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Boosting Adoption of Mobile Health Apps: An Exploration of New Human and Technology Drivers of Adoption

By

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Abstract

Despite the many benefits and the growing accessibility of mobile applications (apps) for healthcare, the adoption rate of these apps is low. Further, existing research into adoption of apps for healthcare takes a narrow approach to adoption frameworks. That is, empirical studies investigate product and technology adoption drivers in terms of how they directly impact app usage and post-adoption usage behaviours. Few studies consider how these drivers underpin theories and models to offer a holistic view of technology adoption processes. Guided by product and technology acceptance theories, namely the Technology Acceptance Model, this thesis identifies and analyses a range of untested drivers of health app acceptance to develop a new model of adoption. The drivers analysed are the following characteristics of app users: i) subjective knowledge and involvement, ii) need for personalisation, iii) trust, iv) perceived convenience and the following characteristics of app technology, v) gamification and vi) aesthetics. This thesis uses the context of health apps and addresses gambling as an empirical research context as it investigates a sample of help-seeking gamblers and employs gambling quit apps as the health app for adoption. This thesis reports on a mixed-methods design study consisting of a qualitative stage—thematic analysis of focus group discussion data—and a quantitative stage—structural equation modelling of web-based survey data. The qualitative stage produced valuable insights into target app users' design and functionality preferences for health apps. The quantitative stage offers novel findings around the adoption drivers investigated. The significant drivers found were subjective knowledge and involvement, need for personalisation, perceived convenience, gamification and aesthetics. Using these findings, the thesis develops a new theoretical model of health app adoption. It then uses the empirical findings to present practical recommendations for app developers and marketers for embedding the significant drivers into the creation and promotion of health care apps.

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Chapter 1: Introduction

1.1 Research Background

Increasingly researchers are focussing on consumer issues that are meaningful and impactful to society (Dahl et al., 2014). In marketing, research on social issues facilitates positive consumer behaviour and conditions (Macfadyen et al., 2003). The findings of such research can assist marketing efforts to shape attitudes, increase awareness and foster use of products and services that create positive and enduring outcomes for society (Walsh et al., 1993). This thesis represents research on social issues because it seeks to understand motivations that have the potential to enhance consumer wellbeing and adapt them to marketing practices. This thesis investigates drivers of consumer adoption of mobile applications (apps) designed for users to manage and improve their health. Mobile apps for healthcare can include health management and monitoring apps, such as for fitness and nutrition, and apps for specific health issues, such as for delivery of therapies for mental health concerns and addictions. These types of health app can contribute positively to consumer wellbeing, so it is important to investigate the factors that drive their adoption. The original contribution to knowledge from this thesis is the creation of a new model of health app adoption that can be used to understand in greater detail the processes behind health app adoption.

Apps in general are specialised software optimised to run on and enhance mobile devices (Liu et al., 2015; MacDonald, 2017), and are used in many aspects of our everyday lives (Dhaliwal et al., 2021). Apps are attractive tools for consumers because they are highly accessible and constantly innovated. People's dependence on apps makes them an easy means to market directly to consumers (Reyes, 2016). The global popularity of mobile devices and telecommunication coverage, free access to national and global app stores, and mass production of free and inexpensive apps have removed barriers to accessibility (Chen et al., 2017; Serrano et al., 2016). The growing number of electronic devices per household (Nicholas et al., 2020), people's growing dependence on apps for daily tasks (Sarwal & Saini, 2021) and the transportability of smartphones (Hobbis, 2020) have further enabled app adoption.

These success factors have allowed apps to move beyond communication and entertainment into other areas, such as healthcare. Mobile health apps (henceforth, mHealth apps) is a developing product category for which marketing research is clearly highly relevant (Bhuyan et al., 2016). The literature advocates the use of mHealth apps to manage general health and wellbeing, counteract increases in the incidence of lifestyle diseases (Thornton et al., 2017) and assist overburdened healthcare systems (Boyce & Katz, 2019; Monash University, 2019). mHealth apps may be able to reduce financial and logistical pressures on healthcare infrastructure by reducing patient travel and using technology already in people's homes (Rahman et al., 2019). While some consumers need and prefer alternative options to access health services, there is huge support for mHealth from industry and researchers because of cuts to public health funding and the growing trend to seek digital healthcare solutions before using traditional services (Chouvarda et al., 2015; Gammon et al., 2015; Hu, 2011). Further, the reach of mHealth apps extends to many sociodemographic groups and enables connections between individuals globally (Serrano et al., 2016). Given the many benefits of using mHealth apps, it is important to increase their adoption through marketing and research efforts.

App adoption in general is a complex theoretical process, as reflected in recent calls for more research on up-to-date theoretical models of app adoption (Kumar & Tuli, 2021). Although most models outline the process of adoption of technology, they do not examine the major motivators of adoption—perceived usefulness and perceived ease of use (Davis et al., 1989). Perceived usefulness is the perceived ability of the technology to enhance performance, whereas perceived ease of use is the perception of the effort required to use the technology (Davis et al., 1989). Venkatesh et al. (2003a) argued that these constructs predict, with great accuracy, consumer attitude towards a given technology, which stimulates consumer intention and action. However, Min et al. (2019) noted that models of adoption can appear outdated when applied to mHealth apps as they were not developed with the technology and context in mind. Therefore, these models need to be expanded and revised for the times and the context, particularly by testing antecedent variables in line with current technology and user expectations (Al-Emran & Granic, 2021; Tian & Dong, 2013). MacDonald (2017) further argued that a poor understanding of mHealth app adoption may be the result of a lack of understanding around antecedents to users' perceived ease of use and usefulness. In

response, this thesis seeks to identify specific antecedents with the potential to drive adoption to develop an up-to-date and contextually relevant model of mHealth app adoption.

Past research has investigated user and technology factors such as user experience and branding, to extend traditional technology acceptance theories (see Alam et al., 2020; Vervier et al., 2019). As technology and users diversify, so do the number of contributing factors and their potential influence. Learning how these factors influence consumer behaviour and theory builds our understanding of how users adopt technology, such as mHealth apps. Despite a growing body of literature respective to apps generally and mHealth apps specifically, there remain several significant gaps in our current understanding about how to increase the adoption of mHealth apps. Despite the value of these apps, consumer adoption remains comparatively low (Blondon et al., 2014; Mustafa et al., 2022). The aim of this thesis is to identify and examine a range of technology adoption antecedents that are untested in the mHealth app adoption literature. These untested drivers of adoption can be scaffolded to contribute to established theory to create a current theoretical framework to better explain mHealth app adoption.

1.2 Research Justification

1.2.1 The Value of mHealth Apps to Society

mHealth apps have the potential to create positive health change for individuals and communities regarding many health issues as well as general health and fitness management (Zhao et al., 2016). A review by van der Maas et al. (2019) covered a range of studies using high-calibre mHealth apps across public health, including diabetes management, depression treatment and smoking cessation as examples. Treatment centres and medicines for these health issues are less accessible for some groups (see Gilbert et al., 2015; Meier et al., 2022; Mohan et al., 2020) than are mHealth apps, which are globally available (Muñoz et al., 2018). mHealth apps provide fast and simple access to and tracking of individual health data through interactive displays that encourage user engagement (Han & Lee, 2018). Further, clinical trials comparing mHealth app intervention groups with control groups have shown that apps lead to better health outcomes: for example, an 18% reduction in blood pressure among hypertension sufferers (Gong et al., 2020); 17% higher mental wellbeing scores for people

experiencing post-natal depression (Kubo et al., 2021); and a 33% higher rate of smoking abstinence for people wanting to quit smoking (Chu et al., 2021). There are also economic benefits to the use of mHealth apps (Iribarren et al., 2017). They can reduce expenses for individuals where the necessary treatment is not government subsidised, such as heart disease in Australia (see Maddison et al., 2015). There are economic benefits for society too. Luxton et al. (2014) presented a case where, in lieu of publicly funded treatment, an mHealth app was prescribed to 1,600 individuals and successfully reduced feelings of work-related stress. The estimated savings in public funding in this case were US$2.8M. Identification of these positive outcomes substantiates the use of mHealth apps as health tools, particularly in cases where patients can supplement existing treatment with mHealth apps; however, the purpose of mHealth is to do just that – supplement existing services and not replace them.

The use of mHealth apps as a treatment tool is a growing trend (Heaven, 2018). Completely replacing some types of treatment with apps is more common in the case of unhealthy consumption behaviours among people who tend to avoid formal healthcare interventions altogether, such as face to face therapies and group sessions (Nilsen, 2010). People are unlikely to be open about potentially embarrassing or stigmatised health issues, such as addictions. In fact, individuals dealing with addiction seek 'formal treatment with a professional as a last resort' and try alternatives first (Evans & Delfabbro, 2005, p. 150). Further, even before the creation of mHealth apps, Young (2005) found that 85% of addicted study participants searched for an online alternative before connecting with face-to-face therapy. Hence, it is likely that groups with addictions feel the same about traditional interventions and are likely to seek mHealth apps as an initial intervention, or even a standalone solution (Rai et al., 2013). This creates an opportunity for mHealth apps to serve consumer needs (Florido-Benítez, 2022); thus, research that encourages adoption of anonymous and autonomous treatments for stigmatised health issues is invaluable for society. Of course, how well an mHealth app can capitalise on the opportunities presented depends on the rate of adoption.

1.2.2 The Current Rate of mHealth App Adoption

Despite the health industry's recognition of mHealth apps as a valuable health tool and a critical direct channel to the public, researchers have reported low adoption rates (Moudud-

Ul-Huq et al., 2021; Walker, 2017; Woldaregay et al., 2018), particularly for chronic illnesses and diseases (Liu et al., 2022). Industry highlights can quantify the adoption rate. In 2018, mHealth app downloads accounted for less than .001% of all app downloads globally (Statista, 2018). To date in 2022, mHealth apps for chronic illnesses and diseases have accounted for less than 1% of all mHealth app downloads (Statista, 2022a). In Australia, fewer than one-third of people have used any type of mHealth app (Statista, 2020), and 13% have paid for an mHealth app (Statista, 2022b). Studies that have quantified mHealth app adoption for specific health conditions, such as diabetes, nicotine dependence and gambling addiction, have also reported low numbers or low popularity among target users (see Brownlow, 2021; Iribarren et al., 2016; McClure et al., 2016). Wind et al. (2020) commented that, aside from a sudden spike in downloads during the COVID-19 pandemic, mHealth apps of all types remain unpopular among consumers. The disconnection between the value of mHealth apps for society and the low adoption rates was an important motivation for this thesis.

The literature highlights the poor understanding of user attributes and specific technology elements—such as the need for personalisation and gamification—as contributors to the low adoption rates (Acikgoz et al., 2022; Liu et al., 2022; Yan et al., 2021). The low adoption has prompted calls for more research on the process of mHealth app adoption (Al-Emran & Granic, 2021; Arnhold et al., 2014). In response, this thesis seeks to identify influential characteristics likely to contribute to mHealth app adoption. The first group of characteristics are specific to the target users of an mHealth app. The second group represents aspects of the technology specific to an mHealth app to which consumers respond with likely adoption. The findings presented in the thesis extend theory in technology adoption and provide critical information for mHealth app developers and marketers. Most mHealth app development to date has not been informed by research (Dhaliwal et al., 2021; Smahel et al., 2017). Further, notwithstanding marketing efforts to promote mHealth apps (see Lee & Chong, 2021; Wynne et al., 2022), adoption typically stems from peer recommendations (Mustafa et al., 2022). Recent research by Lee and Chong (2021) suggested that the promotion of mHealth apps should be informed by empirical research that considers the user and the technology. Hence, this thesis investigates user and technology characteristics that contribute to mHealth app adoption through a marketing lens. The most meaningful contribution of this thesis comes

from identifying and finding ways to exploit these characteristics to ultimately increase mHealth app adoption and positive health outcomes for consumers.

1.3 Research Context

1.3.1 Healthcare Delivery

The delivery of healthcare has evolved as technology has developed and improved. In recent years, the healthcare sector has seen a shift from the classical model, where healthcare professionals are the 'gatekeepers' of patient data and restrict patients' access, to a shared model where healthcare professionals and users collaborate and facilitate joint decision making (Eysenbach & Jadad, 2001). Both patients and practitioners engaging with information technology is vital for sharing health information in this model (Ali et al., 2017). The classical model focussed on specific types of medical information for healthcare professionals (i.e., education, practice and research). The shared model has moved into public health fields such as health information needs and healthcare accessibility (Eysenbach & Jadad, 2001). Healthcare professionals were initially reluctant to engage with take-home health technology because of concerns around quality (Eysenbach & Jadad, 2001). However, they began to understand the model's potential for disseminating information and healthcare technology to people (Altmann & Gries, 2017). The internet, as the key underlying platform for the development of the shared model, has become the go-to source of health information (Krueger, 2010). These changes have led to use of the term 'eHealth'.

1.3.2 eHealth

eHealth is the provision of healthcare via the internet and digital products (Schumacher et al., 2008). In other words, eHealth involves the broad use of the internet through digital technology by both public and practitioners, to support healthcare practices (Martinez-Pérez et al., 2013). The initial interest in eHealth came from commercial healthcare as it was marketed widely to practitioners (Schumacher et al., 2008). As delivery of eHealth improved, it became more accessible to the public (Krebs & Duncan, 2015). Gradually, eHealth products were developed for use with portable devices such as smartphones and wearable devices (Hussain et al., 2015; Rooij & Marsh, 2016). This was the point at which eHealth technology boomed and began a rapid evolution. This technological evolution and the ubiquity of

smartphones enabled greater accessibility to eHealth for individuals. These changes gave rise to the concept of mobile technology for healthcare, or mHealth.

1.3.3 mHealth

One of the earliest references to mHealth was in 2000 when it was defined as 'unwired e-med' (Laxminarayan & Istepanian, 2000). Istepanian and Lacal (2003) later reclassified mHealth as portable media and treatment services for medical workers. It was a decade later that researchers acknowledged that the definition of mHealth should include the public rather than solely clinicians (Silberman & Clark, 2012; Vogel et al., 2013). In the past decade, mHealth apps have become important products for delivery of timely and accessible healthcare (Baig et al., 2015). The growth in mHealth has led to the development of wireless technology removing the traditional boundaries of time, space and invasiveness that existed in classical healthcare models (MacDonald, 2017). This enabled niche products to be developed and marketed to underserviced patients and consumer groups (Maphosa, 2022). Examples include wireless blood glucose monitors for diabetics (Daim et al., 2013) and smart wearable devices that measure vital signs (Striegel, 2019). The definition of mHealth and mHealth products continued to evolve. The value of wireless healthcare technology has led to an exponential growth of research in mHealth apps (Alam et al., 2020), as investment continues to grow leading to new service delivery outreach (Albury et al., 2019). Additionally, eHealth services are being optimised for mobile platforms because of smartphone ubiquity (García et al., 2019) and the advantages that mHealth has over eHealth; that is, accessibility, affordability and convenience (Davis & Ballreich, 2014; Okazaki et al., 2015). Further, users bring their own device thereby removing the burden on healthcare providers to provide hardware (Al-Harthy & Ali, 2022). Despite these benefits, there are some downsides that consumers cannot control, including removal of funding that maintains apps (Campbell et al., 2017), data privacy failures (Papageorgiou et al., 2018) and replacement of traditional services with apps (Igbal et al., 2022). Data privacy is a prevailing issue in app development that can create distrust amongst consumers, particularly in mHealth as personal details and health information are often recorded (Papageorgiou et al., 2018). Notwithstanding these challenges, mHealth apps have become one of the fastest growing categories of app, after games and utilities (Recio et al., 2016), with many healthcare companies developing their own mHealth apps to market their products to consumers (Fritz et al., 2017). Healthcare

companies and app developers have produced a range of mHealth apps for different health issues. For this thesis, it is important to categorise the type of mHealth app being researched.

1.3.4 App Categorisation for This Thesis

Healthcare research classifies mHealth apps based on the health areas they target and their user base. A common classification is to distinguish apps based on their intended usage; a) chronic health and disease or b) general wellness management (IMS Institute for Healthcare Informatics, 2015). While succinct, this does not adequately distinguish the app market groups that are the focus of this thesis. Thus, this thesis combines this classification with the categorisation by Boulos et al. (2014): 1) apps for medical providers; 2) apps for specific health issues; 3) apps for education purposes; and 4) apps for the public. Categories 1 and 3 are developed for professionals, while 2 and 4 are public user oriented (Boulos et al., 2014). The focus of this thesis is Categories a), 2) and 4). This categorisation and identification of the intended user follows the definition of mHealth apps by Mechael (2009)—that they relate to health management for specific health topics by general users, not solely medical professionals. The categorisation of apps for this thesis is shown in Figure 1.1.

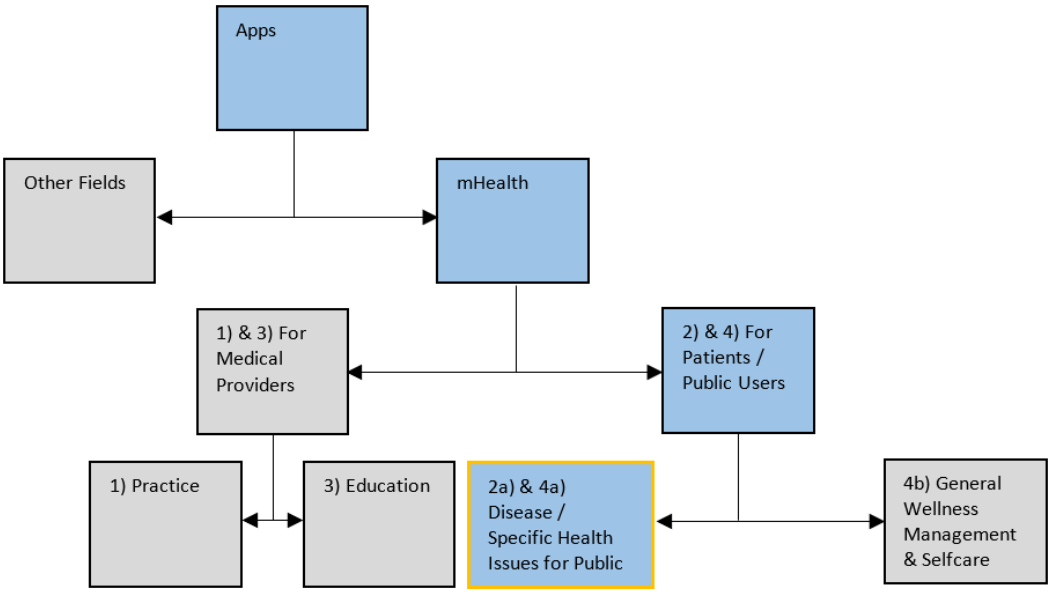


Figure 1.1: App Categorisation

1.4 Research Objectives and Question

The first objective of this thesis is to identify significant user characteristics that substantially drive adoption of mHealth apps via their perceived ease of use and perceived usefulness, both of which lead to a positive attitude towards and intention to use the apps. This contribution presents an important advance in the current understanding of technology adoption. The second objective is to identify new significant technology characteristics that substantially drive mHealth apps' perceived ease of use and perceived usefulness. In achieving these objectives, substantial and important contributions will be made to both relevant theory in the domain of technology acceptance of mHealth apps, and relevant practice in the healthcare sector. These overarching research objectives guide the following research question: What user characteristics and technology characteristics are likely to contribute to mHealth app adoption?

To address the above question, this thesis employs a version of one of the literature's most well-established theoretical models of technology adoption, the Technology Acceptance Model (TAM). The TAM is an information and media systems theory that models the process through which people adopt technology. The original version of the TAM accounts for the foundational elements of technology adoption—that is, perceived ease of use, perceived usefulness, attitude and intention (Davis et al., 1989; Holden & Karsh, 2010)—but studies in health technology and mHealth have expanded the TAM (see Cajita et al., 2017; Holden & Karsh, 2010; Hoque, 2016; Jacob et al., 2019; Ketikidis et al., 2012; Lim et al., 2011; Zhang et al., 2017). An extended model specific to mHealth apps builds on our understanding of the adoption process consumers undergo for mHealth products. Importantly, original TAM elements do not address the needs of modern mHealth; hence the need for expansion and revision (Choi et al., 2010; Tian & Dong, 2013). Further, Choi et al. (2010) and Tian and Dong (2013) emphasised that additional variables are needed to measure adoption across varying types of technology. These findings justify the need to go beyond the original TAM elements and further explore factors that can explain adoption of technology, thus developing a tailored model for mHealth app adoption.

1.5 Thesis Structure

Chapter One – Introduction presents the background to the research and justifies the chosen context, research questions and objectives. The chapter outlines both the breadth and depth of the research contributions. This chapter is important as it establishes the scope of the research by explaining what the research topic is about before establishing the niche research area and context.

Chapter Two – Literature Review reviews the relevant literature across disciplines pertinent to this thesis, including marketing, health, psychology and information technology, to justify the theoretical framework and the inclusion of variables, with particular emphasis on the drivers of technology adoption. The chapter expounds on the context of this research and concludes with a presentation of gaps in knowledge. The chapter is vital as it outlines the gaps of importance and validates the need to fill them.

Chapter Three – Research Framework, Hypotheses and Design begins with a discussion of the thesis' conceptual model and rationalises its development before developing the hypotheses tested in the thesis. The rationale for the design and the research stages of data collection are introduced. Last, the chapter justifies the empirical context for testing the hypotheses.

Chapter Four – Qualitative Study and Stimuli Development begins by introducing the focus of the qualitative stage to justify the stimulus created for the thesis. Next, the chapter outlines the stimulus creation process and its use in data collection. The chapter then outlines the sampling and protocol used for the qualitative data collection, noting the research objectives the approach sought to achieve. After presenting the qualitative findings, the chapter returns to the stimuli to show how the qualitative results improved the stimuli for the subsequent quantitative stage. This chapter is particularly important as it uncovers new knowledge around preferred gambling quit app functionality and aesthetics via qualitative methods and validates the concept represented by the stimuli for a relevant at-risk population.

Chapter Five – Quantitative Methodology presents the approach to the quantitative data collection stage of the research by describing the research design, data collection methods, sample size determination, sampling, data collection procedures, questionnaire content and

subsequent data analysis methods. This chapter is vital to evaluate the reliability and validity of the research.

Chapter Six – Quantitative Analysis and Results presents the empirical testing of the conceptual framework and the statistical approach to the quantitative data. The chapter confirms scale reliability, construct validity and model fit. Structural equation modelling is presented in detail with specification and estimation results followed by presentation of supported and unsupported hypotheses to identify the contributions to knowledge. Supplementary testing of data is included in this chapter to offer additional insights into the factors that can influence mHealth app adoption. It is important to present a distinct analysis of empirical data to allow readers to develop an unbiased idea of what is uncovered by the thesis before the findings are interpreted by the researcher.

Chapter Seven – Discussion and Conclusion summarises the key findings of the study and highlights the relevant contributions to various research fields. The theoretical and practical implications of the findings are discussed in detail alongside recommendations for practice by marketers and app developers. This chapter concludes with research limitations and directions for future research. The chapter is significant as it presents solutions to the research problems presented through the findings. The discussion shows how gaps in the literature are filled and how a contribution has been made as a result.

1.6 Chapter Summary

This chapter presented the background, justification, objectives and contributions of the thesis. It also provided a summary of the thesis structure and content through a chapter-by-chapter outline. The next chapter reviews the theoretical and empirical literature and outlines the important gaps relevant to this thesis that led to the research hypotheses.

Chapter 2: Literature Review

2.1 Introduction

The research question and objectives outlined in Chapter One inform this review of the literature pertinent to how and why people adopt apps, particularly mHealth apps. Through this review, significant gaps in current understanding relevant to the thesis topic are identified. The chapter commences with a background to apps, followed by an exploration of relevant theories established in the literature with respect to technology adoption, such as the Diffusion of Innovations Theory (Rogers, 1962) and the Technology Acceptance Model (TAM) (Davis et al., 1989). The chapter then examines various factors that contribute to technology adoption with a particular focus on mHealth apps, before exploring the role of consumer health and behaviour in the adoption process. Chapter Two concludes with an outline of the significant gaps that inform the research hypotheses specified in Chapter Three.

2.2 Mobile Applications

Mobile applications, or apps, are small, specific software applications generally used on mobile devices: 'small' refers to their size and installation process; and 'specific' refers to their precise functionality. Apps are universal products available globally that are applicable to personal computers as well as handheld and wearable technologies (Tojib & Tsarenko, 2012). Apps are 'on the go' tools that drive most digital media consumption (Fang, 2019). Their potential for consumer engagement stems from features such as attributes of personalisation, multiplatform applications and vividness (Shaw et al., 2022), partnered with their accessibility and portability (Jham, 2018). Apps are interactive products that support gamification and personalisation, enabling them to move beyond communication into services such as entertainment, banking and healthcare. As introduced in Chapter One, health apps are typically known as mHealth apps.

There are currently more than 350,000 mHealth apps available for users to download (Philip et al., 2022) and covering a growing number of health-related areas such as weight loss, mindfulness training and addiction rehabilitation (i.e., smoking and gambling; Pires et al., 2020). The popularity of addiction rehabilitation apps stems from their confidentiality and

accessibility. Confidentiality addresses the risk of shame and accessibility removes treatment barriers (i.e., cost and wait times) associated with face-to-face, clinic-based traditional treatments (Rodda et al., 2013). However, data privacy failure that leads to reduced user trust is a risk (Papageorgiou et al., 2018). While socioeconomic, privacy and user capability factors notably impact app accessibility, one of the greatest benefits is that there are few restrictions to using mHealth apps, so the types of users can vary widely. mHealth users can differ by age, lifestyle aspects (Taylor & Silver, 2019), culture (Rajak & Shaw, 2021) and gender (Schomakers et al., 2022) among other factors. mHealth app creation and maintenance is sometimes dependent on insecure corporate and public funding (Campbell et al., 2017), so the coverage of health issues may not always be secure as the interests of corporations and public policy are not fixed. Nonetheless, for many, mHealth apps are a powerful tool for positive health change. This is important for groups of people who cannot afford face-to-face medical treatment. mHealth apps are particularly valuable where there is limited access to healthcare, such as low socioeconomic and geographically isolated groups (Isler et al., 2012; Lien et al., 2014). It is estimated that millions of people lack access to vital healthcare and up to 7.4% fall below the poverty line because of sudden out-of-pocket health costs (Davis & Ballreich, 2014; Lakner et al., 2022). mHealth apps may offer some relief to these groups if they adopt them. mHealth connects consumers with free, or low-cost, highly portable healthcare tools (Varshney, 2014). Most physicians are willing to prescribe an mHealth app for chronic disease management (Health Research Institute, 2014). Consequently, app users are reporting positive results. Bhuyan et al. (2016) found that 60% of users believed that mHealth apps were beneficial and helped them to achieve goals; 55% transitioned into long-term users (Krebs & Duncan, 2015). In another study, 67% of users saw mHealth apps as supplements to their treatment, and 47% favoured apps as effective substitutes (Rai et al., 2013). However, aside from the sudden spike in mHealth app downloads during the COVID-19 pandemic (Wind et al., 2020), mHealth app uptake is low compared with that for other categories of app (Mustafa et al., 2022). This warrants research on mHealth app adoption.

One of the key streams of research on apps is app adoption, where drivers and barriers are researched across various disciplines including marketing, information technology and health (Al-Emran & Granic, 2021; Stocchi et al., 2022). In the past, researchers used various theories to examine user adoption of different forms of technology, such as online shopping (Ahmed

& Sathish, 2015) and digital payment tools (Sahi et al., 2021). Traditional technology adoption theories, such as the Uses and Gratifications Theory and the Information Systems Success Model, have been employed to explain how consumers adopt apps (Gera et al., 2020; Mondal & Chakrabarti, 2019). A number of these theories are discussed in Section 2.3.

2.3 Technology Adoption

Technology adoption is an area of research in which numerous theories have been developed and used across different areas of literature to identify factors that drive adoption. In the communication literature, scholars have investigated media uses and gratifications (Blumler & Kaatz, 1974; Katz, 1959; Klapper, 1963; Lin, 1999; Rubin, 1995; Ruggiero, 2000) via the Uses and Gratifications Theory and Diffusion of Innovations Theory. Innovation theories such as the Diffusion of Innovations and the Information Systems Success Model are commonly applied in marketing research (Gatignon & Robertson, 1985; Sultan et al., 1990) and management information system studies (Agarwal & Prasad, 1997; Huff & Munro, 1985; Moore, 1987; Moore & Benbasat, 1991), enabling researchers to understand how innovations of technology are disseminated and adopted. Although they provide explanations for progressive adoption, these models do not observe the different situations and domains where new knowledge can be found (Kaur, 2022). Moreover, Loose et al. (2013) argued that theories on innovation, outcomes and gratification wrongly assume that people are largely rational in their behaviour. Hence, their research focussed on the practical aspects of apps and implications of technology adoption, as opposed to a more comprehensive investigation including affective-based drivers of adoption. Moreover, scholars have argued that mass communication adoption theories (i.e., Uses and Gratifications Theory and Media Dependency Theory) that use only or primarily measures of practical attributes, such as level of interactivity and user environment, can quickly become outdated when applied to health and emerging app technologies (El-Wajeeh et al., 2014). These models tend to create a narrow description of how technology is used by a passive population, rather than explaining and interpreting the factors behind why consumer groups adopt the technology. Hence, existing models need to be reviewed and updated according to the current state of play. In the field of apps, the technology is constantly evolving, requiring ongoing investigation and theorisation by researchers. For example, the Information System Success Model (DeLone &

McLean, 1992) is an example of a well-established theoretical framework that is now considered outdated because of its focus on app practicality (Negash et al., 2003). Researchers have tried to overcome this by integrating it with the TAM (Davis et al., 1989) to create a current reflection that includes a wider range of specific variables that contribute to adoption (see Al-Emran & Granic, 2021). Venkatesh (2000) offered a critique of existing theories, positing that many do not measure usability and usefulness, which are deemed two major drivers of technology adoption. The TAM does employ usability and usefulness and is considered one of the most widely recognised theoretical models of technology adoption (Holden & Rada, 2011).

By way of background, the TAM is an extension of the Theory of Reasoned Action (Fishbein, 1967; Fishbein & Ajzen, 1975). It is popular and regarded as the best model to explain adoption of information systems and information technology (Poornima, 2020; Tamilmani et al., 2020) and has been used widely in technology adoption research, including smart apparel (Bakhshian & Lee, 2022) and digital learning platforms (Mustafa & Ali, 2023). Despite its reputation, the TAM also has limitations that justify further research. For example, the TAM is now argued to be outdated as it is too utilitarian and unreliable for today's technology as it was designed for simple technology that served a single purpose unlike modern technology that is highly interactive, multi-functional and is used for numerous purposes (Hess et al., 2014). Recent research has pointed out the simplicity and lack of contextual references in the TAM as other major limitations (Stylios et al., 2022). Further, the original TAM and its predecessor, the Theory of Reasoned Action, were focussed solely on individual-level factors without concern for social and environmental factors and their effects of adoption. The TAM was designed to investigate employee use of workplace technology; therefore, in its original form, it is not suitable to assess modern consumer decision scenarios, such as adopting mobile app products. Ali et al. (2019) recommended overcoming these limitations by identifying contextual variables relevant to the user and technology. Consequently, extending the original TAM to adapt to the context and consumers is a valid response to calls for research on modernising the TAM for mHealth apps (Al-Emran & Granic, 2021; Alsyouf et al., 2022; Saheb et al., 2022).

Despite these criticisms of the TAM, its success is often attributed to its simple framework (Ibidunmoye, 2018). The TAM recognises external variables, perceived usefulness, perceived

ease of use and attitude towards using the technology to link with intentions and use (Davis et al., 1989). More importantly, in publishing the TAM, Davis et al. (1989) noted that external variables—also called 'antecedents'—and their effects change over time, so they should be specific to the context. The TAM provides an explanation in predicting technology adoption where it relies heavily on the importance of consumers' perceived ease of use and usefulness of the product (Venkatesh, 2000). However, specific antecedents that drive these two critical constructs are under researched, particularly in the context of modern mHealth apps (Brew-Sam, 2020). Results of studies suggest that identification of specific and clearly defined antecedents is needed in cases of specific technology to improve the predictive power of the model (Choi et al., 2010; Kim, 2016; Lee et al., 2011; Yang, 2005). Identifying specific, influential antecedents in the mHealth context would substantially extend the TAM and provide robust empirical evidence to support the drivers of technology adoption while pinpointing why the technology is or is not accepted. In fact, a common current misuse of the TAM is to ignore antecedents and place the unadapted model into a unique context (Abdullah et al., 2016). Omission of antecedents provides generalised user opinions on a specific technology rather than specific information to drive technology development (Mathieson, 1991) and limits the exploratory extent of TAM-based research (Ennajeh & Amami, 2014). Ultimately, therefore, identifying specific influential antecedents will extend the theoretical and practical value of the TAM.

Over the past two decades, the TAM has been continuously revised and extended in various forms and contexts. The major revisions produced TAM 2 (Venkatesh, 2000; Venkatesh & Davis, 2000), TAM 3 (Venkatesh & Bala, 2008) and the Health Information Technology Acceptance Model (Kim & Park, 2012), all of which attempted to adapt the original TAM framework to a context by adding generalisable, pre-determined variables and moderators. The flaws of these models were their complexity and high number of pre-determined variables to measure that were not context related. For example, the TAM 2 was proposed with job-related additional variable; that is, variables specific to the use of compulsory technology in places of employment, such as job relevance, output quality, demonstrability and voluntariness. Other variables were specific to computer technology education, such as computer efficacy and anxiety. As a result, the TAM 2 has been criticised as being narrow, alongside other weaknesses including dependence on high levels of subjectivity and

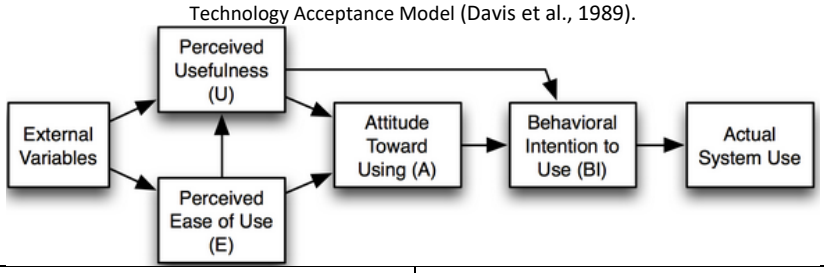
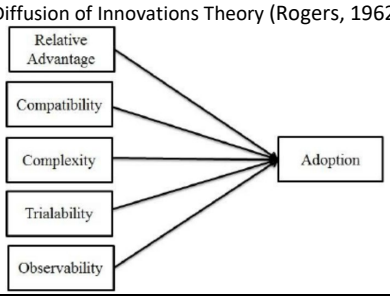
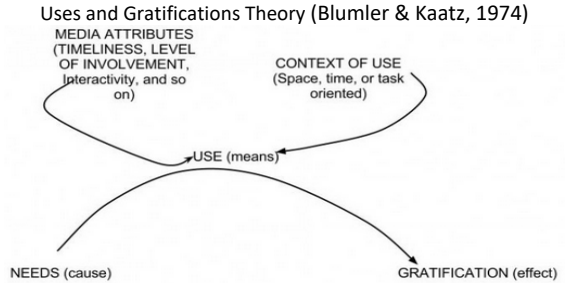
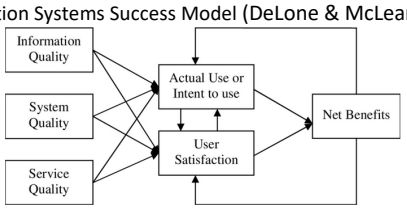
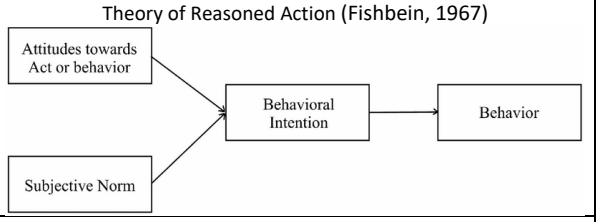
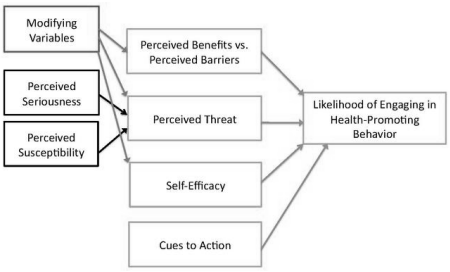
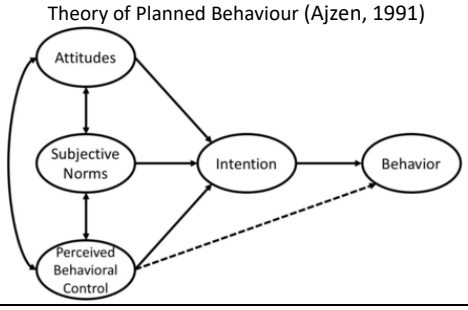
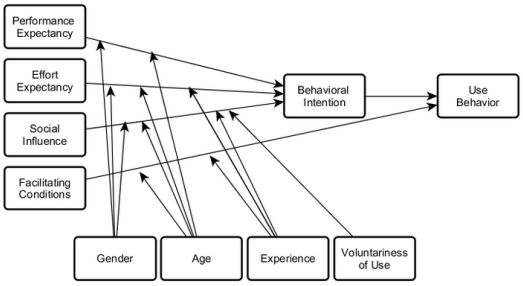
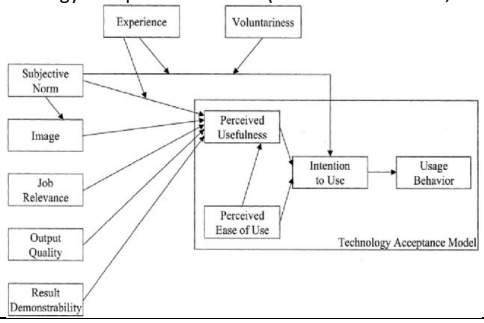
ignorance of attitudinal variables (Arogundade et al., 2016). Further, the literature cites empirical inconsistencies in relationships between the direct paths in the TAM 2 (see Bagozzi, 2007; Bhattacherjee, 2001; Brown et al., 2002; Lee et al., 2003). The TAM 3 attributed particular value to social influences on perceived usefulness and intention, among others (Venkatesh & Bala, 2008). Prior to this, Shen et al. (2006) observed that social influence is not an antecedent to perceived ease of use and usefulness. Further, individuals with chronic health issues, notably 'self-inflicted' health problems, are especially reticent to share treatment details with peers (Nilsen, 2010). Noting this, Khatun et al. (2017) observed that social influence has no significant influence on health technology adoption. This supports the notion that any additional variable to the TAM should be context specific (Davis et al., 1989). The relevance of antecedents changes over time with products and consumers (Chen et al., 2002). The Health Information Technology Acceptance Model has had some success in predicting mHealth adoption (Elsafty et al., 2020); however, Kim and Park (2012)—the researchers who developed the model—noted a lack of consistency in the theoretical relationships. Based on this model, Sun et al. (2013) developed the Unified Model of Health Technology Acceptance, hoping that it would be a more suitable model for predicting health technology adoption. The creators refined it to be more closely aligned with the TAM in terms of simplicity and suggested that the determining factors in consumers' adoption of mobile health services are 1) performance expectancy, 2) social influence 3) facilitating conditions, 4) effort expectancy and 5) health. Their results revealed that performance expectancy, effort expectancy, social influence and facilitating conditions influence adoption intention, whereas health and health-threat appraisals did not have a significant influence, suggesting the model is not effective in predicting mHealth adoption. Further, Ali et al. (2019) found the Unified Model of Health Technology Acceptance to be no more effective than the Health Information Technology Acceptance Model (Kim & Park, 2012) in predicting mHealth app adoption. These findings render the Unified Model of Health Technology Acceptance no more effective than other models. The Unified Theory of Acceptance and Use of Technology also attempted to refine such extensive models (Venkatesh et al., 2003a). However, it proved unsuitable for predicting mHealth app adoption both in the past and, more recently, regarding mental wellbeing apps during the COVID-19 pandemic (Alam et al., 2021; see Table 2.1).

