sample Characteristics and Food Choices

A series of one-way ANOVAs showed that participants in the three placement conditions did not differ significantly in terms of age, BMI, time since last eating or drinking, hunger, dietary restraint or nutrition knowledge (all *p*s > .05; for details see Table S1,

supplementary material). A Chi square test showed that gender did not differ significantly across the three conditions, $\chi^2(6) = 3.91$, $p = .688$. For all conditions combined, participants most frequently consumed fast-food once or twice per week (42.2%, $n = 78$) or once or twice per month (40.5%, $n = 75$). There was no significant difference between conditions in frequency of usual fast-food consumption, $\chi^2(8) = 8.84$, $p = .356$. Taste (mains = 32.4%, sides = 26.0%, desserts = 37.8%) was the most common reason for food choices across conditions and menu categories. Habit (mains = 9.9%, sides = 18.2%, desserts = 11.6%) was another prominent reason for choice, and several participants based their side and dessert choices on what would pair well with their earlier selection/s (sides = 23.2%, desserts = 9.3%; for full listing of reasons see Table S2, supplementary material).

Across conditions, tropical chicken burger (22.6%) and fried chicken club sandwich (16.1%) were the most frequently selected mains, fries (34.1%) and fried chicken tenders (10.3%) were the most frequently selected sides, and caramel sundae (17.2%) and fruit salad (15.1%) were the most frequently selected desserts. Table S3 (see supplementary material) displays the number and percentage of choices for every dish on the menu. Liking ratings (see Table S4, supplementary material) suggest that the most chosen dishes were generally well-liked.

Effect of Placement Condition on Healthy Food Choices

Across all conditions, healthy main (25.4%), side (14.6%) and dessert (24.3%) dishes were chosen less frequently than unhealthy main (74.6%), side (85.4%) and dessert (75.7%) dishes. A 3 (placement condition: top, middle, bottom) x 2 (dietary restraint status: restrained, unrestrained) factorial ANOVA was used to test the main effects of condition and dietary restraint and the condition by dietary restraint interaction on the number of healthy food choices across the three menu categories. There were no significant main effects of

placement condition, $F(2,184) = 0.33$, $p = .721$, $\eta^2 = .002$, or dietary restraint, $F(1,184) = 0.54$, $p = .462$, $\eta^2 = .002$, nor a significant condition by dietary restraint interaction, $F(2,184) = 0.34$, $p = .710$, $\eta^2 = .003$. Contrary to prediction, participants assigned to the top placement condition did not choose more healthy foods than those in the middle or bottom placement conditions. Table 1 displays the mean number of healthy food choices (out of 3) for each condition.

Table 1

Means (and Standard Deviations) for the Number of Healthy Food Choices (out of 3) and Number (and Percentage) for Main, Side and Dessert Choices (Healthy, Unhealthy) by Condition (Top, Middle, Bottom) in Study 4

Condition	**Number of healthy food choices (out of 3)**	
Overall food choices		
Top	0.61 (0.87)	
Middle	0.71 (0.88)	
Bottom	0.63 (0.91)	
Mains	**Healthy**	**Unhealthy**
Top	14 (23.3%)	46 (76.7%)
Middle	15 (23.8%)	48 (76.2%)
Bottom	18 (29.0%)	44 (71.0%)
Sides		
Top	8 (13.3%)	52 (86.7%)
Middle	12 (19.0%)	51 (81.0%)
Bottom	7 (11.3%)	55 (88.7%)
Desserts		
Top	14 (23.3%)	46 (76.7%)
Middle	17 (27.0%)	46 (73.0%)
Bottom	14 (22.6%)	48 (77.4%)

In order to investigate each menu category separately, a series of binomial logistic regressions tested the main effects of condition and dietary restraint and the condition by dietary restraint interaction on food choice, within the main, side and dessert categories. The

placement condition variable was initially dummy coded with the top condition as the reference category, such that two new dummy variables, which compared the top against the middle group, and the top against the bottom group were created. The regressions were then repeated with the bottom condition as the reference category, allowing for comparisons between the middle and the bottom groups. Food choice, the dependent variable, was coded as 0 = unhealthy, 1 = healthy. The moderator variable, dietary restraint status, was coded as 1 = restrained, 2 = unrestrained.

In Step 1 of the logistic regressions, placement condition and dietary restraint were entered. Together, these variables did not predict main choice, $\chi^2(3) = 0.50$, $p = .919$ (Nagelkerke pseudo $R^2 = .004$), side choice $\chi^2(3) = 2.11$, $p = .550$ (Nagelkerke pseudo $R^2 = .02$), nor dessert choice $\chi^2(3) = 3.08$, $p = .380$ (Nagelkerke pseudo $R^2 = .03$). In Step 2, adding the placement condition by dietary restraint product term did not significantly enhance the prediction of main choice, $\chi^2(2) = 1.43$, $p = .490$ (Nagelkerke pseudo $R^2 = .02$), side choice $\chi^2(2) = .93$, $p = .627$ (Nagelkerke pseudo $R^2 = .03$), nor dessert choice $\chi^2(2) = 1.06$, $p = .590$ (Nagelkerke pseudo $R^2 = .03$).[2] See Table 1 for the numbers and percentages of healthy and unhealthy main, side and dessert choices for each condition, and Table S5 (supplementary material) for the full list of statistics for the above series of binary logistic regressions.

Predictors of Healthy Food Choices

A simultaneous multiple regression was conducted to investigate the other general predictors of healthy food choices (liking, hunger, BMI, dietary restraint, nutrition knowledge, gender, frequency of fast-food consumption) alongside placement condition, across the three menu categories. Together, these variables predicted the overall number of healthy food choices, $F(10, 184) = 5.67$, $p < .001$, $R^2 = .26$. As shown in Table 2, liking (of

[2] Running the regression with the bottom condition as the reference group revealed the same pattern of results, such that there was no variation in healthy choices between the middle and bottom conditions, and no significant interaction with dietary restraint.

both healthy and unhealthy foods) and frequency of usual fast-food consumption were the only independent predictors.

Table 2

Inferential and Descriptive Statistics for the Main Effects of Placement Condition, Mean Liking Rating (of Healthy and Unhealthy Dishes), Hunger, BMI, Dietary Restraint, Nutrition Knowledge, Gender and Frequency of Fast-Food Consumption for the Number of Healthy Food Choices (out of 3) in Study 4

Predictor	***B***	**SE**	**B**	***p***	***95% CI***
Top condition (versus middle)	.11	.14	.06	.448	-.17-.39
Top condition (versus bottom)	.003	.15	.002	.984	-.28 - .29
Middle condition (versus bottom)	.11	.15	.06	.465	-.18 - .39
Mean liking of healthy dishes	.21	.05	.34	<.001	.12 - .30
Mean liking of unhealthy dishes	-.35	.06	-.42	<.001	-.47 - -.22
Hunger rating	<.001	.003	-.01	.938	-.01 - .01
Body Mass Index (kg/m^2)	.01	.01	.09	.257	-.01 - .04
Dietary restraint	-.01	.01	-.04	.618	-.03 - .03
Nutrition knowledge	<.001	.02	-.002	.983	-.04 - .03
Gender	-.01	.08	-.01	.891	-.18 - .15
Frequency of usual fast-food consumption	-.23	.08	-.21	.006	-.38 - -.07

$N = 185$.

Discussion

Study 4 investigated the effect of item placement on choices from a fast-food menu. Contrary to prediction, participants who saw healthy foods in the top section of the menu did not select more healthy foods than participants who saw healthy foods in either the middle or bottom sections. There was also no difference in food choice between participants who saw healthy foods in the middle and participants who saw healthy foods at the bottom. Liking and frequency of usual fast-food consumption appeared to be the main drivers of overall healthy food choices. Participants who liked the healthy foods on the menu made more healthy food choices than participants who liked the unhealthy foods on the menu, while the more frequently participants consumed fast foods, the fewer healthy food choices they made. There were also no differences in food choice between conditions within menu categories (i.e., mains, sides, and desserts).

One possible explanation for the lack of an effect of item placement on fast-food choices could be the widespread popularity of fast foods amongst Australian consumers. Fast-food is the most common cuisine purchased by Australian consumers when dining out or ordering takeaway (Cameron et al., 2022). Fast-food businesses also make up the majority of establishments that prepare and sell meals in Australia (Cameron et al.). In support, participants were frequent consumers of fast food, eating it at least once or twice per week. They also frequently attributed their food choices to existing fast-food ordering habits. Therefore, it is possible that participants had such long-standing fast-food ordering habits that they turned to their usual choices no matter where they were positioned on the menu. This fits with Marien et al.'s (2018) suggestion that when an individual's choices or behaviours are driven by habit, considering new or different options is very unlikely.

Study 5: The effect of item placement on food choices from a Chinese menu

As the widespread popularity of fast-food may have overshadowed any impact of item placement on healthy choices in Study 4, we turned our investigation to a different cuisine in Study 5, namely Chinese food. Although Chinese food is commonly consumed in Australia (Ma & Hsiao, 2020), it does not reach the same level of popularity as fast-food (Anderson & Benbow, 2015; Flowers & Swan, 2012; Partridge et al., 2020). Being more meal-like than snack-like, Chinese cuisine also generally offers a more even ratio of healthy to unhealthy options, in comparison to other cuisines which can be predominantly unhealthy (e.g., American; Freedman, 2019). This allowed for more variation within the healthy food options in Study 5 than was possible in Study 4.

Method

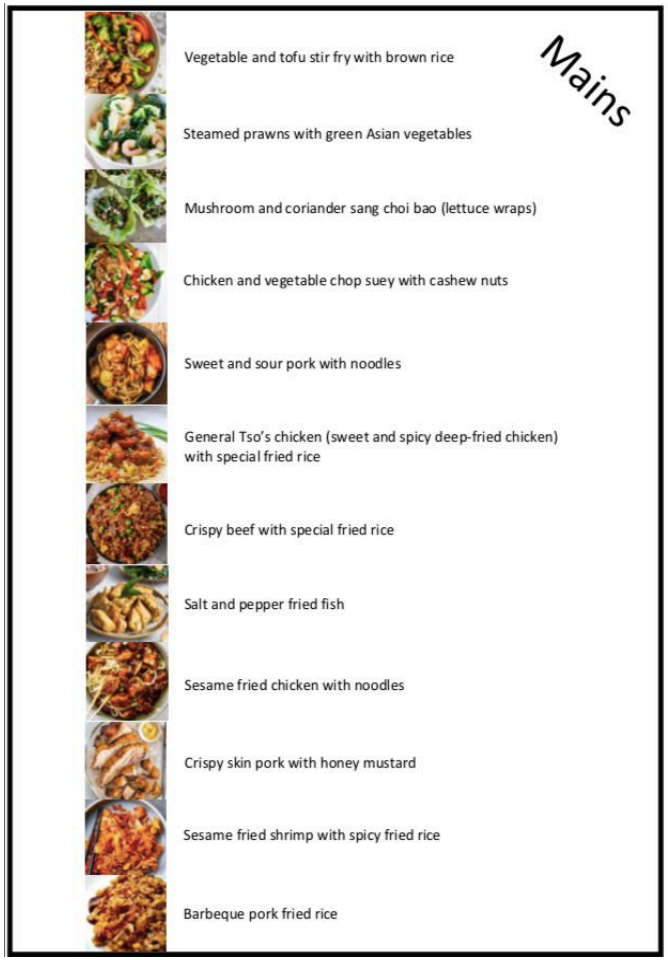
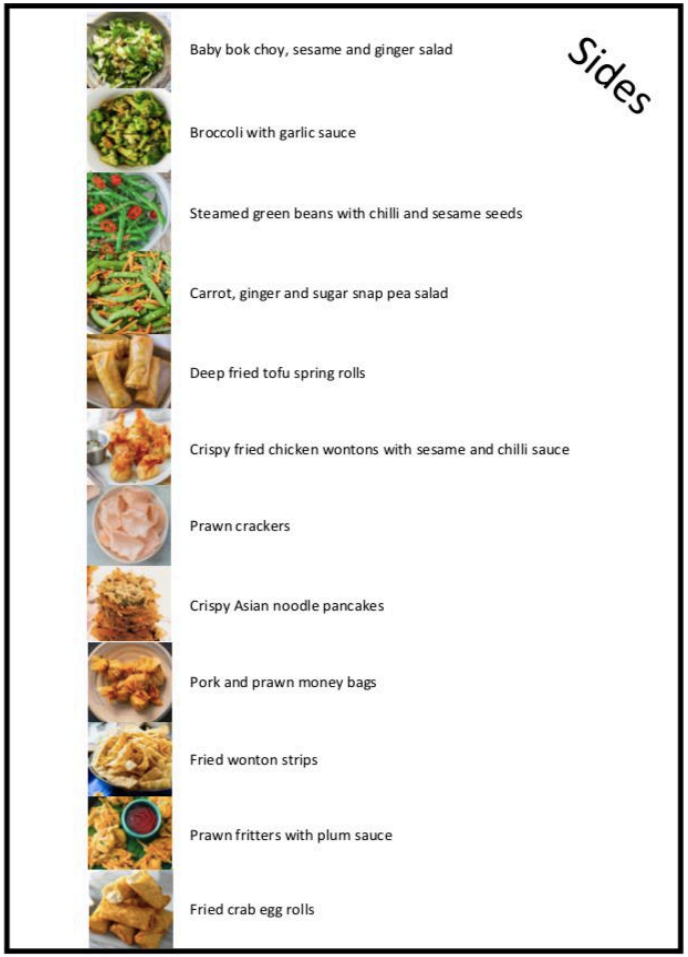
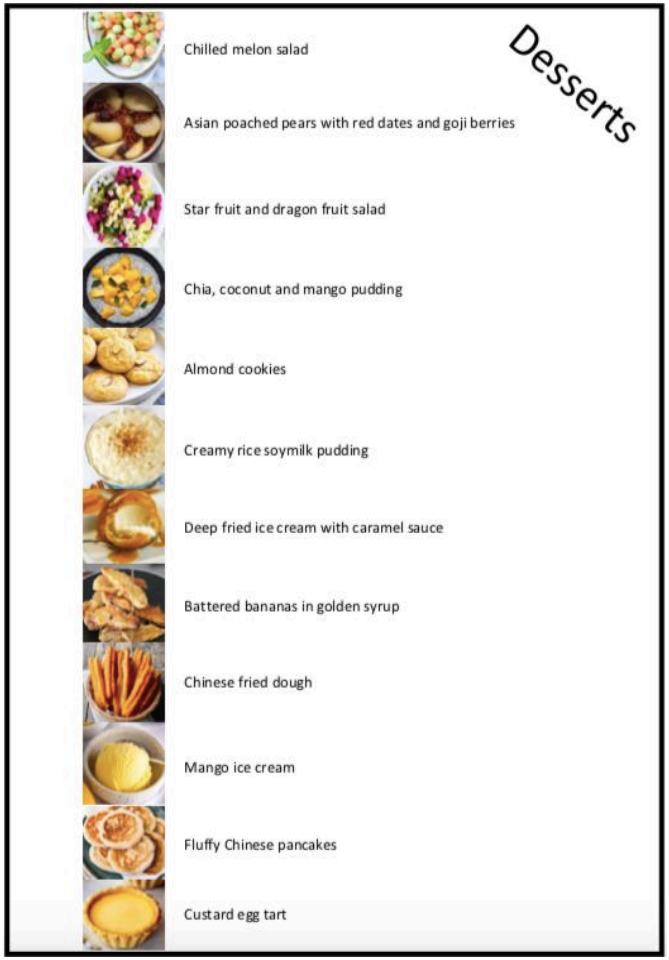
Participants