Table 2.1: Competing Theories of Technology Acceptance

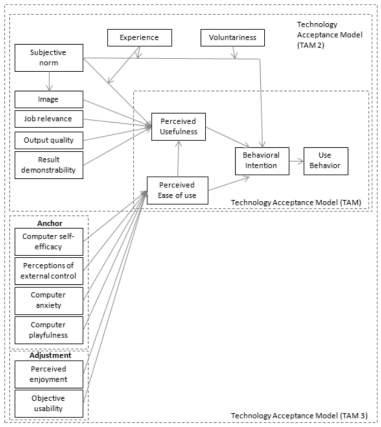
Theory	Constructs
Technology Acceptance Model (TAM): An information systems theory that elicits how people accept and use technology (Davis et al., 1989).	External variables; perceived ease of use; perceived usefulness; attitude towards using; behavioural intention to use; and actual system use.
Uses and Gratifications Theory: A theoretical approach to understanding specifically how and why people seek certain media to satisfy certain needs (Blumler & Kaatz, 1974).	Media attributes; context of use; use, needs; and gratification.
Diffusion of Innovations Theory: A hypothesis outlining the way new product innovations dominate existing products (Rogers, 1962).	Relative advantage; compatibility; complexity, trialability, observability; and adoption.
Information Systems Success Model: A theory that outlines success through relationships among six critical dimensions of information systems success (DeLone & McLean, 1992).	Information quality; system quality; service quality; actual use or intention to use; user satisfaction; and net benefits.
Theory of Reasoned Action: An explanation of relationships between attitudes and behaviours within human action (Fishbein, 1967).	Attitude towards act or behaviour; subjective norm; behavioural intention; and behaviour.
Theory of Planned Behaviour: An explanation of all behaviours over which people can exercise self-control and understand beliefs (Ajzen, 1991).	Attributes; subjective norms, perceived behavioural control; intention; and behaviour.
Health Belief Model: A social psychological health behaviour change model that explains and predicts health behaviours (Rosenstock, 1974).	Modifying variables; perceived seriousness; perceived susceptibility; perceived benefits *v*. perceived barriers; perceived threat; self-efficacy; cues to action; and likelihood of engaging in health-promoting behaviour.
Unified Theory of Acceptance and Use of Technology: A TAM iteration that explains intention to use an information system and subsequent usage behaviour (Venkatesh et al., 2003a).	Performance expectancy; effort expectancy; social influence; facilitating conditions; gender; age; experience; voluntariness of use; behavioural intention; and use behaviour.
TAM 2: An extended TAM that incorporates external social factors that influence intention (Venkatesh & Davis, 2000).	Subjective norm; image; job relevance; output quality; result demonstrability; experience; voluntariness; perceived usefulness; perceived

Theory	Constructs
	ease of use; intention to use; and usage behaviour.
TAM 3: An extension of the TAM 2 that incorporates the effects of trust and perceptions around risk on usability (Venkatesh & Bala, 2008).	Subjective norm; image; job relevance; output quality; result demonstrability; computer self-efficacy; perceptions of external control; computer anxiety; computer playfulness; perceived enjoyment; objective quality; experience; voluntariness; perceived usefulness; perceived ease of use; intention to use; and usage behaviour.
Health Information Technology Acceptance Model: A theory of health technology acceptance that incorporates the Health Belief Model, TAM and Theory of Planned Behaviour (Kim & Park, 2012).	Health status; health beliefs and concerns; subjective norm; HIT reliability; HIT self-efficacy; perceived threat; perceived usefulness; perceived ease of use; attitude; behavioural intention and behaviour.

Despite the above reviewed TAM iterations, the original TAM remains the most popular model (Mugo et al., 2017; Tamilmani et al., 2020) because of its flexibility in terms of context and simplicity (Ajibade, 2018). See Figure 2.1 for a view of the reviewed models. Despite its advantages, the TAM does not reflect the nature of product adoption across all contexts (Min et al., 2019). Rahimi and Jetter (2015) argued that the TAM can be enhanced via inclusion of consumer characteristics in mHealth. This led many authors to successfully increase its predictive power by revising the theory to include additional variables such as value and reliability perceptions (Anderson et al., 2016; Rai et al., 2013; Venkatesh et al., 2016). No single model of health behaviour change or technology adoption has been accepted by all researchers, but many new models use the TAM as their base, noting that the TAM constructs—perceived usefulness, perceived ease of use, attitude and intention—are reliable predictors of adoption (Altmann & Gries, 2017), particularly when supported by antecedents that are contextually relevant (Chen et al., 2002). While it may be beyond one single theory or model to predict all the factors that influence adoption, the TAM appears more suitable than other competing theories for adapting user and technology characteristics. Hence, the original TAM is used in this thesis. The following section outlines important constructs of the original TAM, namely perceived usefulness, perceived ease of use, attitude and adoption intention.

Model
Technology Acceptance Model (Davis et al., 1989). 
Diffusion of Innovations Theory (Rogers, 1962) 
Uses and Gratifications Theory (Blumler & Kaatz, 1974) 
Information Systems Success Model (DeLone & McLean, 1992) 
Theory of Reasoned Action (Fishbein, 1967) 
Health Belief Model (Rosenstock, 1974) 
Theory of Planned Behaviour (Ajzen, 1991) 
Unified Theory of Acceptance and Use of Technology (Venkatesh et al., 2003a) 
Technology Acceptance Model 2 (Venkatesh & Davis, 2000) 

Technology Acceptance Model 3 (Venkatesh & Bala, 2008)



Health Information Technology Acceptance Model (Kim & Park, 2012)

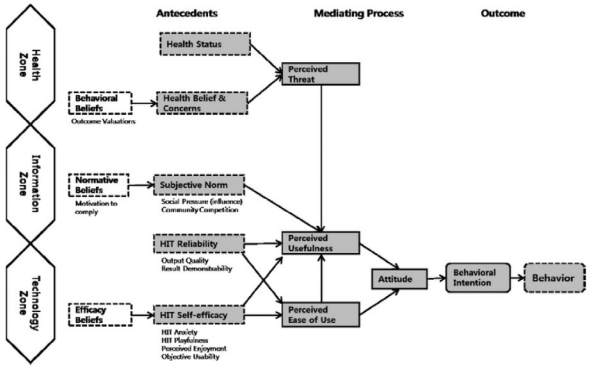


Figure 2.1: Competing Theories of Technology Acceptance—Models

2.4 Technology Acceptance Model Constructs

2.4.1 Perceived Usefulness

Perceived usefulness is referred to as 'the degree to which a person believes using a particular system would enhance his or her job performance' (Davis et al., 1989, p. 320). Over time, perceived usefulness has been extended into different areas of technology adoption research (Venkatesh et al., 2016), predicting both attitude and evaluation of technology innovations (Holden & Karsh, 2010). Perceived usefulness has been established as one of the strongest predictors of use intention (Kijsanayotin et al., 2009; Lakhal et al., 2013; Sumak & Polancic, 2010). In the context of mHealth apps, perceived usefulness is the belief that the mHealth app can help users to amend their behaviour and cease, or at least control it (Venkatesh, 2000). Perceived usefulness is known for its ability to predict behavioural intentions regarding mHealth apps (Cajita et al., 2017; Foster, 2018; Kwon et al., 2017; Manda & Msosa, 2011; Palos-Sanchez et al., 2021; Wu et al., 2011). Its predictive ability is strongest in mHealth research when partnered with perceived ease of use (Deng et al., 2018).

2.4.2 Perceived Ease of Use

Despite a high level of usefulness, consumers may still feel that the technology is not sufficiently user friendly, and this feeling reduces the perceived potential benefits (Ibidunmoye, 2018) reducing likelihood of adoption. Hence, perceived ease of use—that is, the observed extent of effort required to use a technology where lower levels of effort lead to higher readiness to accept—accompanies perceived usefulness (Davis et al., 1989).

Perceived ease of use was originally used to research how professionals adopt technology systems in the workplace (Venkatesh, 2000). In this thesis, it is the degree to which the user believes an mHealth app is user friendly. As with perceived usefulness, in technology adoption research, perceived ease of use generally has a significant influence on technology adoption intention (see Davis, 1989; Kijsanayotin et al., 2009), including apps (Dovalienė et al., 2016). Given conflicting opinions with respect to this, there is an opportunity to empirically test this construct in the mHealth domain. Perceived ease of use is a common concept used in the study of mHealth adoption (Dam et al., 2018). It is known to determine perceived usefulness and attitude (Palos-Sanchez et al., 2021) as well as intention across mHealth app types and contexts (Anderson et al., 2016; Cajita et al., 2017; Hung & Jen, 2012). Hence, it is important to include perceived ease of use when investigating adoption of mHealth apps, to ensure conceptual consistency and validating findings. In the TAM, perceived ease of use has a direct influence on attitude.

2.4.3 Attitude

Attitude towards technology is simply the intended users' positive or negative feelings towards the technology and its purpose (Au & Enderwick, 2000). For instance, users with positive attitudes regard the technology highly and assume positive outcomes from its use (Ardies et al., 2015). Research on mobile apps has consistently found that user attitude towards apps influences adoption intention across apps broadly (Chawla & Joshi, 2019; de Luna et al., 2019; Kuo et al., 2019; Liu & Zhang, 2019; Saroia & Gao, 2019). In the context of mHealth apps, Kwon et al. (2017) found that attitude towards an app predicted adoption intention among young adults. Hung and Jen (2012) extended Kwon et al.'s (2017) findings for middle-aged adults, and Deng et al. (2014) found that attitude's predictive ability was consistent for middle-aged and older groups. Other studies confirmed the influence of attitude on behavioural intention towards mHealth (Alam et al., 2020; Schuster et al., 2015). However, Vervier et al. (2019) and Powell et al. (2014) argued that user attitude towards mHealth apps is not sufficiently studied and our understanding of adoption of mHealth apps through attitude is ambiguous. Therefore, this thesis provides an opportunity to investigate the influence of attitude in an empirical mHealth setting. In the TAM, attitude has a direct influence of adoption intention towards the technology.

2.4.4 Adoption Intention

Adoption intention is the user's readiness to perform a particular behaviour (Davis, 1989), where a higher intention indicates higher likelihood of the actual behaviour being performed (Ajzen, 1991). This is a suitable definition for intention in mHealth app adoption research. However, intention has had many definitions in technology adoption research, such as post-adoption engagement (i.e., information exchange after purchase; Crane et al., 2017), continued usage (i.e., retention and engagement after purchase; Vaghefi & Tulu, 2019), trialling (i.e., short-term probationary usage; Lin & Bautista, 2017) and participation (i.e., interaction with a range of content; Leahey & Rosen, 2014). Intention towards mHealth apps is generally influenced by general app usage habits formed after other apps have been adopted (Gupta et al., 2018; Semiz & Semiz, 2021). Although app involvement is an important factor in this thesis and is introduced in Section 2.5.1, app usage habits fall outside the scope of this thesis.

For definitions of TAM constructs, see Table 2.2. Next, Section 2.5 identifies other factors that may contribute to mHealth app adoption.

Table 2.2: Technology Acceptance Model Construct Definitions

Construct	Definition
Perceived usefulness	'The degree to which a person believes that using a particular system would enhance his or her job performance' (Davis, 1989, p. 320). Perceived usefulness is a major player in technology adoption theories.
Perceived ease of use	Perceived ease of use of technology is the degree to which a user believes that using the technology would reduce or remove any effort (Davis, 1989).
Attitude	Attitude is simply the intended users' positive or negative feelings towards the technology and its purpose (Fishbein & Ajzen, 1975).
Adoption intention	A measure of the strength of one's intention to adopt technology (Davis et al., 1989) whereby intention correlates with adoption likeliness (Ajzen, 1991).

2.5 Other Factors Contributing to mHealth App Adoption

Since research into adoption of mobile apps began in the mid-2000s, substantial research effort has gone into identifying the potentially numerous user, social, technological and

environmental factors that drive adoption by consumers. Subjective norm, for example, is an influential social factor that was adapted into many adoption theories (Kim & Park, 2012) (i.e., TBP and TAM2). Branding (Byun et al. 2018) and technological conditions (Kamal et al., 2020) are some other influential environmental and technological factors. However, no single theory or model can capture all factors, so individual studies are typically bound to handful of related factors. For example, studies have highlighted the characteristics of users, including behaviour (Atkinson, 2013; Ho, 2012), innate qualities (Sripalawat et al., 2011; Wang et al., 2006), habits (Wu et al., 2022a) and intrinsic motivation (Cocosila & Archer, 2009; van der Heijden, 2004). These non-technological drivers of mHealth adoption are important to research (Schuster & Parkinson, 2022). Other studies have focussed on technological features of mobile apps such as visual orientation and device type (Bruner & Kumar, 2005; Karaiskos et al., 2012), and facilitating factors of compatibility and service quality (Mallat et al., 2008; Tan & Chou, 2008). Stocchi et al. (2019) reviewed studies that explored the antecedents of app adoption and highlighted two types of antecedents: user and technology characteristics. User characteristics are the self-identified qualities of the app user, whereas technology characteristics are the attributes of technology that the consumers seek. Adapting these two types of antecedents to the TAM to identify their influence on perceived usefulness and ease of use—with flow-on effects to attitude intention—presents an opportunity for novel mHealth app adoption research (Abdullah et al., 2016). Hence, this thesis employs a series of user and technology characterises as antecedents to perceived ease of use and usefulness and does not use other characteristics, such as social or environmental, to make novel findings. The literature provides insights into what these variables may be. Gao et al. (2013) supported the distinction that perceived ease of use is predicted by user traits, such as trust. Vaghefi and Tulu (2019) noted that perceived usefulness is better predicted by technology characteristics such as aesthetics. These insights acknowledge the user and technology-oriented underpinnings of perceived ease of use and usefulness of mHealth apps. Further, this thesis understands that significant and novel user and technology characteristics positioned as antecedents can overcome the limitations of the TAM by adapting it to research. Relevant literature on these two themes is covered in Sections 2.5.1 and 2.5.2. Two later sections introduce two additional contributing factors: health status severity and product platform preference (Sections 2.5.3 and 2.5.4).

2.5.1 User Characteristics

The first of the two themes is user characteristics. That is, the characteristics or attributes of the app user and how these operate as adoption drivers. The literature notes gaps in our understanding around these user characteristics—subjective knowledge, involvement, trust, personalisation and perceived convenience—as antecedents to perceived ease of use and usefulness.

Subjective Knowledge

Subjective knowledge is simply what we think we know; it is a biased measure rather than an objective test of knowledge (Markus & Wurf, 1987). Further, subjective knowledge has a stronger effect on behaviour than does objective knowledge (Packard & Wooten, 2013) and is a key driver of product adoption (Dessi et al., 2022). The Diffusion of Innovations Theory posits that adoption of innovation depends as much on consumer knowledge as it does on attitude (Rogers, 2003). Subjective knowledge has been addressed in technology adoption studies both inside and outside smartphone research. For instance, studies have confirmed that subjective knowledge influences consumer adoption of health food (Huijts et al., 2012; Wulan et al., 2020), moderates the link between social media usage and online wine buying (Pucci et al., 2019) and influences the adoption of green technology (Piselli et al., 2021). Though offering valuable empirical evidence, these studies were limited with respect to health technology and apps. Importantly, since many of these studies were developed based on the Diffusion of Innovations Theory, they did not use subjective knowledge as an antecedent; rather as a direct contributor to usage. Exceptions were Tan et al. (2022), who found that subjective knowledge influences the perceived ease of use and usefulness of autonomous cars; and Aji et al. (2020) who found that in the context of e-money, subjective knowledge influences perceived ease of use and usefulness. However, their focus was not on consumers' perception and understanding of the technology platform; rather on the banking regulations in the cultural context. Subjective knowledge has also been investigated for its influence on acceptance of mobile platforms.

Jan et al. (2019) examined smartphone advertising and identified a direct link between subjective knowledge and attitude towards the advertisements. Additionally, limited studies

(see Chen & Chang, 2013; Keramati et al., 2012; Koenig-Lewis et al., 2015) have investigated the role of subjective knowledge in the adoption of mobile payment technology. These studies found that subjective knowledge improves intention and usage rates. Moreover, they employed variations of the TAM that did not examine subjective knowledge as an antecedent. For instance, the Unified Theory of Acceptance and Use of Technology and the Unified Theory of Acceptance and Use of Technology 2 are based on iterations of the TAM and have reframed knowledge as experience where it is situated not as an antecedent of perceived ease of use and usefulness but instead as a moderator of their relationships with intention (Venkatesh et al., 2003a, 2012). In the context of health, no studies utilising TAM, or iterations of it, have incorporated experience or knowledge as antecedents (Kim & Park, 2012). The absence of subjective knowledge measures in mHealth adoption research and health technology adoption research broadly represents a gap in the literature. Subjective knowledge and involvement are 'linked' constructs and are well established in the consumer behaviour literature as influencing product and service evaluations, and purchase decisions (Cilingir & Basfirinci, 2014; Lee & Lee, 2009). Involvement is an additional consumer factor that is relevant to perceived ease of use and usefulness (Dou et al., 2017). Subjective knowledge and involvement tend to overlap and have been treated as a joint variable in some studies (Bloch, 1986; Flynn & Goldsmith, 1993). As such, this variable is explained in this chapter in regard to its relevance.

Involvement

Involvement is a consumer's behaviour with a product; how they identify personally with a product, and their buying and usage behaviours (Michaelidou & Dibb, 2008). Involvement is linked to a consumer's motivational state (Mort & Drennan, 2007) and is derived from their perceived importance of a stimulus (Mittal, 1995). In the context of technology, involvement is users' overall participation in the technology (Ives & Olson, 1984). The Diffusion of Innovations Theory highlights how involvement with a given technology increases the adoption intention of similar technologies (Rogers, 2003). Early studies measured involvement with technology by monitoring hours spent using the technology (Kraut et al., 1998; Phillips et al., 1995; Stanger & Jamieson, 1998). However, the proliferation of personal technology devices such as music players in the 2000s pushed researchers to measure involvement with technology using new methods. In the case of smartphones, researchers

have measured involvement using subjective scales such as interest and dependence, as well as objective measures including frequency of use (Rivera et al., 2015). The difficulty of using objective measures of frequency and duration of use is that subjects need experience with the technology and must be constantly observed (Rivera et al., 2015). New and innovative technology with low market penetration that is designed for personal and discrete use would not be suitable for this approach. In line with this reasoning, research can focus on involvement, rather than experience with technology, as a reflection of practice and perceived competency, which is known to underpin adoption of mobile phone services (Mort & Drennan, 2007). In other contexts, involvement as an antecedent of perceived ease of use and usefulness is examined in categories of smart clothing with embedded technology (Chae, 2010) and employee systems (Turan et al., 2015). Concerns around data security are a common barrier for mHealth, yet Zakerabasali et al. (2021) showed that involvement with mHealth overcomes this barrier and even increases willingness to share data. No studies have examined the role of involvement as a driver of mHealth adoption.

Another subjective perception with relevance to consumer adoption behaviour is trust. Involvement with a particular technology platform increases consumer trust in the platform (Al-Kubaisi & Abu-Shanab, 2021). Consumer trust is known to influence adoption of gambling treatment (Rodda, 2014) and mHealth (Deng et al., 2015, 2018). Indeed, insights from marketing research around trust may cast some light on how trust influences perceived ease of use and usefulness of mHealth apps.

Trust

Trust is an important factor for attracting new consumers, but also for maintaining loyalty (Kim et al., 2008). Studies have shown that trust has a more critical effect on consumers in mobile than in internet contexts (Cho et al., 2007). Trust is the subjective belief that a party will fulfil obligations according to the expectations of others (Lu et al., 2011); for example, a user's trust in mobile apps to complete given tasks. Research has shown that trust affects behaviours of mobile technology users. Trust is a pivotal factor in consumer willingness to accept mobile advertising (Atkinson, 2013; Okazaki et al., 2007). Consumers use mobile advertising to meet information-seeking needs, so it is logical to account for consumer trust in other mobile information contexts (Papadopoulou et al., 2002). In mobile banking, for

example, trust determines adoption intention to a greater extent than does perceived ease of use and usefulness (Gu et al., 2009). The same can be said about data mining tools used for analysing sales and customer data for companies (Huang et al., 2012). Trust in food delivery apps increases adoption likelihood (Gani et al., 2021). Lu et al. (2011) posited that behaviour conducted on a mobile app is more vulnerable and uncertain than other settings and thus entails reduced trust from users. This is true for mHealth too.

mHealth can be associated with reduced trust as users must provide personal information (Mallat et al., 2008). Consequently, high levels of trust in mHealth increases intention to use (Schomakers et al., 2022). Deng et al. (2015) found that higher levels of intention to use mHealth services and health information through smartphones are dependent on consumer trust. Deng et al. (2018) found that trust predicts intention to adopt mHealth directly—another example of the Diffusion of Innovations approach to app adoption. In contrast, according to Ortega Egea and Román González (2011), trust influences perceived ease of use and usefulness, and attitude towards physicians' adoption of digital patient records, but they overlooked patient perceptions and behaviours. Trust has been shown to influence perceived ease of use and usefulness of mobile health services for people seeking apps to support their caring responsibilities (Rajak & Shaw, 2021). The level of trust of people with an addiction is overlooked and has not been used as an antecedent to perceived ease of use and usefulness. For gamblers, treatment is tethered to anonymity and confidentiality, making trust in the treatment a key factor (Rodda, 2014). Additionally, trust directly influences adoption of mHealth information services for general health and wellbeing (Deng et al., 2015). Consumer trust is known to influence gamblers' adoption of treatment (Rodda, 2014). Hence, it is likely that trust has relevance in the space of quit gambling technology. There is scope for further research into how trust underpins perceived usefulness and ease of use of mHealth apps. Beyond trust, another user characteristic that is relevant to mHealth behaviour is need for personalisation (Car et al., 2017; Shan et al., 2019).

Personalisation

Personalisation is providing 'individual customers with tailored products and services based on an understanding of their interests and preferences' (Wang et al., 2006, p. 147). Personalisation increases adoption of mobile marketing (Merisavo et al., 2006, 2007) and

purchase intention (Wang & Li, 2012) via strengthening consumer trust (Li & Yeh, 2010; Venkatesh et al., 2003b). A personalised mobile user interface influences app performance (Clarke, 2001; Lee & Park, 2006; Tsalgatidou & Pitoura, 2001). In the context of health services, it is believed that personalisation can change health behaviour. For example, personalised information supports healthy behavioural changes, such as weight loss (Schubart et al., 2011). Personalisation of mHealth app content has been shown to increase adherence to treatment programs (Jakob et al., 2021). Recent studies have shown that personalisation of mHealth services for diabetes management increases patient usage (Shan et al., 2019) and improves patient adherence in medication management (Car et al., 2017). Moreover, users of a brain injury recovery app and their therapists expressed a desire for personalisation to improve app performance (Kettlewell et al., 2018). Similarly, users of mHealth tobacco cessation services apps as well as cardiovascular disease management apps referred to personalisation as a key factor to improve app performance (Abroms et al., 2013; Hors-Fraile et al., 2018) and usage (Coorey et al., 2018; Neubeck et al., 2015). mHealth apps and services that focus on an individual's health behaviour through personalisation of content and interaction have been shown to have positive health effects (Mhurchu et al., 2019). Despite these findings, there have been recent calls for more studies on the personalisation of mHealth, particularly with respect to direct messaging, social support and app content (Shan et al., 2019). More importantly, studies have not examined how personalisation underpins perceived usefulness and ease of use, leaving an important gap in the literature. Another variable relevant to engagement with apps is perceived convenience (Lee et al., 2017). However, this has not been considered for its role in perceived ease of use and usefulness. As such, this variable is explained for its relevance in this chapter.

Perceived Convenience

Brown (1990) defined convenience as the time and effort that a consumer expels in purchasing a product, rather than being related to characteristics. Hence, the perception of convenience, of an app in this case, is driven by the views and judgement of the user. It has been established that perceived product convenience increases product adoption (Chen & Li, 2021). Specifically with technology, convenience is a major player in the appeal of technology, particularly in multipurpose technologies such as the use of smartphones (de Kerviler et al., 2016; Ozturk et al., 2016) and other smart technology (Al-Husamiyah & Al-Bashayreh, 2022).

Studies in mobile banking have shown that convenience is one of the key drivers for consumers to adopt new technology (Eastin, 2002; Jayawardhena & Foley, 2000; Sohail & Shanmugham, 2003; Tan & Teo, 2000) and is the major determinant of using in-store mobile payment (de Kerviler et al., 2016; Teo et al., 2015) and mobile platforms for hotel bookings (Ozturk et al., 2016). Convenience is also one the driving factors of mobile shopping through browsers and apps (Ahuja & Khazanchi, 2016; Mahapatra, 2017). Many other authors have confirmed the influence of convenience on app usage intention (Dovalienė et al., 2016; Kim & Baek, 2018).

To date, few studies have investigated the role of convenience in mHealth adoption. For example, studies have confirmed that convenience has significant predictive ability for mHealth app usage intention (Lee et al., 2017) and adoption (di San Pietro et al., 2019). These studies used the Diffusion of Innovations Theory approach whereby the direct impact on adoption by convenience was measured. Moreover, convenience has been confirmed as a motivator of usage of heart failure recovery apps (Foster, 2018) and apps for post-operative chemotherapy treatment management (Jacob et al., 2019). Despite their contributions, these studies did not examine the influence of convenience on perceived usefulness and ease of use of mHealth apps, thereby leaving an important gap in the literature.

As discussed earlier in the chapter, in addition to user characteristics, technology characteristics are relevant when examining drivers of technology adoption. The next section discusses the following technology characteristics: gamification and aesthetics.

2.5.2 Technology Characteristics

Gamification

Gamification entails game-like behaviours that would enhance consumer experience and entertainment when consuming or using a product (Jin, 2016). The purpose of gamification of technology market research is to increase usage intention (Anoop et al., 2022). Websites and apps that host game-like designs exploit the popularity and rise of gaming and humanistic desires to play (Jin, 2013; Kapp, 2012; Swan, 2012). As a result, gamification is emerging beyond gaming, into other platforms and contexts, including mHealth (Miller et al., 2016) and educational technology (Kayımbaşıoğlu et al., 2016). For these platforms, gamification is

important for reducing attrition (Gunnars et al., 2021). Gamification improves learning experiences (Wan et al., 2021). It achieves this by combining cognitive stimulation and micro-rewards through stories to create step-by-step learning (Jin, 2016), making technology and its surrounding environment more interesting (Swan, 2012; Xu, 2012). In the context of mobile apps, marketers incorporate strategies such as giving badges, passing levels and animated learning, as entertainment (Zichermann & Cunningham, 2011). Gamification is important to mHealth to move tasks of health maintenance into an engaging space. This engagement factor enables mHealth apps to produce better results during quit attempts (Herbec et al., 2021). Bezabih et al. (2021) suggested that high usage drop-off occurs because mHealth apps are under-gamified. Gamification improves user engagement with mHealth (Jin, 2016; Lister et al., 2014; Tonkin et al., 2019; Vaghefi & Tulu, 2019). Research findings also support the benefits of health behaviour change through gamification (Fleming et al., 2017). Schmidt-Kraepelin et al. (2019) found a positive relationship between the extent of gamification of mHealth apps and favourability of user ratings in app stores. Further, the apps that were successful—represented by higher download rates—were consistently gamified compared with the non-gamified, less popular apps (Schmidt-Kraepelin et al., 2019). This demonstrates the importance of gamification in mHealth. Despite these findings, Shan et al. (2019) stated that gamification research in mHealth is underrepresented. More importantly, no research has considered whether perceptions of gamification encourage intention to adopt mHealth apps or how this underlines perceived ease of use and usefulness. Hofacker et al. (2016) and Charles and McDonough (2014) found that favourable aesthetics as a component of gamification play an important role in engagement with both mobile platforms and health technology, which leads to the other technology characteristic, aesthetics.

Aesthetics

The visual experience of technology can affect its use. Research has demonstrated the significance of aesthetics in engagement with the online environment (Varnali & Toker, 2010) and creating positive consumer experiences (Geng & Guo, 2022; Mara & Meyer, 2022). Aesthetics can be seen as the subjective judgement of app attractiveness (Bhandari et al., 2015). Aesthetics has proven to influence satisfaction with technology usage. For example, Kuroso and Kashimura (1995) found that the layout of content on an ATM screen affected consumer satisfaction and perceived ease of use. Moreover, Karvonen (2000) confirmed a

relationship between aesthetics and e-trust of websites. For online shopping, research has shown that the visual experience of a platform affects the likelihood of customers staying on the website and shopping (Jiang & Benbasat, 2003; Rosen & Purinton, 2004). Aesthetics is also considered vital to user experiences of mobile devices (Tarasewich, 2003). The Mobile App Rating Scale (Stoyanov et al., 2015)—the tool most commonly used by researchers to assess mHealth app quality (Wu et al., 2022b)—positions aesthetics as a key factor. In mobile commerce, Cyr et al. (2006) found that aesthetics has a significant effect on perceived usefulness, ease of use and enjoyment. In the context of mobile apps, studies have revealed the direct influence of aesthetics on app adoption (Li & Yeh, 2010) and usage (Kim et al., 2013; Li & Yeh, 2010; Stocchi et al., 2019). In the case of mHealth apps, Anderson et al. (2016) found that visual appearance affects app usage. Moreover, Vaghefi and Tulu's (2019) focus group examination revealed a preference for simple displays: image- and text-heavy screens made it difficult to navigate through apps. The result was dissatisfaction and disengagement. Jacob et al. (2019) found that poor aesthetics, described by a user as 'on screen clutter', negatively influenced how cancer patients managed chemotherapy treatment through an app. Participant concerns here are echoed by the reduction principle, which argues that complex behaviour needs to be reduced to multiple simple steps for improved performance (Oinas-Kukkonen & Harjumaa, 2009). Findings from other focus group studies show that aesthetics is seen as a determinant of mHealth perceived ease of use and usefulness, and even determine intention (Lazard et al., 2021). Despite these studies, there has been a scarcity of empirical studies considering the role of aesthetics in underpinning perceived ease of use and usefulness of mHealth apps.

As a succinct review of these constructs, definitions are listed in Table 2.3.

Table 2.3: Constructs and Definitions

Construct	Definition
Subjective knowledge	Subjective knowledge is simply what we think we know; it is a biased self-assessed judgement made by the consumer as opposed to the outcome of an objective test of knowledge (Markus & Wurf, 1987). In this thesis, it is consumers' subjective knowledge of apps; how competent they believe themselves to be in using and understanding apps.

Involvement	Consumer involvement is the extent to which a consumer identifies with a product or service, their consumer patterns and broader consumer behaviours around how they engage (Michaelidou & Dibb, 2008); in this case, involvement with apps, not experience with technology generally.
Trust	Trust is the willingness to be vulnerable based on a positive expectation towards another party's future behaviour (Mayer et al., 1995); a party can be a product (Lu et al., 2011), such as an app. This thesis considers consumer trust towards apps to fulfil expectations while simultaneously preserving users' privacy and protection (Deng et al., 2015).
Need for personalisation	Personalisation is providing 'individual customers with tailored products and services based on an understanding of their interests and preferences' (Wang et al., 2006, p. 147). A gambler's need for apps to deliver bespoke design and content is the focus here.
Perceived convenience	'The degree to which a consumer perceives that mobile app technology provides instantaneous and timely benefits' is perceived convenience (Kleijnen et al., 2007, p. 36). The convenience of apps is compared with the alternatives of using older technology platforms or traditional methods to undertake a task.
Gamification	Gamification entails game-like behaviours that would enhance consumer experience and entertainment when consuming or using a product, particularly digital technologies (Jin, 2016). The preference for gamification of mHealth gambling apps is addressed in this thesis.
Aesthetics	Aesthetics is the visual appearance, including graphics, colours, layout and design elements of apps (Hoehle & Venkatesh, 2015). Different aesthetics were presented in the qualitative data collection phase, and gamblers' view of the importance of the aesthetics was the focus of the quantitative phase of this thesis.

mHealth research has shown that there can be an interference effect of the health status of the user on the relationship between adoption intention and attitude (see Deng et al., 2018).

2.5.3 Health Status Severity

Health status severity is the assumed probability of harm caused by the condition (Rogers, 1975). Westaway et al. (2003) found that health status severity can contribute to the perceptions of consumers regarding health products and services. They showed that the severity of both physical and psychological health moderates the relationship between satisfaction and ratings—greater severity increases satisfaction. In contrast, Cohen (1996) found an opposite moderating effect between patient physical pain and psychological health. Addressing these contradicting findings is possible through the notions of Protection

Motivation Theory, which suggests that health behaviours are induced first by perceived health threats—both the probability and severity of the threat—and second by coping strategies and tools (Rogers, 1975). Both high perceived vulnerability and severity lead to adoption of health technology (Rogers, 1975). The perceived threat of COVID-19 has a direct influence on intention towards tracing apps (Geber & Friemel, 2022) measured not as a moderator but as a direct contributor. In their medical research, Wang et al. (2020) found that perceived threat from a health condition inflated the intention to use health products. To date, the few studies considering the possible influence of health status severity on mHealth app adoption have reported conflicting evidence around the moderating effect of health status severity between attitude and adoption intention (see Deng et al., 2018; Sun et al., 2013). That is, Deng et al. (2015) found that severity of health status moderates relationships around intention to seek and use mHealth. The authors argued that an individual with a serious illness, encouraged by new optimism, tends to use a greater range of platforms to find information and resources with a greater likelihood of adoption than people with lesser health concerns. The suggestion is that the greater the severity, the greater the use and adoption of new platforms and information (Deng et al., 2015). However, these authors did not include attitude in their model, and mHealth information services for general wellbeing—not apps—were investigated. Deng et al. (2018) later investigated mHealth apps and found that more serious subjective health concerns moderated attitude and adoption intention. Sun et al. (2013) found that perceived vulnerability towards the health condition positively moderated the relationship between attitude and intention of mHealth, whereas the level of severity of the health condition had no effect. However, Sun et al. (2013) and Deng et al. (2018) employed self-perceptions of health condition level, rather than an independent measurement or a valid diagnosis. This may explain the contradictions between studies.

The next section of the review considers consumer preference, specifically product consumption preference, noting the absence of literature around how this can affect technology adoption.

2.5.4 Product Platform Preference

For some types of addictive behaviour where an mHealth app may provide value, such as problem gambling, there are various means of engaging in the activity. For example, a person

can gamble online or in a pub or casino, or by attending a horse race. This can also be true of other addictions with both a 'real world' and digital platform, such as shopping addiction (Wang et al., 2022) and thrill seeking (Steinmetz, 2015). It may be the case that people who use apps to gamble or consume other products and services may be predisposed to adopting apps for treatment uses. Hence, it is appropriate to consider an individual's preferred method of engaging in the potentially unwanted behaviour to consider any effects that these personal preferences may have on mHealth app adoption. For problem gambling specifically, it is known that experience with technology, in particular smartphones and apps, facilitates the transition from analogue gambling consumption to digital gambling (James et al., 2017) and that gambling via apps is the most popular form of gambling (James et al., 2019). However, it is currently unknown whether a preference for digital gambling leads to an app adoption process as distinct to a preference for analogue gambling. This missing research area represents a significant gap in our understanding.

Reviews that consider treatment for digital addictions, such as internet gaming (Kuss & Griffiths, 2012) and internet addiction (Kuss & López-Fernandez, 2016), have shown that researchers focus heavily on the adoption process of clinical and psychological interventions, rather than digital interventions or tools. This leaves a gap in the literature with respect to the adoption process of digital interventions such as mHealth apps.

2.6 Summary of Significant Gaps in the Literature

Decades of research has gone into understanding how people accept and use technology (see Childers et al., 2001; Mathieson, 1991; Schierz et al., 2010; Shemesh & Barnoy, 2020). Despite this, this review has shown that there is a preference for measuring how factors directly influence use; whereas other key factors are omitted. This has led to an absence of literature on how drivers of technology adoption underpin perceived ease of use and usefulness with respect to mHealth app adoption. Specifically, there are substantial gaps in our current understanding of critical drivers in the adoption of mHealth apps to help people manage and control addictive behaviours. Further, the TAM has been inadequately remodelled by scholars to understand adoption of healthcare apps through this dominant model. However, Walker (2017) noted a broad underperformance of healthcare apps because of the absence of

research on mHealth app adoption drivers. The following paragraphs summarise the identified gaps in the literature that drive the underlying arguments of this thesis.

The literature provides evidence of some influence of user and technology characteristics on consumer behaviours; however, this review has shown that these characteristics as antecedents to perceived ease of use and usefulness are overlooked in mHealth research. Considering each variable individually highlights more clearly the gaps in the literature. Subjective knowledge has been adapted by various iterations of the TAM; however, these models tend to frame knowledge as an experiential factor. Further, subjective knowledge is not positioned as an antecedent in these models and has not been used in app adoption research. Consumer product involvement has been used in only a few studies outside mHealth as an antecedent of perceived ease of use and usefulness (see Chae, 2010; Turan et al., 2015). Trust is known to influence adoption of mobile content (Walker, 2017) and mHealth services and products, but not apps (Deng et al., 2015, 2018) and has not been positioned as an antecedent variable to perceived ease of use and usefulness of mHealth apps. Personalisation increases engagement with health services (Car et al., 2017; Shan et al., 2019) but is underrepresented in mHealth app research (Shan et al., 2019) and has not been shown to underpin perceived ease of use and usefulness. Perceived convenience of apps has been known to influence mHealth app intention and usage directly (Jacob et al., 2019; Lee et al., 2017); however, no studies have considered how it underpins perceived ease of use and usefulness. Similarly, gamification of healthcare apps influences behaviours (Tonkin et al., 2019), but has been inadequately studied (Sardi et al., 2017; Shan et al., 2019), and its effects on perceived ease of use and usefulness are unknown. There is a scarcity of studies considering the role of aesthetics in mHealth apps (Kumar et al., 2018). This summary shows that it is unknown whether these antecedents affect perceived ease of use and usefulness.

The next gap is regarding the moderating influence of health status severity on intention. This relationship shows contradictory findings in the literature (see Cohen, 1996; Westaway et al., 2003; Williams & Calnan, 1991) that are not resolved by more recent research based on mHealth (see Deng et al., 2015, 2018; Dou et al., 2017). Additionally, intention was either omitted or used inconsistently in these studies, and authors used self-diagnoses instead of clinical measurements of health conditions. The gap that this thesis investigates is the

moderating effect of health status severity on the relationship between attitude and adoption intention.

The review also introduced consumer preferences as influencing mHealth adoption. This is because research has focussed heavily on the transition to digital gambling (James et al., 2017) but not the transition to digital intervention, which has been overlooked by health researchers (Kuss & López-Fernandez, 2016). This review has revealed empirical evidence addressing aspects of these variables, yet there are gaps that remain.

2.7 Towards a Conceptual Model

The gaps identified in this literature review provide the foundation for a conceptual model of mHealth app adoption. Specifically, the insights gained can formalise relationships between a series of user and technology characteristics presented as antecedents to perceived ease of use and usefulness of mHealth apps. The gaps are used to inform the hypotheses which are outlined in the next chapter to elucidate the expected outcomes of the model paths. Further, contextual variables that are relevant—specifically health status severity and product platform—represent unexplored potential. The review findings also justify the TAM as the foundation for an extended model (see Chapter Three) that includes these previously unexplored antecedents and relationships.

2.8 Chapter Summary

Chapter Two summarised relevant literature on technology adoption to present an argument for gaps around how antecedents influence mHealth app adoption. The chapter also suggests a possible moderation between attitude and intention via health status severity. The review demonstrates that these antecedents can have a profound influence and concurrently are underexplored in mHealth research. The review of the literature highlighted the influence of these variables on technology and app adoption—and in some cases mHealth adoption—but overall demonstrated discrepancies and empirical controversies that require further investigation. The review introduced the TAM constructs before identifying other important factors that contribute to mHealth app adoption. Moreover, it revealed a lack of literature considering the antecedents to perceived ease of use and usefulness, as most studies treated the characteristics as direct determinants of intention and specific usage behaviours.

Importantly, through a comprehensive framework, this chapter outlined gaps of theoretical importance in the literature. Last, a justification for this thesis and exploration of context-specific variables was provided. Chapter Three discusses the conceptual model and details how the gaps found here in Chapter Two inform the hypotheses.

Chapter 3: Research Framework, Hypotheses and Design

3.1 Introduction

Chapter Two provided a thorough review of the relevant literature pertaining to technology adoption, particularly in the domain of mHealth apps. The review revealed several important gaps in knowledge specific to the influence of user and technology characteristics as drivers of mHealth app adoption. The mHealth app adoption literature is focussed on antecedents' direct influence on adoption and post-adoption behaviour (see di San Pietro et al., 2019; Foster, 2018; Schomakers et al., 2022)—similar to the Diffusion of Innovations approach to product acceptance (Rogers, 2003)—revealing gaps in current understanding of mHealth adoption related to the effects of consumer perceptions and technology attributes on perceived ease of use and usefulness. As previously outlined, one of the main limitations of the existing TAM is the current lack of understanding of specific antecedent variables (Stylios et al., 2022) as drivers of perceived ease of use and usefulness (Davis et al., 1989). Chapter Two also confirmed the current limitations of the original TAM in the context of modern technology, such as mHealth apps, which did not exist at the time the model was established (Elsafty et al., 2020). The review further highlighted the conflicting results in the literature with respect to the potential moderating effects of health status severity on the linkage between attitude and intention.

This chapter confirms the constructs to be tested via the development of a conceptual framework (see Figure 3.1 based on extending the existing TAM to investigate the gaps revealed in Chapter Two. This framework illustrates the hypothesised influences of previously untested potential antecedents to perceived ease of use and usefulness with flow-on effects on attitude and intentions and includes the expected moderating effect of health status severity. The chapter also presents an overview of the research design with justification of suitable data analyses and context for testing.

3.2 Research Framework and Hypotheses

Before describing the research design and methodology, it is important to outline the main theoretical aspects of the research, revisit the research question and formalise the hypotheses to be tested.

3.2.1 Drivers of Technology Adoption

The literature reveals several previously untested antecedents worthy of investigation with respect to their possible influence on perceived ease of use and usefulness in the original TAM for mHealth apps. These antecedents, described in Chapter Two are subjective knowledge and involvement, trust, perceived convenience and need for personalisation. Understanding how these antecedents underpin perceived ease of use and usefulness—two crucial factors of adoption (Venkatesh & Davis, 2000)—is valuable for mHealth app developers and marketers. Such insights can support app developers in creating app features that instil these antecedents in designs to ultimately increase app lifecycle and improve user health. Further, the health research findings discussed below provide evidence that elements and techniques derived from these antecedents improve ease of use and usefulness of mHealth apps. However, relationships have not been empirically tested to confirm these findings. To enhance positive user perceptions of ease of use and usefulness, marketers can suggest these antecedents through promotion to extend advertising reach. Again, there is some evidence of this from mHealth research, but empirical linkages have not been tested. For adoption theory, these untested variables represent significant gaps, particularly with regard to mHealth app research. Further, these constructs have been tested in other technology adoption studies; sometimes as antecedents. For example, for adoption of workplace technology (Turan et al., 2015) or as direct drivers of adoption including mobile advertising (Atkinson, 2013) but have not been tested as antecedents to perceived ease of use and usefulness of mHealth apps. Venkatesh and Davis (2000) support this stance by positing that there are determinants of perceived ease of use and usefulness, but these have not been empirically quantified, which allowed this thesis to adapt to the technology, sample and context. Hence, the research question here is as follows: What user characteristics and technology characteristics are likely to contribute to mHealth app adoption? The antecedents identified for testing were grouped into those related to users of mHealth apps and those

directly related to mHealth app technology (Stocchi et al., 2019). All antecedents were tested for their influences on the mediating constructs in the TAM of perceived ease of use and perceived usefulness. Each of the antecedents to be tested is briefly discussed in the next subsections, with reference to the relevant literature presented in Chapter Two.

User Characteristics

A health study by Bardus et al. (2020) suggested that users' subjective knowledge and involvement with an app is a factor in their judgement of how useful and easy to use is the app. They showed that mHealth apps designed for public users have less functionality than apps designed for medical experts, and are superior in terms of usefulness and usability as a result. These apps are designed for public users' knowledge and experience with apps rather than their health knowledge and experience; thus their app knowledge and involvement is linked with perceived usability and usefulness. Turan et al. (2015) theorised an atypical iteration of the TAM with involvement as an antecedent to perceived ease of use and usefulness but never empirically tested their model. Subjective knowledge and involvement are characteristically non-discriminant constructs because of their similar definitions and empirical measures (Bloch, 1986; Flynn & Goldsmith, 1993). Hence, the measures are logically grouped here and hypothesised as a single construct.

Trust in technology is known to influence intention to use mobile platforms directly (Gu et al., 2009), as well as mobile health services (Deng et al., 2015). However, how trust influences the adoption process through the TAM as an antecedent to perceived ease of use and usefulness, and the possible mediating effects of this formation on attitude, has not been tested. Trust is critical to attitude formation, which in turn stimulates consumer action (Butt et al., 2022). Like trust, need for personalisation has been tested for its direct influences on behaviour (see Shan et al., 2019).

The values of tailoring app content to the user are situated in making apps more usable and useful. Personalising app content, or even allowing users to create the content, can make mHealth apps appear simpler to use as users are navigating through familiar information (Tossell et al., 2012). Further, an app is considered more effective when a user can create their own personally relevant and achievable goal, rather than a goal set by another person

(Attwood et al., 2017). From these findings, it can be hypothesised that need for personalisation of mHealth apps underpins perceived ease of use and usefulness. The acceptance process through the TAM with personalisation operating as an antecedent in the 'external variable' position is untested.

Convenience of apps is known to influence both intention to adopt (Lee et al., 2017) and usage (Foster, 2018). This formation is similar to the Diffusion of Innovations Theory (Rogers, 1962) wherein relative advantage, a construct defined largely by convenience (Shaw et al., 2022), is measured for its direct influence on adoption. Health research has shown that apps that require a lot of steps to use are considered inconvenient (see Chen et al., 2019) while mHealth apps that automate processes are considered more user friendly (see Evans, 2017). From this it can be assumed that the convenience of mHealth apps contributes to perceptions of their ease of use. However, how convenience contributes to the technology adoption process through perceived ease of use and usefulness has not been empirically tested with respect to apps or mHealth. Therefore, it is hypothesised that:

H_1 User characteristics (a–d) positively influence perceived ease of use of mHealth apps:
a – subjective knowledge and involvement
b – trust
c – need for personalisation
d – perceived convenience

H_2 User characteristics (a–d) positively influence perceived usefulness of mHealth apps:
a – subjective knowledge and involvement
b – trust
c – need for personalisation
d – perceived convenience

Technology Characteristics

The other group of antecedents in this thesis is technology characteristics, namely gamification and aesthetics of mHealth apps, which have not been positioned as antecedents to perceived ease of use and usefulness of apps or healthcare technology. Numerous studies have investigated the positive influence of gamification on outcomes and engagement with mHealth (Shan et al., 2019) but not its effect on adoption or the technology adoption process. The Unified Theory of Acceptance of Use of Technology posits that conditions that facilitate

technology usage strengthen intention to use, and gamifying technology facilitates usage (Venkatesh et al., 2003a). Users have reported that gamification techniques such as levelling and hint giving make mHealth apps more user friendly (LaBelle et al., 2020; Rasul et al., 2021). For the user, the usefulness of a mHealth app is how well it achieves the health goal; levelling is a technique to achieve goals. This is an example of applying Goal Setting Theory to mHealth apps wherein achievable and measurable goals stimulate behaviour more than do goals shared by a population (Locke & Latham, 2002). Similarly, mHealth apps can use the levelling technique to establish gradual and achievable health goals rather than a single larger goal (Nuijten et al., 2022). Hence, it is logical that positive perceptions of gamification lead to ease of use and usefulness of technology; however, this has not been empirically tested.

Pleasing aesthetics are known to improve perceptions of ease of use and usefulness of mobile devices to increase loyalty (Cyr et al., 2006). The study by Cyr et al. (2006); however, omitted attitude and intention. Research has shown that poor app aesthetics makes navigation more difficult and decreases an app's lifecycle (see Taylor & Levin, 2014). mHealth apps that are difficult to navigate and used too briefly to enable any health change would likely have lower perceived ease of use and usefulness. This suggests that mHealth app aesthetics stimulates perceived ease of use and usefulness. The Refined Diffusion of Innovation Model by Moore and Benbasat (1991) theorises that product image—a construct largely defined by perceptions of product aesthetics—influences adoption directly. However, the model excludes perceived ease of use and usefulness. From these insights, it is hypothesised that:

H_3 Technology characteristics positively influence perceived ease of use of mHealth apps:
a – gamification
b – aesthetics

H_4 Technology characteristics positively influence perceived usefulness of mHealth apps:
a – gamification
b – aesthetics

Davis et al. (1989) identified that perceived ease of use influences perceived usefulness of technology, and Schnall et al. (2015) confirmed this relationship in a mHealth app context. These constructs and relationships are known but have not been tested with the antecedents in this study, so their relationships should not be assumed. Robust research does not assume

from past relationships that usability influences usefulness, but rather strives to confirm or deny these relationships noting the new context and sample of the research. Hence, this study potentially makes a theoretical contribution, and it is hypothesised that:

H_5 Perceived ease of use positively influences perceived usefulness of mHealth apps.

Perceived usefulness and ease of use are the strongest predictors of attitude and behavioural intention towards technology (Davis, 1989; Lakhal et al., 2013; Sumak & Polancic, 2010; Venkatesh & Davis, 2000) and are already established in mHealth research to predict attitude (Anderson et al., 2016; Cajita et al., 2017; Foster, 2018). In the original TAM, perceived usefulness, but not perceived ease of use, is also known to directly influence adoption intention (Davis, 1989). Hence, this thesis does not hypothesise on the path between perceived ease of use and adoption intention. It is expected that this thesis will validate these hypothesised paths; however, there is potential for theoretical contributions to stem from this thesis. From these insights, it is hypothesised that:

H_6 Perceived usefulness positively influences attitude towards mHealth apps.

H_7 Perceived ease of use positively influences attitude towards mHealth apps.

H_8 Perceived usefulness positively influences adoption intention towards mHealth apps.

Davis et al. (1989) found that attitude directly affects intention and has mediating effects on the paths between perceived ease of use and usefulness, respectively, and intention. Venkatesh and Bala (2008), in developing the TAM 3, found that attitude positively and significantly mediates the relationships, as did Kim and Park (2012) when developing the Health Information TAM. Therefore, it is hypothesised that:

H_9 Attitude positively influences adoption intention towards mHealth apps.

H_{10} Attitude mediates the relationship between perceived usefulness and adoption intention towards mHealth apps.

H_{11} Attitude mediates the relationship between perceived ease of use and adoption intention towards mHealth apps.

Davis et al. (1989) suggested that consumers have an attitude towards technology that influences adoption intention; however, when in ill health, the severity of their health moderates this influence. Researchers have identified that health status severity for diseases influences mHealth acceptance; hence, it is intuitive that the same may be true for levels or risk of addictive behaviours. Early research into the moderating influence of health status severity on behavioural intentions and other variables provided contradictory evidence (see Cohen, 1996; Westaway et al., 2003; Williams & Calnan, 1991). To clarify the degree to which health status severity may exert influence on adoption, it is included for testing in this study. Therefore, it is hypothesised that:

H_{12} Health status severity moderates the relationship between attitude and adoption intention towards mHealth apps.

The Theory of Reasoned Action (Ajzen & Fishbein, 1980), the TAM (Davis et al., 1989) and the Unified Theory of Acceptance and Use of Technology (Venkatesh et al., 2003a) present models that finish with adoption preceded by attitude and intention. However, testing for actual adoption or usage of mHealth apps is beyond the scope of this thesis because of time constraints and sample inaccessibility. Ali et al. (2019) noted past studies that finish their models with intention and stated that not measuring beyond intention does not limit technology adoption research. The argument is that TAM studies have demonstrated that behavioural intention effectively predicts actual usage. This has been confirmed by mHealth research (Hoque, 2016). Hence, the causal model in this thesis does not include adoption or usage.

3.2.2 Development of the Causal Model

Hakansson et al. (2004) outlined criteria that enable marketing researchers to justify frameworks and models by judging their adequacy. First, theoretical adequacy criteria posit that incorporating theory into a model helps to explain and predict the phenomena it identifies. Also, it should lend itself to empirical testing. Second, methodological adequacy enables researchers to test relationships precisely and robustly in a model for accurate explanation of phenomena. Theory plays a vital role in research and should always be represented accurately. The proposed model in this thesis and the availability of high-quality,

accessible empirical research on app and mHealth adoption facilitates investigation of the variables and their relationships. Further, the model addresses the gaps identified in Chapter Two and adds to the understanding of the TAM in mHealth app adoption through a transformative consumer research and innovative product adoption lens. The proposed model maps out the roles of the antecedents to perceived ease of use and usefulness to interconnect them with attitude and adoption intention. The model goes beyond current understanding where research has focussed mostly on antecedents' direct relationships with adoption and post-adoption behaviours. Further, the literature does not acknowledge how constructs of the TAM perform in the context of mHealth apps with moderation by health status severity. Thus, the moderation investigation of the relationship between attitude and adoption intention in this thesis will provide a greater understanding of inferences that come from people's personal circumstances. Figure 3.1 illustrates the associations formalised in the hypotheses that will test the relationships between the variables. Please note that mediation relationships are not presented in the causal model.

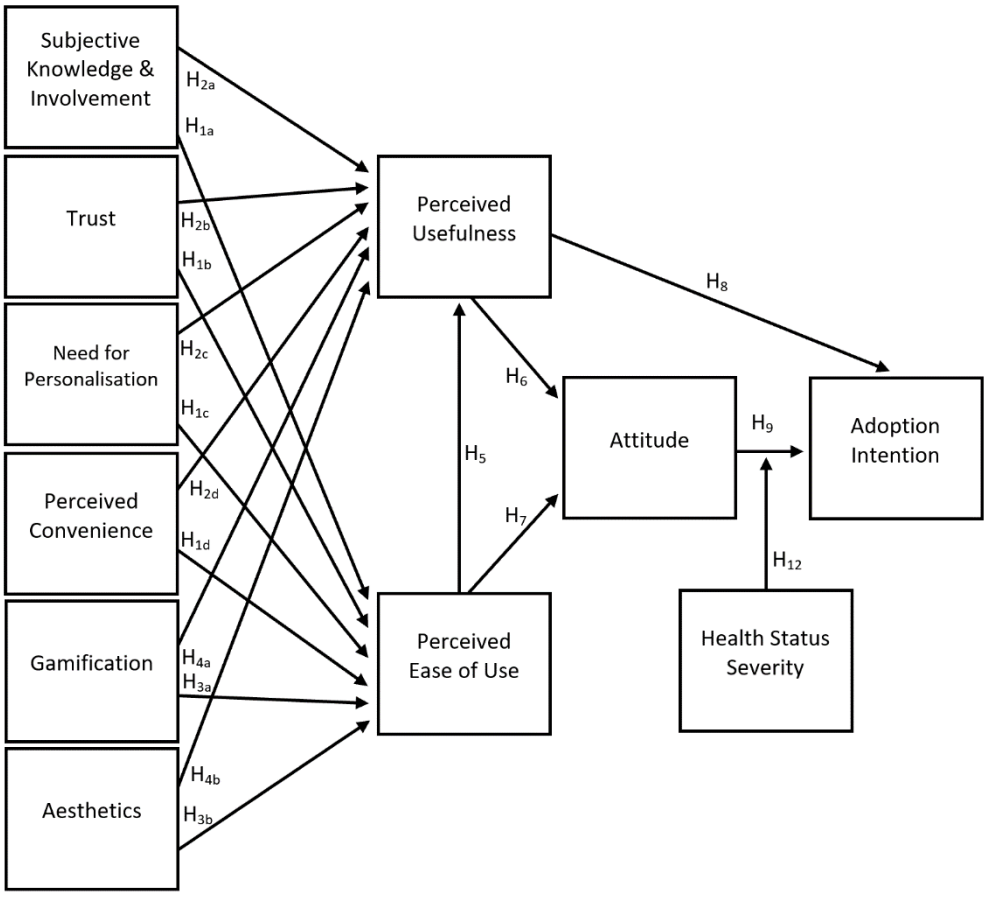


Figure 3.1: Model of Conceptualised Relationships

3.3 Empirical Context: mHealth Gambling Apps

Gambling presents a potential health risk for some consumers. The increased accessibility to gambling (Paterson et al., 2019) and public expenditure on gambling (Victorian Responsible Gambling Foundation, 2019), along with low treatment-seeking rates (Suurvali et al., 2009) suggests that any attempt to mitigate possible harm from problem gambling is worthwhile. This thesis acknowledges debate in the healthcare literature around potentially derogatory names or terms that place blame on the individual; for example, 'problem gambling' and' gambling addict' (see Blaszczynski et al., 2020). However, these names and terms are used in other areas of literature simply to note there are potentially negative impacts from overconsumption and risky behaviours (see Henriksen et al., 2022; Pérez et al., 2021). Despite the negative impacts that gambling can have, little attention is given to accessible solutions such as apps. Apps for recovery addiction are viewed positively by users and incite positive behaviour change (Payne et al., 2015). However, there has been insufficient research on mHealth gambling apps (Ridley et al., 2020). The literature shows that mHealth gambling apps facilitate positive behaviour change (see Bullen et al., 2015; Humphrey et al., 2020), but research has focussed on treatment rather than adoption, which further solidifies the critical gap in the literature that this thesis seeks to address.

3.3.1 Gambling Consumption

Despite problem gambling being experienced by only around 2% of Australians (Park et al., 2021), it cost Australians more than $23 billion in 2019 (Victorian Responsible Gambling Foundation, 2019); a substantial increase from $8 billion in 2010 (Productivity Commission, 2010). The highest contribution to financial expenditure in gambling is made through apps and this is likely to continue growing exponentially (Gao et al., 2021), further enabled by the global liberalisation of online gambling laws (James et al., 2019). Further, the prominence of technology in daily life appears to facilitate the transition to app-based gambling (James et al., 2017). However, despite the economic benefits for gambling operators and governments that come from gambling, there are health risks to gamblers. Despite the success of app-based gambling, commercial gambling apps have been scarcely researched for their impacts (Gao et al., 2021). This growth in problem gambling is compounded by low treatment-seeking rates for traditional therapies, and high attrition rates (Miller & Kavanagh, 2011). Further, the

COVID-19 pandemic has exacerbated the adverse effects of gambling, and healthcare services are restricted (Marsden et al., 2020; Rodda et al., 2022). However, perhaps one of the most problematic factors is that problem gambling is easy to hide (Orford et al., 1996). These findings illustrate the challenges of providing effective problem gambling treatments in Australia. Fortunately, digital gambling treatments overcome the obstacles around traditional therapy, such as the need for anonymity, autonomy and accessibility (Suurvali et al., 2009).

3.3.2 Digital Interventions for Behaviour Control

There is a substantial literature on how gamblers transfer from physical to online gambling platforms (Gainsbury et al., 2012); however, research into digital treatment options has been limited (Rodda & Lubman, 2014). Compared with the more established treatment methods for tobacco and alcohol overuse, a much smaller range of options exist for problem gamblers (Gainsbury & Blaszczynski, 2011). This is exacerbated by low treatment-seeking rates. It is possible that treatment-seeking rates have remained low because of the low availability of digital treatments; however, no studies have investigated this possibility.

Digital intervention for gambling is often preferred over traditional platforms because the obstacles are minor by comparison. Using technologies that are widely and easily accessible overcomes traditional barriers to treatment such as geographic isolation, transportation, personal and professional availability and cultural or language needs (Suurvali et al., 2009). Further, as addiction recovery takes several years and has a high rate of relapse (Dennis et al., 2005), the cost barrier of traditional treatment could be severely reduced with digital interventions. This highlights the importance of cost-effective, long-term support mechanisms such as mHealth apps. Research has shown that apps for addiction recovery are viewed positively by users and incite positive health behaviours. Despite these findings, addiction recovery apps' usability has not developed at the same rate as online services where functions can span numerous pages of a single site (Savic et al., 2013). This is because most apps are not 'one-stop shops' for treatment and users often have a library of apps with varying functionality to cater for the limitations of each (Savic et al., 2013). Further, most mHealth apps are developed commercially despite being adopted in clinical practice, resulting in reduced effectiveness and treatment compatibility (Wallace et al., 2012). mHealth addiction apps are generally created by merging existing information from affiliated and even

non-affiliated websites into apps to capture a new market. This practice can be observed in the few mHealth gambling apps available (Brownlow, 2021). There is room for improvement with digital gambling interventions, notably mHealth gambling apps. However, the benefits these platforms pose over traditional interventions makes any research worthwhile that improves understanding of adoption and dissemination.

3.4 Overview of Research Design

This section outlines the research design of the thesis to introduce the approaches to data collection; the qualitative and quantitative methodologies are presented in Chapters Four and Five respectively. This study employed a mixed-methods approach characterised by a collection of qualitative and quantitative data (Creswell, 2009). The purpose of the qualitative stage is neither to interpret the concepts nor inform the survey; the purpose is primarily to test the research concept of mHealth with the sample and secondly to validate the stimuli. Extant literature is used to inform the survey. Hence, the qualitative stage is dedicated its own chapter which demonstrates how the findings confirm the concept and instruct the stimuli. As the contribution of the thesis stems from the quantitative stage, the processes and interpretation of findings are detailed across multiple chapters.

The mixed-methods approach has both interpretivist and positivist paradigms. Interpretivism is predicated on multiple realities that are too complex to be predicted (Brannen, 2017) while positivism argues that reality is quantifiable through systematic study of data (Mangan et al., 2004). Both paradigms inform the thesis methodology while the positivist paradigm guides the data analysis which confirms new knowledge. Combining interpretivist and positivist research paradigms is a valid means of data triangulation to improve validity (Brannen, 2017). This thesis began by using interpretivism to understand the level of awareness of mHealth and extent of relevant app behaviours in daily life before moving into a controlled research environment (Antwi & Hamza, 2015). This interpretivist approach was vital to the research method as people's awareness and experience with mHealth apps cannot be assumed before constructing a quantitative instrument that is inspired by a rigorous, positivist exploration of past research. The findings of this past research were generalised to this thesis. The concepts under investigation required objective measurement to support or reject the proposed hypotheses. This represents the positivist paradigm in this thesis. A mixed-methods approach

resembles the embedded research design described by Creswell and Clark (2017) where the qualitative phase operates as support to the quantitative data collection. The thesis relies on operationalising the concepts through testing the quantifiable variables. Further, this style facilitated validation of the research and the objectivity needed for this context (Antwi & Hamza, 2015; Straub et al., 2004). The approach was consistent with the positivist belief of the existence of an objective physical and social world where researchers independently gather empirical data (Mangan et al., 2004). The functionalist view here was used in the hope that rational understandings of consumer behaviour could be used by marketers in dissemination or as a basis for future research. This study began its data collection with a qualitative approach.

3.4.1 Qualitative Stage

Focus Groups

The first data collection stage of the study was qualitative. This stage included focus group discussions with help-seeking gamblers around mHealth apps generally, and a 'gambling quit app' specifically. The group was sampled anonymously through promotion by a suitable third party, a gambling support group.

Focus groups sessions were the single method of qualitative data collection because of the ease of reviewing the stimuli, a series of app screenshots, that will be detailed in Section 4.3 (Morgan & Morgan, 1993; Smith, 2003). Despite the inability to secure complete anonymity of participants, the appeal of focus groups for marketing research sits in the potential for group interaction that provides data and insight into participant attitudes and opinions (Stewart et al., 2007). However, there is the risk that participants when in the company of others may feel pressured to provide socially desirable responses rather than truths (Neuman, 2014). This can be a problem in researching gamblers – known to withhold or misreport information about their behaviours (Pulford et al., 2009). However, past research shows how focus group sessions have been used successfully in social marketing gambling research projects and in mHealth research where participants have stated how the controlled, private setting with peers helped them feel safe from shame (Bullen et al., 2015; Humphrey et al., 2019). Further, focus groups are an effective platform to collect data on sensitive concepts

and topics within sensitive contexts (Bagozzi et al., 2013; Farquhar & Das, 1999), including gambling (de Vos et al., 2016; Humphrey et al., 2019; Lamont et al., 2016). Calderwood and Wellington (2013) stated that focus group discussions with people experiencing problem gambling are ideal for testing visual stimuli. This method allows for meaningful and creative discussion through idea debate and exchange, while removing stigma and shame associations (Calderwood & Wellington, 2013). Hence, the use of focus groups is suited to qualitative research objectives.

Qualitative Objectives

The qualitative phase of data collection was not intended to validate the proposed causal model. Rather, data were thematically analysed to test the three objectives of this aspect of the study. The first objective was to assess gamblers' understanding of and attitude towards mHealth apps in general, and gambling quit apps in particular, ensuring that the introduction of mHealth apps and gambling quit apps in the stimuli was suitable. The second objective was to test the stimuli for appropriate functionality and stylistic design. That is, what are the sample's preferred mHealth gambling app functions and design. The third objective was to inform and refine the stimuli to ensure the optimal stimuli were used for the quantitative stage. This was important as it aided in avoiding any subconscious biases that the researcher or stimulus designer that was hired may have. Further, ignoring participants' perceptions and opinions of the stimuli could result in misinterpretation and non-compliance in later stages of data collection (Carter et al., 2011). Hence, focus group discussions were an appropriate method to address the qualitative stage objectives of the thesis and provide supporting findings for the later quantitative stage.

3.4.2 Quantitative Stage

Web Survey

The quantitative stage uses a web-based survey to collect data to test the research hypotheses. Data collection and measurement were conducted according to positivism. Positivist research typically employs a quantitative approach, such as experiments and surveys. This gives researchers stronger tests of causal relationships and captures self-reported consumer behaviours and beliefs through cross-sectional data (Neuman, 2014).

However, a disadvantage of cross-sectional data is that it provides a snapshot of a single point in time rather than considering an ongoing dynamic process (Bowen & Wiersema, 1999). As in the qualitative stage, a population of help-seeking gamblers was sampled in the quantitative stage; recruited via gambling support groups and welfare organisations. The challenge noted earlier with a sample of gamblers is that data is more susceptible to biases and inaccurate recall, particularly with long-term gambling (Wang & Cheng, 2020). The data were analysed using software (SPSS and AMOS) to test the research hypotheses. Experimental research can employ survey sampling both within and outside lab environments with web-based surveys proving the most popular for research outside the lab (Mutz, 2011). With this type of data collection, participants are often randomly assigned to conditions, stimuli and/or presentations of independent variables to measure effects on dependent variables (Mutz, 2011). This thesis will use a web-based, quasi-experimental design, meaning that the survey assigned participants to all stimuli, which were presented as images grouped by the mHealth app functions. These groupings were determined by the findings of the qualitative data analysis. This approach rules out possibly false relationships and may advance theory in areas of research where selection or order-effect biases disadvantage observational research (Mutz, 2011). The use of a web survey also enabled the creation of two additional constructs that were used to conduct supplementary testing: multi-group testing of adoption behaviour and product platform preference.

Multi-Group Testing

This study did not measure beyond adoption intention as this was not possible within the scope of the thesis limitations. However, to validate intention, an alternative adoption behaviour was assessed. Towards the end of the web survey, after intention was measured, survey participants were offered a recommendation for a free, existing mHealth gambling app, along with a website link to more information and download access. The web platform recorded which gamblers clicked on the link, thereby providing a measure of 'adoption behaviour'. This created a dichotomous variable; i) those who presented adoption behaviour and ii) those who did not present adoption behaviour. The thesis does not hypothesise on the behaviour. However, it was used to develop further insights into the relationships in the causal model by splitting the sample by their adoption behaviour and retesting the paths. The

findings from this may extend the theoretical contributions of the thesis around the effect of adoption behaviour on mHealth app adoption.

The other variable that was not hypothesised in the thesis but was explored, was the respondents' product platform preference—digital or analogue—for their gambling behaviour (Hing et al., 2021). Digital gambling refers to the use of personal devices, such as smartphones and personal computers. Analogue gambling is the use of machines or equipment at venues or face-to-face betting at events, such as pokies and sporting games respectively. These data were collected from participants in the web survey by asking them to choose 'how they enjoy gambling' from a list of options. Again, the dichotomous variable that arose from this was not hypothesised. However, the relationships in the model could be investigated by splitting the sample and resting the paths. The influence of product platform preference on the relationships in the model via multi-group analysis may further extend or help to explain some aspects of the results. The primary tool employed for the quantitative data analysis was structural equation modelling, which supports multi-group analysis.

Structural Equation Modelling

Structural equation modelling served as the primary technique to test the paths proposed in the causal model. Structural equation modelling is an advanced multivariate technique that combines both confirmatory factor analysis and multiple regressions in a single model, while also assessing relationship interdependence and dependence of the variables (Kline, 2015). This was the preferred technique of analysis because of its ability to estimate multiple and interrelated dependence in a single analysis. Structural equation modelling is suited to social sciences research that investigates behavioural factors as there are often complex inter-relationships between variables (Hoe, 2008). This technique is widely accepted in business research (Baumgartner & Homburg, 1996). Structural equation modelling was used as the primary technique to test the model paths in this thesis.

3.5 Chapter Summary

Chapter Three presented the research framework where the hypotheses that guided the research were introduced around a discussion of drivers of technology adoption. The chapter outlined the development of the causal model and presented the model to indicate the

known relationships between constructs, the gaps and the TAM constructs. The research design explained the mixed-methods approach and the argument for structural equation modelling as the primary technique to test the model paths. Chapter Three concluded with an introduction to the empirical research context—specifically gambling consumption, quit interventions and the knowledge and research around digital gambling interventions and their relevance to the research design. Chapter Four leads presents the research methodology and preliminary findings from the qualitative analysis and outlines the stimulus development methods.

Chapter 4: Qualitative Study and Stimulus Development

4.1 Introduction

Figure 3.1 in Chapter Three illustrated the stated hypotheses within a discussion of drivers of mHealth app adoption. Chapter 3 also acknowledged the need for an exploratory qualitative component to help develop the stimuli to be used in the quantitative study (a hypothetical mHealth app) and to explore the research context on this thesis. Chapter Four presents the findings of a qualitative investigation of consumer knowledge of and involvement in mobile apps generally, and perceptions and attitudes towards a novel mHealth gambling app specifically. Because of COVID-19 restrictions, virtual focus groups were conducted via Zoom software. The sample consisted of gamblers who had already taken steps to seek help to control their addictive behaviour. A full description of how these individuals were recruited is provided in Section 5.3 on sampling methodology.

Chapter Four begins by outlining the qualitative research objective. The qualitative stage of this research is restricted to a test of concept and stimuli creation which guides the structure of this chapter. The chapter moves to explaining the development of the stimuli tested in the focus groups, before moving onto a description of the qualitative methods employed and how the focus group sessions were conducted. The justification and process for developing the stimuli are outlined in detail, leading into the data collection methods where the stimuli are presented through focus group protocols. The approach to the analysis of the qualitative data is explained and results are presented and scaffolded by the guiding questions discussed later in the chapter. The chapter concludes with the key findings from the focus group sessions and how the findings were used to refine the stimuli for the quantitative stage.

4.2 Focus of Qualitative Study

A qualitative approach was suited for this preliminary phase of the research to gain the insights of potential users of an mHealth app targeting problem gamblers. The purpose of the qualitative stage in this research was not to inform the survey instrument in the quantitative stage of the research like a typical sequential phase mixed-methods research design. The qualitative findings are not intended to extend theory or make an original contribution to

knowledge. Hence, this is not a detailed analysis of the findings in relation to variables and hypotheses. The purpose of the qualitative phase was threefold. First, it is vital that the target audience for these types of app understand mHealth apps in the way they were used in this research. Hence, it was important for the qualitative stage to test explanations of mHealth apps to develop a suitable explanation for the quantitative stage. Second, it was necessary to develop a hypothetical mHealth gambling app suitable for testing that was received positively. The thesis aimed to identify the suitable functionality and stylistic design for an mHealth gambling app. Third, findings from the qualitative stage were used to refine the visual presentation of the stimuli for the quantitative stage. Noting the second and third points, extant literature was considered solely for the development of the stimuli – detailed next in Section 4.3 – and not for conceptual interpretation of constructs and discussion of findings. The findings are to inform the stimuli meaning any contrast with extant literature is tightly bound to this purpose. Hence, the objectives of the qualitative study were to:

1. create an introduction to mHealth gambling apps that the target audience could understand
2. identify the best functions and design for an mHealth gambling app
3. inform the stimuli creation for the quantitative stage of data collection.

4.3 Stimulus Creation

The research created a hypothetical concept app for this thesis and gave it the name NoBets. This was expected to be a temporary name for the hypothetical app; however, it remained, as the participants preferred NoBets over other names discussed by participants in the focus group sessions. NoBets served as the qualitative stimuli in this thesis. This approach of creating and testing an mHealth gambling app in focus group sessions is evident in the literature (see Humphrey et al., 2019). NoBets is multifunctional and was professionally designed in response to the shortcomings identified of current mHealth apps of this kind (Brownlow, 2021). Hence, the stimuli that demonstrated NoBets were a series of static images, presented like app screenshots, that showed potential stylistic designs and app functions. Centring focus group discussion around visual cues like this has been used successfully in mHealth gambling research (see Humphrey et al., 2019). The researcher chose static images for the stimuli rather than creating an operational app, to minimise the time

required to complete the survey and enable greater control over what participants saw. While an operational app may have been more engaging, it would have made the survey time costly for participants. Brevity is an important component for increasing response rates (Andrews et al., 2007). Further, participants may navigate incorrectly and miss functions. This approach of presenting an app through static images in focus groups sessions with help-seeking gamblers has been successful in past research (see Bullen et al., 2015). The stimuli were all original and developed in collaboration with a professional graphic designer. The purpose of the qualitative stimuli was to obtain an understanding of how participants reacted to the different designs and functions presented in NoBets, to then refine the app stimuli for the quantitative phase of data collection. Hence, the following Sections 4.3.1 and 4.3.2 explain the processes behind identifying the possible designs and functions of NoBets.

4.3.1 Designs

The researcher presented different designs to the focus groups to gather their opinions on four colour schemes and two different layouts of app content (see Figure 4.1). It was important to identify a design that the target users received positively, as app aesthetics affect usage and engagement (Alqahtani & Orji, 2020) and can increase perceptions of technology quality (Lee, 2022). Of the four colour schemes, two mimicked the common 'clinical colours' of healthcare technology: high contrast with primarily blue and white colouring (Hudson-Farmer, 2021). The third style represented the most popular current (based on download rates) mHealth app related to problem gambling available in Australia, called GT. The last colour scheme was a unique, bright design based on popular commercial gambling apps available in Australia, which use vibrant reds and greens and white. Participants were also shown different screen layouts in designs that represented the possible layouts of the app; for example, icons grouped together versus icons spaced apart. The different colour schemes, layout options and app functions (described in the next section) of NoBets are illustrated with larger images in Appendix A:Stimulus Design Styles and Appendix B: Focus Group Stimuli for all images.