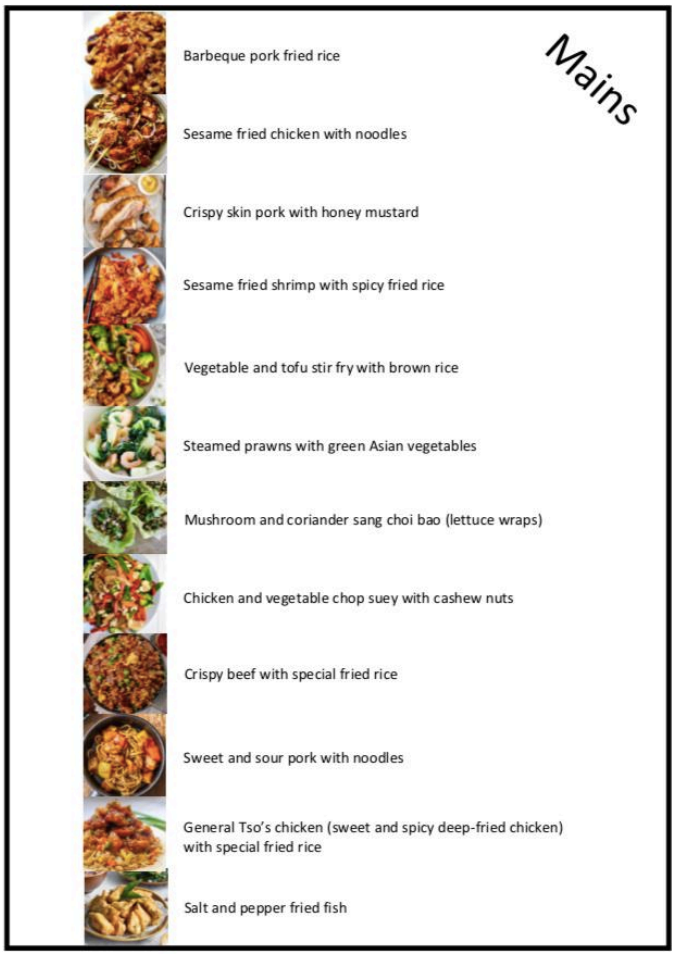
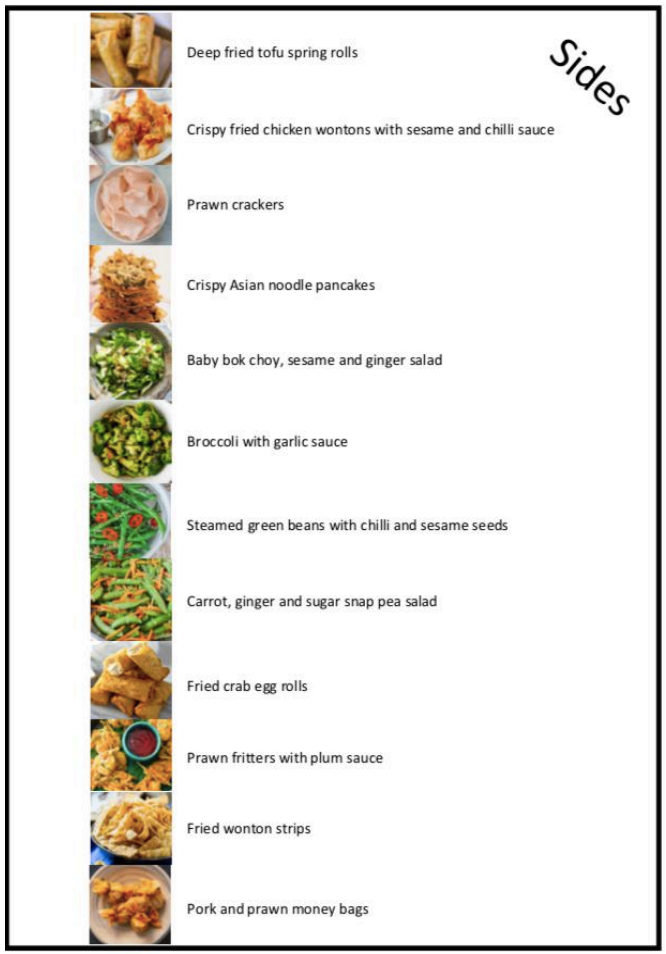
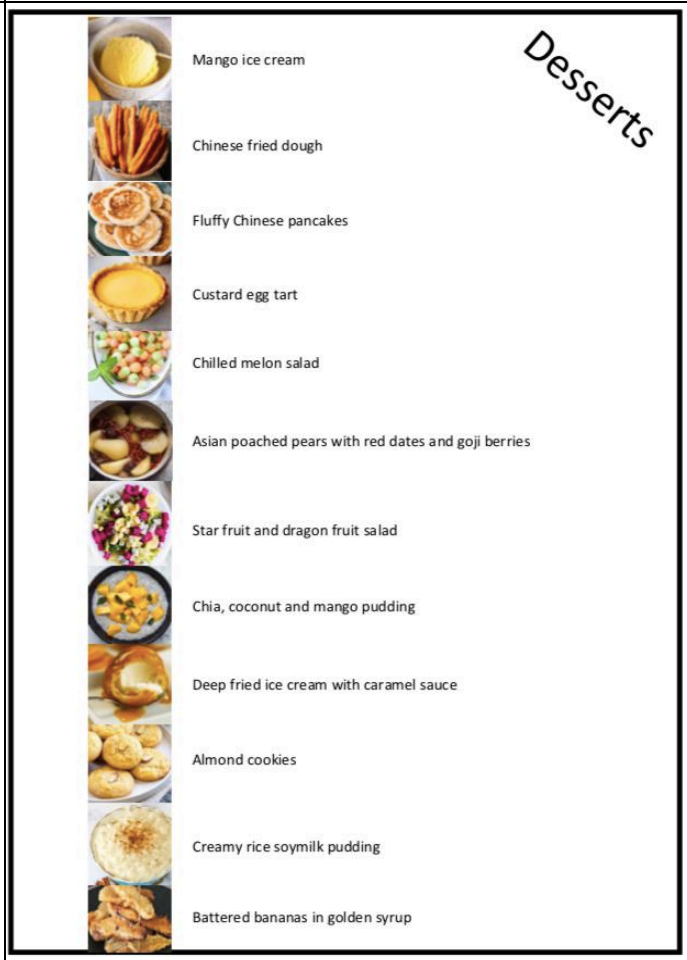
The sample consisted of 184 students (women (N = 158), men (N = 23) and non-binary individuals (N = 3)) from Flinders University, South Australia. Eligibility criteria and methods of participant recruitment were the same as in Study 4.

Design, Materials and Procedure

Design, materials, and procedure were the same as for Study 4, except that the menu was made up of main, side and dessert dishes that are typically seen on Chinese restaurant menus. One version of the menu presented the four healthy dishes first, one version presented them in the middle, and one presented them last (see Figure 2). The Chinese foods were taken from an initial pool of 75 dishes. This initial pool included 30 healthy ‘green’ dishes and 45 unhealthy ‘red’ dishes, which were classified using the Victorian Government Healthy Eating Advisory Service’s FoodChecker (Nutrition Australia & Victoria State Government, 2016). As in Study 4, these selections were confirmed by volunteers (N = 20) aged between 17 and 65 years, who rated photographs of the dishes on perceived healthiness, how well the name of the dish described the image, and their familiarity with the dishes in an online Qualtrics

survey. Ratings were made on 9-point scales. Based on the data from this pilot study, four 'healthy' dishes and eight 'unhealthy' dishes from each menu category were selected. Paired samples *t*-tests showed that together, the 12 healthy main, side and dessert dishes had a significantly higher mean healthiness rating ($M = 6.24$, $SD = 0.57$) than the 24 unhealthy main, side and dessert dishes ($M = 3.17$, $SD = 0.92$), $t(19) = -10.17$, $p = .002$. In addition, the extent to which the names of the dishes described the images did not vary significantly between the 12 healthy ($M = 7.98$, $SD = 0.89$) and the 24 unhealthy ($M = 7.79$, $SD = 0.91$) dishes, $t(19) = -1.85$, $p = .095$. Nor were there significant differences in the familiarity ratings of the 12 healthy ($M = 5.09$, $SD = 2.44$) and the 24 unhealthy ($M = 3.96$, $SD = 1.73$) dishes, $t(19) = -1.56$, $p = .164$.

	Mains with healthy dishes on top	Sides with healthy dishes on top	Desserts with healthy dishes on top
Panel A. Menu for the top placement condition			

	Mains with healthy dishes in the middle	Sides with healthy dishes in the middle	Desserts with healthy dishes in the middle
Panel B. Menu for the middle placement condition			

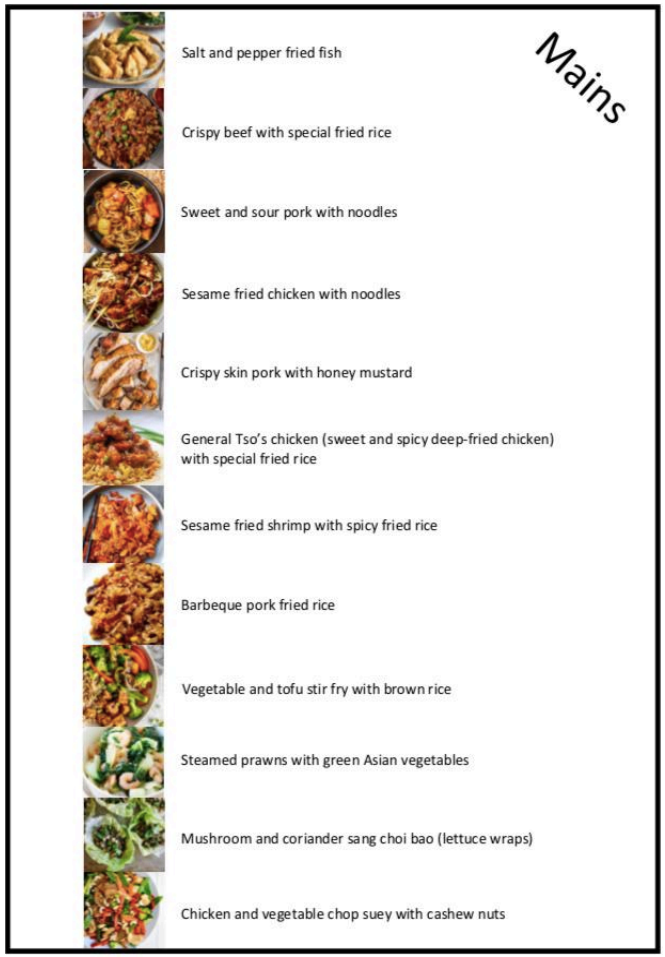
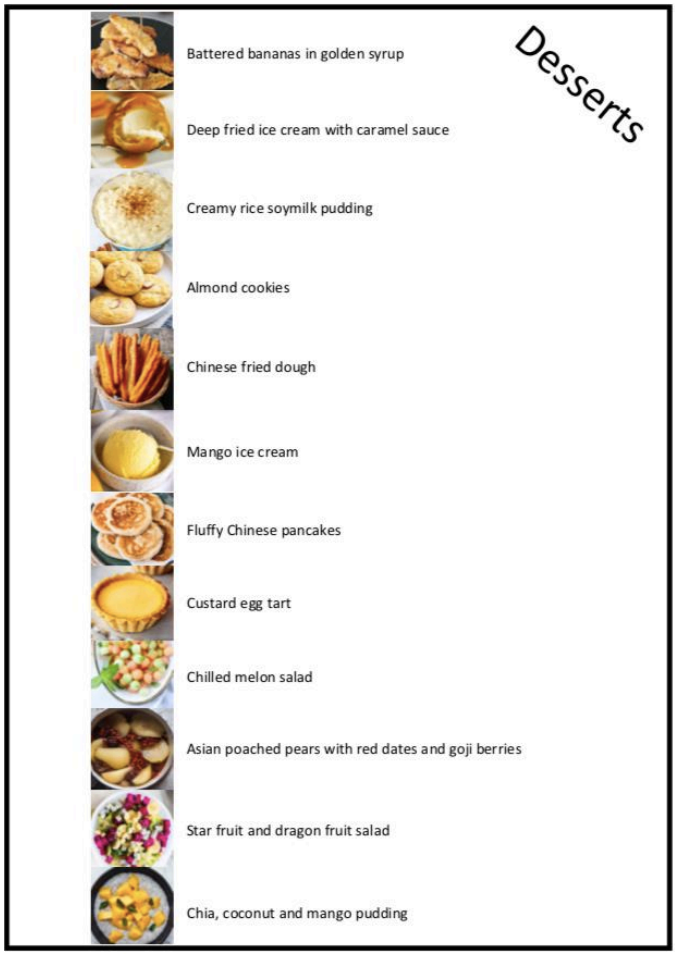
	Mains with healthy dishes on the bottom	Sides with healthy dishes on the bottom	Desserts with healthy dishes on the bottom
Panel C. Menu for the bottom placement condition			

Figure 2. Menus for each of the three placement conditions in Study 5.

In the post-choice questionnaire of the main study (in which participants rated how much they liked each dish), participants had the option to indicate that they were not familiar with a dish, in which case they were not asked to rate how much they liked it. After making their menu selections, participants were asked to rate how often they typically consume Chinese food using the same 7-point scale as in Study 4, which ranged from 'never' to 'more than once per day'.

Results

Sample Characteristics and Food Choices

A series of one-way ANOVAs showed that participants in the three placement conditions did not differ significantly in terms of age, BMI, time since last eating or drinking, hunger, dietary restraint or nutrition knowledge (all *p*s > .05; for details see Table S1, supplementary material). A Chi square test showed that gender did not differ significantly across the three conditions, $\chi^2(4) = 5.38$, $p = .251$. Six participants (3.26%) identified as being of Chinese ethnicity. Most participants consumed Chinese food once or twice per month (54.9%, $n = 101$) or once or twice per year (30.4%, $n = 56$). There was no significant difference between conditions in frequency of usual Chinese food consumption, $\chi^2(12) = 10.17$, $p = .601$. Taste (mains = 30.1%, sides = 24.6%, desserts = 32.4%) and familiarity (mains = 13.7%, sides = 21.9%, desserts = 19.2%) were particularly common reasons for food choices across conditions and menu categories. Visual/aesthetic reasons were also common, particularly for main and dessert choices (mains = 21.3%, sides = 8.2%, desserts = 13.2%; see Table S2, supplementary material).

Across conditions, sesame fried chicken with noodles (25.0%) and sweet and sour pork with noodles (12.5%) were the most frequently selected mains, prawn crackers (25.0%) and crispy fried chicken wontons (15.2%) were the most frequently selected sides, and deep-fried ice cream with caramel sauce (27.7%) and mango ice cream (23.3%) were the most

frequently selected desserts. Table S3 (see supplementary material) shows the number and percentage of times that each dish on the menu was chosen. Liking ratings (see Table S4, supplementary material) suggest that the most chosen dishes were also well-liked. The mean number of dishes (out of 36) that participants identified as unfamiliar was 9.51 (*SD* = 8.97; top condition, *M* = 8.48 (*SD* = 8.37), middle condition, *M* = 10.25 (*SD* = 9.39), bottom condition, *M* = 9.80 (*SD* = 9.19)). There was no significant difference between conditions in the number of dishes identified as unfamiliar, $F(2,183) = 0.65$, $p = .524$, $\eta^2 < .007$.

Effect of Placement Condition on Healthy Food Choices

Across all conditions, healthy main (17.4%), side (28.3%) and dessert (15.8%) dishes were chosen less frequently than unhealthy main (82.6%), side (71.7%) and dessert (84.2%) dishes. A 3 (placement condition: top, middle, bottom) x 2 (dietary restraint status: restrained, unrestrained) ANOVA revealed no significant main effects of placement condition, $F(2,183) = 0.41$, $p = .662$, $\eta^2 = .002$, or dietary restraint, $F(1,183) = 1.25$, $p = .266$, $\eta^2 = .004$, nor a significant condition by dietary restraint interaction, $F(2,183) = 0.002$, $p = .998$, $\eta^2 < .001$, on the number of healthy food choices. Contrary to prediction, participants assigned to the top placement condition did not choose more healthy foods than those in the middle or bottom placement conditions. Table 3 displays the mean number of healthy food choices (out of 3) for each condition.

Table 3

Means (and Standard Deviations) for the Number of Healthy Food Choices (out of 3) and Number (and Percentage) for Main, Side and Dessert Choices (Healthy, Unhealthy) by Condition (Top, Middle, Bottom) in Study 5

Condition	**Number of healthy food choices (out of 3)**	
Overall food choices		
Top	0.65 (0.91)	
Middle	0.52 (0.74)	
Bottom	0.63 (0.76)	
Mains	**Healthy**	**Unhealthy**
Top	11 (17.7%)	51 (82.3%)
Middle	12 (19.0%)	51 (81.0%)
Bottom	8 (13.6%)	51 (86.4%)
Sides		
Top	19 (30.6%)	43 (69.4%)
Middle	16 (25.4%)	47 (74.6%)
Bottom	17 (28.8%)	42 (71.2%)
Desserts		
Top	11 (17.7%)	51 (82.3%)
Middle	6 (9.5%)	57 (90.5%)
Bottom	12 (20.3%)	47 (79.7%)

As in Study 4, a series of binary logistic regressions tested the main effects of placement condition and dietary restraint and the condition by dietary restraint interaction on food choice, within each menu category. Together, placement condition and dietary restraint

did not predict main choice, $\chi^2(3) = 0.61$, $p = .895$ (Nagelkerke pseudo $R^2 = .01$), side choice $\chi^2(3) = 2.96$, $p = .397$ (Nagelkerke pseudo $R^2 = .02$), nor dessert choice $\chi^2(3) = 5.86$, $p = .119$ (Nagelkerke pseudo $R^2 = .05$). The condition by dietary restraint product term did not significantly enhance the prediction of main choice, $\chi^2(2) = 3.25$, $p = .197$ (Nagelkerke pseudo $R^2 = .04$), side choice $\chi^2(2) = .58$, $p = .749$ (Nagelkerke pseudo $R^2 = .03$), nor dessert choice $\chi^2(2) = 4.43$, $p = .109$ (Nagelkerke pseudo $R^2 = .09$).[3] See Table 3 for the numbers and percentages of healthy and unhealthy main, side and dessert choices for each condition, and Table S5 (supplementary material) for the full list of statistics for the above series of binary logistic regressions.

Predictors of Healthy Food Choices

A simultaneous multiple regression showed that the other general predictors (liking, familiarity, hunger, BMI, dietary restraint, nutrition knowledge, gender, frequency of Chinese food consumption) predicted the overall number of healthy food choices alongside placement condition, $F(12, 183) = 6.05$, $p < .001$, $R^2 = .31$. As shown in Table 4, liking and familiarity (of both healthy and unhealthy dishes) were the only independent predictors.

[3] Running the regression with the bottom condition as the reference group revealed the same pattern of results, such that there was no variation in healthy choices between the middle and bottom conditions, and no significant interaction with dietary restraint.

Table 4

Inferential and Descriptive Statistics for the Main Effects of Placement Condition, Mean Liking Rating (of Healthy and Unhealthy Dishes), Mean Number of Unfamiliar (Healthy and Unhealthy) Dishes, Hunger, BMI, Dietary Restraint, Nutrition Knowledge, Gender and Frequency of Chinese Food Consumption for the Number of Healthy Food Choices (out of 3) in Study 5

Predictor	***B***	**SE**	**b**	***p***	***95% CI***
Top condition (versus middle)	-.16	.13	-.10	.201	-.42-.09
Top condition (versus bottom)	-.05	.13	-.03	.735	-.31 - .21
Middle condition (versus bottom)	-.12	.13	-.07	.366	-.38 - .14
Mean liking of healthy dishes	.27	.05	.44	<.001	.18 - .37
Mean liking of unhealthy dishes	-.29	.06	-.39	<.001	-.41 - -.17
Mean number of unfamiliar healthy dishes	-.18	.09	-.24	.037	-.36 - -.01
Mean number of unfamiliar unhealthy dishes	.10	.05	.23	.042	-.004 - .20
Hunger rating	<.001	.002	-.004	.956	-.004 - .004
Body Mass Index (kg/m^2)	-.02	.02	-.10	.212	-.05 - .01
Dietary restraint	.01	.01	.07	.367	-.01 - .03
Nutrition knowledge	.03	.02	.12	.104	-.01 - .06
Gender	-.14	.12	-.08	.263	-.37 - .10
Frequency of usual Chinese food consumption	.003	.06	.004	.957	-.12 - .13

N = 184.

Discussion

Study 5 investigated the effect of item placement on choices from a Chinese menu. Contrary to prediction, but in line with Study 4, the overall number of healthy choices did not vary significantly between conditions. Because participants were not particularly familiar with the Chinese dishes on offer, they may have based their choices predominantly on avoiding the unknown. Indeed, familiarity predicted overall choices, such that greater numbers of unfamiliar healthy dishes were associated with fewer healthy choices, and greater numbers of unfamiliar unhealthy dishes were associated with fewer unhealthy choices. Relatedly, participants may not have been nudged towards healthy choices due to being unable to accurately differentiate between healthy and unhealthy foods. As in Study 4, liking predicted overall food choices, with participants who liked the healthy foods on the menu making more healthy food selections than participants who liked the unhealthy foods on the menu.

Study 6: The effect of item placement on food choices from a mixed Australian menu

Study 6 investigated the effect of item placement in the context of a menu comprising dishes from mixed origins, that are commonly eaten in Australian cuisine (e.g., Middle Eastern falafels, French croissants, British fish and chips). While fast-food is extremely popular and Chinese food is somewhat less well-known amongst Australian consumers (Anderson & Benbow, 2015; Flowers & Swan, 2012; Partridge et al., 2020), mixed Australian cuisine is well-known without being excessively widespread (Newton, 2018). As such, using mixed Australian cuisine might reduce the potential for habitual choices (which may have impacted findings in Study 4) and the avoidance of unfamiliar foods (which may have impacted findings in Study 5) to affect results in Study 6. Furthermore, due to difficulties with recruiting representative samples of men in Studies 4 and 5 (only 21.5% and 12.5% of participants were male, respectively), we recruited a female-only sample in Study 6.

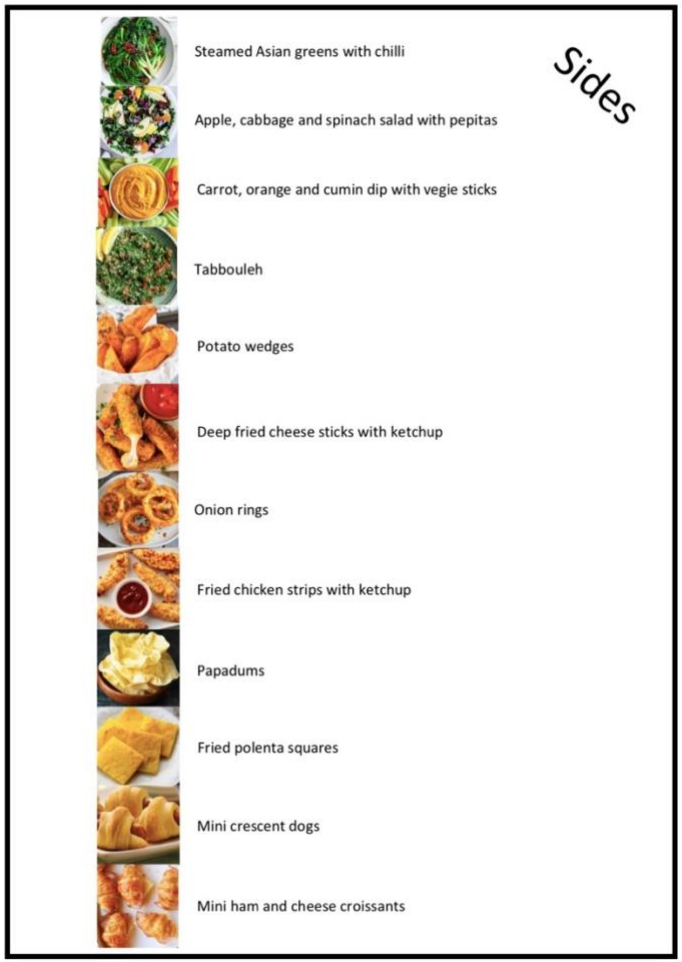
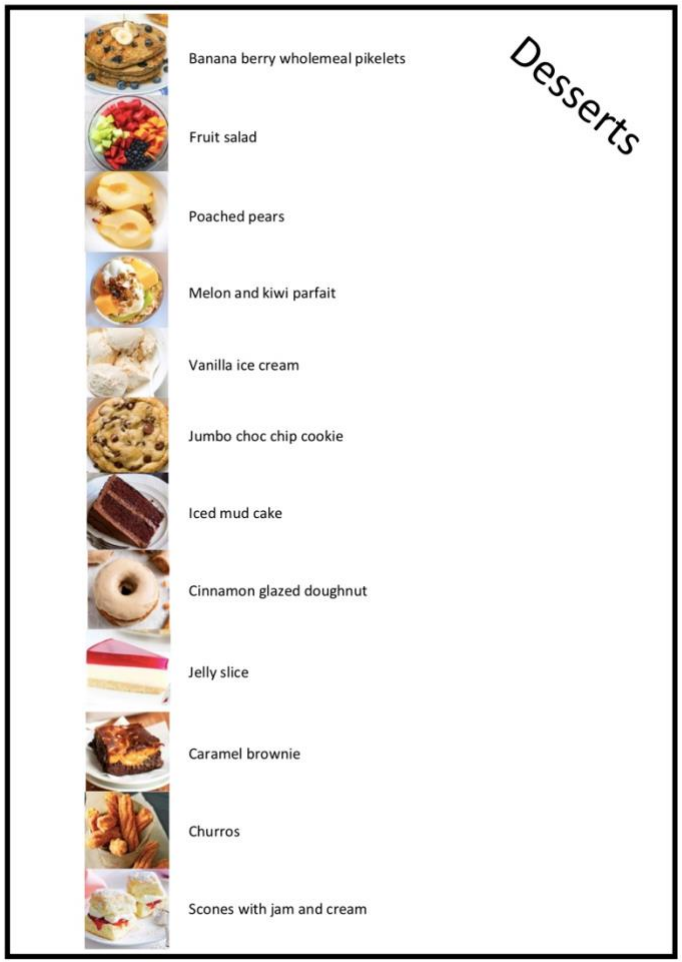
Method

Participants

The sample consisted of 186 students from Flinders University, South Australia. Aside from recruitment being restricted to women, eligibility criteria and methods of participant recruitment were the same as in Studies 4 and 5.

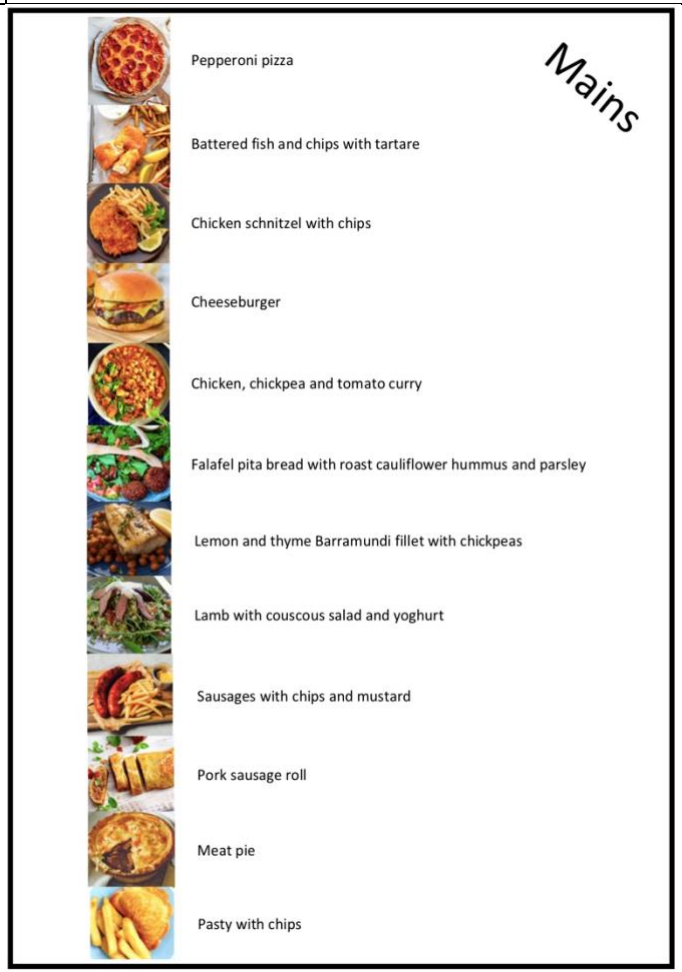
Design, Materials and Procedure

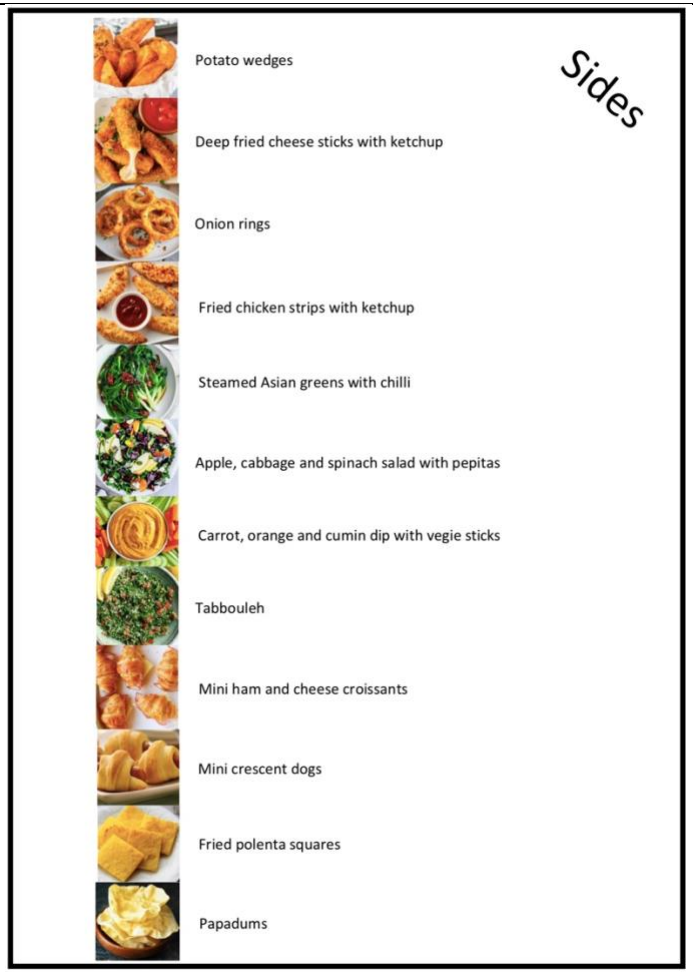
Design, materials, and procedure were the same as for Studies 4 and 5, except that the menu was made up of main, side and dessert dishes commonly served in mixed Australian eateries (see Figure 3). The mixed Australian dishes were taken from an initial pool of 90 dishes. This initial pool included 30 mains, 30 sides and 30 desserts, half of which were healthy (green), and half of which were unhealthy (red), classified using the Victorian Government Healthy Eating Advisory Service's FoodChecker (Nutrition Australia & Victoria State Government, 2016). As in Studies 4 and 5, these selections were confirmed by volunteers (N = 20, 18-52 years), who rated photographs of the dishes on perceived healthiness, and how well the name of the dish described the image. Based on the data from this pilot study, four 'healthy' dishes and eight 'unhealthy' dishes from each menu category were selected. Paired samples t-tests showed that together, the 12 healthy main, side and dessert dishes had a significantly higher mean healthiness rating (M = 8.44, SD = 0.52) than the 24 unhealthy main, side and dessert dishes (M = 2.41, SD = 1.29), $t(19) = 7.85$, $p = .004$. In addition, the extent to which the names of the dishes described the images did not vary significantly between the 12 healthy dishes (M = 8.15, SD = 1.10), and the 24 unhealthy dishes (M = 7.95, SD = 1.29), $t(19) = 1.44$, $p = .188$. In contrast to Studies 4 and 5, we did not measure frequency of consumption for mixed Australian cuisine in the main study because of the breadth and ambiguity of the term.