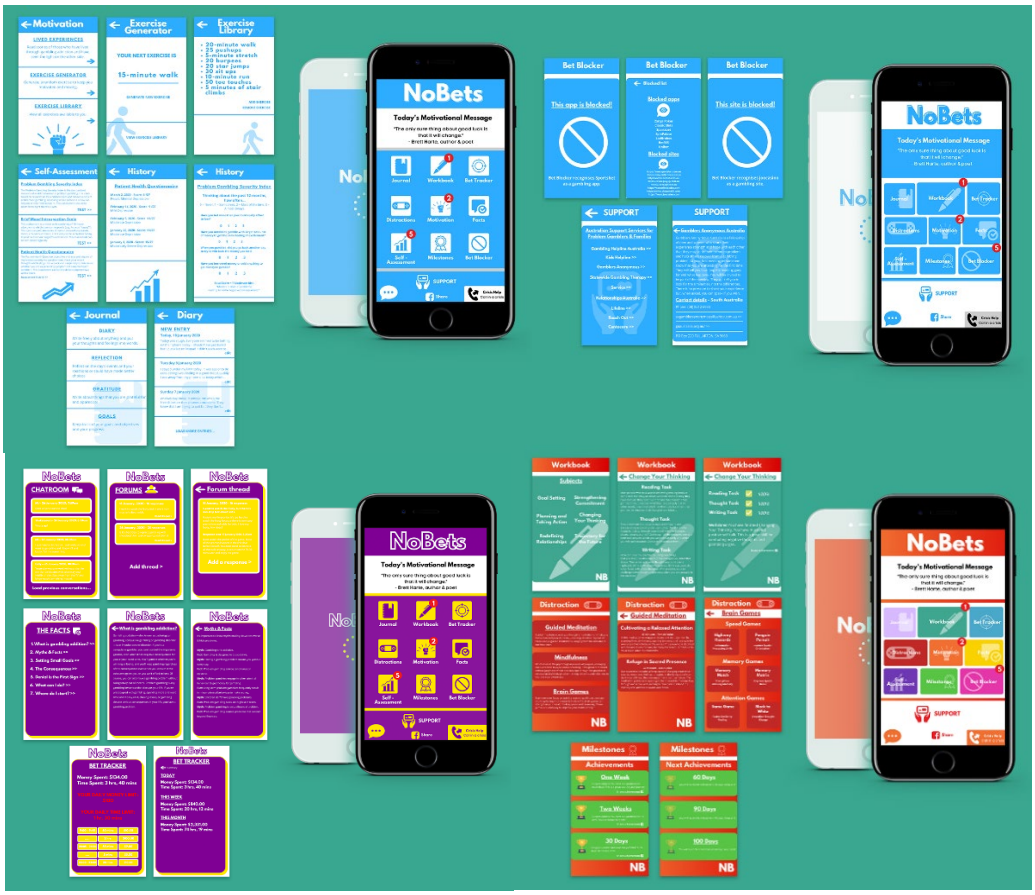


Figure 4.1: Concept App Designs

4.3.2 App Functionality

The choice of functions for NoBets stemmed from an investigation of the mHealth, gambling and technology literature (see Table 4.1). Studies that investigated the quality of mHealth apps judged by experts (see Walrave et al., 2022) and the perceived quality of apps as seen by consumers (see Wallace et al., 2012) informed the choice of functions. This was important for creating the best possible version of NoBets. Most mHealth apps are developed commercially by companies, brands and independent app developers without input from consumers or health experts (Aungst, 2013; Wallace et al., 2012). Further, app rating scales validated by researchers are seldom used to inform app development (Tsai et al., 2022). Aungst (2013) observed that the result is often an app with very few functions that contribute to the health problem considered. Therefore, NoBets is based on important insights from the literature. Whittaker et al. (2021) showed that mHealth apps with a high number of interactive functions that enable health change are received positively. Further, Walrave et

al. (2022) noted that the quality of mHealth apps comes from their functionality. A review of quit smoking apps available in Australia by Thornton et al. (2017) identified functions in high-quality apps such as self-evaluations, progress monitoring, distraction tools, support resources and knowledge building as examples. Apps with these functions would likely be beneficial for managing other health issues too. Hence, NoBets is based on similar functionality. Using these insights, NoBets includes a range of justified functions to demonstrate quality and encourage positive evaluations by the target users that were sampled. See Brownlow et al. (2022) for an evaluation of these mHealth gambling app functions by help-seeking gamblers.

Table 4.1: NoBets Functions for Qualitative Stimuli

Function	Summary and justification
Crisis Help	A fixed icon on the app dashboard calls the Australian Gambling Helpline through mobile devices. - Half of gamblers using online support chats are in crisis and need immediate help (Rodda et al., 2015). - In times of crisis, emotional turmoil, stress or insecurity, people resort to gambling as they lack proper, immediately available outlets to cope (Gainsbury, 2020). - People in treatment communicate more digitally than via other platforms (Sreedharan et al., 2022).
Bet Tracker	Keeps a record of the time and money spent gambling. The function can collate records into daily, weekly and monthly visuals. Users can set daily limits for money and time spent, with breach alerts. - Focus group discussions with practitioners and problem gamblers showed support for behaviour tracking functions in mHealth apps (Bullen et al., 2015; Humphrey et al., 2020).
Support Groups	Connects users with support groups and welfare organisations that offer gambling support services. - Savic et al. (2013) illustrated that functions that link users to specialist support, community groups and resources are rated highly for addiction recovery apps.
Workbook	Contains homework-style materials designed to treat problem gambling. - In focus group discussions, problem gamblers suggested functions to record progress and output to show peers (Humphrey et al., 2019). - Access to educational materials is important for mHealth apps users (Iskandarsyah et al., 2022).

Function	Summary and justification
	- Gamblers using an mHealth app showed greater progress through cognitive behaviour therapy than those completing the paper-based version (Pfund et al., 2020).
Journal	- Keeps a record of entries for users to reflect on progress and changes through four components: 1) prioritise problems and goals, 2) recognise triggers and setbacks, 3) identify self-defeating thoughts, and 4) outlet for self-expression.
	- Expressing through journalling is a therapeutic form of treatment (Richards & Vigano, 2013).
	- Recording behaviour and attitude changes towards chronic illness provides important data for collating and sharing with a treatment provider (Chigurupati, 2011).
Distraction	- Diverts attention from urges via three components: 1) guided meditation, 2) mindfulness training, and 3) brain training games.
	- A review of popular mHealth apps available in Australian app stores revealed that functions offering meditation support and tasks to complete are common (Savic et al., 2013).
Motivation	- Encourages autonomy using motivational messages, lived experience stories and physical exercises.
	- Problem gamblers agreed on the importance of treatment apps with motivational content in focus group discussions (Bullen et al., 2015).
Bet Blocker	- Blocks access to betting apps and websites.
	- Problem gamblers supported the idea of an app that blocks gambling content in focus group discussions (Humphrey et al., 2019). Some software already offers this.
Chat	- Hosts a chatroom for users and a forum/message board for specific discussion.
	- Focus group discussions with problem gamblers revealed a desire for peer connection and support through chat and forum options (Humphrey et al., 2019, 2020).
	- Platforms for human interaction should be part of gambling treatment (Park et al., 2021).
	- Talking with peers during gambling treatment offers more potential than chat bots (So et al., 2020).
Milestones	- Records and displays abstinence and rewards users for hitting benchmarks.
	- Gambling treatment specialists supported reward elements in mHealth apps (Bullen et al., 2015).
	- Displaying progress in mHealth apps improved autonomous health management (Harren et al., 2022).
	- Achieving goals through mHealth encouraged mHealth acceptance (Breland et al., 2021).

Function	Summary and justification
The Facts	- Covers a range of areas of information about gambling addiction, symptoms and quitting. - Having health information available on apps increased intention to use (Gani et al., 2021) and furthered engagement (Alqahtani & Orji, 2020). - Information repositories are common in popular mHealth apps (IMS Institute for Healthcare Informatics, 2015) and enable positive health learning outcomes (Humphrey et al., 2021). - mHealth apps should enable access to reliable recovery and health information (Harren et al., 2022).
Self-Assessment	- Measures gambling risk level, mental health status and mood. - mHealth apps should record health changes for users and their practitioners (Chigurupati, 2011). - Screening tools should be part of gambling treatment (Park et al., 2021).
Share	- Users can share their Milestone achievements and Workbook progress on social media. - Gamblers supported social media sharing of treatment progress when it was optional (Bullen et al., 2015). - Users expected mHealth apps to have social media sharing functionality (Lazard et al., 2021).

4.4 Sampling Methods

Relationships Australia promoted participation in the qualitative phase of this research to participants (see Appendix C: Promotion of Focus Group Sessions). Relationships Australia did not directly approach gamblers involved in their support program because of concerns that their clients may feel pressured to participate. Hence, the call to participate was via individuals linked with their support program through their website and social media. The support program is delivered online, via phone or face to face to anyone living in Australia adversely affected by gambling (Relationships Australia, 2020). The service is designed to teach quit mechanisms, repair relationships and offer support with financial management. The program also links users with peers, counsellors, specialists, researchers and employment programs, and therefore attracts a range of people. Employment programs are particularly important to these groups as unemployment is a driver of problem gambling (Hing et al., 2016). The popularity of Relationships Australia enabled the promotion of the focus group sessions. However, this method was limited as there was no control over who was linked with Relationships Australia. The researcher overcame this in the focus group sessions by

confirming that participants gambled at least twice per week prior to initially seeking help. A convenience sample consisting of 24 adult participants was drawn from the Australian population. Non-probability techniques—that is, convenience sampling—are appropriate for this type of exploratory research (Malhotra & Birks, 2007). There were five focus group sessions. The composition of the sample of respondents is presented in Table 4.2.

Table 4.2: Focus Group Sample Profiles

Respondents	Male	Female	Aged <25	Aged 25–30	Aged 31–35	Aged 36–40	Aged 41+
Total	10	14	2	11	5	3	3

4.5 Conducting Focus Groups

The use of focus groups involving actual gamblers is common in such research (see Bullen et al., 2015). However, this thesis collected qualitative data during one of the peak outbreaks of COVID-19 in Australia, making data collection challenging (Vindrola-Padros et al., 2020). Because of the challenges posed by the pandemic in terms of lockdowns, restrictions on social distancing and public gatherings (Queensland Government, 2020), face-to-face sessions were not possible. Further, the Flinders University Human Research Ethics Committee (HREC) enforced that this thesis aligned with the University's COVID-19 research protocol by conducting online data collection only (Flinders University, 2020). To combat these challenges, the thesis used online focus group sessions with small group numbers via the Zoom platform. While there are some limitations to this approach, such as reduced control over participant environment and the risk of technology failure, virtual focus group discussions are a valid means of data collection (Roberts et al., 2021). Further, this platform offers advantages for both participants (e.g., convenience) and researchers (e.g., the sample is not restricted geographically; Roberts et al., 2021). Screen sharing presented the stimuli to the participants and a voice recorder captured session audio only. The researcher conducted the sessions, which lasted 30–40 minutes each with all respondents participating from private residences. Their locations were not recorded. Participation was voluntary, and confidentiality and anonymity were assured. Participants received an incentive (a $30 eGift voucher). The researcher separated the email addresses and consent forms used to distribute the eGift vouchers to participants (see Appendix D: Focus Group Consent Form). Once the

eGift vouchers were distributed, the researcher deleted all email addresses and correspondence as per the approved ethics clearance. The only identifying details the researcher retained were the age and gender of the participants, to profile the sample. An information sheet (see Appendix E: Focus Group Information Sheet) and support group contact form (see Appendix F: Gambling Support Information with Contacts for Participants) were provided to respondents alongside the online advertisements and at the commencement of the focus group sessions. The Flinders University HREC (see Appendix G: Human Research Ethics Committee Approval Notice) and Relationships Australia (see Appendix H: Relationships Australia Approval Notice for Data Collection) provided ethical clearance prior to data collection.

4.6 Session Protocols

As recommended by Berg et al. (2004), a semi-structured interview guide led the sessions. This encouraged discussion and maintained controlled and consistent themed discussions through open-ended questions (Stewart & Shamdasani, 2014). While the sessions followed a sequence, the order and number of questions asked varied to clarify points and focus discussions. As shown in Figure 4.2, the sessions began with an explanation of the research project and the session protocol. To ease into the discussion, the researcher asked participants to scroll through the apps on their personal mobile phones and list their mHealth apps (e.g., 'Do you have any apps that you use for your personal health? Read them aloud and what do you use the apps for?'). The interviewer clarified that this included apps for illness and diseases, mental health and other areas that they might not initially have considered. The purpose was to confirm that participants understood the concept of an mHealth app. This warm-up activity and transition into discussion was developed by the National Institute for Health Innovation (personal communication May 2020). Next, participants discussed their views on addiction treatment apps (e.g., 'Do you think people can treat an addiction using an app?' 'Do you believe that it would be a good platform?'). Follow-up questions suggested tobacco and alcohol addictions as examples, the support an app could offer, the designers and the perceived usefulness of these apps. These questions moved the participants from understanding mHealth to considering its role in addiction. From this point, participants began to form and share opinions about mHealth apps for addiction. This was an

ideal segue to ask specifically about mHealth gambling apps (e.g., 'Did you know there are apps for people who want to control or quit gambling?'). Most participants had no prior knowledge of gambling quit apps, but the researcher encouraged them to discuss their views. Discussion about popularity and possible users led to the next question, about perceived usefulness. Follow-up questions centred on pros and cons, uses, apps and traditional therapies, app styles and the mobile platform. These questions gauged participants' support for mHealth gambling apps and what they expected an app to do.

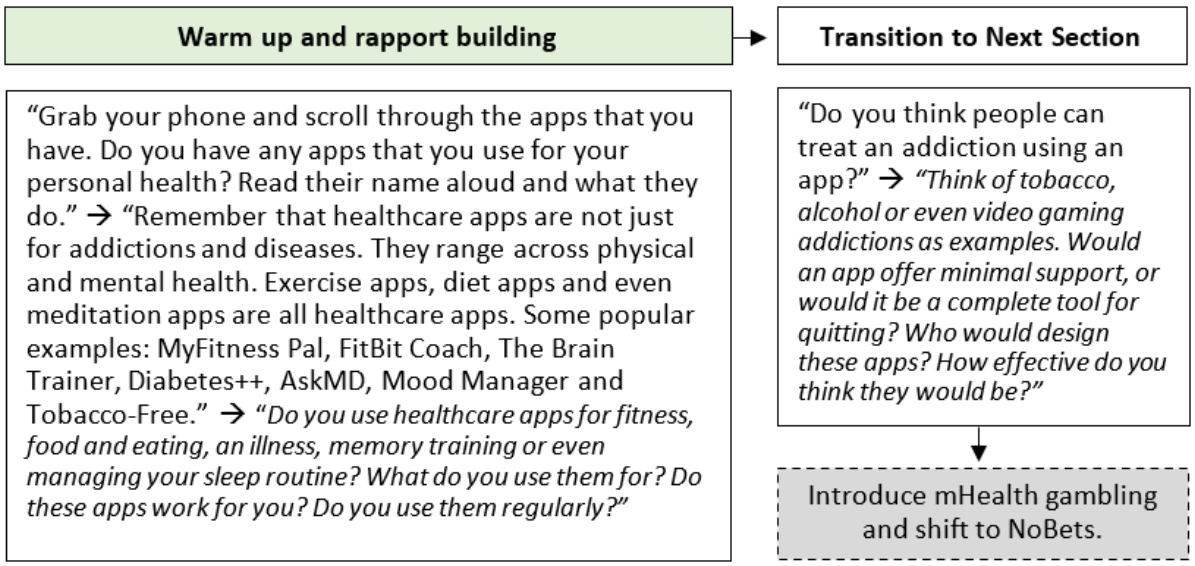


Figure 4.2: Focus Group Discussion—Warm Up

The next stage was designed to gain feedback on the stimuli; images presenting the different styles (see Figure 4.3). Centring focus group discussion around visual cues has been used successfully in mHealth gambling research (Humphrey et al., 2019). First, it ensured that the functions of the app displayed in the stimuli were clear and easily understandable. Second, it identified the more appealing aesthetics of NoBets and reduced the number of possible colour and layout schemes. As a way to ease into the stimuli and app, images of the NoBets home screen and loading screen were shown first. The researcher asked participants for first impressions (e.g., 'What are your immediate thoughts of our app's design and style? Was it what you were expecting?') and their likes, dislikes and preferences for colours and layout (e.g., 'Of the four options, which do you like and dislike?'). Follow-up questions directed discussion to preferred colours, legibility, layout simplicity, professionalism and personal

favourites. Once participants seemed comfortable with the stimuli, the researcher asked for feedback on each of the functions.

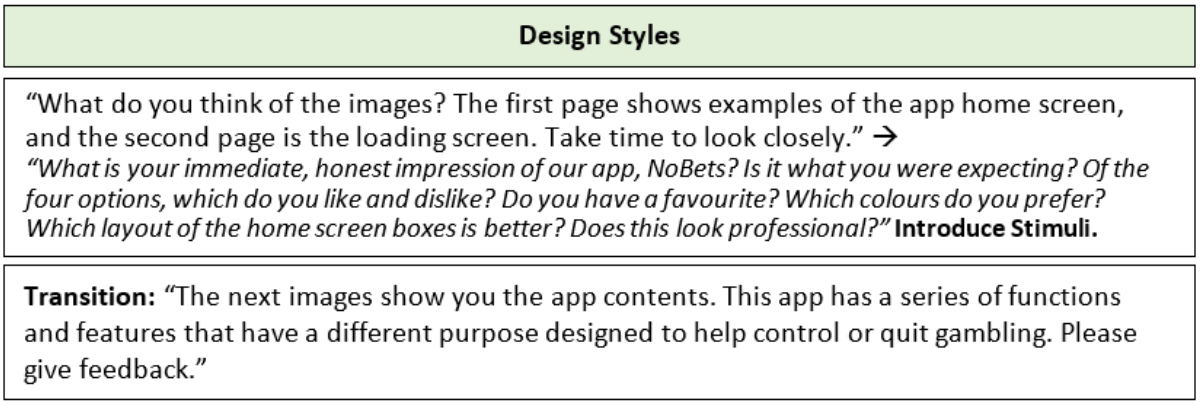


Figure 4.3: Focus Group Discussion—Design Styles

The functions were presented as the 'tools' to accomplish different tasks. In the stimuli, two or three grouped images demonstrated each function. Each function was shown for 20 seconds to keep the sessions on schedule and to ensure that participants could quickly and easily understand each function. This was important as difficult-to-understand stimuli that take multiple reads may cause a spike in attrition in an online survey. After participants viewed each function, gathering their feedback began with a broad, general question regarding their evaluation (see Figure 4.4). Follow-up questions considered understandability, perceived ease of use, perceived usefulness, perceived regularity of use, and improvements and changes. The stimuli presented the functions through different designs styles.

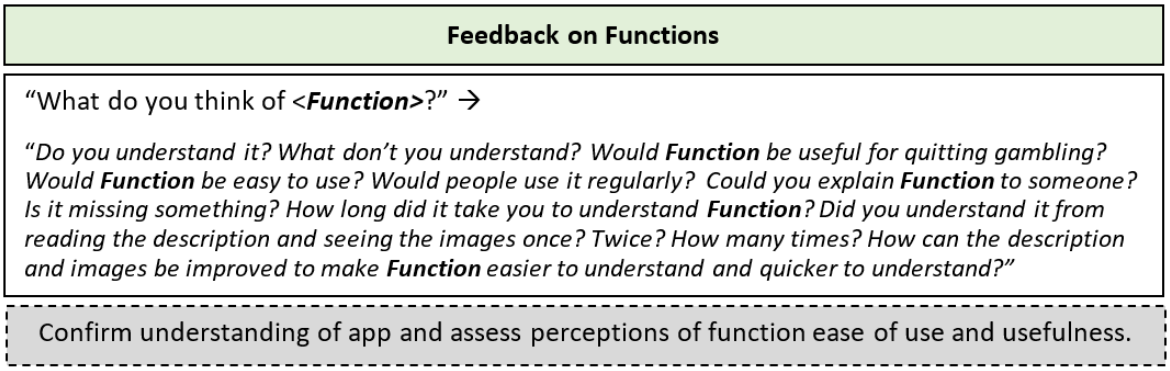


Figure 4.4: Focus Group Discussion—Feedback on Functions

To gauge the opinions about the styles, the researcher asked participants about the design with follow-up questions on colours, layout, professionalism, sizes, and likes and dislikes (see

Figure 4.5). Participants chose their most and least preferred colour schemes, and explained why. Participants also discussed the different layouts where the function icons were spaced apart, positioned close together and stacked.

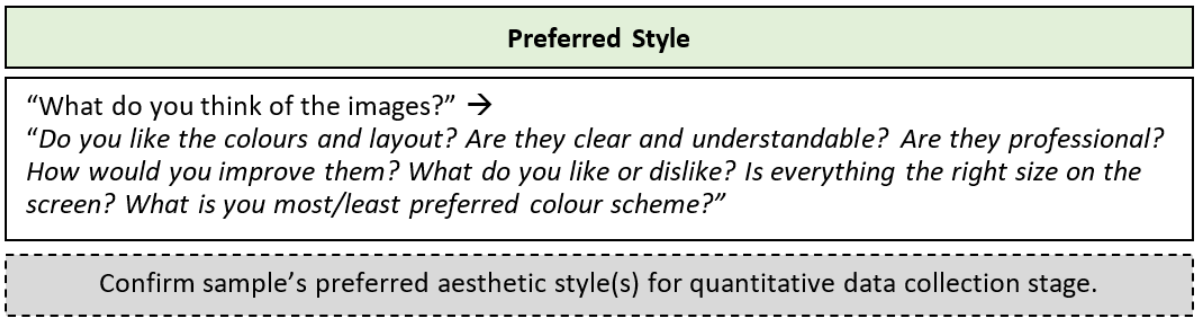


Figure 4.5: Focus Group Discussion—Preferred Style

The discussions concluded by assessing the participants' verdicts on NoBets in terms of their attitude and intention (see Figure 4.6). The discussions generated important data for the thesis. To achieve the qualitative research objectives, the researcher used a deductive approach to thematically analyse the data.

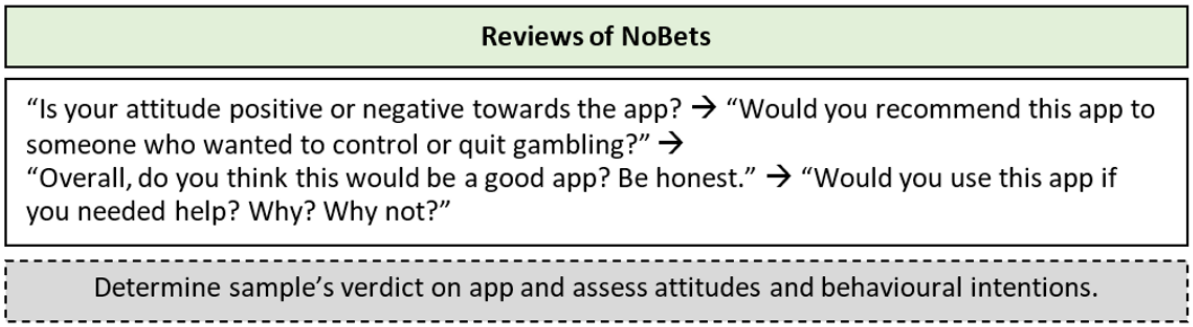


Figure 4.6: Focus Group Discussion—Reviews of NoBets

4.7 Data Analysis and Results

This thesis took a deductive approach to coding where structured codes were established before analysis. The codes were not based on any theoretical framework; rather, the researcher developed them to resolve the qualitative research objectives introduced in Section 4.2 (see Appendix I: Qualitative Analysis Codes for a simplified set of the codes). The researcher transcribed the audio files using an orthographic transcription approach that considered important aspects of conversation, such as turn-taking, laughter, pauses,

abbreviations and slang, overlapping speech and inaudibility (Braun & Clarke, 2013). Words, phrases and sentences were units of analysis (Berg et al., 2004). Additional quotations from participants that are not shown in this chapter are presented in Appendix J: Additional Quotations from Focus Group Sessions. The results are discussed below reflecting the qualitative research objectives. Note that the qualitative stage of this research is for a test of concept and stimuli creation, so the discussion of results aligns with these aims rather than how findings can inform the survey instrument, extend theory or contribute to knowledge.

4.7.1 Objective One: Create an Appropriate Introduction

The initial discussion during the sessions showed that all participants understood the descriptions of 'healthcare apps' and 'quit apps' given. They were able to talk about their own experiences of using mHealth apps without needing clarification, as most had used them. To introduce NoBets, the researcher developed a brief definition derived from Bullen et al. (2015) that referred to a) apps for quitting and b) a range of functions designed to help quit gambling. The target audience quickly and easily understood the definition and functions and the role of NoBets as an intervention tool. This achieved Objective One. Hence, this method of introducing gambling quit apps and NoBets was replicated in the quantitative study.

4.7.2 Objective Two: Identify the Best Functions and Design—Stimuli Development

Functions

For the most part, participants made positive comments about the functions illustrated, as outlined in Table 4.1. However, some functions were not supported and were consequently removed from NoBets. Any negative views brought on by poorly received functions would disadvantage the quantitative findings by negatively affecting perceived usefulness and ease of use, attitude and adoption intention.

Journal received mixed reviews. Several participants commented that they would never use *Journal*, but it might work well for other users. The separation of different types of journalling—such as, goal setting and gratitude—was popular among respondents. All participants supported *Milestones* and some likened rewards to gambling:

> I think it's a good idea. I think a lot of gamblers are seeking rewards especially when they're trying to change the behaviours. I think a milestone could feel like a bit of a win and tie into the gambling scenario of wanting wins.

Participants liked seeing visual progress and rewards. There were concerns that users might cheat to win trophies; however, the participants acknowledged that this reflected the user. Participants had mixed views on *The Facts* but noted the positives of having a source of trustworthy information; a sentiment expressed in the literature (Primhak et al., 2019):

> This is not my preferred section because once you read it, you've finished using it. It doesn't do anything else, but still I think this is a good idea to have reliable information about quitting gambling in the app because people who can't afford therapy might read all sorts of crazy shit online about quitting.

Initially participants were concerned that *Bet Blocker* was flawed as people could use other platforms to gamble:

> I think this is a great idea because most people are betting on their phone, so it stops them from that easy access that betting apps offer. I suppose people who play pokies or go to casinos can't use this though.

Despite these concerns, all participants concurred that *Bet Blocker* would offer some support. For *Motivation,* the consensus was that content would become stagnant:

> It's a good idea, but it just wouldn't have the fresh content that keeps people coming back to it. How many times can you read the same stories and motivational messages or do the same workout before you get sick of it?

Most participants liked *Distraction* and supported the brain games component. The meditation and mindfulness components received mixed reviews; however, all participants agreed that they would benefit some users:

> I think this [*Distraction*] is a really good section to have in an app. It's important to take that thought process away from gambling and put it towards something else.

Chat was mostly well received, yet there were concerns around privacy and circulation of negative content:

> I think Chat would be effective if it was used strategically, but an open chat forum that is not monitored by a health professional could end up with wrong advice being given.

Most participants doubted the utility of *Self-Assessment* with concerns around the frequency of use required and that users may lie to avoid unwanted results. Subsequently, *Self-Assessment* was removed. Participants noted that *Workbook* could supplement and even replace formal treatment:

> Perhaps people who can't afford therapy or some people would need to do this in conjunction with somebody like a professional to help them between sessions.

Participants were uncertain of *Bet Tracker* as similar tools existed in commercial gambling apps already but were not popular. The consensus was to remove *Bet Tracker*. *Support* was positively received. Participants pointed out that this information was already online, but they agreed that it was best to have this directory amalgamated and easily accessible. Participants were initially unclear about *Crisis Help.* After this barrier was cleared and suggestions were made to improve the clarity, participants all agreed that it was a good function:

> I like that *Crisis Help* is at the bottom. When you just snap under pressure, you need to be able to find help ASAP and talk it out.

Mostly, participants were against *Share*. There were some supportive comments around the benefits of sharing progress. However, participants were concerned with privacy.

> It [*Share*] also says that you can post on social media, which is an interesting idea. I wonder how many people want to do that. Maybe some people would be really proud of the progress, but I feel like the majority would not want to advertise their gambling addiction.

Therefore, *Share* was removed from the app. In summary, *Journal, Milestones, The Facts, Bet Blocker, Distraction, Chatroom, Workbook, Support* and *Crisis Help* were kept for the quantitative stimuli, whereas *Bet Tracker, Self-Assessment, Motivation* and *Share* were omitted. This achieved the initial component of Objective Two. The other component was to identify the preferred app design for NoBets.

Design

Participants provided practical feedback on designs, specifically colours and spacing of content, which the researcher analysed. Participants preferred the blue-on-white style and offered feedback that the light blue text was unclear with small font sizes and the blue should be darker to make the text more legible. Some participants disliked the red-green combination:

> I don't like the colours. I think they are too vibrant. If you're trying to wake me up and excite me and jog my nervous system, it might work. But I don't think it goes with what you are trying to do here.

They made similar comments about the purple-and yellow-style:

> The purple sends me off straight away. It's too strong and aggressive.

Further, participants likened the purple–yellow and green–red combinations to commercial betting apps and suggested that health apps should look distinct. No comments were made about the white-on-blue style. Therefore, dark blue text and imagery on a white background were the colour scheme chosen for NoBets in the quantitative stimuli. Participants preferred the spaced layout of content over the boxed-in style:

> Is it too busy? I like the separation of the functions [icons] on home screen one. I like that it separates and that there is clear space—my eyes know what to look for.

Therefore, the spaced layout style was used for NoBets in the quantitative stimuli. These participant insights helped to achieve Objective Two. Further, they were vital for informing the quantitative stimuli.

4.7.3 Objective Three: Inform the Stimuli

This section does not discuss the layout or design of the NoBets app; rather, it outlines how the stimuli arrangement was flawed and subsequently improved by participant feedback. Some participants were not accurately reading the descriptions of the functions. They often asked for more information or suggested components to add to functions that were not obvious in the images but were outlined in the descriptions. In these cases, the researcher

asked participants to comment on the descriptions to diagnose the problems. However, in all cases they stated that the descriptions were understandable and not too long:

> The words make sense. I am just slack and didn't want to read it all if the pic can show me in two seconds.

Further discussion showed that this was an issue of how the descriptions were presented visually:

> The explanations do makes sense, but I just only looked at the pictures for some reason. I don't know why—I guess the pictures are eye-catching and the words are just words.

During the quantitative stage, it was imperative that the stimuli could stand on their own. From this insight, adjustments to the stimuli made the descriptions more prominent. This achieved Objective Three. These amendments are presented in Appendix K: Stimuli Amendments.

The participants provided valuable data, and the results of the analyses confirmed the achievement of the qualitative research objectives. Auxiliary findings from the discussions showed that the sample of help-seeking gamblers had some experience with using mHealth; however, they had no experience and minimal awareness of mHealth gambling apps specifically. This suggested that adoption of mHealth gambling apps was low and that there was a need for research into mHealth gambling app adoption. Most importantly, the qualitative objectives were achieved:

1. Create an introduction to mHealth gambling apps that the target audience can understand.

The researcher developed a brief description that referred to a) gambling quit apps and b) a range of functions designed to help quit gambling. The participants quickly and easily understood this definition. Hence, this definition was suitable for the quantitative stage of data collection:

2. Identify the best functions and design for an mHealth gambling app.

Based on the data, a dark blue text with white backdrop was the chosen colour scheme on a spaced layout style for NoBets. The functions that remained in the quantitative stimuli included *Journal, Milestones, The Facts, Bet Blocker, Distraction, Chatroom, Workbook, Support* and *Crisis Help.* The researcher refined NoBets to align with these preferences for the quantitative stage:

3. Inform the stimuli for the quantitative stage of data collection.

The analysis of the data showed that the stimuli illustrated could be refined to reflect the most suitable stimulus arrangement necessary for testing in the quantitative stage.

4.8 Chapter Summary

This chapter introduced the research objectives and detailed how the researcher developed a suitable research methodology and recruited an appropriate sample of help-seeking gamblers. The format of the focus group discussions and the protocols put in place showed the transparency and integrity of the research in this qualitative stage. The data analysis approach was suitable, and the findings explained and demonstrated that the qualitative objectives were achieved. More importantly, the findings fed into the quantitative stage of this study. Chapter Five presents the methodology for the quantitative stage of data collection and how NoBets was used as the quantitative research instrument.

Chapter 5: Quantitative Methodology

5.1 Introduction

Chapter Four presented the methodology of the focus group sessions undertaken, and the findings. Chapter Four also highlighted how the findings from the qualitative data analysis were employed in developing the stimuli to represent the hypothetical mHealth app, NoBets, in the online survey. This chapter provides a comprehensive overview of the methodology used in the quantitative stage of the thesis, including the measures used for each construct. Chapter Five begins by describing the sampling methods used and the process of determining the appropriate sample size. It then details the organisation of the research instrument and reviews the items for each scale measure. Next, the chapter moves into a brief rationalisation of the data analysis approach used to illustrate the results of hypothesis testing, presented in Chapter Six. Last, Chapter Five reviews the efforts made to protect the respondents and the data sourced from those respondents during data collection.

5.2 Research Setting and Respondents

The thesis used an online survey to gather data from suitable respondents. Specifically, the sample was a group of help-seeking gamblers who had contacted gambling support groups for help in managing their gambling behaviour. The respondents were involved in various recovery programs at different stages but identified as recent or current gamblers who gamble(d) at least two days per week. These targeted groups included Family Gambling Help, Relationships Australia Queensland, Lifeline Central Victoria and Mallee, Smart Recovery, Gambling Help New South Wales and the Victorian Responsible Gambling Foundation. These groups circulated the link to the online survey along with additional information about the thesis to target respondents. Although participation was incentivised for individuals, the welfare and support groups did not gain financially, or by any other means, from the survey. These groups helped solely with sampling of respondents.

5.3 Sampling

5.3.1 Recruitment

Non-probability, convenience sampling was used to recruit respondents for the survey. Convenience sampling is a suitable technique for exploratory research (Malhotra & Birks, 2007). As noted in Section 5.2, the researcher engaged gambling support groups to promote the survey directly to the target sample; however, these groups were largely resistant to help. Fifty groups rejected requests for support. Ultimately, the seven groups introduced in Section 5.2 helped recruit help-seeking gamblers by posting the survey on their digital platforms (see Appendix L: Groups Contacted for Recruitment). The 'snowballing' effect that comes from promoting directly to target respondents increased exposure of the survey beyond the sampling methods employed. The survey was hosted on the Qualtrics platform. The online survey enabled greater access to a large sample of gamblers involved in varying gambling activities than would be possible with face-to-face methods (Wood & Griffiths, 2007). Using anonymous online surveying is ideal for attracting problem gamblers, or individuals who may wish to be in better control of their gambling behaviour, to protect them from the risk of personal shame and stigma (Griffiths, 2010). Using this approach, the thesis was able to achieve the required sample size.

5.3.2 Sample Size Determination

The researcher determined the sample size for the survey using three criteria: 1) the desired statistical power; 2) the expected effect size; and 3) the statistical techniques to be used for data analysis. Statistical power represents the probability that statistical tests will correctly reject null hypotheses, whereas the effect size indicates the strength of the relationships between variables, where .1 is considered small; .3, medium; and .5, large, (Cohen, 1988). As the main objective of this thesis to examine the influence of antecedents on perceived ease of use and usefulness leading to attitude and intention, as well as possible moderation of the link between attitude and intention by health status severity, the researcher chose a suitable approach to analysis through structural equation modelling.

Appropriate sample size determination is important for research, yet the specific sample size requirements for structural equation modelling research is a controversial issue (Westland,

2010). This is because there is no absolute standard for sample size and no general rule of thumb that applies to research using structural equation modelling (Muthén & Muthén, 2002). Hair et al. (2010) made the general recommendation that structural equation modelling samples should involve 100–400 respondents, and Iacobucci et al. (2007) leniently suggested that sample sizes could be as low as 50. This thesis considered these numbers and applied the suggestion by Westland (2010) to estimate the appropriate sample size for structural equation modelling research. That is, a prospective power analysis was conducted based on the estimation of the error function, lower bound sample for a structural equation model and normal distribution cumulative distribution function (see Appendix M: Estimation of the Error Functions, Lower Bound Sample Size for a Structural Equation Model and Normal Distribution Cumulative Distribution for formulae). These formulae were incorporated into an a priori sample size calculator for structural equation models (Soper, 2021). This thsis followed Cohen (1988) and Westland (2010) and applied the following parameter values to calculate the optimal sample size: 13 observed variables, 6 latent variables, .3 anticipated effect size, .05 desired probability and .8 statistical power level. To claim statistical significance, the desired probability value, or *p* value, should typically be less than or equal to .5 (Cohen, 1988). In behavioural research, statistical power levels need to be equal to or greater than .8 (Cohen, 1988). Based on the calculation employed in the thesis, the minimum sample size required to detect the specified effects was 161. This thesis achieved a sample size of 252 usable questionnaires for the hypothesis testing detailed in Chapter Six.

5.4 Data Collection

The online questionnaire was comprised of six segments with a range of question types, including single-item (e.g., age), multi-item (e.g., employment status) and seven-point scale measures determined from the literature as described in Chapter Three (also see Appendix N: Online Survey). Items throughout the survey were randomised to minimise order effects. The scales used in the survey instrument to measure the variables are presented in Section 5.5. Segment One of the survey offered respondents preliminary information about the thesis, participation details, ethics approval details, and links to the detailed information sheet and consent form (see Appendix O: Online Survey Information Sheet and Consent Form). As part of giving consent, respondents indicated their gender and confirmed that they

were above 17 years of age, were completing the survey for the first time, and understood the research, intended outcomes and their right to withdraw at any time. Other demographic questions were positioned at the end of the survey.

Segment Two grouped the gambling-related questions together. It presented the measure for health status severity as a gambling risk level and asked about the respondents' product platform preference (i.e., preferred gambling platform: digital or analogue). Any respondent who was categorised with no gambling risk according to the total points they scored on the Canadian Problem Gambling Index (Ferris & Wynne, 2001) was excluded. Note that unlike the seven-point scale measures used elsewhere in the thesis, the Canadian Problem Gambling Index uses a four-point scale. This exclusion criterion was applied because individuals presenting no likelihood of problem gambling are not among the intended users of mHealth gambling apps and thus not part of the target population of this thesis. Included respondents were categorised according to their score: 1–2 points implies low risk; 3–7, moderate risk; and >8 at risk (Ferris & Wynne, 2001). This categorisation also allowed for the development of health status severity construct.

Segment Three grouped the measures for user characteristics, including subjective knowledge and involvement, trust, need for personalisation and perceived convenience. The items for these constructs were grouped into a single question using a matrix table to maximise survey brevity and usability. Items were randomised with a forced response.

Segment Four demonstrated the final version of the hypothetical concept app, NoBets (see Figure 5.1), via the stimuli (see Appendix P: Survey Stimuli). NoBets was introduced and detailed in Chapter Four. The app name, product description and respondent instructions accompanied a screenshot of the app home screen to introduce the app. All nine included functions were individually presented through nine matrix tables to each respondent; this presented the images and descriptions. Following this, the segment asked questions about attitude towards the perceived utility of each function. The purpose of these questions about the functions was to force the respondents to engage with the stimuli by providing an evaluation of the functions. Note that the thesis did not use these data from functions; instead, they went into the conference presentation cited in Chapter Four to support the stimulus justification (see Brownlow et al., 2022).

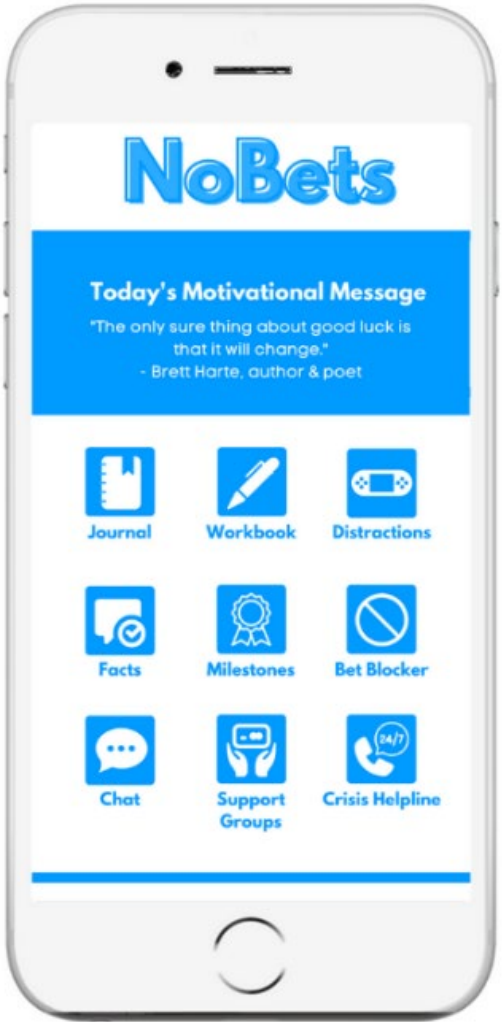


Figure 5.1: Concept App—NoBets

Segment Five presented the measures for technology characteristics and the TAM constructs: gamification, aesthetics, perceived ease of use, perceived usefulness, attitude and intention. This segment included the method used to observe the adoption behaviour. As introduced in Chapter Three, this segment presented a screen that recommended to respondents a real, existing quit gambling app available from app stores, and offered a link for them to learn more about the product details and download the app for free. In the survey, the link opened in a background tab that allowed respondents to continue in the open survey tab on Qualtrics. The measure was dichotomous as the survey platform recorded whether respondents clicked the link for more information or opted to continue the survey without showing the adoption behaviour.