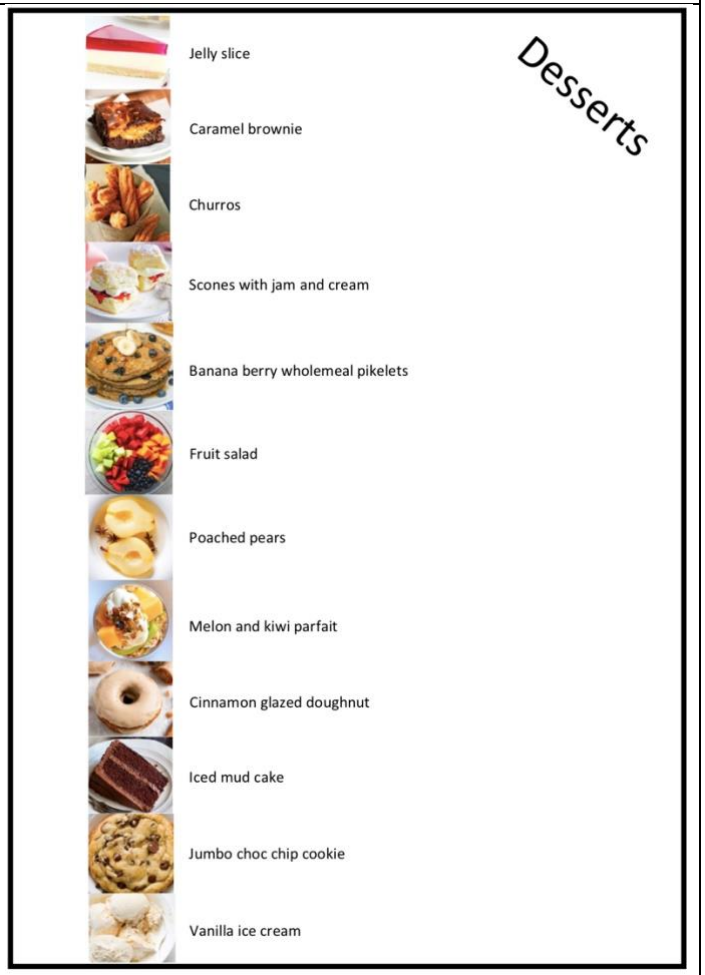
	Mains with healthy dishes on top	Sides with healthy dishes on top	Desserts with healthy dishes on top
Panel A. Menu for the top placement condition			

Panel B. Menu for the middle placement condition

Mains with healthy dishes in the middle	Sides with healthy dishes in the middle	Desserts with healthy dishes in the middle







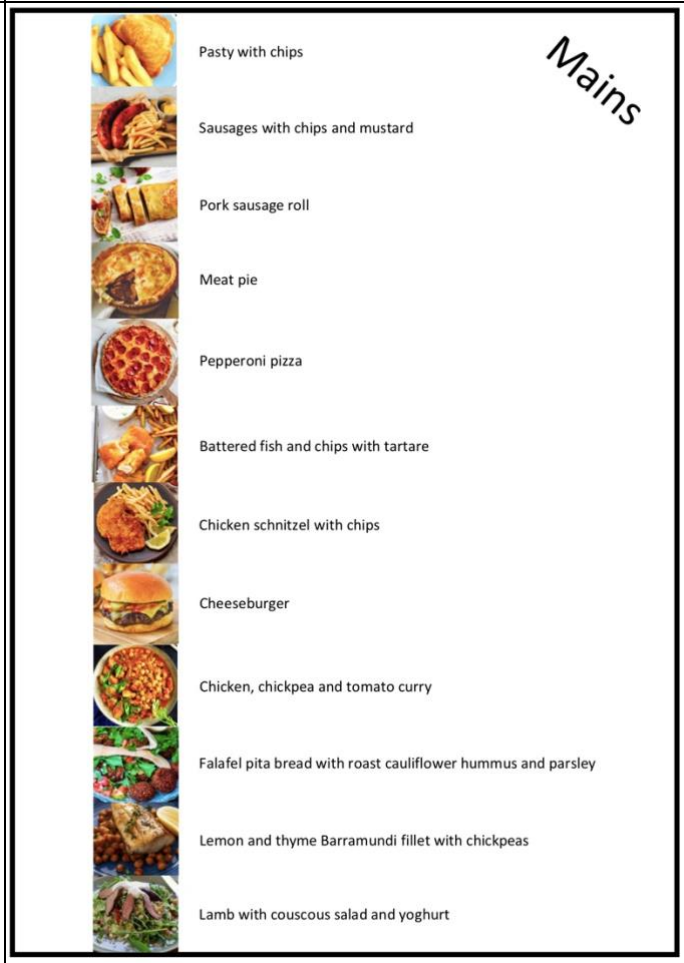
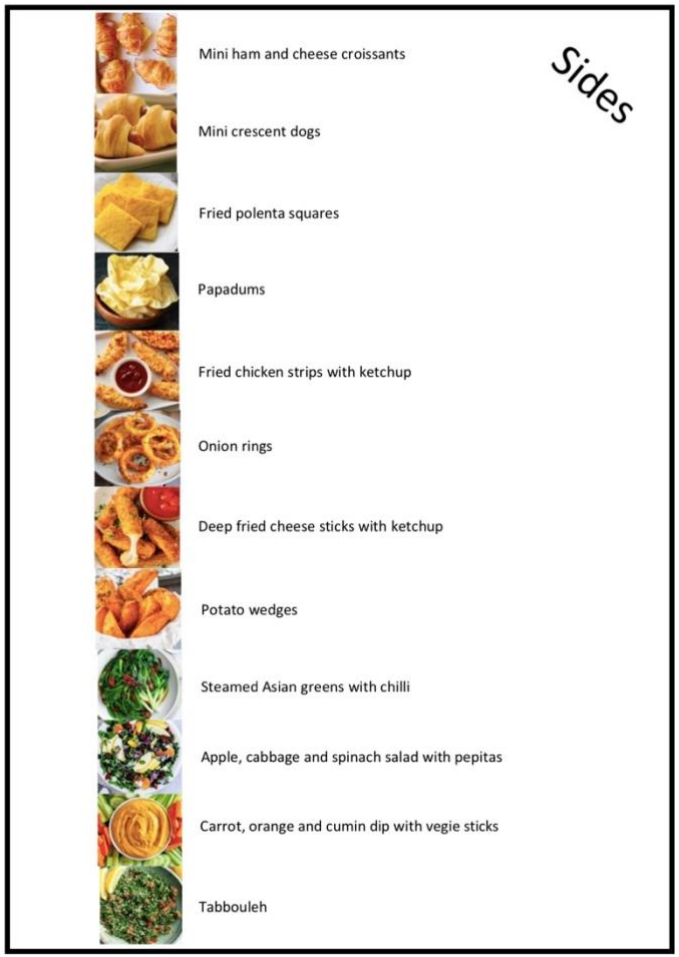
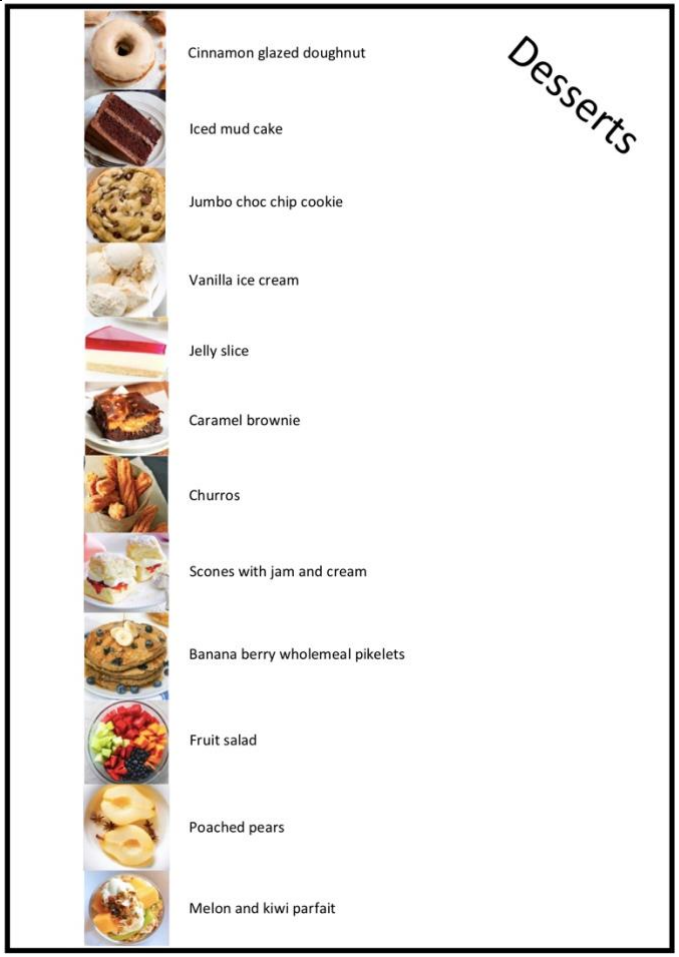
	Mains with healthy dishes on the bottom	Sides with healthy dishes on the bottom	Desserts with healthy dishes on the bottom
Panel C. Menu for the bottom placement condition			

Figure 3. Menus for each of the three placement conditions in Study 6.

Results

Sample Characteristics and Food Choices

A series of one-way ANOVAs showed that participants in the three placement conditions did not differ significantly in terms of age, BMI, time since last eating or drinking, hunger, dietary restraint or nutrition knowledge (all *p*s > .05; for details see Table S1, supplementary material). Taste (mains = 34.1%, sides = 34.6%, desserts = 48.9%) and health (mains = 8.2%, sides = 8.2%, desserts = 11.0%) were prominent reasons for food choices across conditions and menu categories (see Table S2, supplementary material).

Across conditions, chicken schnitzels (34.4%) and cheeseburgers (14.5%) were the most frequently selected mains, potato wedges (29.0%) and deep-fried cheese sticks (23.1%) were the most frequently selected sides, and churros (25.6%) and fruit salad (17.2%) were the most frequently selected desserts. Table S3 (see supplementary material) shows the number and percentage of times that each dish on the menu was chosen. Liking ratings (see Table S4, supplementary material) show that the most frequently selected dishes were generally well-liked.

Effect of Placement Condition on Healthy Food Choices

Across all conditions, healthy main (24.7%), side (18.8%) and dessert (26.3%) dishes were chosen less frequently than unhealthy main (75.3%), side (81.2%) and dessert (73.7%) dishes. A 3 (placement condition: top, middle, bottom) x 2 (dietary restraint status: restrained, unrestrained) ANOVA revealed a significant main effect of placement condition, $F(2,185) = 6.73$, $p = .002$, $\eta^2 = .042$. Pairwise comparisons revealed that, as predicted, participants in the top placement condition ($M = 0.84$, $SD = 0.91$) made significantly more healthy food choices than those in the middle placement condition ($M = 0.41$, $SD = 0.59$), $p = .002$, $d = .56$. In addition, participants in the bottom placement condition ($M = 0.79$, $SD = 0.92$) also made significantly more healthy food choices than those in the middle placement condition, $p =$

.007, d = .49. Healthy choices did not differ between the top and bottom placement conditions, p = .758, d = .05. The mean number of healthy food choices (out of 3) for each condition is displayed in Table 5. There was no significant effect of dietary restraint, $F(1,185) = 1.89$, p = .171, η^2 =.005, nor a significant condition by dietary restraint interaction, $F(2,185) = 1.34$, p = .265, η^2 =.008.

A series of binary logistic regressions then tested the main effects of placement condition and dietary restraint and the condition by dietary restraint interaction on food choice, within each menu category. Together, placement condition and dietary restraint predicted main, $\chi^2(3) = 8.28$, p = .041 (Nagelkerke pseudo R^2 = .07), side, $\chi^2(3) = 7.81$, p = .050 (Nagelkerke pseudo R^2 = .07), and dessert choices, $\chi^2(3) = 9.97$, p = .019 (Nagelkerke pseudo R^2 = .08). See Table 5 for the numbers and percentages of healthy and unhealthy main, side and dessert choices for each condition. The condition by dietary restraint product term did not significantly enhance the prediction of main ($\chi^2(2) = 3.85$, p = .146; Nagelkerke pseudo R^2 = .10), side ($\chi^2(2) = 3.03$, p = .220; Nagelkerke pseudo R^2 = .09) or dessert choices ($\chi^2(2) = 2.02$, p = .364; Nagelkerke pseudo R^2 = .09). Thus, dietary restraint did not moderate the effect of condition on food choice in any of the menu categories.

Table 5

Means (and Standard Deviations) for the Number of Healthy Food Choices (out of 3) and Number (and Percentage) for Main, Side and Dessert Choices (Healthy, Unhealthy) by Condition (Top, Middle, Bottom) in Study 6

Condition	**Number of healthy food choices (out of 3)**	
Overall food choices		
Top	0.84 (0.91)	
Middle	0.41 (0.59)	
Bottom	0.79 (0.92)	
Mains	**Healthy**	**Unhealthy**
Top	19 (29.7%)	45 (70.3%)
Middle	10 (16.9%)	49 (83.1%)
Bottom	17 (27.0%)	46 (73.0%)
Sides		
Top	18 (28.1%)	46 (71.9%)
Middle	5 (8.5%)	54 (91.5%)
Bottom	12 (19.0%)	51 (81.0%)
Desserts		
Top	18 (28.1%)	46 (71.9%)
Middle	9 (15.3%)	50 (84.7%)
Bottom	22 (34.9%)	41 (65.1%)

Analysis of individual main effects showed that condition independently predicted side ($Wald(2) = 6.73$, $p = .035$) and dessert choices ($Wald(2) = 7.61$, $p = .022$), but not main choice ($Wald(2) = 4.60$, $p = .100$). The odds of choosing a healthy side ($b = -1.42$, $SE = .55$,

Wald(1) = 6.64, *p* = .010, *ExpB* = 0.24) and dessert (*b* = -1.00, *SE* = .48, *Wald*(1) = 4.27, *p* = .039, *ExpB* = 0.37) were greater for those in the top condition than for those in the middle condition, and the odds of choosing a healthy dessert were greater for those in the bottom condition than for those in the middle condition, *b* = -1.29, *SE* = .47, *Wald*(1) = 7.51, *p* = .006, *ExpB* = 0.28. While condition was not an independent predictor of main choice overall, the odds of choosing a healthy main were still greater for those in the top condition than for those in the middle condition, *b* = -1.00, *SE* = .47, *Wald*(1) = 4.54, *p* = .033, *ExpB* = 0.37. Dietary restraint independently predicted main choice (*b* = 0.06, *SE* = .03, *Wald*(1) = 4.60, *p* = .032, *ExpB* = 1.06), but not side (*b* = 0.02, *SE* = .03, *Wald*(1) = 0.04, *p* = .835, *ExpB* = 1.01) or dessert choices (*b* = 0.02, *SE* = .03, *Wald*(1) = 2.25, *p* = .133, *ExpB* = 1.04). See Table S5 (supplementary material) for the full list of statistics for the above series of binary logistic regressions.

Predictors of Healthy Food Choices

A simultaneous multiple regression showed that other general predictors (liking, hunger, BMI, dietary restraint, nutrition knowledge) predicted the overall number of healthy food choices alongside placement condition, $F(14, 183) = 5.72$, $p < .001$, $R^2 = .34$. As shown in Table 6, condition, liking (of both healthy and unhealthy foods), and BMI were independent predictors of food choices.

Table 6

Inferential and Descriptive Statistics for the Main Effects of Placement Condition, Mean Liking Rating (of Healthy and Unhealthy Dishes), Hunger, BMI, Dietary Restraint and Nutrition Knowledge for the Number of Healthy Food Choices (out of 3) in Study 6

Predictor	***B***	**SE**	**B**	***p***	***95% CI***
Top condition (versus middle)	-.39	.13	-.21	.002	-.63-.14
Top condition (versus bottom)	-.05	.12	-.03	.676	-.29 - .19
Middle condition (versus bottom)	-.34	.12	-.18	.007	-.58 - -.09
Mean liking of healthy dishes	.29	.04	.43	<.001	.21 - .37
Mean liking of unhealthy dishes	-.41	.05	-.54	<.001	-.50 - -.32
Hunger rating	-.002	.002	-.06	.270	-.01 - .002
Body Mass Index (kg/m^2)	-.01	.004	-.13	.031	-.02 - -.001
Dietary restraint	.01	.01	.09	.129	-.004 - .03
Nutrition knowledge	.003	.01	.01	.825	-.02 - .03

N = 186.

Discussion

Study 6 investigated the effect of item placement on choices from a mixed Australian menu. Participants who saw a menu with healthy foods in the top or bottom sections made more healthy choices than participants who saw healthy foods in the middle section. These effects were observed regardless of dietary restraint status. Furthermore, placement condition predicted the overall number of healthy food choices over and above other variables (including liking, hunger, BMI, dietary restraint, and nutrition knowledge), indicating that

placement interventions have the potential to promote healthy food choices independently of other factors.

As in Study 5, in the present study there were variations in the effect of placement condition on food choice between menu categories. Specifically, participants in the top condition were more likely to make healthy main, side and dessert choices than those in the middle condition, while those in the bottom condition were more likely to make healthy dessert choices, but not healthy main or side choices. Furthermore, when a range of other predictors were entered, condition predicted side and dessert choices, but not main choices. Overall, the findings of Study 6 are consistent with previous studies supporting the use of placement interventions to promote healthy food choices from menus (Feldman et al., 2011; Romero & Biswas., 2016; Gynell et al., 2022).

General Discussion

Summary of Key Findings

The present studies aimed to directly compare three variations of a placement intervention (top, middle, bottom) against one another to determine the best approach for promoting healthy food choices from longer menus with multiple choices. This was achieved across three experiments using three different cuisines: fast-food (Study 4), Chinese (Study 5), and mixed Australian (Study 6). In all studies, we measured nutrition knowledge, liking of the food dishes on the menu, and dietary restraint, to explore their effects on food choice alongside placement condition. Dietary restraint was also tested as a moderator, in line with previous findings that nudges are more effective amongst restrained eaters than unrestrained eaters (Deek et al., 2022; Kemps et al., 2016; Papies & Hamstra, 2010; Tonkin et al., 2019).

We found that placement condition had no effect on the overall number of healthy food choices from the fast-food (Study 4) and Chinese (Study 5) menus. Placement condition did, however, predict the overall number of healthy food choices from the mixed Australian

menu (Study 6), such that participants made more healthy food choices when they saw healthy dishes listed in the top or bottom sections of the menu, in comparison to the middle section. This effect was driven primarily by participants' side and dessert choices. Dietary restraint did not moderate the relationship between placement condition and food choice in any of the three studies.

The present findings suggest that placement interventions do have the potential to promote healthy choices, although this might be limited to certain cuisines. Specifically, our placement intervention effectively promoted healthy food choices in the context of a mixed Australian menu, but not in the context of a fast-food or a Chinese menu. As indicated previously, the literature on placement interventions and food choices is inconsistent. Some studies suggest that consumers prefer items from the middle of a menu (e.g., Choi et al., 2010), or that placement has no impact on food choice (e.g., Bergman et al., 2021). However, other findings suggest that foods placed in the top and/or bottom sections of a menu are the most chosen (Dayan & Bar-Hillel, 2011; Deek et al., 2022; Feldman et al., 2011; Gynell et al., 2022). Study 6 supports these latter findings and extends them to a longer menu with multiple choices. In line with Dayan and Bar-Hillel, Deek et al., Feldman et al., and Gynell et al., the Study 6 findings suggest that primacy effects (i.e., the notion that people best remember the first things that they see or read; Andersson & Nelander, 2021; Wansink & Hanks, 2013) may occur for healthy mixed Australian foods in the context of online menus. In line with Dayan and Bar-Hillel, the Study 6 findings also suggest that recency effects (i.e., the notion that people best remember the last things that they see or read, because they are at the forefront of their memory; Bowen & Morris, 1995; Mantonakis et al., 2009) may occur in this context.

Because food choices in the present studies were presented using online menus, participants could easily see the full menu by scrolling up or down the page. In contrast, other

studies which have revealed middle preferences have used large-scale settings such as supermarket shelves (e.g., Chandon et al., 2009; Christenfeld, 1995; Foster et al., 2014). In large-scale settings, consumers often have to crane their neck to see top items or bend down to see bottom items, while middle items are conveniently located at eye-level. This could explain why our findings overall contradict the notion that consumers favour middle items when choosing from a set of options (e.g., Chandon et al.; Choi et al., 2010; Christenfeld; Foster et al.).

Differences in findings between studies

The discrepancies in the findings of the present set of studies could be at least partially due to differences in the popularity and familiarity of the three cuisines that were used. Due to the widespread popularity of fast food in Australia (Cameron et al., 2022), participants in Study 4 may have had long-standing fast-food ordering habits, which led them to turn to their usual choices, regardless of where they were positioned on the menu. Frequent mentions of habit as a reason for choice support this suggestion. Many participants in Study 4 also based their choices on what would complement their previous selections. This could be because fast food is heavily marketed, often in the context of 'meal-deal' promotions (e.g., a burger, fries and soft serve; Sacks et al., 2021). Therefore, participants' preconceived ideas of which fast foods should be paired together may have influenced their choices over and above the placement of the foods.

Fast food has also been consistently linked to unhealthy eating behaviours (Poti et al., 2014; Stender et al., 2007). Therefore, simply telling participants to imagine that they were ordering from a fast-food restaurant in the Study 4 instructions may have acted as an unhealthy-eating prime, activating the hedonic goal of food enjoyment (Hu & Min, 2022) and increasing the salience of the unhealthy options on the menu. To address this, future healthy-eating initiatives in fast-food menu contexts could implement healthy-eating primes (such as

healthy food images on menu covers, similar to Deek et al. (2022) and Tonkin et al. (2019)) in conjunction with placement interventions. Such primes could disrupt automatic associations between fast-food and unhealthy eating, instead activating healthy-eating goals, which could increase the salience of healthy options when they are seen in optimal locations on the menu.

In contrast to Study 4, participants in Study 5 did not consume Chinese food particularly often (most participants consumed Chinese food just once or twice per month), nor did they imply that they had pre-established Chinese food-ordering habits. Chinese cuisine also appeared to be less well-known amongst our sample, with participants classifying on average 26.4% (n = 9.51) of the Chinese dishes as unfamiliar. Many participants explained that, when choosing from the Chinese menu, they avoided foods that they were not familiar with, and selected something that they knew they would like. Relatedly, familiarity predicted overall food choices, such that greater numbers of unfamiliar healthy dishes were associated with fewer healthy choices, and greater numbers of unfamiliar unhealthy dishes were associated with fewer unhealthy choices. This suggests that our placement intervention in Study 5 may have been overpowered by participants' desires to avoid the unknown.

Being Australian consumers from predominantly non-Chinese backgrounds (only 3.26% identified as being of Chinese ethnicity), our participants in Study 5 may also have had difficulty distinguishing between healthy and unhealthy foods, due to being unfamiliar with the ingredients and preparation techniques used in some of the Chinese dishes. For example, 'battered bananas', which were coded as unhealthy in the analyses, may have appeared healthy due to containing fruit, but are typically covered in a sugary batter, deep-fried, and served with golden syrup. Thus, participants may not have been nudged towards healthy choices due to being unable to tell which dishes were actually healthy. To address

this issue, future interventions could implement evaluative labelling systems (e.g., traffic light systems that colour code foods as green (healthy), amber (less healthy) or red (unhealthy); Olstad et al., 2015; Thorndike et al., 2014) alongside placement interventions. This way, consumers could be guided by the evaluative labels, as opposed to their own (lack of) knowledge, when differentiating between healthy and unhealthy options.

In contrast to fast-food and Chinese cuisine, mixed Australian cuisine tends to sit around the middle of the scale when it comes to popularity and familiarity amongst Australian consumers (Flowers & Swan, 2012). Relative to Study 4, habit was not a particularly prominent reason for choice in Study 6. This suggests that participants in Study 6 may not have had pre-established ordering habits like participants in Study 4 and were therefore more open to being nudged towards healthy choices. In line with Anderson and Benbow (2015) and Flowers and Swan's (2012) research on Australian consumers' knowledge and perceptions of different cuisines, it is also likely that participants in Study 6 were better accustomed to the ingredients and preparation techniques used in mixed Australian cooking, than they were to those in Chinese cooking (Study 5). This could have reduced the chance of unhealthy dishes being misinterpreted as healthy dishes (and vice versa), which may have affected our findings in Study 5. Consistent with this reasoning, participants in Study 6 rarely referred to familiarity when explaining their reasons for choice. Instead, based on our finding that participants made more healthy choices when healthy foods were placed in the top or bottom sections of the menu, it seems that selections in Study 6 may have been guided by the placement of the dishes on the menu.

Differences in findings between menu categories

In addition to variations between the present studies, findings between menu categories also varied in Study 6. Specifically, condition independently predicted side and dessert choices, but not main choices. This could be because side and dessert dishes are often

spontaneously added to meals with little thought or consideration (Cory et al., 2021), or consumed impulsively (Mason et al., 2018). As implicit interventions capitalise on impulsive or mindless choices driven by automatic processes (Bowen & Morris, 1995; Thaler & Sunstein, 2008), this may explain why our placement intervention was most effective for side and dessert choices in Study 6. Alternatively, because sides and desserts are typically smaller dishes and do not make up the bulk of a meal, participants may have been less likely to revert to their usual orders and more open to trying something new, having already selected a main that they knew they would like. In general, it seems that placement techniques appear to work particularly well for discretionary food choices (i.e., sides and desserts), rather than main meals. This fits with Gynell et al.'s (2022) findings in the context of snack choices and is consistent with research showing links between discretionary foods and automatic decision-making processes (Cory et al., 2021; Mason et al., 2018).

Other predictors of food choice

In all of the present studies, liking of foods predicted the overall number of healthy food choices. Not surprisingly, participants who liked the healthy foods on the menu generally made more healthy food choices than participants who liked the unhealthy foods on the menu. These findings support the idea that liking is a key determinant of food choice and consumption behaviours (Jones et al., 2010).

In some instances, food choice was also predicted by other variables. In Study 4, frequency of fast-food consumption predicted overall choices, such that the more frequently participants typically consumed fast food, the fewer overall healthy food choices they made. This is consistent with our earlier point that frequent fast-food consumers may associate fast-food with unhealthy eating. Body mass index predicted overall choices in Study 6, such that the lower participants' BMI, the greater the number of healthy food choices they made. This

finding is consistent with existing research suggesting that individuals with a lower BMI are more inclined to eat healthy foods (Hong et al., 2016).

Dietary restraint

Dietary restraint did not moderate the effect of condition on food choice in any of the present studies. As such, the positive effects of top and bottom placement in mixed Australian cuisine appear to apply to both restrained and unrestrained eaters. This is consistent with earlier studies (e.g., Gynell et al., 2022; Keegan et al., 2019) which found no effect of dietary restraint on the efficacy of nudges to promote healthy eating. However, it contradicts other research supporting the idea that healthy-eating nudges are more effective for restrained eaters (Deek et al., 2022; Kemps et al., 2016; Papies & Hamstra, 2010; Tonkin et al., 2019). As Gynell et al. (2022) suggest, one explanation for these inconsistencies is that when a manipulation is implemented simultaneously with a choice-set (as in the present studies), restrained eaters are not given sufficient time to activate diet-related goals. In contrast, when a manipulation is implemented prior to choice (e.g., Kemps et al.'s photographs of grapes presented before a taste-test task, or Papies and Hamstra's healthy recipe poster positioned at the entrance to a butcher's store), restrained eaters have time to activate their diet-related goals before making a choice. Because of these inconsistent findings, future studies should continue to explore the impacts of dietary restraint on the effectiveness of implicit interventions in different settings.

Practical implications

The present studies have several practical implications. First, in the mixed Australian menu in Study 6, placing healthy items in either the top or bottom sections of the menu resulted in a significantly higher overall number of healthy food choices, in comparison to placing healthy items in the middle section of the menu. This suggests that, if implemented consistently in specific contexts, placement interventions could translate to consistently

healthier choices amongst Australian consumers. Compounded over time, these consistently healthier choices could contribute to gradual public health improvements by increasing nutrient intake. Second, the Study 6 findings provide valuable insight for business owners in the food and hospitality industry (especially those who utilise online platforms such as UberEATS®, Deliveroo® and Menulog®), who may wish to contribute to society by increasing healthy food choices, without sacrificing their own profits. This is because placement interventions are easily and cheaply implemented, and unlikely to impact revenue by discouraging purchases (Dayan & Bar-Hillel, 2011; Junghans et al., 2015; Veling & Lawrence, 2019).

Strengths and Limitations

A strength of the present research relates to replication. Specifically, Study 5 replicated Study 4, and Study 6 replicated Studies 4 and 5, whilst also extending them to varied menu contexts. Replication in science, which is critical in increasing the validity of research findings (Coles et al., 2018), is particularly important in the context of inconsistent or contradictory literature, such as that on placement interventions and food choices.

One limitation of the present research is that, although the menus were similar to those seen on genuine online ordering platforms, participants' choices were hypothetical, and they did not actually receive and consume the food. This could limit the generalisability of our findings to real-world food ordering contexts, where consumers anticipate eating the dishes that they order. Accordingly, the next step is to trial the placement interventions in a real online ordering context.

Another limitation of the set of studies is in the gender imbalance of participants recruited. Men were in the minority in Studies 4 and 5, and only women were recruited in Study 6. To generalise the present findings, future research should explore the effect of placement interventions using more representative samples of men. Such research is

important, as the majority of online delivery service users in Western societies are men (Keeble et al., 2020). Lastly, due to time and cost constraints, student samples were used in all three studies. While such student samples provided a useful starting point in the present research, future research should utilise samples that better represent the general population.