The final segment was the end of survey message, which offered gratitude to respondents for their time and provided a document with information resources and contact details for welfare organisations (see Appendix F: Gambling Support Information with Contacts for Participants). The measure scales used in the research instrument are introduced in Section 5.5.

5.5 Measurement Scales

The following subsections offer details on the measurement scales derived from the literature and modified as necessary for use in the thesis.

5.5.1 Measuring Health Status Severity

A gambling disorder can be identified by the level of problems and subsequent negative outcomes faced by the gambler. Three screening measures are commonly used in the literature to identify a gambling disorder: 1) a one-item screening (i.e., Have you ever had an issue with your gambling?; Thomas et al., 2009); 2) the three-item Brief Bio-Social Gambling Screen (Gebauer et al., 2010), which assesses withdrawal, lying and financial difficulties; and 3) the three-item Short Problem Gambling Screen (Toce-Gerstein et al., 2009), which assesses lying, preoccupation and control. Although these screens are efficient, they lack the complexity for categorisation the severity of gambling disorders, preventing comparisons between groups. To remedy this, the thesis uses the Canadian Problem Gambling Index (Ferris & Wynne, 2001). This nine-item measure assesses involvement in gambling, problem behaviours, consequences and correlates of harm, and categorises gamblers by risk level and frequency of these habits on a four-point scale (Ferris & Wynne, 2001). It was important to categorise the respondents in the current thesis using the different risk levels to filter out individuals with no indication of problem gambling (i.e., no risk) as they were not the intended sample. The items for the measure are presented in Table 5.1: Health Status Severity (HSS) Items.

Table 5.1: Health Status Severity (HSS) Items

Thinking about the last 12 months…	
HSS1.	Have you ever bet more than you could afford to lose?
HSS2.	Have you needed to gamble with larger amounts of money to get the same feeling of excitement?
HSS3.	Have you gone back another day to try to win back the money you lost?
HSS4.	Have you borrowed money or sold anything to get money to gamble?
HSS5.	Have you felt that you might have a problem with gambling?
HSS6.	Has gambling caused you any health problems, including stress or anxiety?
HSS7.	Have people criticised your betting or told you that you had a gambling problem, regardless of whether or not you thought it was true?
HSS8.	Has your gambling caused any financial problems for you or your household?
HSS9.	Have you felt guilty about the way you gamble or what happens when you gamble?

Response format: 0 = never; 1 = sometimes; 2 = most of the time; 3 = almost always.

5.5.2 Measuring Product Platform Preference

Two product platform preferences were recorded in this study. The first was digital gambling, which is the use of a personal device such as a smartphone, tablet or computer to gamble. The second was analogue gambling, which is the use of public mechanisms in analogue settings for gambling, such as casinos, bookies, poker machines and KENO. Categorising gamblers based on platform preference is not uncommon in the literature (see Hing et al., 2021). To measure platform preference, the survey asked respondents about their gambling preferences via three options: 1) digital – using personal devices, such as a mobile phone or personal computer, 2) analogue – at events or via machines at venues and 3) no preference. It is known that experience with technology, in particular smartphones and apps, facilitates the transition to digital gambling from analogue gambling (James et al., 2017) and that gambling via apps is the most popular form of gambling globally (James et al., 2019). However, it is unknown how product platform preference, such as a digital gambling preference over analogue, can influence adoption of gambling quit apps. This missing information represents a significant gap in our understanding. The investigation of product platform preference was not hypothesised and is offered as supplementary testing in this thesis.

5.5.3 Measuring User Characteristics

Subjective Knowledge and Involvement

Subjective knowledge is a consumer's perception of their own expertise with respect to a product, service or activity (Monroe, 1976; Wirtz & Mattila, 2003). The multi-item measurement scale developed by Flynn and Goldsmith (1993) was used in the current study to measure respondents' self-assessed opinion of their knowledge of apps generally. Research has shown subjective knowledge to be highly associated with product, service or activity involvement with past research; but when used together, they have not been found to be discriminant statistically, such as in an exploratory factors analysis (Bloch, 1986; Flynn & Goldsmith, 1993). Hence, subjective knowledge and involvement in this thesis were treated as a single construct measuring both (subject to scale validation tests). This was justified because the literature introduces need, value and interests as the underlying constructs of involvement (Zaichkowsky, 1985). Contemporary involvement with technology is someone's perceived relevance rather than a measure of exact use (Mano & Oliver, 1993). Following these insights, the measure used in this thesis was adapted from Mittal (1995) to suit the app context. The items for the measure are presented in Table 5.2.

Table 5.2: Subjective Knowledge and Involvement (SKI) Items

SKI1.	I know how to judge the quality of 'apps'.
SKI2.	I use apps extensively.
SKI3.	I feel confident when I use 'apps'.
SKI4.	I feel confident about my knowledge of 'apps'.
SKI5.	I have a strong interest in 'apps'.
SKI6.	'Apps' are important to my lifestyle.
SKI7.	Using 'apps' gives me pleasure.

Response format: 1 = strongly disagree; 7 = strongly agree.

Trust in Apps

Trust entails consumer confidence in a product to fulfil its promise or purpose while preserving integrity. A consumer trusts a product or service when they believe it will meet both their direct (i.e., satisfying immediate needs) and indirect expectations (i.e., being free

of errors and malfunctions; Lu et al., 2011). Hence, this thesis measured trust in regard to both direct and indirect expectations of apps, by developing measurement items based on the scale developed by Slade et al. (2015). The items for the measure are presented in Table 5.3.

Table 5.3: Trust (T) Items

T1.	I trust 'apps' are reliable.
T2.	I think 'apps' are secure.
T3.	I trust 'apps' to do the job right.
T4.	I believe ‘apps’ are trustworthy.

Response format: 1 = strongly disagree; 7 = strongly agree.

Need for Personalisation

To quantify a consumer’s need for personalisation of apps, a measure needs to address how important personalisation of an app and its content are to the user. Personalised technology is user centric and tailored based on user preferences (Wang et al., 2006). Past research findings suggest that personalisation should emphasise long-term values and benefits for consumers (Fan & Poole, 2006; Postma & Brokke, 2002). Accordingly, this thesis developed a measurement scale for the need for personalisation based on the work of Tan and Chou (2008). The items for this measure are presented in Table 5.4.

Table 5.4: Need for Personalisation (P) Items

P1.	'Apps' should have information specific and valuable to me.
P2.	'Apps' should continuously customise to my needs.
P3.	I only want to receive useful information from 'apps'.

Response format: 1 = strongly disagree; 7 = strongly agree.

Perceived Convenience

Perceived convenience is a characteristic of the individual measured by the observed speed of technology where availability and accessibility reduce the effort required to use it (Berry et al., 2002). It relates to the time and effort that a consumer believes is needed to use a product to complete a task (Brown, 1990). Marketing researchers distinguish convenience from the

monetary value of products by measuring the time and effort that consumers surrender for convenience (see Etgar, 1978; Kelley, 1958; Kotler & Zaltman, 1971). Following this notion, this thesis measured perceived convenience using the items developed by Childers et al. (2001), adapted for mobile apps. The items for the measure are presented in Table 5.5.

Table 5.5: Perceived Convenience (C) Items

C1.	'Apps' save time.
C2.	'Apps' are convenient to use.
C3.	Using 'apps' is an efficient way to do things.

Response format: 1 = strongly disagree; 7 = strongly agree.

5.5.4 Measuring for Technology Characteristics

Gamification

Gamifying involves adding game-like elements to apps that engage the user (Jin, 2016). Definitions of gamification and common gamified features generally include progress via rewards, points or levels, and entertainment (Jin, 2016; Swan, 2012; Xu, 2012; Zichermann & Cunningham, 2011). Noting that the hypothetical app developed for this thesis, NoBets, was introduced through the stimuli at this point, the measures for gamification were based on the items developed by Baptista and Oliveira (2017) for app gamification. These items are presented in Table 5.6.

Table 5.6: Gamification (G) Items

G1.	This new ‘app’ looks enjoyable: people would probably use it a lot.
G2.	This new ‘app’ seems fun: people will want to use it.
G3.	This new ‘app’ gives rewards, so people would probably use it.

Response format: 1 = strongly disagree; 7 = strongly agree.

Aesthetics

Aesthetics of technology is the subjective judgement of attractiveness of the device and the content displayed (Bhandari et al., 2015). Hence, items used for this measure in this study were framed to reflect the on-screen presentation of the app via the stimuli. Empirical studies

have shown how aesthetics can be measured experimentally to test for effects of beauty on behaviour or through the exploration of people's subjective perceptions of appearance (Berlyne, 1974; Lavie & Tractinsky, 2004; Swede, 1993). This thesis employed the former with an interest in measuring aesthetics for its effect on app perceptions and behaviour. Further, Gestalt Theory argues that the experimental approach should measure aesthetics as a whole rather than by component (Foster, 1995; Osborne & Balakian, 1968). Hence, the items used for aesthetics reflect the entire app rather than its parts or a sum of the parts. Accordingly, based on Cyr et al. (2006), the researcher developed four items to measure perceived aesthetics in the mHealth app interfaces. The items for the measure are presented in Table 5.7.

Table 5.7: Aesthetics (AE) Items

AE1.	This new 'app' has attractive screen designs (colours, boxes, etc.)
AE2.	This new 'app' looks professionally designed.
AE3.	This new 'app' looks and feels visually appealing.
AE4.	This new 'app' has meaningful graphics.

Response format: 1 = strongly disagree; 7 = strongly agree.

5.5.5 Measuring Perceived Ease of Use, Perceived Usefulness, Attitude and Intention

The measurement scales used for perceived ease of use and usefulness, attitude and intention were taken from the original definitions in the TAM (Davis et al., 1989) and adapted for this thesis. Perceived usefulness is assessed by the assumed ability of technology to perform the task better than alternative means, where the effort of using the technology is a worthwhile trade-off (Davis, 1989). Perceived ease of use is the expected freedom from effort in using the technology compared with a traditional alternative (Davis, 1989). An attitude towards a behaviour or object can be measured by the degree of favourable or unfavourable evaluation held (Copeland, 1923). Intention is the planned behaviour (Fishbein, 1967). The measures for perceived ease of use, perceived usefulness, attitude and intention for NoBets presented in the stimuli were based on the items developed for mobile apps by Chau and Hu (2002). The items for these measures are presented in Table 5.8.

Table 5.8: Perceived Ease of Use (PEOU), Perceived Usefulness (PU), Attitude (ATT) and Intention (INT) Items

PEOU1.	This new ‘app’ would be easy to get it to do what I want.
PEOU2.	This new ‘app’ would be difficult to become skilful with.
PEOU3.	This new ‘app’ would be easy to use.
PEOU4.	It would be easy for me to learn how to use this ‘app’.
PU1.	This new ‘app’ would be useful for quitting/changing gambling.
PU2.	This new ‘app’ can probably improve unwanted gambling behaviour.
PU3.	This new ‘app’ can probably improve the ability to control gambling.
PU4.	This new ‘app’ would make quitting/controlling gambling easier.
ATT1.	This new ‘app’ is, overall, a good 'app'.
ATT2.	This new ‘app’ is unpleasant.
ATT3.	This new ‘app’ would be beneficial to people.
INT1.	I might use an app like this to manage my gambling at some point.
INT2.	In the future, I intend to use this type of 'app'.
INT3.	I predict I will use an 'app' like this eventually.

Response format: 1 = strongly disagree; 7 = strongly agree.

5.6 Data Analysis

Analysis of the data involved descriptive and inferential analysis through a series of statistical tests. For the descriptive statistics, means testing of groups within variables, descriptive statistics and linear regression were used to profile the sample. For inferential analysis, a confirmatory factor analysis tested the validity and reliability of the measurement items. SPSS version 27.0 was the statistical tool used to perform these tests. After model fit was demonstrated, structural equation modelling was used to test the model paths via AMOS SPSS version 27.0, to examine the stated hypotheses. This technique is also suitable for multi-group testing, as explored in this thesis. These forms of analysis and their justification are detailed in Chapter Six.

5.7 Protection of Human Subjects

The researcher conducted data collection in an ethical manner to protect respondents. The thesis gained approval from the Flinders University Human Research Ethics Committee (HREC) (see Appendix G: Human Research Ethics Committee Approval Notice). The data have the potential to be considered protected health information under some legislation (Office for Civil Rights, 2003). Hence, participation was voluntary, and efforts were taken to ensure anonymity. The researcher separated the email addresses used to distribute the participation gift vouchers from the survey data. No psychological harm or coercion was involved in the data collection. These efforts were based on standards established by the 'safe harbor' method of de-identification of data (Office for Civil Rights, 2003). All data collected were stored electronically in a password-protected personal computer.

5.8 Treatment of Data

Collection of quality data ensured rigour of the findings of the thesis. The researcher deleted all incomplete surveys (dropouts) from the sample, and the forced response settings required respondents to answer all questions. Based on a recommendation of Reuning and Plutzer (2020), the researcher removed surveys that did not have sufficient response variance scores (i.e., straight-liners and near straight-liners) via Likert scale deviation testing. Additionally, responses with excessive variance scores (i.e., erratic scoring on Likert scales) were removed (Reuning & Plutzer, 2020). Further, the research omitted responses with a completion time of less than five minutes because of concerns that these respondents may not have fully understood the questions and answered them earnestly, reducing the subsequent data quality. To prevent repeated submissions, only one submission was allowed from each IP address detected by the Qualtrics platform.

5.9 Chapter Summary

Chapter Five presented a detailed description of the quantitative data collection methodology, explaining the measures used, sampling method and sample size determination. The chapter outlined the survey content and procedures before explaining the instrument and supporting procedures and detailing the measures of individual constructs.

Chapter Five concluded with an outline of the tests performed to test the hypothesised relationships in the causal model. It then discussed in detail how the thesis made additional efforts to protect the respondents and the data collected, particularly around ethical data collection and treatment of respondents and how data were handled securely. This summarised the methodological approach for achieving the research objectives and enabling the thesis to make important contributions. Next, Chapter Six is devoted to presenting the data analysis and hypothesis testing results.

Chapter 6: Quantitative Analysis and Results

6.1 Introduction

The previous chapter provided a detailed overview of the quantitative methodology employed in the thesis. This overview included the sampling methods for the empirical study, sample size determination calculations and the organisation of the online questionnaire used in the survey. Chapter Five also provided the rationale for the data analysis approach used to illustrate the results of hypothesis testing and concluded by outlining the steps taken to ensure the research was conducted ethically with consideration of the participants and treatment of data.

Chapter Six presents the results of the quantitative data analysis and hypothesis testing. Via a series of statistical analyses, the research tested hypotheses to investigate a range of constructs for how they influence consumers' perceptions of app ease of use and usefulness, with flow-on effects to intention to adopt the hypothetical mHealth app, NoBets. The methods included i) descriptive statistics and testing of the means to describe the sample, ii) testing to detect collinearity, iii) exploratory factor analysis to prepare the data for structural equation modelling to test the causal model, iv) testing for indirect (mediation analysis) and interactive effects (moderation analysis) and v) supplementary multi-group testing to offer additional insights into the direct paths. This chapter also details the confirmatory factor analysis, including steps taken to set up, estimate and evaluate model fit; assess the validity and reliability of the models; and detection of common method bias. Results are presented through a series of tables and figures within the chapter.

6.2 Statistical Techniques for Data Analysis

Analysing the data involved descriptive and inferential statistics. For descriptive statistics, measures of central tendency and of variability, as well as crosstabs (i.e., contingency tables) profiled the sample. For inferential statistics and hypothesis testing, several techniques analysed the quantitative data, with structural equation modelling serving as the primary technique to test the hypotheses proposed in the conceptual model. A limitation of this type

of path analysis is that it generally cannot present many hypotheses through paths – this can be overcome with structural equation modelling.

Structural equation modelling is an advanced multivariate technique that combines confirmatory factor analysis and multiple regressions in a single model while also assessing relationship interdependence and dependence of the variables (Kline, 2015). It has significant advantages over other comparable multi-variate techniques (Nunkoo & Ramkissoon, 2012); however, it is not without limitations. One major limitation of structural equation modelling is the complexity of the technique, for example, path coefficients, factor loadings and variances, so a common practice amongst researchers is to supplement the results with post hoc justifications to bring the model in line with the data (Kaplan, 2001). However, this limitation can be overcome with appropriate guidance (Nunkoo & Ramkissoon, 2012). The technique allows researchers to construct unobserved latent variables and estimate any relationships among the latent constructs that are uncontaminated by measurement errors (Kline, 2015). This is particularly important as common tests, such as an analysis of variance, ignore the potential measurement error in the model, which may cause bias in the estimated parameters and generate misleading inferences (Wang & Wang, 2019). Structural equation modelling can concurrently model multiple dependent variables and test for overall model fit; manage non-normal data well; and measure direct and indirect effects simultaneously (Wang & Wang, 2019). Further, structural equation-based, multi-group analysis is a recognised method of grouping (or splitting) data based on criteria and analysing each group's direct paths, offering deeper insights into the relationships (Al-edenat & Alhawamdeh, 2022). The advantages noted here that structural equation modelling has over other modelling approaches, particularly the ability to conduct multi-group analyses, makes it most suitable for this thesis.

To test for the validity of the measurement items, exploratory factors analysis was conducted. Exploratory factor analysis allows researchers to easily identify problematic variables (Goldberg & Velicer, 2006). Confirmatory factor analysis determined the reliability of the measurement items, while model fit indices measured discrepancies between observed and model-implied correlation/covariance matrices. The researcher tested direct causal relationships between constructs and indirect (mediation) paths via a user-defined estimands approach. This mediation approach has the disadvantages of selection bias and missing data;

however, the analysis can contribute to a better understanding of the relationships between the variables, particularly when there is no obvious connection. The research tested the interactive (moderation) path using an interaction variable. Last, the research tested direct paths with two sets of split samples as part of multi-group analyses. This chapter outlines the statistical analysis and results. The interpretation of the findings and their contributions are presented in Chapter Seven. IBM SPSS and AMOS versions 27 were the statistical solutions to conduct the afore-mentioned analyses. Before the sample is introduced, this chapter first outlines steps taken to manage missing data.

6.3 Dealing with Missing Data

Missing data or values occur when a data value is not stored fully or correctly in a variable (Graham, 2009). The challenge of missing data is that they are common in most research and can influence conclusions drawn from the data. Hence, it is important to check for missing data, or better yet, prevent them entirely (Kang, 2013). Particularly around sensitive research topics like gambling, participants often withhold information in their responses (Griffiths, 2010), so measures need to be taken to avoid collection of missing data caused by respondents withholding information. In this thesis, to avoid collection of false data, e.g., respondents underreporting a certain behaviour, the instrument included minimal questions about gambling behaviours and spendings, and questions focussed on gambling preferences. To avoid missing data, the forced response setting required participants to answer all questions in the survey. Despite these measures, some missing data occurred in the form of partially completed surveys and surveys without sufficient response variance (i.e., straight-liners and near straight-liners). To ensure the conclusions drawn from this thesis would be based on valid data, the researcher removed these partial and poor variance responses from the dataset.

6.4 Descriptive Analysis: Sample Profile

The quantitative sample consisted of 252 respondents who completed an online survey. The survey recorded limited demographic details (see Table 6.1: Sample Characteristics for an overview). Participants ranged from 18 to 88 years of age. The sample included 139 females (mean age 46.5 years), 109 males (mean age 42.0 years), one non-binary participant (aged

26) and three respondents who opted to not disclose their gender (mean age 47.0 years). A female-dominant sample of gamblers is uncommon. Gambling and gambling harm are presented by men more than women (Zhongming et al., 2021), and gambling studies generally contain male-dominant samples, leading to gender bias (Horch & Hodgins, 2013). The reason for the sample skew is that women are more likely than men to perform health-protective behaviours and participate in health behaviour research (Ryan et al., 2019). With regard to the education levels of the sample, 129 respondents (52.3%) were university educated, 120 respondents (47.6%) identified high school or a TAFE qualification as their highest level of education and the remaining three participants (1.2%) reported that they had received no formal education. All respondents indicated that they had never used an mHealth gambling app; however, this was not a prerequisite for inclusion. This outcome may have been a result of promoting the survey through groups and organisations with bricks-and-mortar offices and clinics, and the results may have been different if the sample did not have this commonality.

Individuals had to present certain gambling attributes to participate in the survey. As a prerequisite to participation, only individuals who presented symptoms of problem gambling according to the Canadian Problem Gambling Index (Ferris & Wynne, 2001) completed the study. Based on their self-assessments of certain gambling behaviours and their subsequent index scores, the sample included 138 low-risk gamblers (54.8%), 47 moderate-risk gamblers (18.7%) and 67 at-risk/problem gamblers (26.6%). These different levels of gambling risk represented a proxy of participants' health status severity. Regarding product platform preference, most of the participants gambled digitally—143 (56.7%) using personal devices, such as smartphones and computers to place bets (in this thesis labelled as digital gamblers)—and the remaining 109 (43.3%) gambled at physical venues, including casinos, bars and betting venues (in this thesis labelled as analogue gamblers). The thesis observed the adoption behaviour for 111 participants (44%); that is, participants who opted to seek more information about a recommended quit app when offered a website link at the end of the online survey. The sample characteristics are presented in

Table 6.1.

Table 6.1: Sample Characteristics

Profile	Characteristics	Count	Percentage
Gender	Female	139	55.2
	Male	109	43.3
	Other	4	1.5
Age (years)	18–30	59	23.4
	31–50	101	40.1
	50+	92	36.5
Education level	No formal education	3	1.2
	High school or TAFE	120	47.6
	Tertiary	129	52.3
Health status severity (gambling risk level)	Low risk	138	54.8
	Moderate risk	47	18.7
	At-risk/problem	67	26.6
Product platform preference (gambling preference)	Digital	143	56.7
	Analogue	109	43.3
Adoption behaviour	Yes	111	44.0
	No	141	56.0

n = 252

6.5 Descriptive Analysis: Preliminary Findings

To illustrate the characteristics of the sample, cross-tabulation analyses provided some insight into the sample and basic relationships between variables. The benefit of this test is that obvious identifiers, such as demographics, can be separated into exclusive groups and contrasted to show relationships that are not readily apparent (Dickinson, 2020). Though not hypothesised on in this thesis, the purpose of these analyses is to examine linkages between the factors of education level, health status severity, product platform preference, gender and age. Findings show some conflicting results relative to the literature. Chi-square testing in SPSS was performed.

This thesis identified an uncommon relationship between education level and health status severity. Previous research in Australia (Abbott et al., 2016) and internationally (Ekholm et al.,

2014) has identified an inverse relationship between the level of education and problem gambling; whereas in the current study sample, higher formal education levels were associated with higher gambling severity. University-educated participants more strongly presented at-risk/problem gambling tendencies (n = 50, 19.8% of the sample) than did participants whose highest level of educational completion was high school or TAFE (n = 17, 6.8%). Respondents with less formal education were mostly positioned in the low (n = 68, 27%) and moderate risk (n = 35, 13.9%) groups, outnumbering university-educated participants.

Further, linkages between adoption behaviour and health status severity, gender, product platform preference (gambling preference), education level and age were explored because this topic is underrepresented in the literature and thus the analysis provided novel insights. Chi-square testing showed that the 111 (44%) participants who sought information on mHealth gambling apps, were significantly more likely to be at-risk/problem gamblers ($\chi(2) = 73.39$, $p < .001$), men ($\chi(3) = 16.62$, $p < .001$), digital gamblers ($\chi(1) = 28.96$, $p < .001$) and university-educated participants ($\chi(4) = 29.98$, $p < .001$) than were those who did not seek further information. Age had no effect on adoption behaviour ($\chi(5) = 9.80$, $p = .08$). These findings suggest that well-educated males with more severe health statuses, a digital platform preference and high levels of formal education are the likely adopters of mHealth apps. These findings offer some insights into the characteristics of the sample. The properties of the constructs used for hypothesis testing are shown in Table 6.2.

Table 6.2: Properties of Constructs

Construct	Mean	Standard deviation
Subjective knowledge and involvement	4.28	1.80
Trust	3.99	1.72
Need for personalisation	4.48	1.70
Perceived convenience	5.00	1.63
Gamification	3.76	2.27
Aesthetics	3.98	1.84
Perceived ease of use	4.57	1.55
Perceived usefulness	4.89	1.55
Attitude	5.33	1.62
Adoption intention	3.93	2.43

6.6 Testing for Linearity

Linearity is the consistent slope of change that shows a relationship between variables (Hansen, 1999). If linearity between constructs is not consistent (i.e., the relationship is radically inconsistent), the reliability of structural equation modelling analyses can be reduced (Tarka, 2018). An ANOVA test is a simple yet rigorous means to check for linearity (Gaskin, 2022). A significance (*p*) value of less than .05 shows that the relationship between an independent and a dependent variable is not linear and is thus problematic (Gaskin, 2022). The results of the ANOVA test show that, with the exception of that between trust and adoption intention, no relationship was significant (see Table 6.3; Tarka, 2018). This indicated that structural equation modelling would be a reliable test to identify causal relationships involving the other constructs in the model.

Table 6.3: Deviation from Linearity

Independent variable	Significance
Subjective knowledge and involvement	.58
Trust	.02
Need for personalisation	.26
Perceived convenience	.49
Gamification	.13
Aesthetics	.13
Perceived ease of use	.21
Perceived usefulness	.16
Attitude	.15

Note: The dependent variable for this analysis is adoption intention.

6.6.1 Multicollinearity

Whereas linearity considers the linear relationship between independent variables, multicollinearity represents a linear relationship among independent variables even if no pair has a high correlation. Multicollinearity is undesirable, as it can result in incorrect tests of significance given insufficient unique variance between independent variables (O'Brien, 2007). Multicollinearity can lead to skewed and misleading results because it can cause wider confidence intervals that produce less reliable probabilities for the effect of independent variables (Alin, 2010). To test for multicollinearity, tolerance and variance inflation factors for each construct were assessed for any indications of multicollinearity issues, which would include low tolerance measures and high variance inflation factor values (O'Brien, 2007; see Table 6.4). Results shows that all tolerance measures were higher than the preferred threshold of .10 and none of the variance inflation factor values exceeded the suggested maximum of 3.0 (O'Brien, 2007). The only exception was perceived ease of use (variance inflation factor = 3.25), which was considered above the suggested maximum but still below the acceptable maximum of 5.0 (Gareth et al., 2013). This confirmed that there were no multicollinearity issues.

Table 6.4: Collinearity Statistics

Variable	Tolerance	Variance inflation factor
Subjective knowledge and involvement	.457	2.020
Trust	.470	2.130
Need for personalisation	.574	1.741
Perceived convenience	.502	1.993
Gamification	.463	2.162
Aesthetics	.551	1.816
Perceived ease of use	.307	3.257
Perceived usefulness	.683	1.463
Attitude	.686	1.458
Adoption intention	.569	1.756

6.7 Exploratory Factor Analysis

Exploratory factor analysis is a statistical technique used to determine the correlation between constructs in a dataset, enabling them to be grouped based on correlation strength (Costello & Osborne, 2005). An exploratory factor analysis prepares and 'validates' the constructs to be used in a structural equation modelling analysis. This method prepares the variables for cleaner structural equation modelling (Williams et al., 2010). The exploratory factor analysis component is a criticism of structural equation modelling in that the technique is not based on raw data but on empirical covariances. Important components of an exploratory factor analysis covered here are rotation, appropriateness of data, communalities, factor structure and convergent and discriminant validity.

6.7.1 Rotation

Rotation allows for clear differentiation of factor loadings. This is important for interpretation of data. While several rotation types exist, normality testing in this study determined that varimax rotation was the most appropriate in this thesis. Normality refers to the distribution of data for a specific variable and can be measured by skewness (data are abnormally weighted in one direction) and kurtosis (the position of outliers in the distribution; Gaskin, 2022). As recommended by Streiner (2005), this thesis performed multivariate normality testing to assess normality. Neither skewness nor kurtosis were significant, indicating the data

were normally distributed, with values less than the +/−2.2 (Gaskin, 2022) and +/−1 (Sposito et al., 1983) thresholds hold respectively (see Table 6.5).

Table 6.5: Multivariate Normality

Test	Statistic	Significance
Mardia skewness	1.39	.20
Mardia kurtosis	.97	.18

A varimax rotation is suitable for normally distributed data (Fabrigar et al., 1999). Hence, varimax rotation was used in this study. Compared with other rotations, varimax renders a more accurate factor solution as it allows correlation between factors (Osborne et al., 2014).

6.7.2 Appropriateness of Data

Testing for appropriateness of data is important for verifying whether the measured variables are sufficiently intercorrelated, thus justifying the factor analysis (Watkins, 2018). A robust method for testing the factorability of a correlation matrix is the Bartlett's test of sphericity supplemented by the Kaiser–Meyer–Olkin measure of sampling adequacy (Watkins, 2018). Most of the items showed acceptable factorability as judged by the Kaiser–Meyer–Olkin measure (see Table 6.6), which exceeded the .80 threshold required for factorability (Tabachnick et al., 2007). Bartlett's test of sphericity ($p < .001$) also indicated sufficient deviation from anormal distribution, meaning that the variables related to one another enough to enable a meaningful exploratory factor analysis.

Table 6.6: Kaiser–Meyer–Olkin Measure of Sampling Adequacy and Bartlett's Test of Sphericity

Test		Value
Kaiser-Meyer-Olkin measure of sampling adequacy.		.84
Bartlett's test of sphericity	Approximate Chi-Square	15408.93
	df	703
	Significance	<.000

6.7.3 Communalities

Communalities are indicators of the degree of variance in each variable accounted for by all factors (Hogarty et al., 2005). Communalities show the extent to which an item is correlated with all other items in the measurement scale, where higher communalities are better (Hogarty et al., 2005). If communalities for a variable are low (.0–.4) there may be challenges in loading onto a single factor (Costello & Osborne, 2005). In this thesis, all items across the constructs scored communalities above the benchmark of .75 (Sharma et al., 2005), indicating that no items needed to be removed (see Table 6.7).

Table 6.7: Communalities

Item	Initial	Extraction	Item	Initial	Extraction	Item	Initial	Extraction
SKI1	1.000	.919	P3	1.000	.821	PEOU3	1.000	.856
SKI2	1.000	.768	C1	1.000	.872	PEOU4	1.000	.943
SKI3	1.000	.871	C2	1.000	.886	PU1	1.000	.878
SKI4	1.000	.840	C3	1.000	.856	PU2	1.000	.937
SKI5	1.000	.859	G1	1.000	.875	PU3	1.000	.789
SKI6	1.000	.867	G2	1.000	.832	PU4	1.000	.902
SKI7	1.000	.780	G3	1.000	.804	ATT1	1.000	.817
T1	1.000	.907	AE1	1.000	.781	ATT2	1.000	.806
T2	1.000	.937	AE2	1.000	.778	ATT3	1.000	.791
T3	1.000	.955	AE3	1.000	.875	INT1	1.000	.867
T4	1.000	.904	AE4	1.000	.909	INT2	1.000	.879
P1	1.000	.848	PEOU1	1.000	.845	INT3	1.000	.855
P2	1.000	.851	PEOU2	1.000	.946			

Extraction method: Principal component analysis.

6.7.4 Factor Structure

Factor structure refers to the correlational relationship among a number of variables tested in an exploratory factor analysis to measure particular constructs. The test results shows how variables group or load onto factors. An ideal structure shows each variable strongly loading onto a single factor with minimal cross-loading to present a clean factor structure. Put simply, an equal number of variables and factors each spread evenly represents a perfect structure.

In this study, coefficients below .4 were suppressed to avoid displaying negligible cross-loading and make results easier to interpret (Hair et al., 2010; Hogan et al., 2009; Osborne et al., 2014; Samuels, 2016). As shown in Table 6.8: Rotated Component Matrix, most variables loaded onto a unique factor accounting for a significant proportion of the variance. The exception was perceived convenience and need for personalisation, which cross-loaded onto a factor together, as did attitude with adoption intention. There was no cross-loading of individual items across factors. As expected, all items from both attitude and adoption intention loaded onto the same factor (factor three 14.14% of variance explained). The likely explanation for this is that attitude and intention are concurrent. The Theory of Reasoned Action (Ajzen & Fishbein, 1980), the Technology Acceptance Model (TAM) (Davis et al., 1989) and the Unified Theory of Acceptance and Use of Technology (Venkatesh et al., 2003a) argue that attitude reflects intention. Therefore, construct validity testing was carried out to check whether these constructs were sufficiently discriminant. One other factor cross-loaded: perceived convenience and need for personalisation loaded (factor four 7.41% of variance explained). Again, construct validity testing showed that these constructs were sufficiently discriminant.

Table 6.8: Rotated Component Matrix

	Factor							
Item	**One**	**Two**	**Three**	**Four**	**Five**	**Six**	**Seven**	**Eight**
SKI1	.901							
SKI2	.763							
SKI3	.914							
SKI4	.852							
SKI5	.853							
SKI6	.891							
SKI7	.812							
T1							.825	
T2							.891	
T3							.877	
T4							.885	
P1				.813*				

	Factor							
Item	**One**	**Two**	**Three**	**Four**	**Five**	**Six**	**Seven**	**Eight**
P2				.742*				
P3				.769*				
C1				.766*				
C2				.768*				
C3				.719*				
G1		.817						
G2		.800						
G3		.730						
AE1								.859
AE2								.696
AE3								.874
AE4								.890
PEOU1					.889			
PEOU2					.925			
PEOU3					.805			
PEOU4					.916			
PU1						.853		
PU2						.858		
PU3						.712		
PU4						.921		
ATT1			.759*					
ATT2			.754*					
ATT3			.749*					
INT1			.891*					
INT2			.891*					
INT3			.872*					
% variance per factor	25.92	22.96	14.14	7.41	5.54	4.23	3.80	2.00
Eigenvalues	9.85	8.44	5.38	2.82	2.10	1.63	1.44	1.05

Extraction method: Principal component analysis.

Rotation method: Varimax with Kaiser normalisation.

Note. Rotation converged in eight iterations. Values with * indicate double loading.

6.7.5 Convergent Validity

When variables within a single factor are highly correlated, there is convergent validity. There are thresholds for sufficient or significant factor loadings. Convergent latent constructs should have measures with over 50% of explained or common variance to be adequate for convergent validity (Fornell & Larcker, 1981). Similarly, Hair et al. (2010) posited that average variance extracted and standardised factor loadings should be at least .50 to show adequate convergence. Based on Fornell and Larcker (1981), average variance extracted for the latent construct with indicator variables x_1, x_2… x_n was calculated using the following formula:

$$AVE = \frac{\Sigma[\lambda_i^2]\text{Var}(X)}{\Sigma[\lambda_i^2]\text{Var}(X)+\Sigma[\text{Var}(\varepsilon_i)]}$$

where λ_i^2 is the standardised loading of x_i on X, Var represents variance, ε_i represents measurement error of x_i and Σ is the sum (Fornell & Larcker, 1981). Construct reliability should score .70 at a minimum (Hair et al., 2010). This was calculated using standardised loadings of indicator variables and measurement error (ε_i) in the following formula from Hair et al. (2010):

$$\text{Construct reliability} = \frac{(\Sigma \text{ std loadings})^2}{(\Sigma \text{ std loadings})^2+\Sigma\varepsilon_i}$$

Convergent validity was assessed from factor loadings for each item extracted by confirmatory factor analysis. Convergent validity indicates the consistency in measurement (Hair et al., 1998). This is achieved when the items within a single factor are highly correlated with each other and is verified through the average variance extracted (Ahmad et al., 2016). Whereas factor loadings indicate the relationship between a construct and its loadings, the average variance extracted is a measure of the average amount of variance that latent constructs can explain (dos Santos & Cirillo, 2021). This assesses convergence. The average variance extracted was calculated as the sum of squared standardised factor loadings divided by the number of manifest (indicator) variables (Hair et al., 2010). de Winter et al. (2009) suggested that for a sample size of 252, a sufficient average variance extracted score should be no less than .4. However, Coakes and Steed (2012) stated that factor loadings with a minimum value .50 that average out to .70 or more per factor are appropriate regardless of

sample size, which was supported by Hatcher and O'Rourke (2013) and Ahmad et al. (2016). The average variance extracted for all variables was greater than .70 (see Table 6.9). Testing was performed using AMOS 27.0.

Table 6.9: Average Variance Extracted

Latent construct	Average variance extracted
Subjective knowledge and involvement	.79
Trust	.89
Need for personalisation	.87
Perceived convenience	.92
Gamification	.86
Aesthetics	.82
Perceived ease of use	.89
Perceived usefulness	.79
Attitude	.94
Adoption intention	.96

6.7.6 Discriminant Validity

Discriminant validity is a measure of whether a scale is distinct from other variables and is accomplished when the model has no redundant items (Ahmad et al., 2016). This was examined using criteria from Fornell and Larcker (1981) who suggested the items should be highly loaded on their respective constructs. Discriminant validity occurs when variables relate more strongly to their own factor than another (Coakes & Steed, 2012). Average variance extracted can estimate discriminant validity (Fornell & Larcker, 1981). When squared correlations between latent constructs are less than an individual average variance extracted, the latent constructs have greater extracted variance than the variance shared between the latent constructs (Fornell & Larcker, 1981). Discriminant validity of the target latent variables occurs when this variance is seen across all latent constructs. The square root of the average variance extracted must be higher than the correlation between the two constructs (Fornell & Larcker, 1981). A further requirement for discriminant validity is that the correlation among the latent exogenous constructs is less than .85. Exogenous constructs are not influenced by

other constructs in the system or model; they are determined outside the model and then brought in (Awang, 2015; Kline, 2015).

6.8 Confirmatory Factor Analysis

Confirmatory factor analysis is the next step after exploratory factor analysis. This analysis determines the best factor structure for data to obtain a more interpretable factor solution through rotation. Unlike an exploratory factor analysis, which explores how variables relate to each other and group together based on correlations, a confirmatory factor analysis is used to confirm the factor structure (Brown, 2015).

6.8.1 Model Fit

Model fit is how well data match the relationships hypothesised in a model, and good fit is achieved by accounting for the major correlations. Good model fit is important because it means that that model represents the data. In this thesis, the model chi-square (χ^2) goodness-of-fit statistic and corresponding *p* value tested the overall model fit. If the *p* value associated with the χ^2 statistic is above .05, the model is accepted as having a good fit with the expectation of accepting the null hypotheses (Wang & Wang, 2019). Acceptance of the null indicates that no difference between the estimated model and observed sample variance and covariance is identified (Hooper et al., 2008). However, researchers have noted that the χ^2 statistic is sensitive to sample size, so rejection of model fit should not be based solely on this statistic (Wang & Wang, 2019). Kline (2015) recommended four indices to demonstrate acceptable model fit: 1) the model Chi-square (CMIN/DF), 2) the root mean square error of approximation, 3) the Comparative Fit Index, and 4) the standardised root mean square residual. Table 6.10 shows acceptable model fit values for the four indices.

Table 6.10: Fit Indices

Fit indices	Structural model	Accepted level
Chi-square (CMIN/DF)	4.97	<5.00 (Wheaton et al., 1977) >2.00 (Byrne, 2013)
Root mean square error of approximation	.012	<.08 (Kenny & McCoach, 2003; Kline, 2015)
Comparative Fit Index	.84	≥.80 (Hu & Bentler, 1999; Kline, 2015)
Standardised root mean square residual	.07	<.08 (Hu & Bentler, 1999; Kline, 2015)

First, Chi-square assesses overall fit by judging discrepancies between the sample and fitted covariance matrices (Kenny & McCoach, 2003). The Chi-square fit is particularly sensitive to sample size in that it can fail to detect true difference when the sample size is small. Chi-square values are expected to be non-significant when there is good model fit; however, they are almost always significant even in cases of good fit (Mindrila, 2010), as was the case in the present dataset ($p < .001$). Thus, they can generally be replaced with tests more suited for the sample size. Others have suggested that the Chi-square index is problematic because of this small sample size issue as well as large model size sensitivity and the resulting Type I errors, and thus can be disregarded (see Markland, 2007; Steiger, 1990; Yuan, 2005) in favour of other indices (Barrett, 2007). Kenny (2020) recommended that it is appropriate to use the Chi-square test for a sample size as large as that in the thesis (n = 252). For the CMIN/DF value, Wheaton et al. (1977) suggested that a value of less than 5.00 is acceptable, and Byrne (2013) argued that a value greater than 2.00 represents an adequate fit. On this basis, the Chi-square (CMIN/DF) value of 4.97 in this thesis suggested a strong model fit.

Second, the root mean square error of approximation (RMSEA) test measures the difference between values—specifically sample and population values—predicted by an estimator or model, and observed variables (Kenny & McCoach, 2003). RMSEA values closer to zero indicate a better fit, but values of .01, .05 and .08 indicate excellent, good and mediocre fit respectively (Kenny & McCoach, 2003; Kline, 2015). The data produced an RMSEA value of .012, indicating a close to excellent model fit.

Third, the Comparative Fit Index compares the intended model with the null model assuming zero covariance between the observed variables. This index compares the fit of the target

model to the fit of a null model (Kline, 2015). This is because it estimates relative model fit improvements per degree of freedom over the null (Kline, 2015). The index is suitable for data with low respondent numbers as it is not sensitive to sample size (Kline, 2015). A value equal to or greater than .80 indicates acceptable fit (Hu & Bentler, 1999; Kline, 2015). The Comparative Fit Index value of .84 (Table 6.10) exceeded the recommended acceptance threshold.

Fourth, the standardised root mean square residual is an absolute measure of fit (Maydeu-Olivares et al., 2018). It is the standardised difference between observed and predicted correlation (Hu & Bentler, 1999). This is a biased measure better suited to smaller sample sizes (Kenny & McCoach, 2003), making it appropriate for these data. Besides model χ^2 statistics, the standardised root mean square residual is depicted as the most informative because of its ability to reflect on how data fit the overall model covariance (Diamantopoulos & Siguaw, 2000). The standardised root mean square residual should be less than the cut-off value of .08 to show a good model fit (Hu & Bentler, 1999; Kline, 2015). Table 6.10 presents a standardised root mean square value of .07, suggesting a good fit (Mindrila, 2010). Other authors have argued that values closer to zero represent a better fit, but any value less than .08 is acceptable (Hu & Bentler, 1999; Kline, 2015). Overall, the values of all four indices met recommended respective thresholds, and thus the thesis confirmed that the model fitted the data.

Table 6.11: Validity and Reliability

Construct	Composite reliability	Average variance extracted	Maximum shared variance	Inter-construct correlation									
				Subjective knowledge & involvement	Trust	Need for personalisation	Perceived convenience	Gamification	Aesthetics	Perceived ease of use	Perceived usefulness	Attitude	Adoption intention
Subjective knowledge & involvement	.963	.791	.032	**.89**									
Trust	.969	.887	.005	.56	**.94**								
Need for personalisation	.951	.867	.084	.14	.28	**.93**							
Perceived convenience	.971	.918	.180	.55	.50	.52	**.96**						
Gamification	.948	.859	.393	-.33	-.14	.28	.04	**.93**					
Aesthetics	.948	.820	.044	-.30	-.17	.24	.06	.83	**.91**				
Perceived ease of use	.970	.891	.393	-.01	-.01	.10	.33	.57	.40	**.94**			
Perceived usefulness	.939	.794	.169	.10	.10	-.05	.19	.51	.47	.29	**.89**		
Attitude	.977	.935	.259	.15	.20	-.08	.16	.40	.35	.22	.57	**.97**	
Adoption intention	.988	.964	.259	.26	.19	-.33	-.04	−.11	-.17	-.11	.24	.52	**.98**

Note: Diagonal values (**in bold**) represent the square root of the average variance extracted.

Discriminant validity exists as all interactions (square root of average variance extracted) were less than .85 with values higher than the respective correlations.

6.8.2 Validity and Reliability

Convergent and discriminant validity and reliability are essential for confirmatory factor analysis. If research constructs fail to demonstrate appropriate validity and reliability, the causal model testing is null (Malhotra & Birks, 2007). The measures used in this thesis to confirm validity and reliability were composition reliability, average variance extracted and maximum shared variance (see Table 6.11).

As shown in Table 6.11, the data had validity, as evidenced by the average variance extracted for all constructs exceeding .5 and reliability with all composite reliability measure values exceeding factors above .7 for all constructs (Malhotra & Birks, 2007). Discriminant validity was confirmed based on the square root of the average variance extracted being greater than any inter-factor correlations (Hair et al., 2010).

Item reliability tested via Cronbach's alpha (see Table 6.12) showed acceptable alpha scores (>.90) for all measures and at least three items per factor (Herche & Engelland, 1996; Swain et al., 2008).

Table 6.12: Cronbach's Alpha for Likert Items

Constructs	Cronbach's alpha	Number of items
Subjective knowledge and involvement	.96	7
Trust	.97	4
Need for personalisation	.95	3
Perceived convenience	.97	3
Gamification	.95	3
Aesthetics	.94	4
Perceived ease of use	.95	4
Perceived usefulness	.94	4
Attitude	.98	3
Adoption intention	.99	3

Table 6.13: Shapiro–Wilk and Kolmogorov–Smirnov Tests of Normality

Item	Kolmogorov–Smirnov[a]			Shapiro–Wilk			Item	Kolmogorov–Smirnov[a]			Shapiro–Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.		Statistic	df	Sig.	Statistic	df	Sig.
SKI1	.227	252	.000	.855	252	.000	C3	.201	252	.000	.881	252	.000
SKI2	.176	252	.000	.895	252	.000	AE1	.129	252	.000	.933	252	.000
SKI3	.178	252	.000	.895	252	.000	AE2	.143	252	.000	.900	252	.000
SKI4	.162	252	.000	.902	252	.000	AE3	.135	252	.000	.931	252	.000
SKI5	.218	252	.000	.892	252	.000	AE4	.158	252	.000	.921	252	.000
SKI6	.159	252	.000	.887	252	.000	PEOU1	.226	252	.000	.906	252	.000
SKI7	.220	252	.000	.875	252	.000	PEOU2	.201	252	.000	.923	252	.000
T1	.165	252	.000	.935	252	.000	PEOU3	.185	252	.000	.916	252	.000
T2	.195	252	.000	.921	252	.000	PEOU4	.183	252	.000	.928	252	.000
T3	.188	252	.000	.928	252	.000	PU1	.254	252	.000	.886	252	.000
T4	.158	252	.000	.932	252	.000	PU2	.225	252	.000	.914	252	.000
P1	.165	252	.000	.910	252	.000	PU3	.254	252	.000	.868	252	.000
P2	.130	252	.000	.917	252	.000	PU4	.232	252	.000	.889	252	.000
P3	.155	252	.000	.914	252	.000	ATT1	.252	252	.000	.859	252	.000
G1	.197	252	.000	.859	252	.000	ATT2	.214	252	.000	.842	252	.000
G2	.176	252	.000	.896	252	.000	ATT3	.210	252	.000	.846	252	.000
G3	.175	252	.000	.848	252	.000	INT1	.172	252	.000	.834	252	.000
C1	.203	252	.000	.890	252	.000	INT2	.195	252	.000	.806	252	.000
C2	.204	252	.000	.891	252	.000	INT3	.174	252	.000	.847	252	.000

a. Lilliefors significance correction

It is important to test scale reliability to determine if items are internally consistent. Testing for scale reliability can be achieved using the Shapiro–Wilk and Kolmogrov–Smirnov tests of normality. In this thesis, the tests showed that all scale items were significant ($p < .001$; see Table 6.13). This indicated that the variance for each item differed significantly from a normal distribution ($p < .05$) and the null hypothesis was thus rejected.

6.8.3 Common Method Bias

Common method bias is a bias in the data caused by something external to the measures. It may be caused by a question or questions asked, such as a systematic response bias that can come from using online surveys. Common method bias is present when a single factor explains the majority of the variance (Podsakoff et al., 2003). A Harman's single-factor test showed that the greatest percentage of variance explained by a factor in this thesis was less than 26%, confirming that no single factor explained the majority of variance and no bias was present in the measures. A more robust approach to test common method bias is the common latent factor method, whereby a common variable is used to determine the common variance (Chang et al., 2010). This test compares the standardised regression weights of all items with and without a common latent factor (MacKenzie & Podsakoff, 2012). A Harman's single-factor test revealed non-significant differences of less than .2 (Serrano Archimi et al., 2018) between all regression weights, to confirm an absence of common method bias (see Table 6.14).

Table 6.14: Common Method Bias Results

Construct	Indicators	Standardised regression weights		Difference
		With common latent factor	Without common latent factor	
Subjective knowledge and involvement	SKI1	.960	.998	.038
	SKI2	.840	.911	.071
	SKI3	.906	.917	.011
	SKI4	.900	.957	.057
	SKI5	.888	.993	.105
	SKI6	.890	.912	.022
	SKI7	.834	.865	.031
Trust	T1	.929	.974	.045
	T2	.943	.992	.049
	T3	.985	.986	.001
	T4	.908	.970	.062
Need for personalisation	P1	.965	.978	.013
	P2	.958	.983	.025
	P3	.868	.983	.115
Perceived convenience	C1	.950	.961	.011
	C2	.977	.990	.013
	C3	.947	.984	.037
Gamification	G1	.939	.996	.057
	G2	.932	.944	.012
	G3	.910	.956	.046
Aesthetics	A1	.873	.982	.109
	A2	.837	.910	.073
	A3	.924	.977	.153
Perceived ease of use	PEOU1	.876	.970	.094
	PEOU2	.989	.991	.002
	PEOU3	.934	.973	.039
	PEOU4	.973	.980	.007

Construct	Indicators	Standardised regression weights		Difference
		With common latent factor	Without common latent factor	
Perceived usefulness	PU1	.883	.961	.078
	PU2	.998	.998	.009
	PU3	.810	.945	.135
	PU4	.863	.915	.052
Attitude	ATT1	.943	.970	.027
	ATT2	.982	.985	.003
	ATT3	.976	.985	.009
Adoption intention	INT1	.997	.998	.001
	INT2	.973	.988	.015
	INT3	.975	.976	.001

6.9 Causal Model

This section is intended to state the significant direct paths – an interpretation of the significant paths and the contribution of the findings is discussed in Chapter Seven.

6.9.1 Path Analysis: Direct Effects

Using path analysis in SPSS AMOS, the study tested for causal effects. This allows a researcher to capture the model, even complex models like in this thesis. Standardised beta coefficients and *t* statistics tested the significance and direction of direct paths (see Figure 6.1).

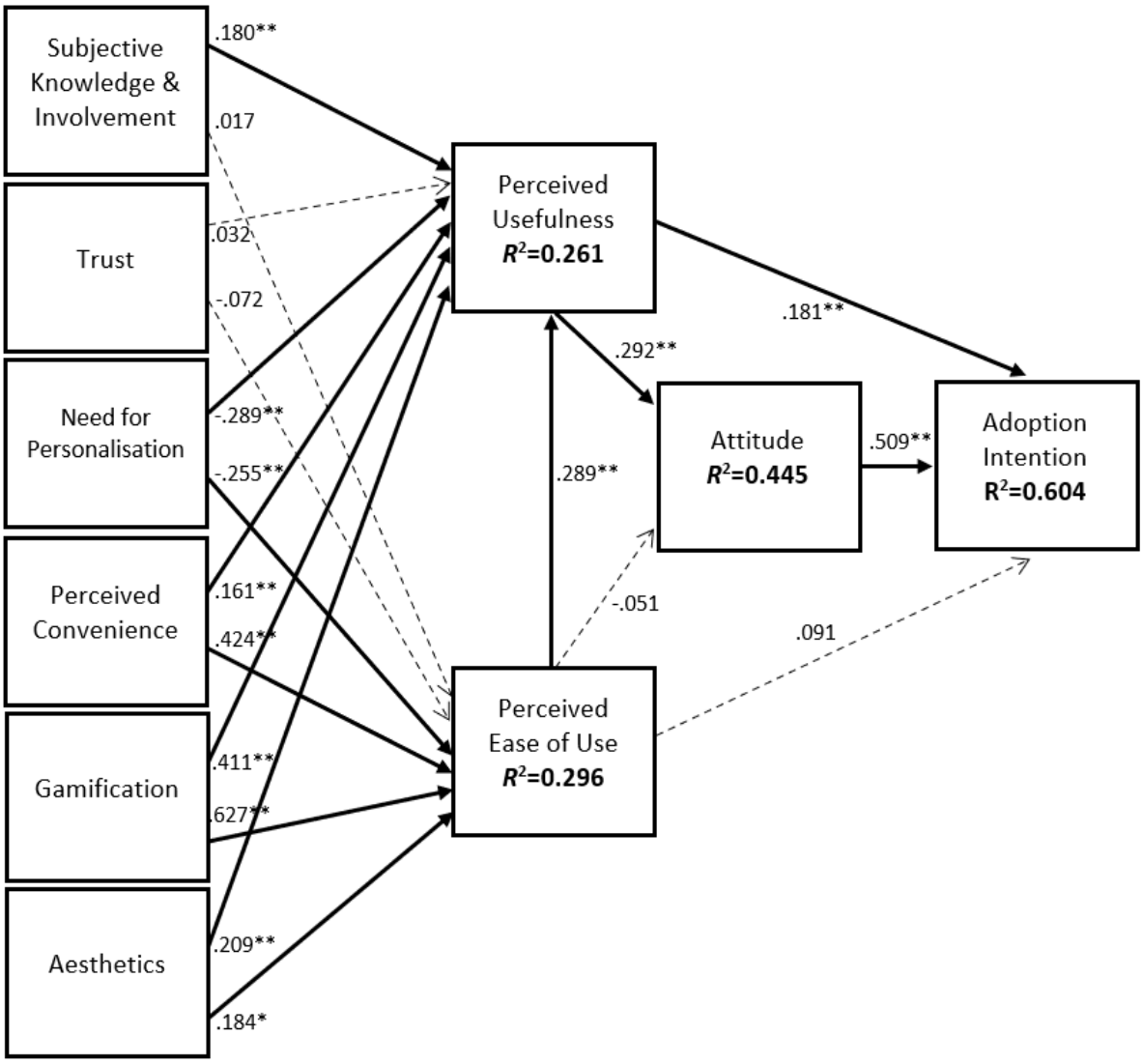


Figure 6.1: Causal Model

Notes: Standardised regression weights (β) are presented. ** $p < .01$, * $p < .05$. Variance explained (R^2) is marked in **bold**.

Significant paths are marked solid lines. Non-significant paths are marked dashed lines.

The findings (see Table 6.15) showed that both user characteristics (subjective knowledge and involvement and perceived convenience) and technology characteristics (gamification and aesthetics) positively influenced perceived ease of use and usefulness, but not the path between trust and perceived ease of use (β = .072, p = .07); the path between trust and perceive usefulness (β = .032, p = .50); nor the paths connecting subjective knowledge and involvement with perceived ease of use (β = .017, p = .67). Although the relationships that need for personalisation shared with perceived ease of use (β = −.289, p = .001) and perceived usefulness (β = −.255, p = .001) were significant, the influence was negative rather than

positive as originally hypothesised. These results support Hypotheses $1_{(d)}$, $2_{(a \& d)}$, $3_{(a \& b)}$ and $4_{(a \& b)}$, but not Hypotheses $1_{(a, b \& c)}$ and $2_{(b \& c)}$.

Table 6.15: Path Analysis: Direct Effects

Paths		*β*	Sig.
Subjective knowledge & involvement → Perceived ease of use	H_{1a}	.017	.666
Subjective knowledge & involvement → Perceived usefulness	H_{2a}	.180	<.001**
Trust → Perceived ease of use	H_{1b}	−.072	.073
Trust → Perceived usefulness	H_{2b}	.032	.507
Need for personalisation → Perceived ease of use	H_{1c}	−.255	<.001**
Need for personalisation → Perceived usefulness	H_{2c}	−.289	<.001**
Perceived convenience → Perceived ease of use	H_{1d}	.424	<.001**
Perceived convenience → Perceived usefulness	H_{2d}	.161	<.001**
Gamification → Perceived ease of use	H_{3a}	.627	<.001**
Gamification → Perceived usefulness	H_{4a}	.411	<.001**
Aesthetics → Perceived ease of use	H_{3b}	.184	.030*
Aesthetics → Perceived usefulness	H_{4b}	.209	<.001**
Perceived ease of use → Perceived usefulness	H_5	.289	<.001**
Perceived usefulness → Attitude	H_6	.292	<.001**
Perceived ease of use → Attitude	H_7	.051	.144
Perceived usefulness → Adoption intention	H_8	.181	<.001**
Attitude → Adoption intention	H_9	.509	<.001**

** $p < .01$, * $p < .05$.

Path analysis also showed that perceived ease of use positively influenced perceived usefulness ($\beta = .289$, $p = .001$) but not attitude ($\beta = .051$, $p = .14$). This supports Hypothesis 5 but not Hypothesis 7. Perceived usefulness influenced attitude ($\beta = .292$, $p = .001$) and adoption intention ($\beta = .181$, $p = .001$), providing support for Hypotheses 6 and 8. Finally, attitude positively influenced adoption intention ($\beta = .509$, $p = .001$), in support of Hypothesis 9.

6.9.2 Path Analysis: Indirect Effects

Testing for the Mediation Role of Attitude

Mediation is used to accurately explain the causal effect of a precursor variable on a dependent variable (Castro & Roldán, 2013). In line with Hypotheses 10 and 11, this section tests for a mediating role of attitude in the relationships among perceived usefulness, perceived ease of use and adoption intention, using the user-defined estimands approach (Ames et al., 2020). The Baron and Kenny (1986) approach was not chosen as it has been shown to be a flawed method, based on its inappropriate presumption of an overall relationship and weaknesses in the confirmatory logic of the procedure (Gürbüz & Bayik, 2021; Zhao et al., 2010). The Sobel method (Sobel, 1982) too was not employed in this thesis is considered outdated, and unlike newer methods, it assumes that indirect effects are normally distributed (Hayes, 2009). The user-defined estimands approach names two parameters and creates an indirect effect from them with the mediator variable intersecting the parameters (Gaskin, 2016). A key criterion of this approach is bootstrapping. With perceived usefulness and adoption intention as the parameters and attitude as the mediating variable, the user-defined estimands approach was used to test Hypothesis 10. Bootstrapping for 2,000 resamples with bias-corrected confidence intervals at 90 was performed. The results indicated a significant indirect effect (β = .181, p < .001), supporting Hypothesis 10.

Like the TAM (Venkatesh & Davis, 2000), no significant relationship was detected when testing for a direct influence of perceived ease of use on attitude (β = −.051, p = .14) and was not hypothesised in this thesis. It is legitimate to conclude that mediation occurs when the total effect is not significant (Hayes, 2017). The test for a mediating effect of attitude in the relationship between perceived ease of use and adoption intention using the user-defined estimands method (Gaskin, 2016) revealed a significant mediation effect (β = .230, p < .001). Hence, Hypothesis 11 is supported.

Testing for Multiple Mediation Effects

This thesis tested for indirect effects of the antecedents—subjective knowledge and involvement, trust, need for personalisation, perceived convenience, gamification and aesthetics—on adoption intention through perceived ease of use, perceived usefulness and

attitude create multiple mediation (Hayes, 2017). Although these indirect effects were not hypothesised, they were tested to offer additional insights. The thesis tested for multiple mediation via the user-defined AMOS AXB estimands and bias-corrected bootstrap method (Aslam et al., 2019; Castro-González, 2019). Multiple mediation testing results are provided in Table 6.16.

Table 6.16: Multiple Mediation

Paths	*β*	Sig.
Subjective knowledge & involvement → Perceived usefulness → Attitude → Adoption intention	.119	.010*
Subjective knowledge & involvement → Perceived ease of use → Attitude → Adoption intention	.001	.492
Trust → Perceived usefulness → Attitude → Adoption intention	.033	.320
Trust → Perceived ease of use → Attitude → Adoption intention	−.007	.067
Need for personalisation → Perceived usefulness → Attitude → Adoption intention	−.263	.018*
Need for personalisation → Perceived ease of use → Attitude → Adoption intention	−.020	.178
Perceived convenience → Perceived usefulness → Attitude → Adoption intention	.163	.010*
Perceived convenience → Perceived ease of use → Attitude → Adoption intention	.030	.116
Gamification → Perceived usefulness → Attitude → Adoption intention	.291	.007*
Gamification → Perceived ease of use → Attitude → Adoption intention	.037	.122
Aesthetics → Perceived usefulness → Attitude → Adoption intention	.059	.333
Aesthetics → Perceived ease of use → Attitude → Adoption intention	.014	.061

* $p < .05$.

The results identified three instances of positive, multiple mediation effects: i) perceived usefulness and attitude mediated the relationship between subjective knowledge and involvement and adoption intention; ii) perceived usefulness and attitude mediated the relationship between perceived convenience and intention; and iii) perceived usefulness and attitude mediated the relationship between gamification and intention. There was one instance of negative, multiple mediation where perceived usefulness and attitude mediated

the relationship between need for personalisation and intention. All instances of multiple mediation were the result of the pairing of perceived usefulness and attitude, rather than perceived ease of use and attitude.

6.9.3 Path Analysis: Moderating Effects

Testing for the Moderating Effect of Health Status Severity

Moderation analysis can be used to test whether the influence of an independent variable on a dependent variable remains significant or varies with the presence of another independent variable that becomes the moderator (Edwards & Lambert, 2007). Simply put, moderation analysis in this thesis tested whether the moderator variable (health status severity) changed the strength of the relationship between the independent variable (attitude) and dependent variable (adoption intention). Analysing the interaction of these three variables would identify any moderating effect (Huey Yiing & Zaman Bin Ahmad, 2009). Using SPSS, first, the standardised *z* score values for the variables were calculated to create new variables. From these, the value of the interaction variable was calculated by multiplying the independent and moderating variables. In AMOS, the steps were to i) establish the covariance between the predictors (attitude, health status severity and interaction variables) and ii) identify the causal relationship between these predictors and the dependent variable (intention). Findings showed no moderation effect. Attitude had a significant effect on intention (estimate measure = .37, p = .001). However, health status severity (estimate measure = .30, p = .10) and the interaction variable (estimate measure = .34, p = .09) did not have significant effects on intention, meaning there was no moderation and Hypothesis 12 is not supported. Table 6.17 summarises the results of hypothesis testing in this thesis: most of the hypotheses are supported.

Table 6.17: Summary of Hypothesised Relationships

	Hypothesis	Test result
H_1	a) Subjective knowledge and involvement, (b) trust, (c) need for personalisation and (d) perceived convenience positively influence perceived ease of use of mHealth apps.	(a) Not supported (b) Not supported (c) Not supported (d) Supported
H_2	a) Subjective knowledge and involvement, (b) trust, (c) need for personalisation and (d) perceived convenience positively influence perceived usefulness of mHealth apps.	(a) Supported (b) Not supported* (c) Not supported* (d) Supported
H_3	(a) Gamification and (b) aesthetics positively influence perceived ease of use of mHealth apps.	(a) Supported (b) Supported
H_4	(a) Gamification and (b) aesthetics positively influence perceived usefulness of mHealth apps.	(a) Supported (b) Supported
H_5	Perceived ease of use positively influences perceived usefulness of mHealth apps.	Supported
H_6	Perceived usefulness positively influences attitude towards mHealth apps.	Supported
H^7	Perceived ease of use positively influences attitude towards mHealth apps.	Not supported
H_8	Perceived usefulness positively influences adoption intention towards mHealth apps.	Supported
H_9	Attitude positively influences adoption intention of mHealth apps.	Supported
H_{10}	Attitude towards mHealth apps positively mediates the relationship between perceived usefulness and adoption intention of mHealth apps.	Not supported
H_{11}	Attitude towards mHealth apps positively mediates the relationship between perceived ease of use and adoption intention of mHealth apps.	Supported
H_{12}	Health status severity moderates the relationship between attitude and adoption intention of mHealth gambling apps.	Not supported

* A significant positive influence was hypothesised, but a significant negative influence was observed.

6.10 Supplementary Testing—Multi-Group Analyses

6.10.1 Testing for Effects of Adoption Behaviour

As stated previously, this thesis did not measure adoption or usage. As a way to measure a form of adoption behaviour, after all constructs were measured, survey participants were presented with a recommendation for a free, existing mHealth gambling app (marketed as a 'gambling quit app') and a website link to more information and download access. The survey web platform, Qualtrics, recorded which participants followed the link, producing a dichotomous *click* or *no click* variable. Clicking indicated that, at the very least, respondents were interested in seeking more information. This information-seeking action was treated as an adoption behaviour and created an additional construct and data. One approach for using this data would be to test for an association between adoption intention and adoption behaviour. However, structural equation modelling was the main statistical technique in this thesis, with adoption intention as the outcome or dependent variable. Hence, a test of association with adoption intention was not compatible. Instead, a multi-group analysis was conducted whereby the sample was split into two groups: those who clicked the link to show the adoption behaviour (i.e., the adoption behaviour is present; n = 111) and those who did not (i.e., the adoption behaviour is not present; n = 141). The researcher retested the hypothesised direct paths in each of the two samples to determine whether the results differed in the presence of adoption behaviour. The results showed that adoption behaviour had a degree of influence on constructs that contribute to the adoption of mHealth apps.

Analysis of the split sample revealed a significant relationship between aesthetics and perceived usefulness when adoption behaviour was present. However, for the sample that did not show adoption behaviour, there was no significant relationship between these two constructs. Rather, in that sample alone there were three significant relationships between constructs: i) trust and perceived usefulness; ii) trust and perceived ease of use; and iii)

aesthetics and perceived ease of use (see

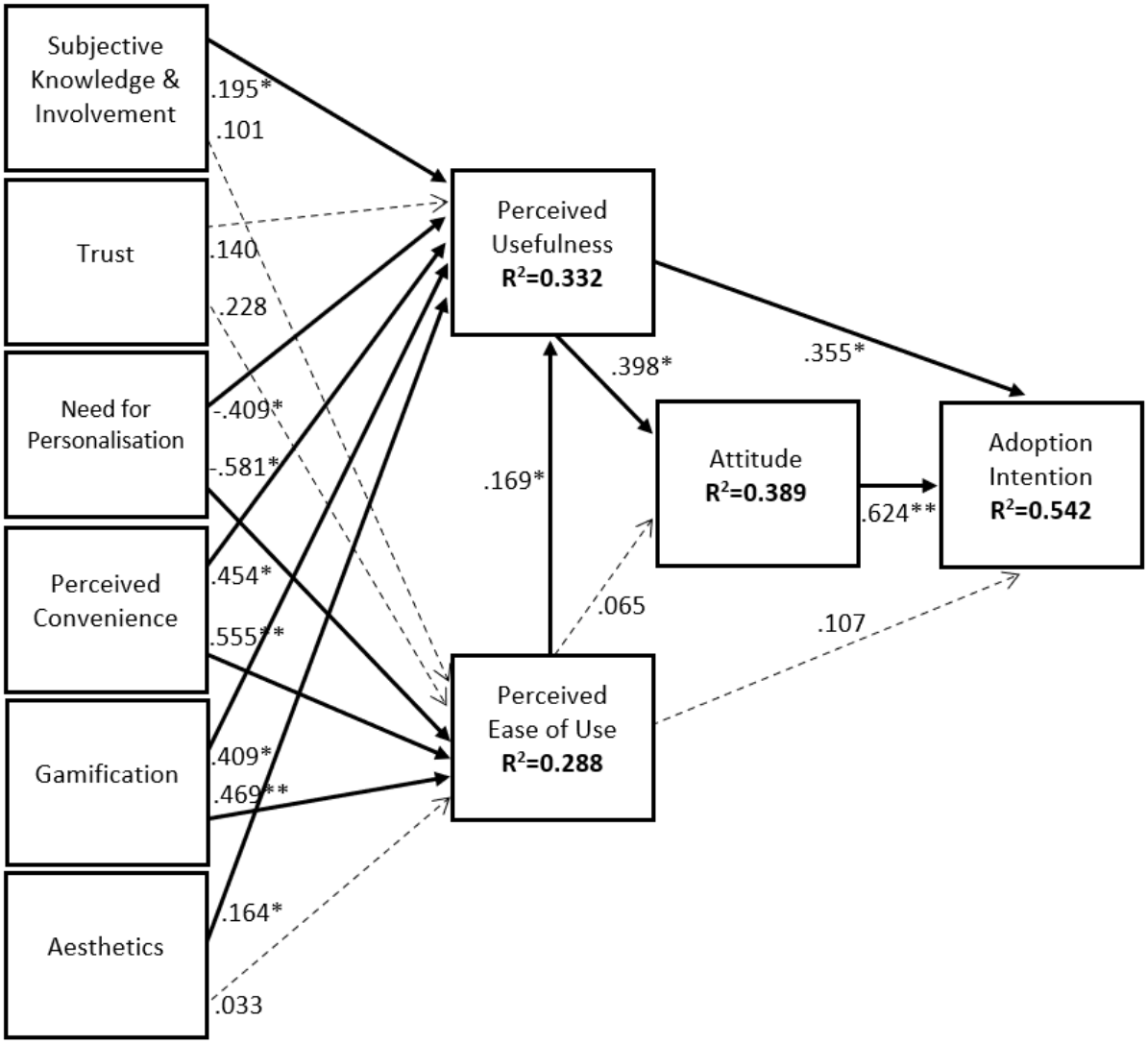


Figure 6.2 and

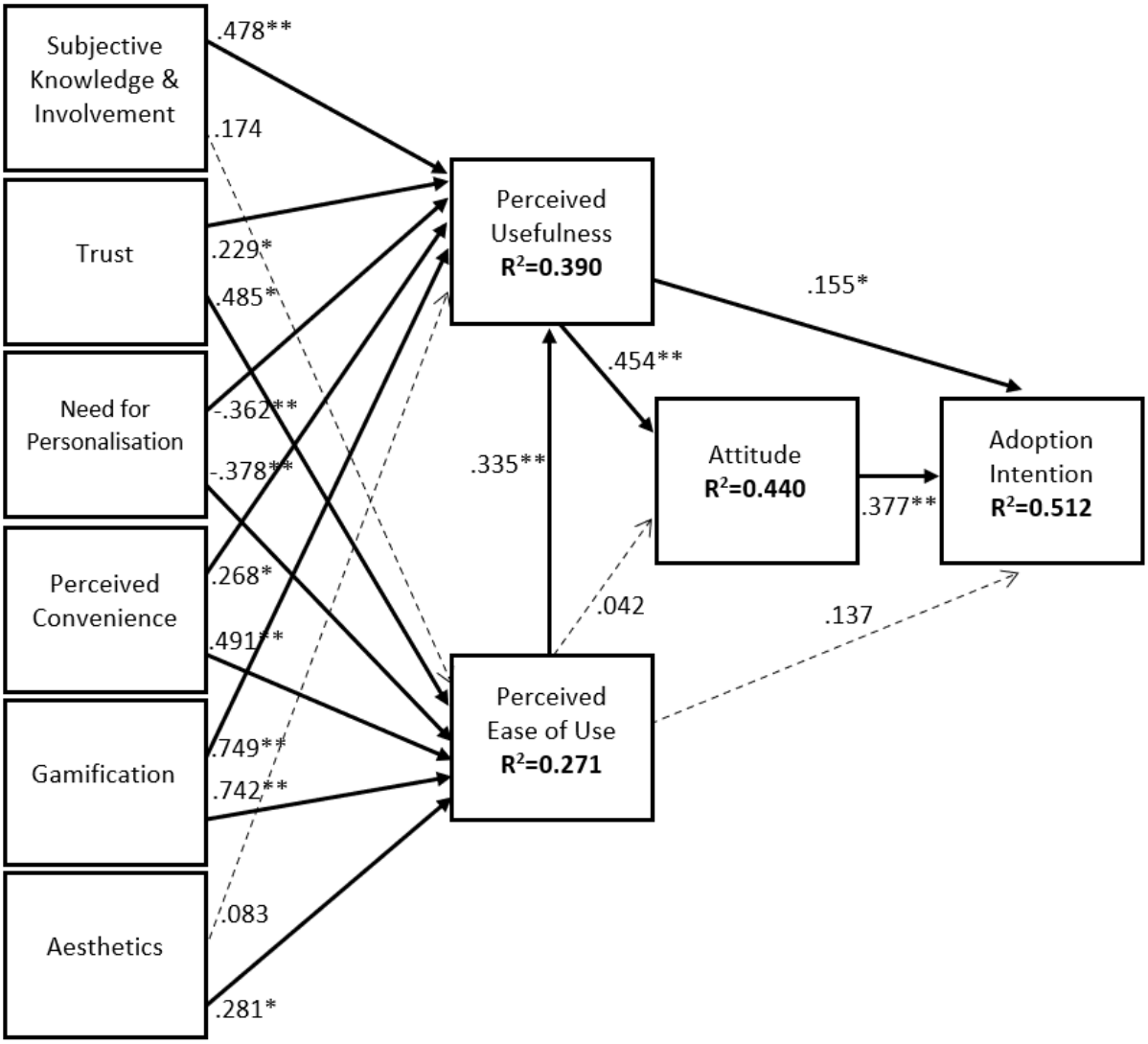


Figure 6.3). A comparison of the beta values for the adoption behaviour present and absent samples is provided in Table 6.18.

Table 6.18: Direct Paths of Adoption Behaviour Sample Split

Direct paths	Adoption behaviour	*β*
Subjective knowledge and involvement → Perceived ease of use	Present	.101
	Absent	.174
Subjective knowledge and involvement → Perceived usefulness	Present	.195*
	Absent	.478**
Trust → Perceived ease of use	Present	.228

Direct paths	Adoption behaviour	*β*
Trust → Perceived usefulness	Absent	.485*
	Present	.140
Need for personalisation → Perceived ease of use	Absent	.229*
	Present	-.581*
Need for personalisation → Perceived usefulness	Absent	-.378**
	Present	-.409*
Perceived convenience→ Perceived ease of use	Absent	-.362**
	Present	.555**
Perceived convenience → Perceived usefulness	Absent	.491**
	Present	.454*
Gamification → Perceived ease of use	Absent	.268*
	Present	.469**
Gamification → Perceived usefulness	Absent	.742**
	Present	.409*
Aesthetics → Perceived ease of use	Absent	.749**
	Present	.033
Aesthetics → Perceived usefulness	Absent	.281*
	Present	.164*
Perceived usefulness → Attitude	Absent	.083
	Present	.398*
Perceived usefulness → Adoption intention	Absent	.454**
	Present	.355*
Perceived ease of use → Perceived usefulness	Absent	.155*
	Present	.169*
Perceived ease of use → Attitude	Absent	.335**
	Present	.065
Perceived ease of use → Adoption intention	Absent	.042
	Present	.107
Attitude → Adoption intention	Absent	.137
	Present	.624**
	Absent	.377**

* $p < .05$, ** $p < .001$

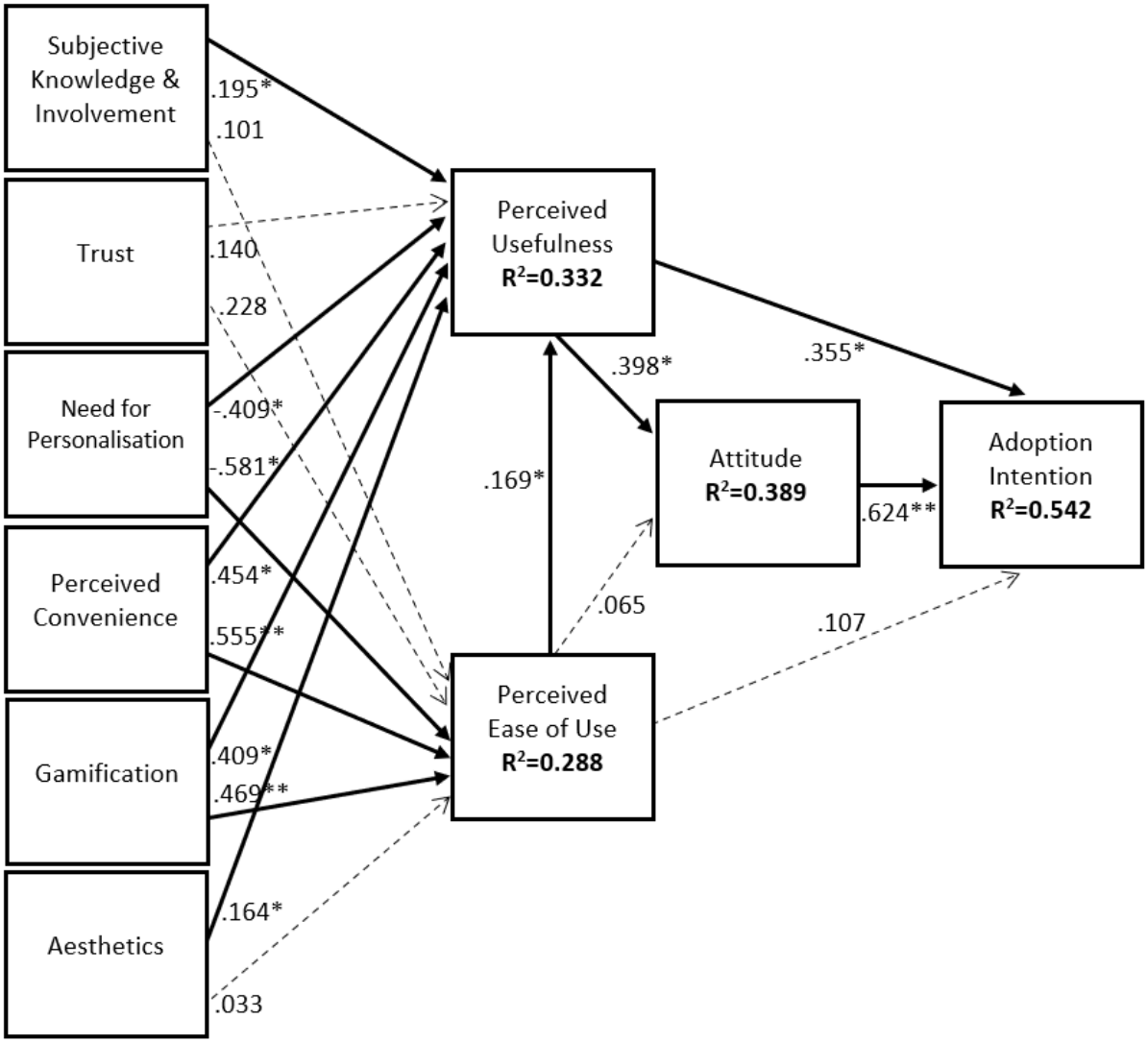


Figure 6.2: Direct Paths for Adoption Behaviour Present

Notes: Standardised regression weights (*β*) are presented. ** *p*< .001, * *p* < .05. Significant paths are solid lines. Non-significant paths are marked dashed lines.