Conclusion

The present studies have demonstrated that placement interventions can be useful tools for promoting healthy food choices from online menus, dependent on the type of cuisine. Specifically, our placement intervention effectively promoted healthy food choices in the context of mixed Australian cuisine, but not in the context of fast-food or Chinese cuisine. We propose that in the context of very popular cuisines (e.g., fast-food) and cuisines that are less well-known (e.g., Chinese cuisine), placement interventions may need to be paired with additional interventions in order to maximise their effectiveness. Overall, our findings contribute to the literature on nudging healthier food choices using placement interventions by extending existing research (e.g., Dayan & Bar-Hillel; Feldman et al., 2011; Gynell et al., 2022) to the context of a longer online menu with multiple choices. Our findings also point to important future research directions and offer suggestions for food and hospitality businesses that may wish to encourage healthier choices without compromising revenue.

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Supplementary Material to

A placement intervention for food choices from online menus

Table S1

Means (and Standard Deviations) of Sample Characteristics by Placement Condition in Studies 4, 5 and 6

Study 4	**Top (*n* = 60)**	**Middle (*n* = 63)**	**Bottom (*n* = 62)**	**All conditions (*n* = 185)**	***F* (2,184)**	***p***
Age (in years)	20.98 (6.17)	23.22 (8.52)	23.65 (9.92)	22.64 (8.40)	1.78	.172
Body Mass Index (kg/m^2)	23.42 (4.84)	25.16 (5.61)	24.41 (6.20)	24.34 (5.61)	1.46	.236
Time since eating or drinking (minutes)	127.63 (74.61)	141.29 (105.82)	146.76 (147.57)	138.69 (113.32)	.46	.634
Hunger (rated from 0 – 100)	39.00 (24.46)	39.67 (23.88)	46.03 (23.27)	41.58 (23.95)	1.63	.199
Revised Restraint Scale score	14.53 (6.29)	16.19 (6.49)	13.97 (6.03)	14.92 (6.32)	2.09	.126
Consumer Nutrition Knowledge Scale score	11.68 (3.55)	11.36 (3.32)	11.35 (3.52)	11.46 (3.45)	.17	.844
Study 5	**Top (*n* = 62)**	**Middle (*n* = 63)**	**Bottom (*n* = 59)**	**All conditions (*n* = 184)**	***F* (2,183)**	***p***
Age (in years)	21.40 (7.31)	21.86 (6.94)	20.37 (5.87)	21.23 (6.74)	.77	.465

Body Mass Index (kg/m^2)	23.45 (4.62)	23.06 (4.13)	23.41 (3.69)	23.31 (4.16)	.17	.844
Time since eating or drinking (minutes)	126.97 (138.51)	150.79 (204.72)	130.17 (115.14)	136 (157.93)	.41	.662
Hunger (rated from 0 – 100)	40.90 (27.16)	43.71 (27.83)	42.20 (24.22)	42.28 (26.37)	.18	.839
Revised Restraint Scale score	14.47 (7.28)	15.08 (7.35)	15.63 (6.53)	15.04 (7.06)	.40	.669
Consumer Nutrition Knowledge Scale score	10.66 (3.88)	10.13 (3.77)	10.46 (3.60)	10.41 (3.74)	.32	.726
Study 6	**Top (*n* = 64)**	**Middle (*n* = 59)**	**Bottom (*n* = 63)**	**All conditions (*n* = 186)**	***F* (2,185)**	***p***
Age (in years)	20.19 (5.32)	20.10 (3.64)	20.13 (5.63)	20.14 (4.94)	.01	.995
Body Mass Index (kg/m^2)	26.49 (18.80)	24.87 (5.42)	23.40 (5.67)	24.91 (11.95)	1.05	.353
Time since eating or drinking (minutes)	155.94 (186.86)	153.86 (171.31)	105.83 (80.62)	138.31 (154.33)	2.14	.121

Hunger (rated from 0 – 100)	40.51 (25.20)	42.08 (28.78)	35.43 (24.88)	39.28 (26.30)	1.08	.342
Revised Restraint Scale score	13.80 (5.79)	16.49 (6.23)	14.95 (6.95)	15.03 (6.40)	2.73	.068
Consumer Nutrition Knowledge Scale score	10.53 (3.88)	10.98 (3.30)	10.25 (3.49)	10.58 (3.57)	.64	.526

Notes. Revised Restraint Scale scores range from 0 to 35, with higher scores indicating greater eating restraint. Consumer Nutrition Knowledge Scale scores range from 0-20, with higher scores indicating better nutrition knowledge.

Table S2

Reasons for Choice by Menu Category (Mains, Sides, Desserts) in Studies 4, 5 and 6

Study 4		
Mains	**Sides**	**Desserts**
Taste (32.4%)	Taste (26.0%)	Taste (37.8%)
Visual/aesthetics (15.9%)	Paired well with previous choice (23.2%)	Habit (11.6%)
Health (13.2%)	Habit (18.2%)	Paired well with previous choice (9.3%)
Habit (9.9%)	Health (8.3%)	Health (8.7%)
Familiarity (9.3%)	Sufficiently filling (3.9%)	Familiarity (5.8%)
Sufficiently filling (6.6%)	Familiarity (3.3%)	No too filling (5.2%)
Not too filling (4.4%)	Easy to eat (2.8%)	Visual/aesthetics (4.7%)
To satisfy a craving (2.7%)	Texture (2.8%)	Easy to eat (3.5%)
Had not had for a long time (2.2%)	To satisfy a craving (2.8%)	Had not had for a long time (3.5%)
Appealing name (1.1%)	Visual/aesthetics (2.8%)	To satisfy a craving (3.5%)
To try something new (1.1%)	Not too filling (2.2%)	Temperature (2.9%)
Easy to eat (0.5%)	Had not had for a long time (1.7%)	Sufficiently filling (1.2%)
Texture (0.5%)	To try something new (1.7%)	Texture (1.2%)
		To try something new (1.2%)
Study 5		
Mains	**Sides**	**Desserts**
Taste (30.1%)	Taste (24.6%)	Taste (32.4%)
Visual/aesthetics (21.3%)	Familiarity (21.9%)	Familiarity (19.2%)
Familiarity (13.7%)	Not too filling (9.3%)	Visual/aesthetics (13.2%)

Habit (10.4%)	Health (9.3%)	To try something new (11.0%)
Appealing name (6.0%)	Visual/aesthetics (8.2%)	Health (5.5%)
Health (4.9%)	Habit (6.6%)	Paired well with previous choice (4.9%)
Sufficiently filling (3.3%)	Paired well with previous choice (6.0%)	Appealing name (4.4%)
To satisfy a craving (3.3%)	Appealing name (3.3%)	Not too filling (2.7%)
Not too filling (2.2%)	Had not had for a long time (3.3%)	Habit 2.2%)
To try something new (2.2%)	To try something new (3.3%)	Had not had for a long time (2.2%)
Had not had for a long time (1.1%)	To satisfy a craving (2.2%)	To satisfy a craving (1.6%)
Texture (1.1%)	Texture (1.6%)	Texture (0.5%)
Religion/culture (0.5%)	Sufficiently filling (0.5%)	

Study 6		
Mains	**Sides**	**Desserts**
Taste (34.1%)	Taste (34.6%)	Taste (48.9%)
Habit (13.2%)	Pairs well with main (15.9%)	Health (11.0%)
Visual/aesthetics (11.5%)	Health (8.2%)	To satisfy a craving (6.6%)
Health (8.2%)	Habit (8.2%)	Had not had for a long time (9.2%)
Sufficiently filing (7.7%)	Visual/aesthetics (6.6%)	Not too filling (9.2%)
Familiarity (7.1%)	Familiarity (6.0%)	Familiarity (4.9%)
To satisfy a craving (7.1%)	Texture (3.8%)	Visual/aesthetics (4.9%)
Had not had for a long time (4.9%)	Not too filling (3.3%)	Habit (4.3%)

Not too filling (2.2%)	Sufficiently filling (3.3%)	Paired well with previous choice (4.3%)
Texture (1.6%)	To try something new (3.3%)	Appealing name (1.6%)
To try something new (1.6%)	Had not had for a long time (2.7%)	Easy to eat (1.1%)
Placement on the menu (0.5%)	To satisfy a craving (2.7%)	Texture (1.1%)
	Appealing name (0.5%)	To try something new (1.1%)
	Easy to eat (0.5%)	

Table S3

Number (and Percentage) of Choices for Main, Side and Dessert Dishes (in Order of Most to Least Chosen) in Studies 4, 5 and 6

Study 4	
Main dishes	**Number (and percentage) of times chosen**
Tropical fried chicken burger	42 (22.6%)
Fried chicken club sandwich	30 (16.1%)
Grilled chicken and mixed salad wrap	26 (14.0%)
Triple cheeseburger	23 (12.4%)
Double beef burger with bacon	18 (9.7%)
Beef burger salad bowl	9 (4.8%)
BBQ bacon wrap	7 (3.8%)
Breakfast burger	7 (3.8%)
French fry burger	7 (3.8%)
Grilled fish burger with mixed greens	6 (3.2%)
Low-carb corn and zucchini burger	6 (3.2%)
Crumbed fish and tartare sauce burger	4 (2.2%)
Side dishes	
Fries	63 (33.9%)
Fried chicken tenders with mayonnaise	19 (10.2%)
Chilli cheese fries	15 (8.1%)
Potato bites	14 (7.5%)
Spring rolls	14 (7.5%)
Onion rings	13 (7.0%)
Chicken nuggets with honey mustard sauce	11 (5.9%)

Vegie pasta salad	9 (4.8%)
Hash brown	9 (4.8%)
Mediterranean salad	7 (3.8%)
Grilled chicken tenders	6 (3.2%)
Green garden salad	5 (2.7%)
Dessert dishes	
Caramel sundae	32 (17.2%)
Fruit salad	28 (15.1%)
Chocolate mousse	27 (14.5%)
Plain soft-serve ice cream cone	18 (9.7%)
Hotcakes with butter and golden syrup	17 (9.1%)
Jumbo choc chip cookie	17 (9.1%)
Mixed berry parfait with Greek yogurt	14 (7.5%)
Apple pie	13 (7.0%)
Chocolate soft-serve ice cream cone	11 (5.9%)
Strawberry sundae	5 (2.7%)
Wholemeal carrot and walnut muffin	2 (1.1%)
Vanilla yogurt	1 (0.5%)

Study 5

Main dishes	**Number (and percentage) of times chosen**
Sesame fried chicken with noodles	46 (25.0%)
Sweet and sour pork with noodles	23 (12.5%)
Crispy beef with special fried rice	22 (12.0%)
General Tso's chicken with special fried rice	20 (10.9%)
Vegetable and tofu stir fry with brown rice	15 (8.2%)

Salt and pepper fried fish	15 (8.2%)
Barbeque pork fried rice	13 (7.1%)
Crispy skin pork with honey mustard	11 (6.0%)
Chicken and vegetable chop suey with cashew nuts	9 (4.9%)
Mushroom and coriander sang choi bao	5 (2.7%)
Sesame fried shrimp with spicy fried rice	3 (1.6%)
Steamed prawns with green Asian vegetables	2 (1.1%)
Side dishes	
Prawn crackers	46 (25.0%)
Crispy fried chicken wontons	28 (15.2%)
Broccoli with garlic sauce	23 (12.5%)
Spring rolls	23 (12.5%)
Baby bok choy, sesame and ginger salad	15 (8.2%)
Prawn fritters with plum sauce	9 (4.9%)
Steamed green beans with chilli and sesame seeds	9 (4.9%)
Pork and prawn money bags	8 (4.3%)
Fried crab egg rolls	8 (4.3%)
Crispy Asian noodle pancakes	7 (3.8%)
Carrot, ginger and sugar snap pea salad	4 (2.2%)
Fried wonton strips	4 (2.2%)
Dessert dishes	
Deep fried ice cream with caramel sauce	51 (27.7%)
Mango ice cream	43 (23.3%)

Chia, coconut and mango pudding	13 (7.1%)
Custard egg tart	12 (6.5%)
Chinese fried dough	11 (6.0%)
Creamy rice soymilk pudding	11 (6.0%)
Battered bananas in golden syrup	10 (5.4%)
Almond cookies	9 (4.9%)
Fluffy Chinese pancakes	8 (4.3%)
Asian poached pears with dates and goji berries	7 (3.8%)
Starfruit and dragon fruit salad	5 (2.7%)
Chilled melon salad	4 (2.2%)

Study 6

Main dishes	**Number (and percentage) of times chosen**
Chicken schnitzel	64 (34.4%)
Cheeseburger	27 (14.5%)
Falafel pita bread with cauliflower hummus	17 (9.1%)
Pepperoni pizza	17 (9.1%)
Battered fish and chips with tartare	15 (8.1%)
Lamb with couscous salad and yogurt	15 (8.1%)
Chicken, chickpea and tomato curry	10 (5.4%)
Meat pie	6 (3.2%)
Pasty with chips	5 (2.7%)
Lemon and thyme Barramundi with chickpeas	4 (2.2%)
Pork sausage roll	3 (1.6%)
Sausages with chips and mustard	3 (1.6%)

Side dishes	
Potato wedges	54 (29.0%)
Deep fried cheese sticks	43 (23.1%)
Onion rings	20 (10.8%)
Steamed Asian greens with chilli	18 (9.7%)
Fried chicken strips with ketchup	12 (6.5%)
Mini crescent dogs	8 (4.3%)
Papadums	7 (3.8%)
Tabbouleh	7 (3.8%)
Apple, cabbage and spinach salad with pepitas	6 (3.2%)
Mini ham and cheese croissants	5 (2.7%)
Carrot, orange and cumin dip with vegie sticks	4 (2.2%)
Fried polenta squares	2 (1.1%)
Dessert dishes	
Churros	42 (25.6%)
Fruit salad	32 (17.2%)
Scones with jam and cream	25 (13.4%)
Caramel brownie	24 (12.9%)
Iced mud cake	19 (10.2%)
Jumbo choc chip cookie	11 (5.9%)
Banana berry wholemeal pikelets	10 (5.4%)
Vanilla ice cream	8 (4.3%)
Jelly slice	5 (2.7%)

Cinnamon doughnut	4 (2.2%)
Melon kiwi parfait	3 (1.6%)
Poached pears	3 (1.6%)

Table S4

Means (and Standard Deviations) of Liking Ratings for Main, Side and Dessert Dishes (in Order of Most to Least Liked) in Studies 4, 5 and 6

Study 4	
Main dishes	**Liking rating**
Grilled chicken and mixed salad wrap	7.13 (1.70)
Fried chicken club sandwich	6.89 (1.70)
Tropical fried chicken burger	6.25 (2.37)
Triple cheeseburger	6.20 (2.42)
BBQ bacon, egg and hash brown wrap	5.83 (2.18)
Breakfast burger	5.77 (2.07)
Double beef burger with bacon	5.76 (2.37)
French fry burger	5.18 (2.26)
Beef burger salad bowl	4.92 (2.33)
Low-carb wholemeal corn and zucchini burger	4.46 (2.50)
Grilled fish burger with mixed greens	4.44 (2.67)
Crumbed fish and tartare sauce burger	4.32 (2.78)
Side dishes	
Fries	8.02 (1.44)
Hash brown	7.25 (2.00)
Grilled chicken tenders	7.17 (1.69)
Spring rolls	6.95 (1.86)
Fried chicken tenders with mayonnaise	6.79 (1.96)
Potato bites	6.75 (1.95)