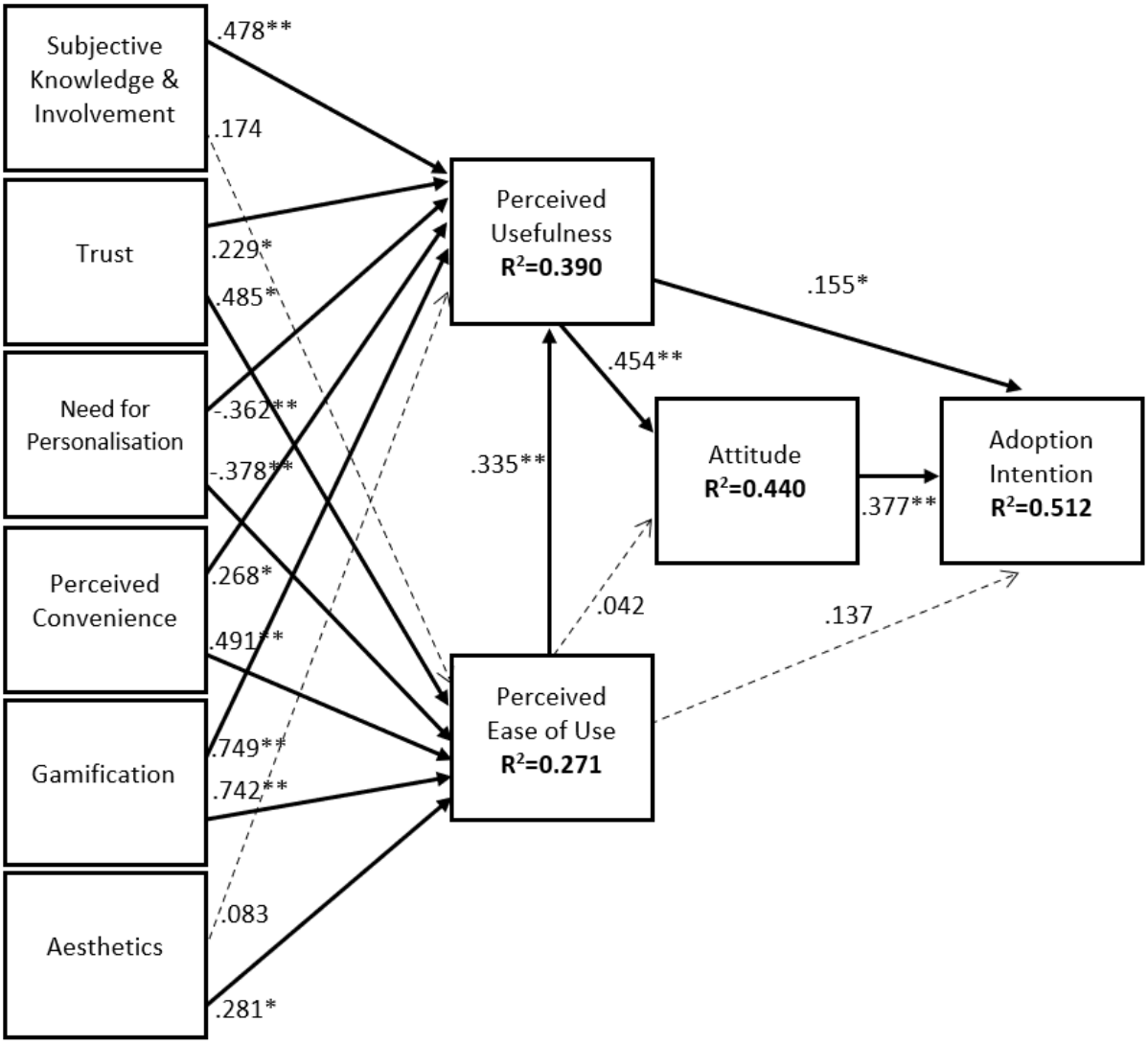


Figure 6.3: Direct Paths for Adoption Behaviour Absent

Notes: Standardised regression weights (*β*) are presented. ** $p < .001$, * $p < .05$. Significant paths are solid lines. Non-significant paths are dashed lines.

Relationships between constructs that changed from significant to non-significant, or vice-a-versa, when the sample was split by adoption behaviour are displayed in Figure 6.4.

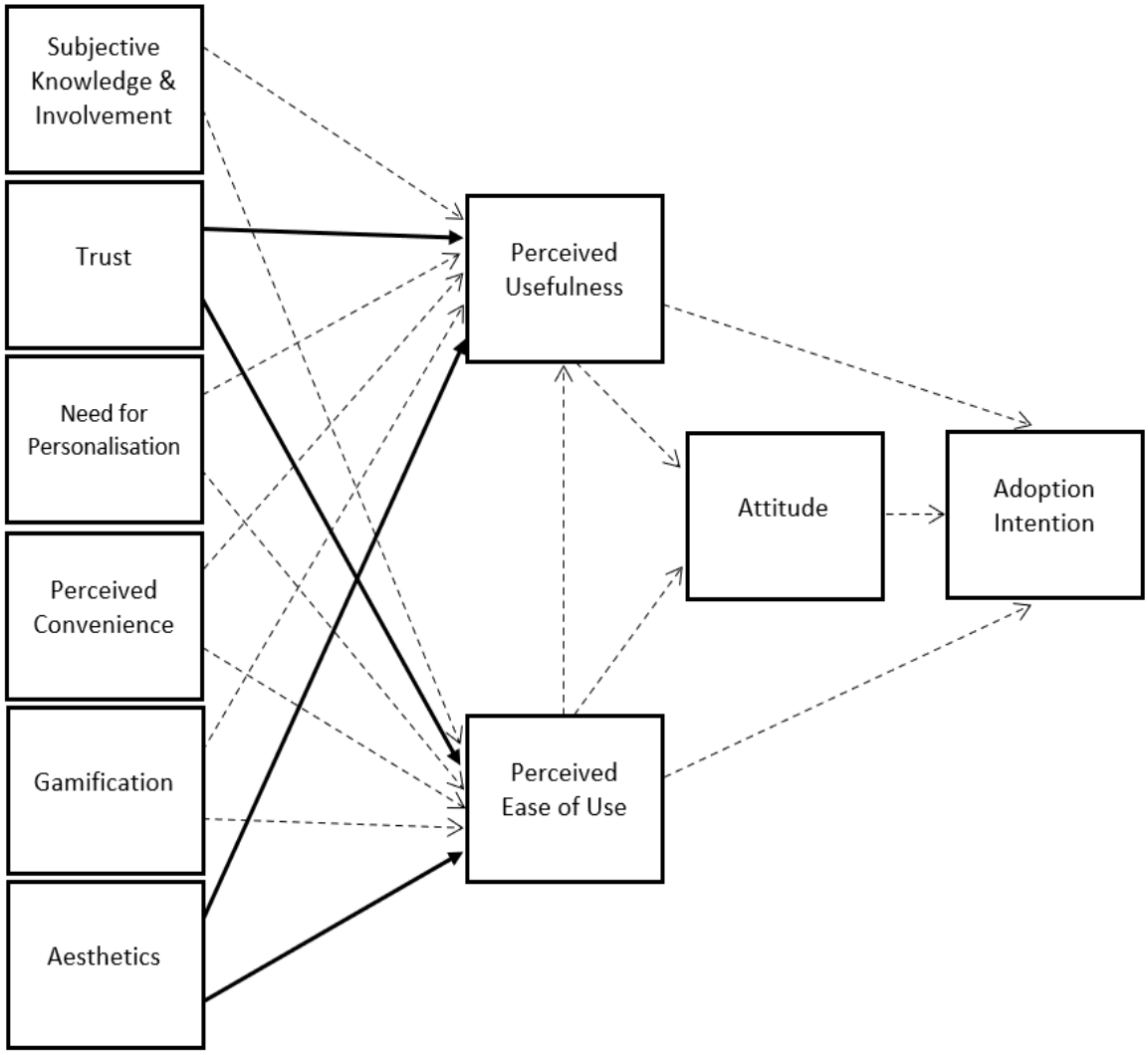


Figure 6.4: Direct Path Changes by Adoption Behaviour Presence/Absence

Note: Solid lines represent a change in significant or non-significant direct paths between the adoption behaviour present and absent samples; dashed lines represent no difference in direct paths when adoption behaviour samples were compared.

6.10.2 Testing for Effects of Product Platform Preference

The instrument collected data on the samples' product platform preference (gambling preferences) where they identified as either primarily digital gamblers or analogue gamblers. The researcher used these data in supplementary tests situated around retesting of hypothesised paths using a split sample (multi-group analysis). In order to test for the influence of gambling preference, the sample was split into two groups: digital gamblers (n = 143) and analogue gamblers (n = 109). The previous tests were re-run to determine whether the results differed according to the preference using digital or analogue gambling,

as separate samples. The results demonstrated that platform preference had a degree of influence on constructs that contribute to adoption of mHealth apps.

A significant relationship was found between perceived ease of use and perceived usefulness for digital gamblers only. Analogue gamblers presented four unique significant relationships: 1) trust and perceived ease of use; 2) trust and perceived usefulness; 3) aesthetics and perceived usefulness; and 4) perceived usefulness and adoption intention (see Table 6.19).

Table 6.19: Direct Paths of Product Platform Preference Sample Split

Direct paths	Preference	*β*
Subjective knowledge and involvement → Perceived ease of use	Digital	.037
	Analogue	.128
Subjective knowledge and involvement → Perceived usefulness	Digital	.098*
	Analogue	.380*
Trust → Perceived ease of use	Digital	−.260
	Analogue	.334*
Trust → Perceived usefulness	Digital	−.319
	Analogue	.330**
Need for personalisation → Perceived ease of use	Digital	−.540**
	Analogue	−.396*
Need for personalisation → Perceived usefulness	Digital	−.581**
	Analogue	−.459**
Perceived convenience → Perceived ease of use	Digital	.400**
	Analogue	.204**
Perceived convenience → Perceived usefulness	Digital	.272**
	Analogue	.179*
Gamification → Perceived ease of use	Digital	.507*
	Analogue	.712*
Gamification → Perceived usefulness	Digital	.545**
	Analogue	.572**
Aesthetics → Perceived ease of use	Digital	.318*
	Analogue	.468**
Aesthetics → Perceived usefulness	Digital	.204

Direct paths	Preference	*β*
Perceived usefulness → Attitude	Analogue	.374*
	Digital	.694**
Perceived usefulness → Adoption intention	Analogue	.314*
	Digital	.255
Perceived ease of use → Perceived usefulness	Analogue	.524**
	Digital	.598**
Perceived ease of use → Attitude	Analogue	.214
	Digital	−.097
Perceived ease of use → Adoption intention	Analogue	.192
	Digital	.115
Attitude → Adoption intention	Analogue	.171
	Digital	.668*
	Analogue	.128**

* $p < .05$, ** $p < .001$.

The direct path models in

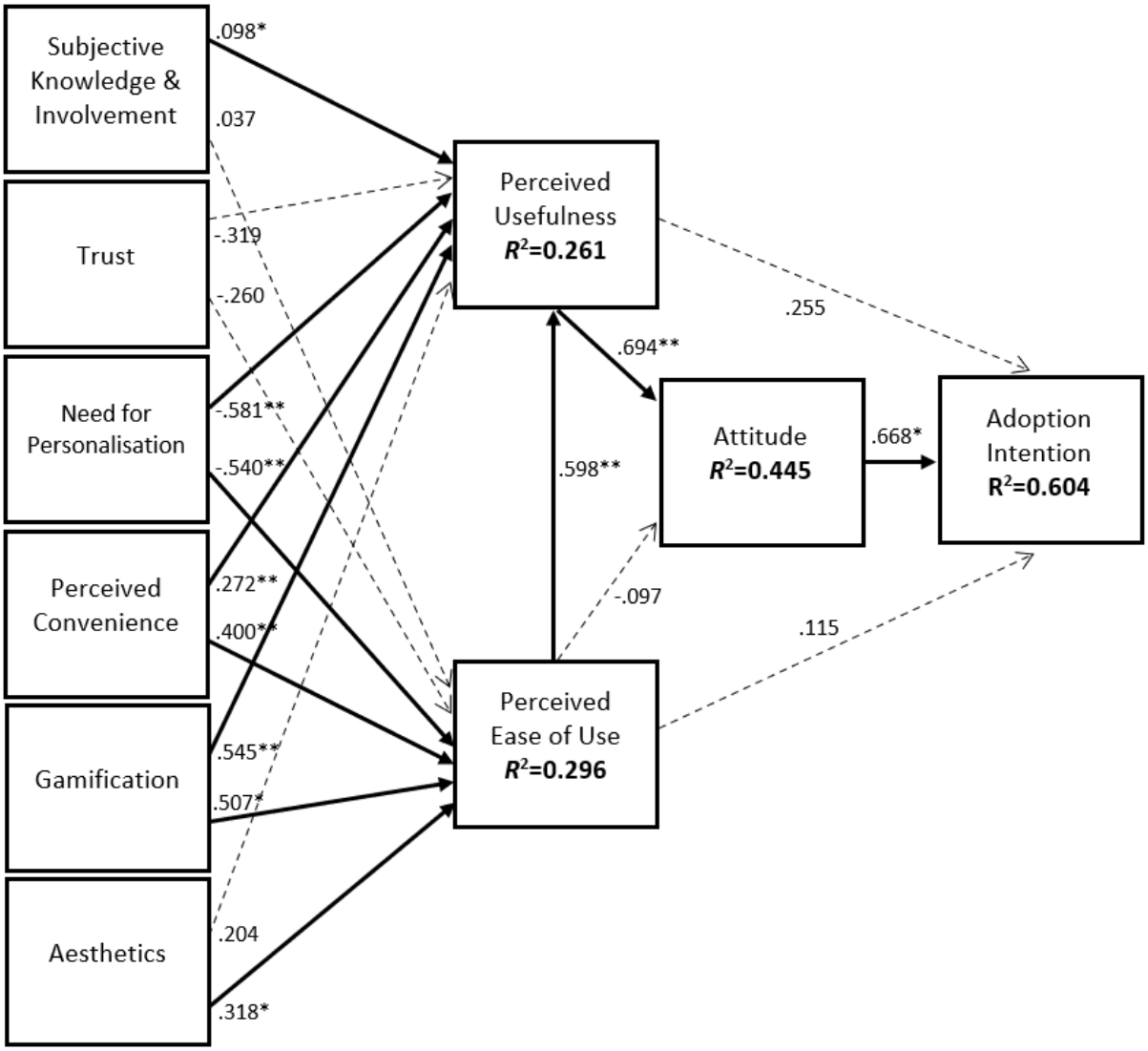


Figure 6.5 and Figure 6.6 are a visual representation of the changes in relationships when the samples for digital gamblers and analogue gamblers were compared.

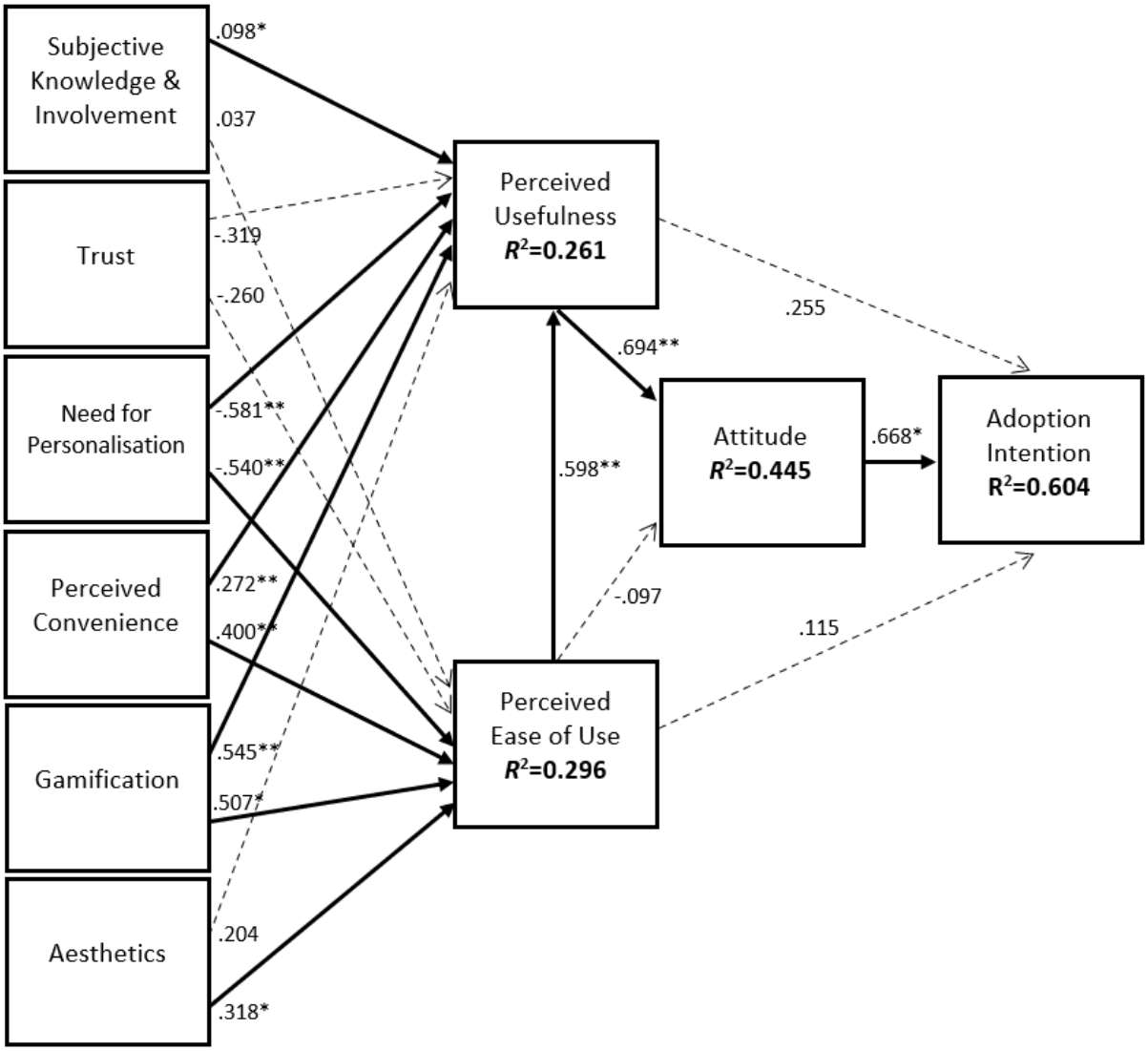


Figure 6.5: Direct Paths for Digital Gamblers

Notes: Standardised regression weights (*β*) are presented. ** $p < .01$, * $p < .05$. Significant paths are solid lines. Non-significant paths are dashed lines.

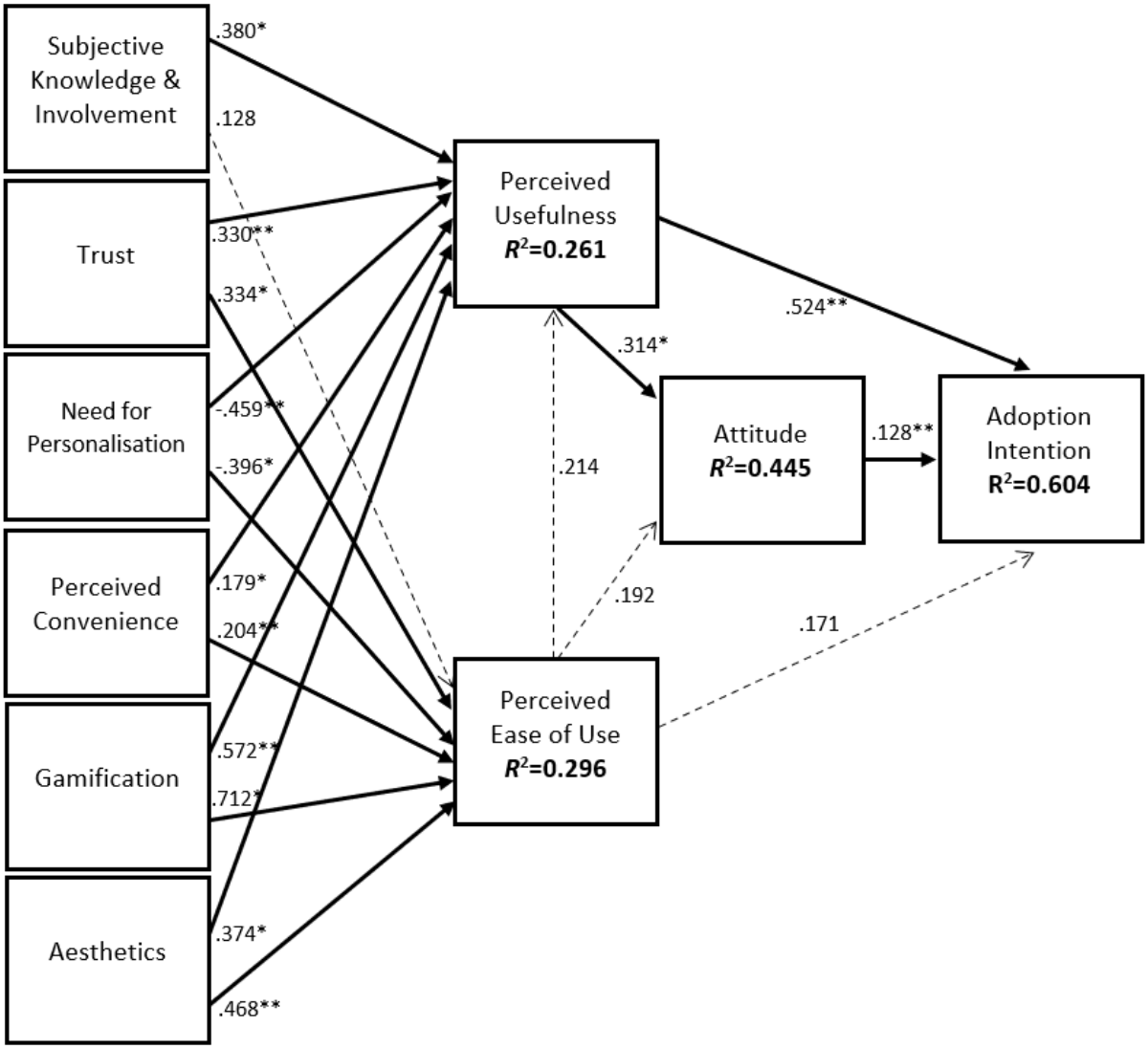


Figure 6.6: Direct Paths for Analogue Gamblers

Notes: Standardised regression weights (*β*) are presented. ** $p < .01$, * $p < .05$. Significant paths are solid lines. Non-significant paths are dashed lines.

Relationships between constructs that changed from significant to non-significant, or vice-a-versa, when the sample was split by platform preference are shown in Figure 6.7.

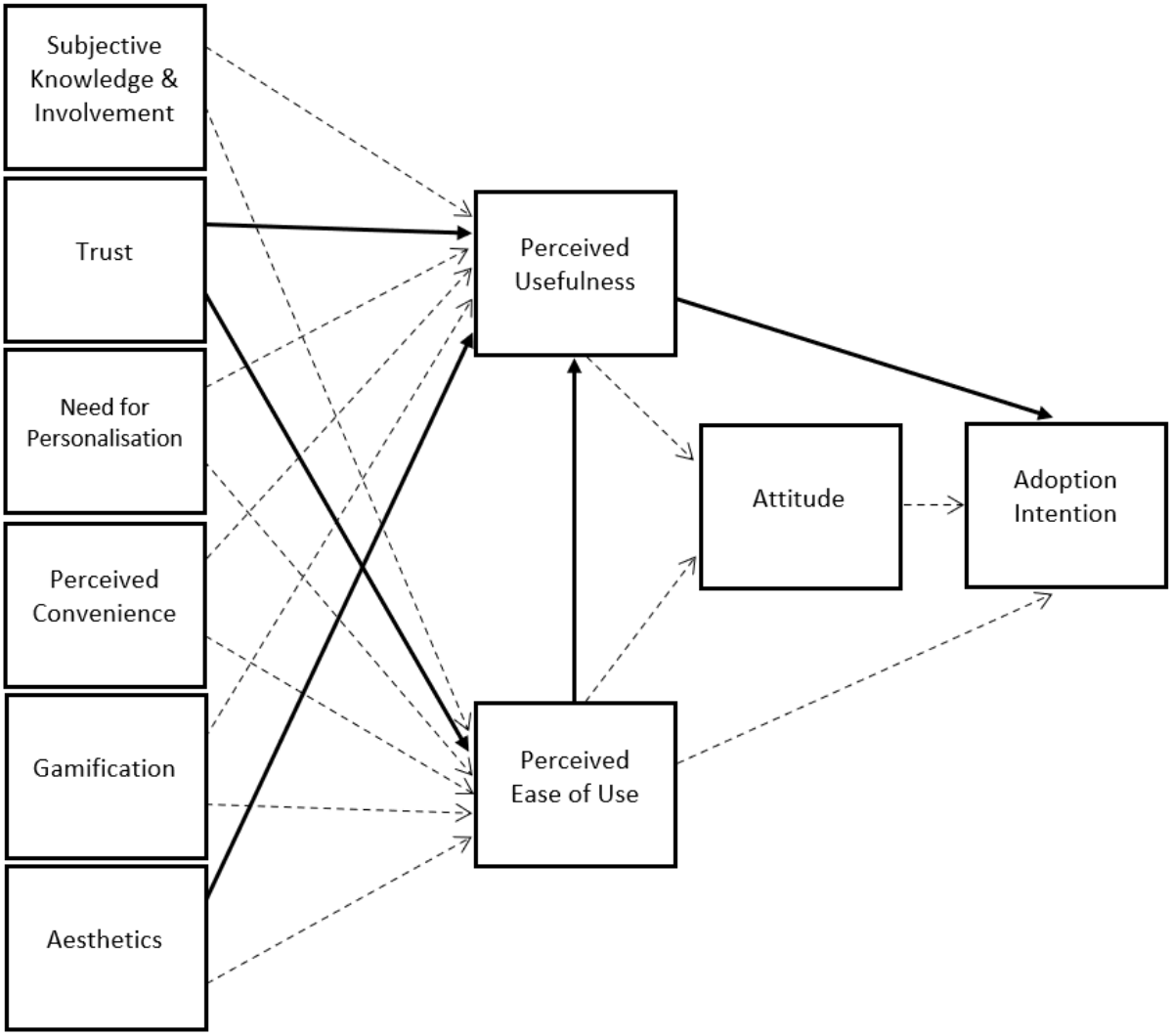


Figure 6.7: Direct Path Changes by Product Platform Preference

Note: Solid lines represent a change in significant or non-significant relationship between digital and analogue gamblers; dashed lines present no difference when digital and analogue gamblers when compared.

6.11 Chapter Summary

In this chapter, the hypothesised effects of antecedents on adoption intention through the TAM, accounting for mediation by attitude and moderation by health status severity, were tested. Descriptive statistics profiled the sample and crosstab (contingency) table testing showed significant associations among demographic, psychographic and socioeconomic factors. A confirmatory factor analysis showed reliability and validity of the measures and structural equation modelling identified the model. Direct paths were retested with split sample groups to identify how results changed or remained constant when the sample was

split by product platform preference (digital and analogue) or adoption behaviour. This chapter concluded with a summary of the hypothesised relationships, which showed that most of the stated hypotheses were supported and revealed many important new findings. The empirical findings included that most of the antecedents (user and technology characteristics) directly influenced perceived ease of use and usefulness; there was no moderation of health status severity on the relationship between attitude and intention; mediation and double mediation were present; and product platform preference and adoption behaviour influenced some of the direct paths in the model. The significance of these findings contrasted against extant literature and theory, their contribution to the literature, the study limitations and directions for future research are presented in the next chapter.

Chapter 7: Discussion and Conclusion

7.1 Introduction

Chapter Six presented the results of the quantitative data analysis and identified significant paths in the model. The outcome of the hypothesis testing in Chapter Six, specifically the effect of the antecedents on perceived ease of use and usefulness, provides new and important findings. Chapter Seven begins with a discussion of the hypothesis testing followed by a discussion of the supplementary testing of product platform preference and adoption behaviour. The chapter also explains how the significant drivers inform the theoretical contributions and practical implications set out for this thesis to make its contribution to knowledge. The practical implications in the chapter are a series of recommendations based on the significant drivers that are relevant to both mHealth app developers and marketers. The chapter acknowledges policy implications then briefly outlines the research limitations, which leads to suggested directions for future research. Last, the chapter presents the thesis conclusions.

7.2 Discussion

This section provides a discussion around the outcomes of the hypothesis testing. It begins by outlining the supported hypotheses and then offers explanations for unsupported hypothesis notwithstanding the empirical and theoretical support presented in the literature review. Last, the section presents insights into the outcomes of the multi-group analyses and discusses the effect of adoption behaviour and product platform preference on the relationships in the conceptual model.

7.2.1 Supported Hypotheses

The thesis provides empirical support for a range of hypothesised relationships among the antecedents, perceived ease of use, perceived usefulness, attitude and adoption intention. Hypotheses $1_{(c–d)}$, 2_a, $2_{(c–d)}$, $3_{(a–b)}$, $4_{(a–b)}$, 5–6 and 8–11 were supported. First, subjective knowledge and involvement significantly influenced perceived usefulness, supporting Hypothesis 2_a. These findings were expected as research has shown that subjective knowledge and involvement drive adoption of mobile platforms (Koenig-Lewis et al., 2015;

Mort & Drennan, 2007). Other research has shown that involvement contributes directly to perceived usefulness of technology (Chae, 2010; Turan et al., 2015). Therefore, usability and usefulness are dependent on the users' involvement with mHealth apps. This involvement is a precursor to perceived ease of use and usefulness and can overcome usability and utility barriers.

Second, the results revealed that need for personalisation positively affected perceived ease of use and usefulness. These findings supported Hypotheses 1_c and 2_c. This was expected as research has shown that personalisation of content increases perceived ease of use and usefulness in navigating mobile advertising (Merisavo et al., 2006, 2007). This is because app users with a greater need for content personalisation expect to collect, navigate and benefit from app content in a manner suited to them specifically; unlike others who accept what is presented in the app by default. Third, the results supported the substantial effect of perceived convenience on both perceived ease of use and perceived usefulness. These findings confirmed Hypotheses 1_d and 2_d, in that higher levels of perceived convenience led to higher levels of perceived ease of use and usefulness of mHealth apps. This supports earlier findings that a lack of convenience leads users to view mobile technology as not 'user friendly' (Amin et al., 2014). Naturally, mHealth apps that are convenient in terms of accessibility (cost and distribution platform) and availability (hosted by personal devices) enable rapid adoption by consumers (Deng et al., 2018; Shemesh & Barnoy, 2020). Fourth, both of the technology characteristics—aesthetics and gamification—affected perceived ease of use and usefulness. From these findings, Hypotheses $3_{(a–b)}$ and $4_{(a–b)}$ were supported. Based on the literature, aesthetics has an established linkage with app adoption (Hoehle & Venkatesh, 2015) and usage (Stocchi et al., 2019), particularly in the mHealth app context (Anderson et al., 2016) where greater perceived aesthetics improves engagement. App users with higher engagement are better able to maximise app usability and utility (Huang et al., 2021; Turan et al., 2015). Gamification is typically investigated in mHealth for how it influences app engagement (Tonkin et al., 2019) and health behaviour change (Fleming et al., 2017), whereas technology adoption and perceived ease of use and usefulness are overlooked. The fundamental goals of gamifying technology are to present a step-by-step process and micro-reward usage (Jin, 2016). It is likely that these factors increase use and experience, which improves usability of an mHealth app while creating a perception of prolonged usefulness for

the user. The coordinated processes of games make them easier to navigate, and the reward system creates the impression of accomplishment of goals or purpose (Rahman et al., 2018).

Fifth, the results confirmed the influence of perceived ease of use on perceived usefulness, thus supporting Hypothesis 5. This result is in line with the literature positing that for technology to be useful it must be usable for the individual first (Shemesh & Barnoy, 2020; Venkatesh, 2000).

Sixth, in line with the TAM and recent mHealth app studies, findings revealed an effect of perceived usefulness on attitude (see Alam et al., 2020; Venkatesh & Davis, 2000), supporting Hypothesis 6 that perceived usefulness affects attitude towards mHealth apps. Hypotheses 8 and 9 suggested that adoption intention is influenced by perceived usefulness and attitude, respectively, wherein negative attitudes towards apps and poor perceptions of app utility reduce intention to adopt. These hypotheses were supported. The findings are consistent with foundational technology adoption research in that perceived usefulness and attitude affect adoption intention (Davis et al., 1989; Venkatesh & Davis, 2000). More recent mHealth research using the base TAM to assess app adoption has also confirmed this relationship (Shemesh & Barnoy, 2020).

Last, Hypotheses 10 and 11 predicted that attitude mediates the relationships between perceived usefulness and intention, and perceived ease of use and adoption intention, respectively. These hypotheses were both supported. For Hypotheses 5–10, which directly reflect linkages in the TAM, the implication of the findings of this thesis is that these relationships are consistent with similar and dissimilar contexts.

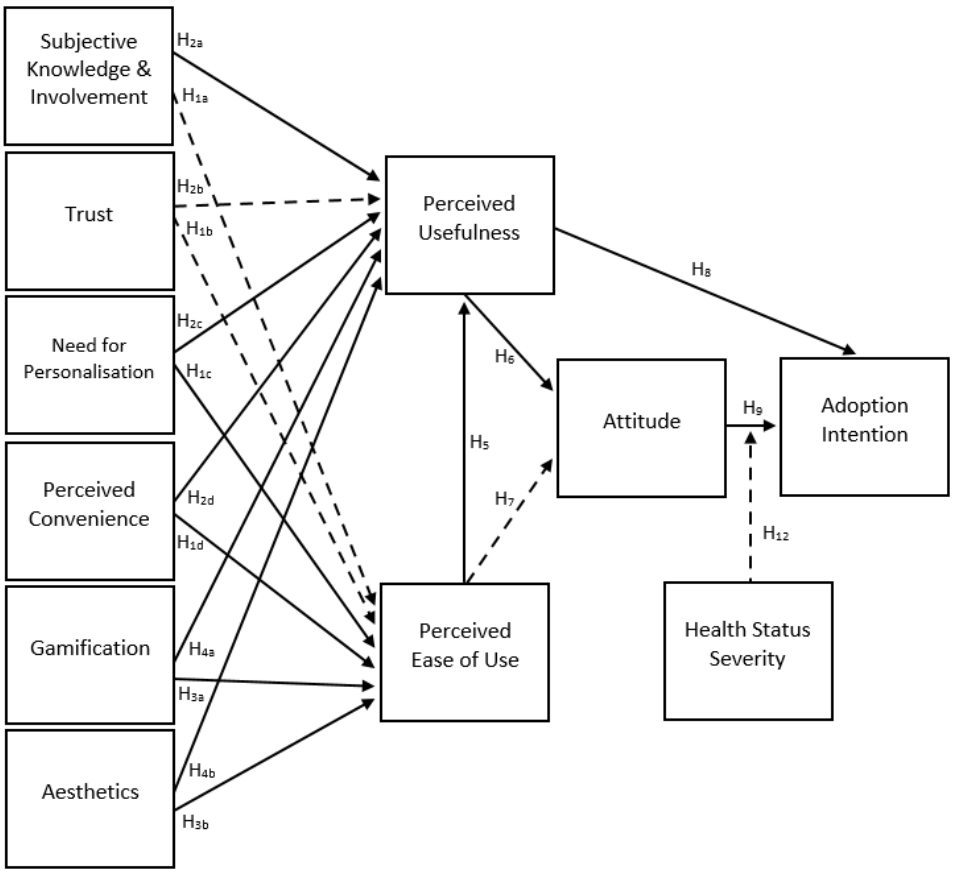
7.2.2 Unsupported Hypotheses

Five hypotheses in this thesis were not supported: $1_{(a–b)}$, $2_{(b)}$, 7 and 12. The results showed that subjective knowledge and involvement did not affect perceived ease of use. Hence, Hypothesis 1_a was not supported. This conflicts with the literature (Aji et al., 2020; Turan et al., 2015) where subjective knowledge and involvement of technology influence perceived ease of use. Studies have typically applied the Diffusion of Innovations Theory and examined direct linkages of subjective knowledge and involvement with adoption and adoption behaviours. The one exception that—contrary to the outcome of testing Hypothesis 1_a—is

that subjective knowledge affects perceived ease of use; however, this study did not consider mobile technologies (Tan et al., 2022). Hence, there is scarce evidence from the literature to explain this outcome. Moreover, Hypotheses 1_b and 2_b were not supported as the findings demonstrated that trust contributed to neither perceived ease of use nor perceived usefulness of mHealth apps. This is surprising as trust is known to affect adoption of mobile platforms in advertising (Atkinson, 2013) and banking (Gu et al., 2009). A likely explanation is that mHealth entails reduced trust. Mallat et al. (2008) argued that mHealth apps typically require users' personal and sometimes identifying information for treatment, leading to lower trust compared with other apps. This creates a disconnect as user trust in technology increases adoption, but mHealth technology naturally incurs lower user trust. The non-significant effect of trust is likely because of a sample of gambler's tendency to withhold information around gambling behaviours. Withholding this information may suggest lower trust levels because people believe that mHealth apps might share personal health information (Scott et al., 2015). Additionally, for gamblers, treatment is linked to a strong desire to maintain anonymity and confidentiality, making trust a key precursor for gamblers to accept treatment in any form (Rodda, 2014).