Chicken nuggets with honey mustard dipping sauce	6.28 (2.32)
Green garden salad	5.89 (2.24)
Onion rings	5.73 (2.53)
Mediterranean salad	5.66 (2.40)
Vegie pasta salad	5.49 (2.28)
Chilli cheese fries	5.47 (2.47)
Dessert dishes	
Fruit salad	7.18 (1.98)
Plain soft serve ice-cream cone	6.83 (2.06)
Jumbo choc chip cookie	6.66 (2.03)
Hotcakes with butter and golden syrup	6.39 (2.23)
Chocolate mousse	6.35 (2.22)
Vanilla yogurt	6.33 (2.13)
Mixed berry parfait with Greek yogurt	6.10 (2.12)
Caramel sundae	6.05 (2.50)
Chocolate soft serve ice-cream cone	6.03 (2.28)
Apple pie	5.63 (2.48)
Strawberry sundae	5.48 (2.36)

Study 5

Main dishes	**Liking rating**
Sesame fried chicken with noodles	7.13 (1.71)
General Tso's chicken with special fried rice	6.79 (1.75)
Crispy beef with special fried rice	6.76 (1.89)
Barbeque pork fried rice	6.47 (1.99)
Sweet and sour pork with noodles	6.41 (2.05)

Chicken and vegetable chop suey with cashew nuts	6.23 (1.76)
Salt and pepper fried fish	6.13 (2.34)
Steamed prawns with green Asian vegetables	5.94 (2.10)
Crispy skin pork with honey mustard	5.79 (2.20)
Vegetable and tofu stir fry with brown rice	5.62 (2.43)
Sesame fried shrimp with spicy fried rice	5.43 (2.32)
Mushroom and coriander sang choi bao	5.31 (2.47)
Side dishes	
Prawn crackers	6.95 (2.15)
Broccoli with garlic sauce	6.36 (2.03)
Crispy fried chicken wontons with sesame chilli sauce	6.69 (1.74)
Steamed green beans with chilli and sesame seeds	6.13 (1.91)
Crispy Asian noodle pancakes	6.00 (1.84)
Deep fried tofu spring rolls	5.96 (2.30)
Baby bok choy, sesame and ginger salad	5.64 (2.18)
Pork and prawn money bags	5.59 (2.26)
Fried wonton strips	5.56 (1.97)
Carrot, ginger and sugar snap pea salad	5.32 (2.04)
Prawn fritters	5.22 (2.24)
Fried crab egg rolls	4.84 (2.32)
Dessert dishes	
Mango ice cream	7.00 (2.07)
Deep-fried ice cream with caramel sauce	6.72 (2.26)
Fluffy Chinese pancakes	6.47 (1.91)
Chia, coconut and mango pudding	5.90 (2.29)

Starfruit and dragon fruit salad	5.83 (2.16)
Chinese fried dough	5.82 (2.05)
Almond cookies	5.78 (1.85)
Chilled melon salad	5.72 (1.96)
Creamy rice soymilk pudding	5.66 (2.27)
Custard egg tart	5.61 (2.35)
Battered bananas in golden syrup	5.56 (2.37)
Asian poached pears with dates and goji berries	5.17 (2.08)

Study 6

Main dishes	**Liking rating**
Chicken schnitzel	7.24 (2.03)
Cheeseburger	6.85 (2.13)
Pepperoni pizza	6.32 (2.22)
Battered fish and chips with tartare	6.13 (2.51)
Lamb with couscous salad and yogurt	6.05 (2.28)
Falafel pita bread with roast cauliflower hummus and parsley	5.82 (2.22)
Meat pie	5.80 (2.31)
Pasty with chips	5.62 (2.05)
Chicken, chickpea and tomato curry	5.53 (2.24)
Lemon and thyme Barramundi fillets with chickpeas	5.21 (2.44)
Sausages with chips and mustard	4.80 (2.31)
Pork sausage roll	4.72 (2.38)
Side dishes	
Potato wedges	7.22 (1.75)
Fried chicken strips with ketchup	6.61 (1.95)

Mini ham and cheese croissants	6.07 (2.14)
Steamed Asian greens with chilli	5.78 (2.26)
Deep fried cheese sticks with ketchup	5.73 (2.69)
Papadums	5.69 (2.17)
Onion rings	5.40 (2.58)
Carrot, orange and cumin dip with vegie sticks	5.27 (2.11)
Mini crescent dogs	5.04 (2.34)
Fried polenta squares	4.66 (2.03)
Tabbouleh	4.34 (2.47)
Apple, cabbage and spinach salad with pepitas	4.25 (2.03)
Dessert dishes	
Fruit salad	7.30 (1.85)
Churros	6.87 (2.12)
Scones with jam and cream	6.77 (2.05)
Cinnamon doughnut	6.66 (1.95)
Caramel brownie	6.63 (2.06)
Jumbo choc chip cookie	6.54 (1.96)
Vanilla ice cream	6.41 (2.04)
Iced mud cake	6.27 (2.11)
Banana berry wholemeal pikelets	6.09 (2.06)
Melon and kiwi parfait	5.28 (2.13)
Jelly slice	4.90 (2.39)
Poached pears	5.12 (2.22)

Table S5

Main Effects of Condition and Dietary Restraint and the Condition by Dietary Restraint Interaction for Main, Side and Dessert Choices (Healthy, Unhealthy) in Studies 4, 5 and 6

Study 4						
Predictor	***b***	***SE***	***Wald***	***p***	**Odds Ratio**	**95% CI**
Mains						
Placement condition			.49	.783		
Top condition (versus middle)	.03	.43	.01	.943	1.03	.45 – 2.38
Top condition (versus bottom)	.26	.42	.40	.529	1.30	.57 – 2.96
Middle condition (versus bottom)	-.23	.41	32	.571	.79	.35 – 1.78
Dietary restraint	.05	.34	.02	.890	1.05	.54 – 2.05
Interaction condition x dietary restraint			1.42	.493		
Sides						
Placement condition			2.06	.357		
Top condition (versus middle)	.42	.50	.72	.395	1.53	.58 – 4.06
Top condition (versus bottom)	-.33	.57	.32	.570	.72	.23 – 2.23
Middle condition (versus bottom)	.75	.54	1.95	.163	2.12	.74 – 6.06

Dietary restraint	-.01	.43	.001	.974	.99	.43 – 2.28
Interaction condition x dietary restraint			.90	.637		
Desserts						
Placement condition			.41	.813		
Top condition (versus middle)	.15	.42	.12	.726	1.16	.51 – 2.64
Top condition (versus bottom)	-.13	.44	.08	.776	.88	.37 – 2.09
Middle condition (versus bottom)	.27	.43	.41	.522	1.31	.57 – 3.03
Dietary restraint	-.57	.36	2.52	.113	.57	.28 – 1.14
Interaction condition x dietary restraint			1.06	.589		

Study 5

Predictor	***b***	***SE***	***Wald***	***p***	**Odds Ratio**	**95% CI**
Mains						
Placement condition			.55	.760		
Top condition (versus middle)	.09	.46	.04	.846	1.09	.44 – 2.71
Top condition (versus bottom)	-.27	.51	.29	.591	.76	.28 – 2.06
Middle condition (versus bottom)	.36	.50	.53	.467	1.44	.54 – 3.82

Dietary restraint	-.01	.03	.03	.863	1.00	.94 – 1.05
Interaction condition x dietary restraint			3.17	.205		
Sides						
Placement condition			.52	.772		
Top condition (versus middle)	-.29	.40	.51	.475	.75	.34 – 1.65
Top condition (versus bottom)	-.17	.41	.17	.682	.85	.38 – 1.88
Middle condition (versus bottom)	-.12	.42	.09	.771	.89	.39 – 2.00
Dietary restraint	.04	.02	2.51	.113	1.04	.99 – 1.09
Interaction condition x dietary restraint			.57	.751		
Desserts						
Placement condition			3.07	.215		
Top condition (versus middle)	-.76	.55	1.91	.167	.47	.16 – 1.37
Top condition (versus bottom)	.17	.47	.13	.719	1.18	.47 – 2.97
Middle condition (versus bottom)	-.93	.54	2.92	.088	.40	.14 - 1.15
Dietary restraint	.05	.03	2.46	.117	1.05	.99 – 1.11

Interaction condition x dietary restraint			4.06	.131		
Study 6						
Predictor	***b***	***SE***	***Wald***	***p***	**Odds Ratio**	**95% CI**
Mains						
Placement condition			4.60	.100		
Top condition (versus middle)	-1.00	.47	4.54	.033	.37	.15 - .92
Top condition (versus bottom)	-.28	.41	.48	.488	.75	.34 – 1.68
Middle condition (versus bottom)	-.72	.47	2.31	.129	.49	.19 - 1.23
Dietary restraint	.06	.03	4.60	.032	1.06	1.01 – 1.13
Interaction condition x dietary restraint			3.64	.297		
Sides						
Placement condition			6.73	.035		
Top condition (versus middle)	-1.42	.55	6.64	.010	.24	.08 - .71
Top condition (versus bottom)	-.50	.43	1.35	.245	.61	.26 – 1.41
Middle condition (versus bottom)	-.93	.57	2.63	.105	.40	.13 – 1.21
Dietary restraint	.01	.03	.04	.835	1.01	.94 – 1.07
Interaction condition x dietary restraint			2.98	.225		
Desserts						
Placement condition			7.61	.022		

Top condition (versus middle)	-1.00	.48	4.27	.039	.37	.14 – .95
Top condition (versus bottom)	-.29	.39	.57	.450	.75	.35 – 1.60
Middle condition (versus bottom)	-1.29	.47	7.51	.006	.28	.11 - .69
Dietary restraint	.04	.03	2.25	.133	1.04	.99 – 1.10
Interaction condition x dietary restraint			1.98	.371		

CHAPTER 5: GENERAL DISCUSSION

Chapter Overview

As outlined in Chapter 1, the overarching aim of the present thesis was to investigate the effectiveness of implicit healthy-eating interventions in food menu contexts, with a particular focus on placement interventions. Within this overall aim, each of the studies in the thesis had their own specific sub-aims. These included reviewing the literature on implicit healthy-eating interventions in the context of food menus (Study 1, Chapter 2), comparing different approaches within a placement intervention to encourage healthier choices from physical and online snack menus (Studies 2 and 3, Chapter 3), and comparing different approaches within a placement intervention to encourage healthier choices from longer online menus across three different cuisines (Studies 4-6, Chapter 4). A further aim was to investigate the role of dietary restraint (i.e., the tendency to control or restrict food intake in an attempt to lose or maintain body weight; Savage et al., 2009) in the effectiveness of placement interventions on healthy food choices (Studies 2-6, Chapters 3 and 4). This general discussion chapter will summarise and discuss the key findings of the present thesis. Theoretical and practical implications will also be discussed, followed by considerations of strengths, limitations, and recommendations for future research.

Summary of Findings

Chapter 2 presented the results of a systematic review, which addressed the first sub-aim of reviewing the literature on implicit healthy-eating interventions in the context of food menus. The review evaluated six implicit intervention types (placement, priming/cueing, defaults, naming, ratios, and signage) across 23 studies. Overall, placement and default interventions appeared to be the most effective interventions to promote healthier eating behaviours in menu contexts. Priming/cueing, ratio, and naming interventions also showed

potential, but require further investigation due to limited existing literature. Signage interventions were consistently unsuccessful at increasing healthy eating behaviours.

Given the potential effectiveness of placement interventions outlined in Chapter 2, Chapter 3 presented the results of Studies 2 and 3, which addressed the second sub-aim by comparing the placement of healthy items in the top, middle, and bottom sections of a menu against one another, to determine which could most effectively promote healthy snack food choices. Study 2 compared these presentations using a physical menu, while Study 3 did so using an online menu. In Study 2, the placement of healthy foods on the physical menu did not predict food choice, with no significant differences in the likelihood of choosing a healthy snack between conditions. However, in Study 3, the placement of healthy foods on the online menu did predict food choice. Specifically, a greater number of participants made a healthy snack choice when healthy options were placed at the top of the online menu, in comparison to when they were placed in the middle or at the bottom of the menu.

In the General Discussion of Chapter 3, it was suggested that ordering food from online platforms could trigger automatic decision-making behaviours, as digital devices such as smartphones have been linked to instant gratification and spontaneous or impulsive tendencies (Abell, 2019). As implicit interventions shape behaviours through capitalising on automatic decision-making behaviours (Bowen & Morris, 1995), this could explain the observed effect of the placement intervention in the online setting. However, we cannot be certain that this was the case, as we did not directly assess cognitive processes in the present thesis. Future studies should explore this further by investigating the cognitive processes underlying food-choice behaviours in the context of implicit interventions.

It was further suggested that the variations in the findings of Studies 2 and 3 could be due to the overall layout of the menus. Menu items in Study 2 were presented in an array, while those in Study 3 were presented in a single column. Therefore, participants in Study 2

could see all the items at once, while participants in Study 3 had to scroll down to see the full list. Some research (e.g., Feldman et al., 2011) has suggested that menu items that are viewed first receive the most cognitive attention, which could explain why healthy items in the top section of the online menu were chosen more in Study 3. Indeed, it seems that primacy effects (i.e., the idea that people most easily remember, and therefore favour, the first things that they see or read; Andersson & Nelander, 2021; Wansink & Hanks, 2013) may occur for healthy snack foods in single-page online menus.

Chapter 4 presented Studies 4-6, which addressed the third and final sub-aim of the thesis by investigating a placement intervention to encourage healthier food choices from longer online menus across different cuisines. In three experimental studies, menus specific to three different cuisines (fast-food, Study 4; Chinese, Study 5; mixed Australian, Study 6) were created to compare the same three placement approaches as in Studies 2 and 3 (i.e., top, middle, bottom) against one another to determine the best way to promote healthier main, side and dessert choices. In Studies 4 and 5, placement condition had no effect on the overall number of healthy food choices from the fast-food and Chinese menus. However, in Study 6, participants who saw a mixed Australian menu with healthy foods in the top or bottom sections of the menu made more healthy choices than participants who saw healthy foods in the middle section. This was particularly the case for side and dessert choices.

The General Discussion of Chapter 4 presented several suggestions as to why the placement intervention effectively promoted healthier choices from the mixed Australian cuisine menu, but not the fast-food or Chinese cuisine menus. First, due to the frequent widespread consumption of fast-food throughout Australia (Cameron et al., 2022), participants in Study 4 (fast-food menu) may have had such well-established fast-food ordering habits, that they reverted to their usual choices no matter their placement on the menu. In line with consistent links between fast-food and unhealthy consumption behaviours

(Poti et al., 2014; Stender et al., 2007), instructing participants to imagine ordering from a fast-food menu may also have primed unhealthy eating by triggering hedonic food enjoyment goals (Hu & Min, 2022) and enhancing the salience of the unhealthy foods on the menu. In Study 5, Chinese cuisine was not particularly well-known amongst our sample of mostly Australian consumers (only six participants (3.26%) identified as being of Chinese ethnicity). Therefore, our placement intervention may have been overshadowed by participants' tendency to avoid unknown foods. Participants may also have had trouble distinguishing between healthy and unhealthy foods, due to being unaccustomed with some Chinese food preparation techniques and ingredients. In contrast to Studies 4 and 5, participants in Study 6, like typical Australian consumers (Anderson & Benbow, 2015; Flowers & Swan, 2012), would have been familiar with the mixed Australian dishes on the menu but not to the extent that these elicited habitual choices. It was suggested that within this context, the placement intervention was better able to guide food choices. Like in Study 3 (Chapter 3), it is possible that primacy effects occurred for healthy foods from mixed Australian cuisine, in longer online menus. It is also possible that recency effects (i.e., the notion that the last things that people see or read are preferred, as they are most clearly remembered; Bowen & Morris, 1995; Mantonakis et al., 2009) may also occur in this context. One possible explanation for why recency effects occurred in Study 6, but not Study 3, is that snack foods (like those in Study 3) are typically chosen compulsively, with little thought or consideration (Teichert et al., 2020). In contrast, being generally larger portions of food, full meal choices are often deliberated over more carefully (Bellisle, 2014). Therefore, in Study 3, if participants who wanted a healthy snack did not see a healthy option first (i.e., at the top of the menu), they may have automatically picked something unhealthy instead, without bothering to look at items further down the list. However, in Study 6, if participants who were looking for a healthy meal did not see a healthy option first, they may have looked more closely through all

sections of the menu, paying more attention to healthy items both in the top and bottom sections of the menu.

Notably, dietary restraint did not moderate the effect of placement condition on food choice in any of the empirical studies in the present thesis. While this finding is consistent with some research (e.g., Keegan et al., 2019), it is inconsistent with other studies (e.g., Deek et al., 2022; Kemps et al., 2016; Papies & Hamstra, 2010; Tonkin et al., 2019), which have shown that healthy-eating nudges may be more effective for restrained eaters than for unrestrained eaters. In the General Discussions of Chapter 3 and 4, it was noted that these inconsistencies could be due to the timing of the manipulations. Similar to Keegan et al., the healthy-eating nudges in the present studies were presented simultaneously with the food options. By contrast, in studies where dietary restraint moderated the effect of healthy-eating nudges on food choice, the nudge was presented prior to the food options, giving restrained eaters opportunity to activate their diet-related goals (Deek et al.; Kemps et al.; Papies & Hamstra; Tonkin et al.). Overall, the findings of this thesis make a novel contribution to knowledge by furthering our understanding of emerging healthy-eating interventions, particularly those that focus on item placement and food menus. This is important, as such interventions had not previously been studied in great depth.

Theoretical Implications

The findings of the present thesis have some important theoretical implications. First, they are broadly consistent with nudging theory. Nudges aim to guide people toward desirable choices or behaviours, without explicitly telling them what to do (Thaler & Sunstein, 2008). This is typically achieved by making the desirable choices or behaviours the easiest or most noticeable options, such that they are subconsciously favoured (Thaler & Sunstein, 2008). All of the studies in the present thesis focused on nudging, in the form of

implicit interventions that aim to encourage healthier eating behaviours by making healthy options more salient.

The systematic review (Study 1; Chapter 2) provided insight into which healthy-eating nudges are most effective in food menu contexts, and for which specific populations. Most notably, placement interventions were found to be consistently effective amongst adults, while default interventions were consistently effective for younger populations (e.g., teenagers and school children). The findings of Studies 2-6 (Chapters 3 and 4) suggest that nudging may be more effective in online than physical settings, although this cannot be confirmed, given that only one of the present empirical studies was conducted in a physical setting. Furthermore, Studies 4-6 (Chapter 4) suggest that nudges in food choice contexts may be best suited to cuisines that are well-known, without being overly popular (e.g., mixed Australian cuisine). For cuisines that are exceedingly popular (e.g., fast-food), any nudging effects may be overshadowed by consumers' existing food choice habits. Conversely, for cuisines that are less well-known (e.g., Chinese cuisine), nudges may fail to override consumers' tendencies to avoid unfamiliar foods. Notably, though, without pre-specified and robust replication of the present results, these interpretations are only speculative.

While the findings of Studies 2-6 are specific to placement interventions, it is likely that similar effects may occur for other nudges. For example, naming interventions whereby healthy foods are labelled with descriptive names intended to increase their salience (e.g., "gently steamed succulent sea scallops nestled in brown rice"; Feldman et al., 2011, p.269) may also be effective for familiar cuisines. For less well-known cuisines, food names or descriptions that highlight specific ingredients or cooking methods are unlikely to appeal to consumers who may be unfamiliar with the terminology that is used.

The present findings can also be linked to dual processing theories (Epstein, 1994), which distinguish between cognitions that are quick, automatic and unconscious, and those

that are slow, deliberate and well-thought-out (Evans, 2008). Specifically, the present finding that implicit interventions (which are said to utilise unconscious cognitions; Hollands et al., 2016) were broadly effective in increasing healthier food choices is consistent with the idea that everyday, mundane activities such as choosing something to eat are predominantly unconscious (Cory et al., 2021; Mason et al., 2018).

Further to this, while food choices may be largely unconscious, Strack and Deutsch's (2004) Reflective-Impulsive Model suggests that social behaviours such as eating are jointly determined by both impulsive (automatic, unconscious) and reflective (deliberate, rational) mental systems. Therefore, it is possible that reflective and impulsive cognitions may influence food choices in conjunction with one another. This further highlights the aforementioned need for future research to investigate the cognitive processes underlying food-choice behaviours in the context of implicit healthy-eating interventions.

Practical Implications

The present thesis also has several practical implications. The systematic review (Study 1; Chapter 2) found that placement and default interventions have particularly good evidence for promoting healthier eating from menus, and that there is some support for the use of priming/cueing, ratio, and naming interventions in this context. Studies 2 and 3 (Chapter 3) showed that the setting in which placement interventions are implemented is important, with our placement intervention increasing healthier snack choices from an online menu, but not a physical menu. Studies 4-6 (Chapter 4) further showed that the efficacy of placement interventions for food menus may depend on the cuisine that is targeted, with our placement intervention increasing healthier choices from a mixed Australian cuisine menu, but not from fast-food or Chinese menus.

From an industry perspective, the findings of the present thesis provide useful insight for business owners in the food and hospitality realm, who may wish to encourage healthier

eating without forgoing their own profits. Unlike explicit interventions which can negatively impact sales, implicit interventions simply guide consumers toward certain choices (Carins & Bogomolova, 2021). In fact, as healthy foods such as fruit and vegetables typically have higher profit margins (Futrell Dunway et al., 2017), the profits of businesses that implement implicit interventions to promote healthier choices could potentially increase. Because of the freedom-preserving nature of implicit interventions, they are also widely approved of by consumers (Junghans et al., 2015).

Further to this, the findings of Studies 4-6 suggest that marketing and nudging interventions may work best in the context of familiar items, or if used in a way that makes foods look more familiar to consumers. In light of this, businesses specialising in less well-known cuisines could pair less familiar healthy foods with well-known healthy foods, before placing these dishes in optimal menu locations to increase their salience. For example, starfruit and dragonfruit salad, a dessert dish on the Chinese menu in Study 5, could be paired with a fruit that is more common in Australia, such as mango or pineapple. This could increase the perceived familiarity of the dish amongst Australian consumers, reducing the likelihood of healthy-eating interventions being overshadowed by the avoidance of unfamiliar foods.

With the majority of the present empirical studies (i.e., all but Study 2) using online settings, our findings are especially relevant for food businesses that utilise online ordering and delivery platforms, such as UberEats® and Deliveroo®. This is important, with these online platforms seeing tremendous growth as of late, particularly since the beginning of the COVID-19 pandemic (Hobbs, 2020; Stephens et al., 2020). In light of such widespread popularity, online food businesses have a social responsibility to contribute to efforts to promote healthier eating (Knai et al., 2015). As the present findings suggest, they could do this by placing healthier items at the top of their menus. Furthermore, because implicit

placement interventions were most effective in the context of discretionary foods, our findings also lend themselves to food businesses that specialise in such foods (e.g., snack bars and dessert shops; Fayet-Moore et al., 2019). As 98% of Australian adults consume discretionary foods, 60% of whom exceed the recommended limit of three servings per day (Fayet-Moore et al.), the importance of identifying and investigating healthy-eating interventions that are effective in this context is evident.

From a broader public health perspective, the overall findings of the present thesis could eventually translate to general health improvements, for example, with healthier food choices increasing nutrient intake. Cumulated over time, this could result in wide-reaching positive outcomes at a population level. Thus, gradually improving diet-quality could reduce incidences of diet- and lifestyle-related diseases such as heart disease, diabetes, and some cancers (Cena & Calder, 2020; Key et al., 2007; Mente et al., 2009; Walsh et al., 2021).

Strengths and Limitations

The studies in the present thesis have some notable strengths. First, the systematic review (Study 1; Chapter 2) included only implicit healthy-eating interventions that were well-aligned with nudging strategies (Thaler & Sunstein, 2008). By contrast, previous systematic reviews and meta-analyses on healthy-eating nudges had included interventions that were somewhat explicit (e.g., calorie labelling and pricing interventions; Arno & Thomas, 2016; Wilson et al., 2016; Vecchio & Cavallo, 2019). Therefore, our systematic review made a novel and useful contribution to existing literature by directly comparing only truly subtle and implicit healthy-eating interventions.

Second, in Study 2 (Chapter 3), which was conducted before the beginning of the COVID-19 pandemic, participants received their chosen food items, and were able to either eat them in the laboratory or take them home to consume. As such, Study 2 was similar to real-world food ordering situations, in which consumers receive and eat their chosen foods.

Third, the menus in the online studies (i.e., Studies 3-6; Chapters 3 and 4) were realistic, and very much like those seen on real online food ordering platforms. For example, all menus used coloured images to display the food items, and were simple and easy to navigate. Like in real online ordering contexts, participants in Studies 4-6 (Chapter 4) also had the opportunity to change their choice after making their initial selections, if they wished to do so.

Despite these strengths, studies in the present thesis also have some limitations. First, the majority of the studies included in the systematic review (Study 1; Chapter 2) used participants of relatively high socio-economic status, from high-income countries or regions. Likewise, the present empirical studies (Chapters 3 and 4) were conducted in Australia, a high-income country. Consequently, our findings may not necessarily be generalisable to all demographics, particularly individuals from disadvantaged or low socio-economic backgrounds.

Second, as mentioned above, apart from Study 2 (Chapter 3), all of the empirical studies were conducted during the COVID-19 pandemic. Therefore, most of the data collection necessarily took place online to comply with social distancing regulations and recommendations. As a result, food choices were hypothetical, and participants did not receive and consume their chosen foods. This limits the generalisability of our findings to real food ordering contexts, in which customers expect to actually consume the foods that they order.

Furthermore, there were differences in the genders included in each study. Female samples were used in Studies 2 and 3 (Chapter 3) due to dieting behaviours being consistently more prevalent in women than in men (Lemon et al., 2009). As no effects of dietary restraint were found in these studies, all genders were recruited in Studies 4 and 5 (Chapter 4). However, due to difficulties with recruiting a representative sample of men in

these studies, a female-only sample was again used in Study 6 (Chapter 4). As such, the findings of Studies 2, 3 and 6 are not necessarily generalisable to all genders.

Additionally, the study procedures and data analysis plans for the empirical studies (i.e., Studies 2-6; Chapters 3 and 4) were not pre-registered. Therefore, the research plans were not formally disclosed prior to conducting the research. Nevertheless, we were transparent in the reporting of our findings, and the analysis of our data was consistent with initial plans.

Lastly, while the terminology used to describe different types of implicit interventions in the present thesis was consistent with terminology used in existing research (e.g., 'placement' interventions; Feldman et al., 2011; 'default' interventions; Dalrymple et al., 2020; 'cueing' interventions; Tonkin et al., 2019), the thesis could have benefited from utilising standardised typologies, such as Hollands et al.'s (2017) TIPPME (typology of interventions in proximal physical micro-environments) typology for changing environments to change behaviour. Utilising a standardised typology would have maximised consistency with existing research in this field, and helped to better locate the contribution of the present research in the wider literature.

Future Research Recommendations

The findings of this thesis point to several important future research directions. In line with differences in the genders included in each study, future research could usefully investigate placement interventions using samples that better represent men. As the present studies were conducted using samples from mostly wealthy regions, future research could also explore healthy-eating nudges and placement interventions in low-income or disadvantaged populations, for whom dietary quality is often particularly poor (Grech et al., 2017). Furthermore, in line with our use of hypothetical food choices during the COVID-19 pandemic (i.e., Studies 3-6), future studies on placement interventions could utilise settings in

which participants receive their chosen food items (e.g., drive-through services at takeaway food businesses).

If follow-up studies further support the findings of the present thesis, and extend them to more varied samples (e.g., non-student samples), it would be useful to consider further optimizing placement interventions through incorporating additional components. Specifically, in the General Discussion of Chapter 4, it was suggested that for cuisines which may be automatically associated with unhealthy eating or hedonic consumption (e.g., fast-food), priming/cueing interventions (e.g., images of healthy food items on menu covers; Deek et al., 2022; Tonkin et al., 2019) could inhibit such associations by activating health goals instead. This could increase the salience of the healthy options when they are presented in optimal locations on the menu. Additionally, for less well-known cuisines, it was suggested that pairing a placement intervention with an evaluative labelling intervention (e.g., traffic light systems that code foods based on healthiness, or descriptive labels such as 'low fat' or 'low sugar'; Szakály et al., 2020) could increase the strength of the placement intervention by making the healthy and unhealthy foods more easily distinguishable. To potentially maximise the effectiveness of placement interventions even further, future research could also explore a placement intervention that capitalises on both primacy (Andersson & Nelander, 2021; Wansink & Hanks, 2013) and recency (Bowen & Morris, 1995; Mantonakis et al., 2009) effects. Specifically, as Study 3 (Chapter 3) found evidence in support of placing healthy items in the top section of the menu, and Study 6 (Chapter 4) found evidence in support of placing healthy items in both the top and bottom sections of the menu, future research could directly compare these two approaches across a range of cuisines.

Lastly, as outlined previously, research (e.g., Abell, 2019) suggests that online platforms and digital devices are associated with impulsive behaviours. The findings of the

thesis support this, suggesting that nudges, which rely on automatic and impulsive tendencies, work best in online contexts. However, the specific psychological mechanisms driving placement effects are yet to be determined. Therefore, future research on placement interventions in online contexts could look more closely at the underlying mechanisms that drive food choices (e.g., by measuring impulsivity).

Conclusion

The present thesis addressed the overarching aim of investigating the efficacy of implicit healthy-eating interventions in food menu contexts, with a focus on placement interventions. This was first addressed by way of a systematic review that evaluated the literature on implicit interventions aimed at promoting healthier eating behaviours. The review was followed by five empirical studies which compared three variations of a placement intervention to promote healthier choices from a menu, using varied settings and cuisines. The thesis demonstrated that, in general, implicit interventions can effectively promote healthier eating behaviours in certain menu contexts. More specifically, it demonstrated that placing healthy foods in the top section of an online snack menu can increase healthier choices, while placing healthy foods in both the top and bottom sections of a longer online menu can increase healthier meal choices, dependent on the cuisine. Theoretically, the present findings support nudging strategies, showing that subtle adjustments to the way in which healthy food options are presented on a menu can increase their salience, thereby encouraging healthier eating. From a practical perspective, the present findings offer valuable insights for food purveyors who wish to increase their sales of healthy foods, without impacting profits. Future studies should test placement interventions using more representative samples to include more men, and also individuals from lower socio-economic or disadvantaged backgrounds. Like in Study 2 (Chapter 3), they could further measure real (as opposed to hypothetical) food choices using longer menus. Investigating the

presentation of healthy foods in both the top and bottom sections of the same menu page, as well as examining the effectiveness of placement interventions in conjunction with priming/cueing and evaluative labelling interventions, would also be worthwhile. Lastly, and perhaps most importantly, if implemented into practice, the novel findings of the present thesis could usefully contribute to general public health improvements by gradually improving diet-quality, potentially reducing instances of diet- and lifestyle-related illness and disease (Cena & Calder, 2020).

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