Contrary to the established TAM (Venkatesh & Davis, 2000) and previous findings (see Kim et al., 2016; Natarajan et al., 2017; Tarute et al., 2017; Tojib & Tsarenko, 2012; Yang, 2013) the results of this thesis showed that perceived ease of use did not affect attitude whereas perceived usefulness did. Hypothesis 7 was not supported. Perceived usefulness is known to be a stronger predictor of attitude than is perceived ease of use (Porter & Donthu, 2006; Shih, 2004). Although both are predictors of attitude, Venkatesh and Bala (2008) suggested that utility of technology is more important to the user than usability, which may explain cases where perceived usefulness is significant and perceived ease of use is not. A small number of studies on technology adoption of mobile platforms—that is, mobile payments (Chang et al., 2021), mobile banking (Kumar & Yukita, 2021) and m-gaming (Kaltum et al., 2018)—reported the same finding. The study authors concluded that, in their contexts, consumers are results driven and not process driven. Hence, usability is overlooked as it reflects the process, whereas utility reflects the results and is attributed value. This may be why Hypothesis 7 was not supported.

Hypothesis 12 proposed a moderating effect of health status severity in the relationship between attitude and adoption intention. Health status severity is associated with conflicting findings in mHealth adoption research; health severity can positively moderate (Deng et al., 2018) or have no moderation affect (Sun et al., 2013) on the relationship between attitude and intention. Similar to Sun et al. (2013), the thesis found no moderation effect, which resulted in Hypothesis 12 being rejected.



See Figure 7.1 for a visual representation of supported and unsupported hypotheses.

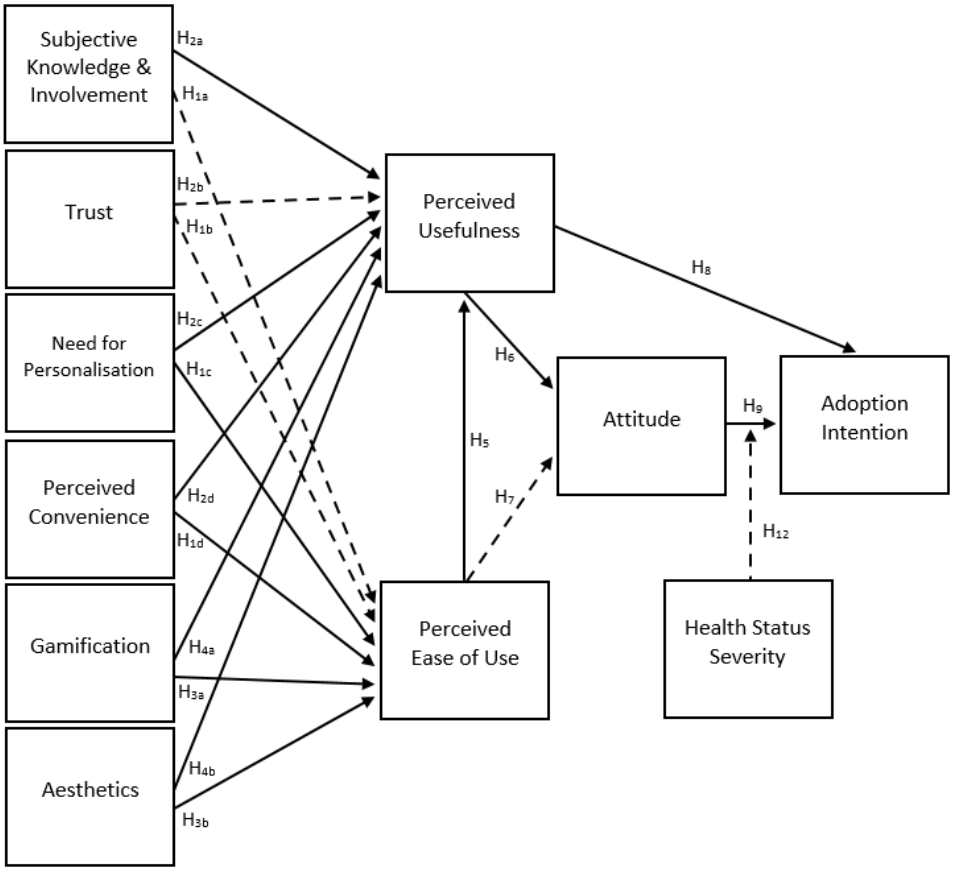


Figure 7.1: Significant Paths and Hypotheses

Note: Significant paths are marked with solid lines. Non-significant paths are marked with dashed lines.

7.2.3 Multi-Group Analyses—Additional Insights

The theoretical implications from the hypothesis testing are discussed in the next section following a discussion of the results of multi-group analyses in two subsections. As outlined in Chapter Six, multi-group analyses were conducted for i) the adoption behaviour split sample and ii) the product platform preference split sample. Insights are discussed here, starting with adoption behaviour.

Adoption Behaviour

At the end of the online survey participants were offered a link to view a recommended quit app. The survey platform then recorded whether participants clicked the link or not, which demonstrated whether the adoption behaviour was present or absent, respectively. A multi-group analysis was conducted whereby the sample was split into two groups: i) adoption

behaviour present (n = 111) and ii) adoption behaviour absent (n = 141). Although not formally hypothesised in this thesis, these tests were employed to provide additional insights into relationships in the conceptual model. Multi-group structural equation modelling is a valid approach to investigate model relationships (Koufteros & Marcoulides, 2006). The multi-group analysis showed that from the 18 direct paths in the model, 14 were consistent with the direct effects shown in Chapter Six (full sample, n = 252) and four paths differed (reflecting the following hypotheses: 1_b, 2_b, 3_b and 4_b).

Notable outcomes are the linkages for trust, aesthetics, perceived ease of use and perceived usefulness. For the subsample where the adoption behaviour was present, trust had an influence on neither perceived ease of use nor perceived usefulness. This suggests that for the 'adopters' trust was not a factor in determining perceived ease of use and usefulness of mHealth apps; unlike for the 'non-adopters', where trust was a significant antecedent. Higher levels of trust towards technology created positive perceptions of perceived ease of use and usefulness. Further, in the sample of adopters alone, aesthetics affected perceived usefulness wherein positive perceptions of app aesthetics increased app usability (see Figure 6.2). The adopters indicated that attractive aesthetics makes mHealth apps useful, whereas the non-adopters indicated that attractive aesthetics makes apps easier to use (Figure 6.3). The other sample split in this thesis was based on the respondents' product platform preference.

Product Platform Preference

The second part of the multi-group testing involved retesting all the direct paths for a split sample split based on product platform preference (digital *v*. analogue gamblers). The direct paths were tested for digital gamblers (n = 143) and then analogue gamblers (n = 109) and compared using multi-group structural equation modelling (Koufteros & Marcoulides, 2006). This multi-group analysis showed that 13 relationships produced the same outcomes for the two subsamples, while five relationships produced different outcomes (reflecting the following hypotheses: 1_b, 2_b, 3_b, 4_b, 5 and 8).

Notable outcomes are the linkages found for trust, aesthetics, perceived ease of use, perceived usefulness and adoption intention. The causal model of direct paths (full sample, n = 252) and the subsample of digital gamblers showed that trust had no significant influence

on perceived ease of use and usefulness. However, the subsample of analogue gamblers revealed a significant influence. This suggested that for those who preferred analogue or traditional gambling platforms, trust in the platform implied perceptions of usability and usefulness. In contrast, those with a digital preference gauged usability and usefulness regardless of the level of trust. This may be an important idea to consider when executing promotional strategies intended to persuade consumers to transition from traditional to modern or innovative products. Further, exclusive to the digital gamblers, aesthetics did not influence perceived usefulness. Digital gamblers also showed that perceived ease of use influenced perceived usefulness, whereas perceived usefulness did not influence adoption intention. In the opposite manner, the analogue subsample showed that perceived ease of use did not influence perceived usefulness whereas perceive usefulness influenced adoption intention. This suggests that usability determined usefulness only when there was a preference for a digital platform. To review, Table 6.19 showed that all paths that presented different outcomes were based on perceived ease of use and usefulness: i) trust to perceived ease of use; ii) trust to perceived usefulness; iii) aesthetics to perceived usefulness; iv) perceived ease of use to perceived usefulness; and v) perceived usefulness to adoption intention. These findings around changes in direct paths based on consumption platform preference suggest that the TAM's focus on perception, attitude and intention overlooks a technology consumption or usage preference of the user, which was shown in this thesis to have relevance. These findings demonstrate that consumer preferences have the potential to change and negate some of the known relationships of the TAM and the relationships here that have extended the TAM.

7.3 Theoretical Contributions

This thesis presents an extensive review of the theoretical and empirical literature from marketing, information technology and healthcare, to identify gaps in knowledge on mHealth adoption. The thesis addressed these gaps by developing a comprehensive conceptual model that integrates several antecedents with one of the literature's most researched frameworks, the TAM (Tamilmani et al., 2020). More specifically, this thesis first demonstrates antecedents to address the TAM's limitations of being too general (Altmann & Gries, 2017), which are discussed in this section. Next, this section notes the relevance of context to the research

findings. Antecedents and context as separate elements offer some level of insight but are limited in explaining technology adoption. Hence, combining these elements creates a mechanism for developing a deeper understanding of technology adoption and presents a new model of mHealth app adoption. This section concludes by proposing a synthesis between adoption models via consumer information-seeking behaviour constructs.

7.3.1 Adoption Antecedents

The relationships that the antecedents have with perceived ease of use and usefulness demonstrate theoretical insights into mHealth app adoption beyond the approach of measuring direct effects on adoption and post-adoption behaviours. This has been noted in previous research as a 'linear' approach to technology adoption because of its likeness to the Uses and Gratification Theory (Kaur et al., 2020). The Uses and Gratification Theory has been criticised for overlooking the roles of consumer beliefs, attitudes and subjectivity (Kaur et al., 2020; Loose et al., 2013). Further, its linear approach to measuring predominantly direct effects on behaviour fails to appreciate the complexity of adoption processes, particularly as technology evolves (El-Wajeeh et al., 2014). Hence, it is important to not focus on a linear approach to adoption theory but to study the complex relationships between the TAM antecedents and intention (Kumar & Bervell, 2019). By including several complex relationships, such as mediation and double mediation, this thesis investigates the nuances in interactions between the antecedents and the TAM. By extending the TAM in this direction, this thesis presents an extended theoretical base for the study of mHealth app adoption. Further, it demonstrates how to incorporate specific user and technology characteristics as antecedents that are essential to the formation of perceptions, attitudes and intentions of mHealth app users.

The significant user characteristics identified in this thesis are subjective knowledge and involvement; need for personalisation; and perceived convenience. The positive influence of subjective knowledge and involvement on perceived usefulness suggests that higher levels of app awareness and experience increase the perception that apps are useful. This finding expands on the Diffusion of Innovation Theory, which suggests that contact with technology creates positive associations (Rogers, 1995). These associations are typically interpreted as intention (see Foster, 2018; Lee et al., 2017). This thesis extends on this to demonstrate how

greater levels of contact with apps create positive perceptions of usefulness for users. Although the literature shows that personalisation influences app behaviour (see Jakob et al., 2021), in the current thesis need for personalisation had a negative influence on perceived ease of use and usefulness, meaning that as the need for personalisation of apps increased the perceptions of usefulness and usability decreased. The suggestion is that app experience reduces the need for tailored content as experienced users are able to navigate apps and maximise outcomes more easily than lesser experienced users. The literature suggests that personalised mHealth apps are seen to perform better than other apps (see Hors-Fraile et al., 2018). However, this thesis offers the finding that personalisation of content does not guarantee strong perceptions of usability and usefulness. Conversely, this thesis reveals that users who perceive apps as convenient also perceive them to be useful and usable. The Self-Determination Theory depicts convenience, with user perceptions that technology is helpful (Chang et al., 2012). Previous adoption models show direct relationships between app convenience and app behaviours, arguing that convenience is an intrinsic motivation for the behaviour (see Al-Husamiyah & Al-Bashayreh, 2022; di San Pietro et al., 2019). This thesis goes further to create a new theoretical linkage, and depicts that perceptions of convenience influence user perceptions that mHealth apps are useful and usable to achieve a health goal.

The other group of antecedents alongside user characteristics in this thesis are technology characteristics. The significant technology characteristics are gamification and aesthetics. Gamification in this thesis had positive influences on perceived ease of use and usefulness, meaning that participants who observed the app stimuli to have a high degree of gamification also perceived the app to be highly useful and usable. Existing theory does not consider this. The Theory of Gamified Learning posits that gamification of technology affects user learning attitude and learning outcomes (Landers, 2014). This theory is limited to user attitude and behaviour and does not consider how gamification of technology can influence user perceptions of the technology. Further, past iterations of the TAM depict gamification as contributing to behaviours, not perceptions (see di San Pietro et al., 2019). This thesis takes a new theoretical approach and posits that gamification underpins perceptions of ease of use and usefulness. Like gamification, aesthetics influenced perceived ease of use and usefulness to create new theoretical linkages between constructs. This is important as technology adoption research has typically employed the stimulus–response framework when

considering aesthetics (Cho et al., 2019); thus, aesthetics has been treated as a stimulus to identify a behaviour (see Vaghefi & Tulu, 2019). This thesis takes a theoretical stance to mHealth app aesthetics; not in terms of how it underpins adoption behaviours but for how it contributes to perceptions of ease of use and usefulness. When these user and technology characteristics come together in individuals, adoption intention is higher than in those who present few or none of these characteristics. These united characteristics provide a greater understanding of mHealth app adopters, and stronger inferences can thus be drawn from the adoption process. In particular, the likely mHealth app adopter has high subjective knowledge and involvement, low need for personalisation and high perceived convenience of apps, coupled with high participant perceptions of gamification and pleasing aesthetics in the app stimuli. See Figure 7.2 and Figure 7.3 for a comparison of the original TAM and the new relationships identified in this thesis. The practical implications of these antecedents for mHealth app developers and marketers are discussed in Section 7.4. The remainder of this section discusses the theoretical implications of the research context and then closes by alluding to a synthesis between adoption models.

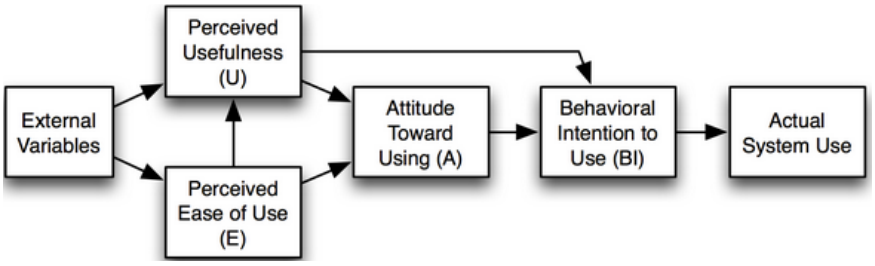


Figure 7.2: Original TAM

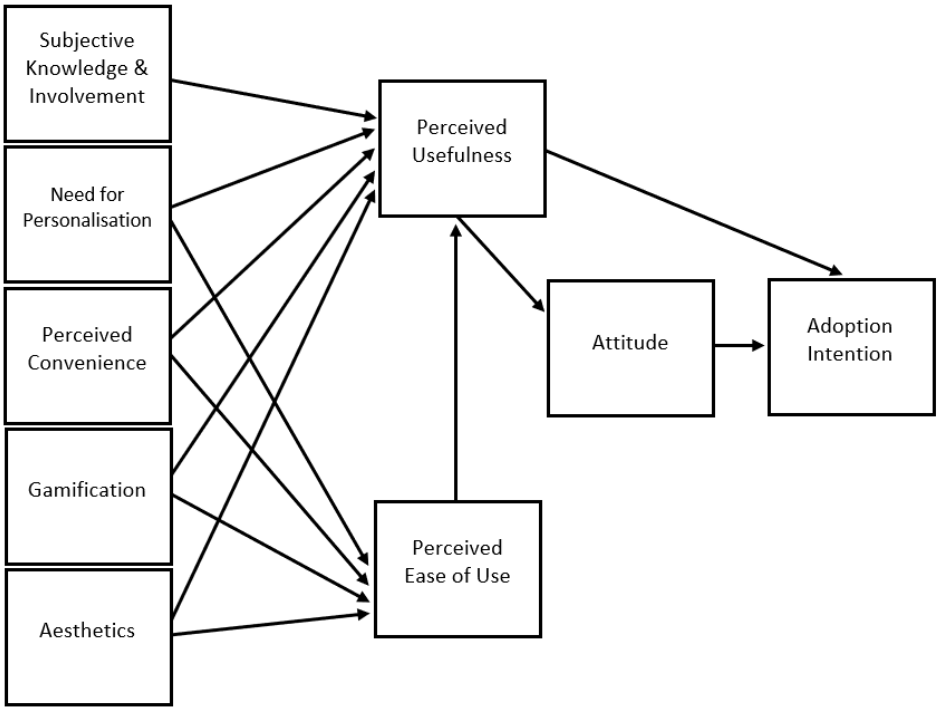


Figure 7.3: Model from this Thesis

7.3.2 Relevance of Research Context

Theoretical contributions beyond inclusion of antecedents come from the influence of context in this thesis. As the TAM was originally designed to measure technology adoption at work where the use of technology was mandatory (Venkatesh, 2000), this thesis extends beyond that mandatory setting. This thesis provides support for the TAM in voluntary adoption situations, where attitudes and intentions are assessed in an unrestricted manner and organisational objectives and managerial coercion are not contributing factors. Rather, individual health issues and goals drive adoption. While mHealth apps can be prescribed by medical doctors to patients as part of a treatment program (Della Vecchia et al., 2022), the non-mandatory research setting of this thesis is an important factor as mHealth app usage is

typically a setting where adoption is voluntary (Woldeyohannes & Ngwenyama, 2017). Other than the context setting for this thesis, contributions came from the context-specific variable in this thesis, health status severity. While past iterations of the TAM show that health status is as a factor for behaviour (Deng et al., 2018; Dou et al., 2017), health status of app users is rarely researched for how it brings insights to technology acceptance theories. This thesis attempted to address conflicting findings around the moderation of the relationship between attitude and intention. The novel element was the use of a clinical measure for health (i.e., the Canadian Problem Gambling Index), rather than an app user's self-assessment. However, health status was not shown to moderate the relationship between attitude and intention which confirms the challenges around integrating health factors of app users in technology adoption research. The implication is that research context (i.e., technology, app users and health measurement tools) is a factor of mHealth app adoption that requires greater theoretical investigation.

7.3.3 Participant Information Seeking

The way the thesis measured adoption behaviour concept offers further theoretical implications. In the quantitative stage, the option to seek product information was presented to participants at the end of the survey when participants could click (or not) on a link to download a quit gambling app. Clicking on the link showed that participants were, at the very least, interested in the app and seeking more information. Considering other marketing models and theories alongside this 'information seeking' and the TAM can add to theory, e.g., the consumer buying process. There is an overlap between the step of information seeking in this thesis and information search in the consumer buying process. The consumer buying process outlines the five basic steps consumers take when evaluating a purchase decision: 1) problem recognition, 2) information search, 3) alternatives evaluation, 4) purchase decision, and 5) post-purchase evaluation (Prasad & Jha, 2014). The interpretation of information seeking presented in this thesis is that the individual, after exposure to and awareness of an mHealth app, actively seeks product information (Canziani & MacSween, 2021). In the consumer buying process, information search is where the consumer actively collects information to inform a purchase decision (Weisfeld-Spolter & Rippé, 2022). Noting that information search is not the initial stage of the consumer buying process, consumers do not necessarily follow the process in sequence (Patsiotis et al., 2020). With these similarities

between the two concepts, there is a potential synergy between the theoretical framework of this thesis and the consumer buying process. Information seeking can bridge into information search of the consumer buying process suggesting that an mHealth app user can shift between these models. This new theoretical approach may offer a more holistic view of mHealth app acceptance.

7.4 Practical Implications

The results of this thesis have relevance for mHealth app developers and marketers. The findings reflect those antecedents, including subjective knowledge and involvement, need for personalisation, perceived convenience, gamification and aesthetics, as predictors of mHealth app perceived ease of use and usefulness. Understanding how these antecedents underpin perceived ease of use and usefulness, two crucial factors of adoption (Venkatesh & Davis, 2000), is valuable for informing mHealth app developers and marketers, so recommendations are presented to both developers and marketers based on these factors. Such insights can support app developers to create apps that bear these antecedents in their designs to ultimately increase app lifecycle and improve user health. This outcome provides consumers with a product to achieve health goals that can operate as a standalone health tool or in cooperation with other treatment approaches. Further, health studies that were discussed in Section 7.3 present evidence that elements and techniques derived from these antecedents can in fact improve ease of use and usefulness of mHealth apps. mHealth app marketers can increase positive user perceptions of ease of use and usefulness by suggesting the presence of these antecedents through promotion to extend advertising reach and encourage adoption. mHealth research shows some evidence of marketing success in this challenge which is discussed later in Section 7.4.2. Starting with app development, this section discusses implications based on the paths in the conceptual model with supporting examples of mHealth apps for developers in Section 7.4.1.

7.4.1 Implications for App Developers

Subjective Knowledge and Involvement

In this thesis, subjective knowledge and involvement predicted perceived usefulness but not perceived ease of use. This result implies that people who self-evaluate to be knowledgeable

about apps may attempt to reinforce their self-belief about being knowledgeable through effectively using mHealth apps. These users are focussed on achieving health goals through knowledge and are less concerned with applying knowledge to navigate technology easily. Hence, developers should cater to users' level of understanding and experience and not assume users' capability; for example, simple user modes that accommodate users with learning disorders who may be apprehensive or inexperienced with standard user modes (Rossi, 2019). Developers should also consider expert users. Bardus et al. (2020) noted that mHealth apps designed for experts working in healthcare score highly on the information quality domains of app rating scales. These types of app are developed for complex health diagnoses and treatment plans for patients. For this expert group, basic apps with limited features and functionality may impede users. These examples demonstrate how developing apps on the basis of users' knowledge and involvement can enable perceived usefulness.

Personalisation

This thesis found that need for personalisation influenced perceived ease of use and usefulness: people with a stronger need for personalisation of apps had lower perceptions that mHealth apps are easy to use and useful. This finding might suggest that users who need personalisation in apps have less experience with easy to use and useful mHealth apps. Personalisation can be used to increase an app's ease of use and usefulness as tailoring an app and using individual information familiarises the content for the user, making it easier to navigate (Tossell et al., 2012). However, developers must be mindful that this can pose a risk to users' data privacy. Personalisation creates custom health goals that are achievable and relevant to the user (Attwood et al., 2017). An example app that does this is Drinkaware, an alcohol consumption management app that simplifies healthy behaviours by making goals both easier to create and less sizable, so that they are easier to achieve (see Figure 7.4). This approach creates tailored content and personalised treatment plans through the app. This way the user engages with the app more frequently and on a more personal level to achieve a health goal (Madeira et al., 2018), which is important for extending the app's lifecycle. Therefore, for users, navigating their own created content makes the app easier to use, and achieving more modest and meaningful health goals makes the app more useful.

Figure 7.4: Drinkaware App

Convenience

This thesis shows that perceived convenience is also an important factor for mHealth app developers to consider. People using mHealth apps to achieve specific health goals expect these apps to be convenient. A component of app convenience is accessibility; that is, how much effort is expended with each use of the app (Chen et al., 2019). If there are design or compatibility issues between the app and device that lead to a spike in effort for the user, lower perceptions of convenience would result (Choi et al., 2022). Hence, app developers should ensure that the programming of the app facilitates use across devices. In addition, poor app development that forces users to take multiple steps for each interaction with the app is likely to decrease perceptions of convenience. Consequently, users' engagement with the app decreases, or even ceases, which blocks the app from becoming useful in achieving its health goal. MyFitnessPal, a calorie-counting app shown to be effective in clinical trials (see Evenepoel et al., 2020), is an example of developers improving an inconvenient mHealth app. Users reported inconvenience with manually logging meal details (Chen et al., 2019). The developers overcame this with features that automated food logging, including showing lists of users' frequent foods and the ability to scan barcodes of packaged food to log nutritional information (see Figure 7.5). These additions led to users perceiving MyFitnessPal as more

convenient as the process was simplified making the app easier to use (Evans, 2017). This example demonstrates how convenience underpins app ease of use and usefulness. Hence, mHealth apps should be developed to be multi-device compatible, and in a manner that automates or minimises steps in using the app to increase its convenience.

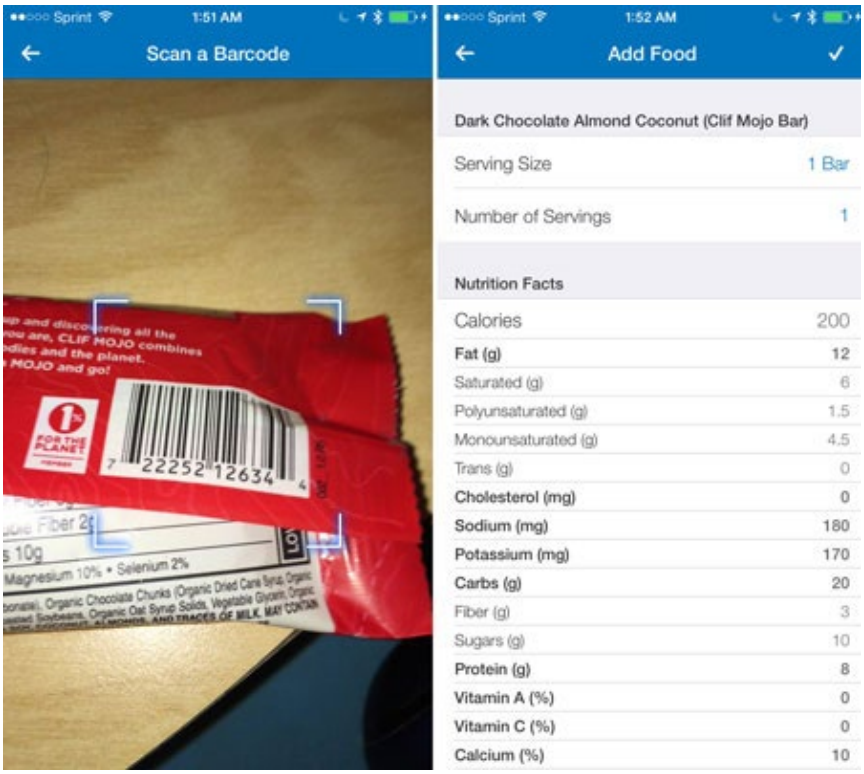


Figure 7.5: MyFitnessPal App

Aesthetics

Aesthetics is also an important factor for mHealth app developers. Research has investigated the influence of many aspects of mHealth app aesthetics, such as colour and layout, on app evaluations and usage behaviours (see Alsswey et al., 2020; Rizzo, 2020). These studies have shown that pleasing aesthetics encourages more positive evaluations and usage behaviours that support opportunities for an mHealth app to become useful. Headspace is an example mHealth app that scores highly on the aesthetics domain (Mani et al., 2015) of the Mobile App Rating Scale, a tool for assessing mHealth app quality (see Stoyanov et al., 2015). Headspace is a mental health app that uses a simple design and displays information in a structured manner, as if the content were stacked in order (see Figure 7.6). App visuals should have order or structure (Kumar et al., 2018) with a simple design that eases navigation (Taylor

& Levin, 2014). The Headspace app is recognised for its design (Kellen & Saxena, 2020), making it extremely popular among many competing mental health apps (Lau et al., 2021). The implication for app developers is that having users' preferred colours and layout presented orderly is important for increasing ease of use and enabling users to achieve health goals.

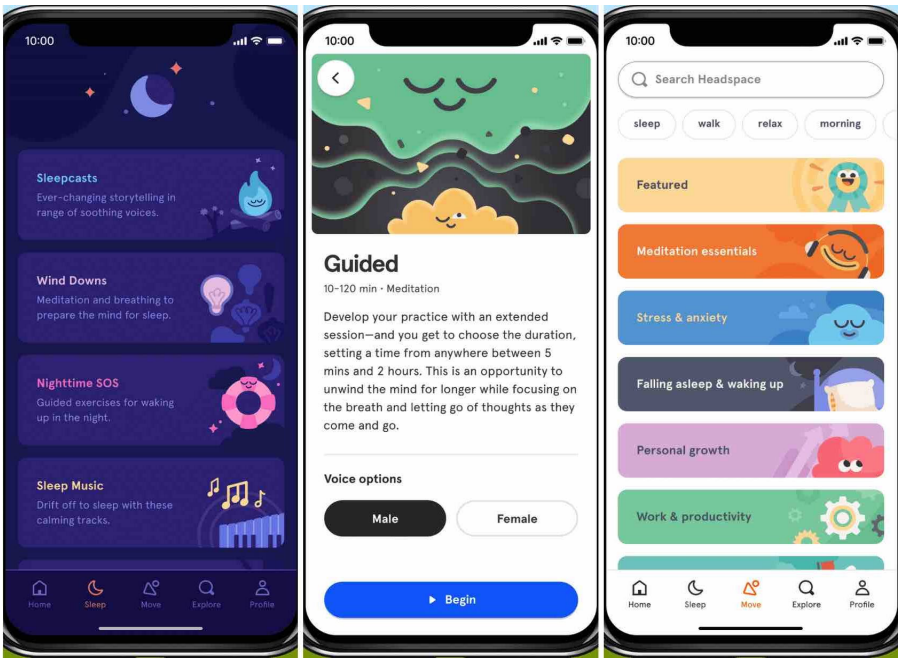


Figure 7.6: Headspace App

Gamification

This thesis found that positive perceptions of gamification promoted perceptions of mHealth app ease of use and usefulness. A substantial literature proves that gamification of mHealth apps promotes app engagement and enables positive health change (Bitrián et al., 2021; Gorman et al., 2020). To create these outcomes, mHealth app developers should use gamification techniques to enhance user perceptions of ease of use and usefulness. Examples of gamification in mHealth apps are digital rewards, goal setting and progress tracking (Hoffmann et al., 2017; Sama et al., 2014). mHealth apps that use these techniques are more effective in achieving health goals and have longer lifecycles, making the apps more effective (Resnick et al., 2021). Reducing tasks to a step-by-step level and giving hints for easier navigation are effective gamification techniques to make apps more user friendly (LaBelle et al., 2020; Michelle et al., 2014; Rasul et al., 2021). This shows how gamification underpins

perceived ease of use and usefulness of mHealth apps. An example mHealth app that uses these techniques effectively is SmartCat, an anxiety management app for children. SmartCat uses coaching techniques to support therapy-based games. The app also uses a system of levels and gradual reward giving supported by an easy-to-use design for children with relevant anxiety management goals for their age (Pramana et al., 2018; see Figure 7.7).

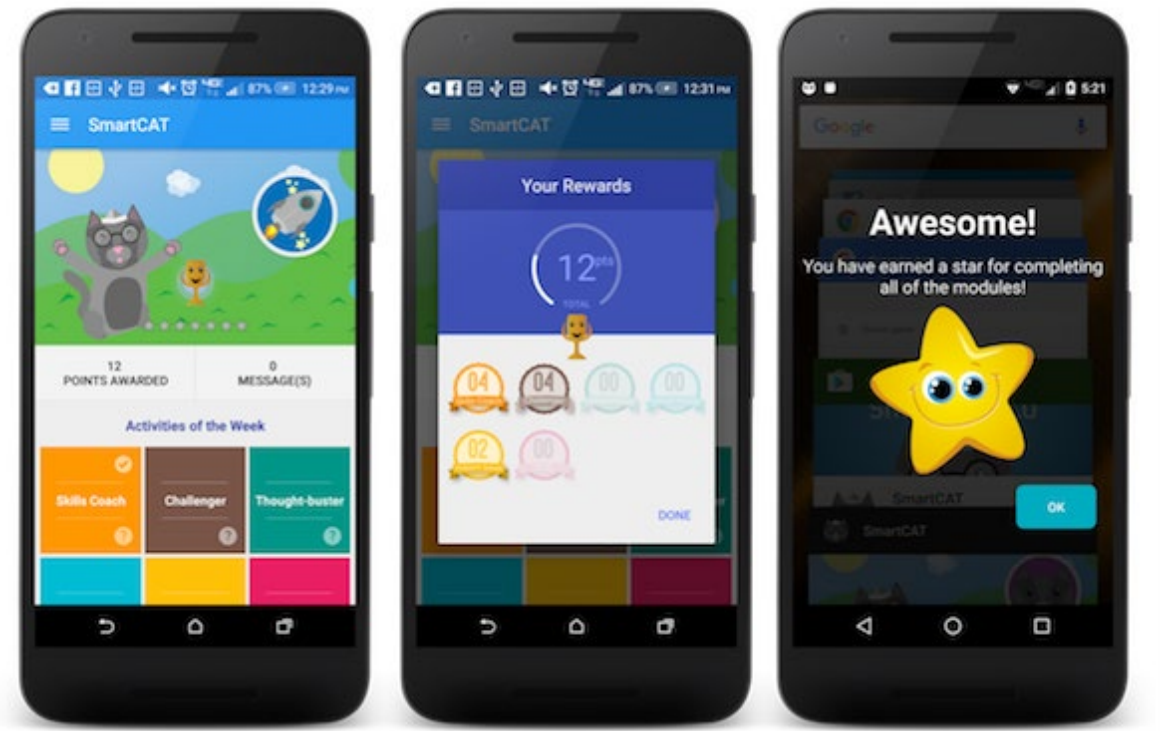


Figure 7.7: SmartCat App

Ease of Use

Gamification techniques create a high perception of perceived ease of use and usefulness but can also tangibly make mHealth apps easier to use. This is important because perceived ease of use is a driver of mHealth app intention and adoption (Anderson et al., 2016; Palos-Sanchez et al., 2021). For example, similar to gaming, mHealth apps could have a simple user mode that limits the options and functions. As users begin to navigate more confidently, they are able to upgrade the mode or receive suggestions for adding functions (Hirose & Tabe, 2016). Another technique is to create a user profile, similar to a character profile in a game. This is common in mHealth apps that store user data to minimise user input and interaction (Ozturk et al., 2016). Monitor Your Weight, a weight loss app, is an example of this technique that

maintains detailed records of users' weight and health details and uses them to set appearance and weight loss goals (Honary et al., 2019; see Figure 7.8).

Figure 7.8: Monitor Your Weight App

Usefulness

This thesis confirmed, alongside previous research (see Foster, 2018), that perceived usefulness of mHealth apps predicts intention, which is important for stimulating consumer action. People use mHealth apps expecting them to facilitate certain health goals. Hence, an mHealth app must fulfil these goals to be useful. For app developers, creating functions that are tailored to the particular health issue and health goal are essential for making an mHealth app useful (Walrave et al., 2022). Further, apps with larger numbers of interactive functions improve user attitude, which in turn can encourage app usage (Whittaker et al., 2021). Thornton et al. (2017) demonstrated this by reviewing quit smoking apps to identify that the popular apps hosted multiple functions tailored to quitting smoking. Further, Peiris et al. (2019) trialled a multifunctional quit smoking app with functions uniquely developed for a target user group, reporting better cessation rates than generic apps (see 7.9). Hence, these mHealth apps were more popular and useful. From these insights, it is clear that the number

and quality of functions and how well these functions are tailored to specific health issues are critical factors that determine usefulness of mHealth apps.

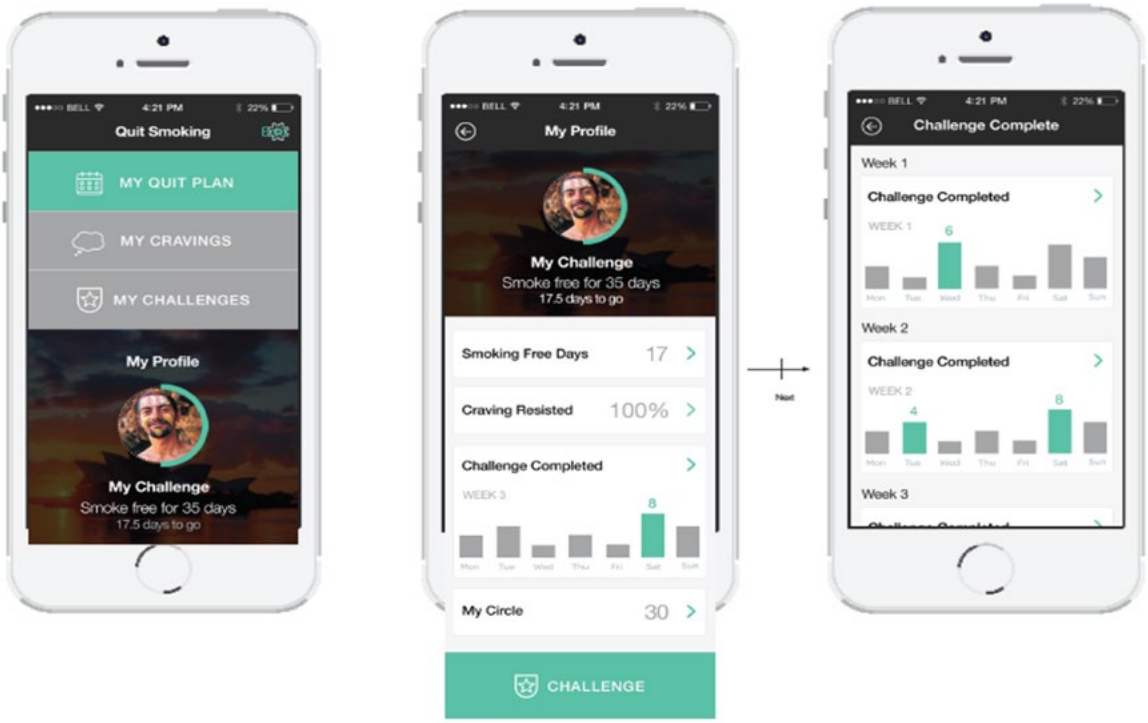


Figure 7.9: Quit Smoking App

Design

The qualitative findings reveal how mHealth app design, specifically colours and layout, can affect target users' perceptions of mHealth apps. Specifically, the findings include the preference for a clinical-looking app; empty spaces, spread icons, white background and dark blue tones for text and shapes. Regarding colour, research has also noted a positive effect of blue designs in mHealth apps (see Rizzo, 2020). Regarding layout, the on-screen display of mHealth apps is important to target user attitudes (Alsswey et al., 2020), and apps with organised displays and reduced content permit ease of navigation (Kumar et al., 2018; Taylor & Levin, 2014). According to Information Processing Theory, visual complexity creates uncertainty (Nasar, 1987). For apps, this leads to reduced perceived ease of use and usefulness (Ghose et al., 2013). Hence, it is important for app developers to look beyond functionality and consider user preferences such as design (Bhandari et al., 2015). The blue-on-white scheme and spaced on-screen layout from the quantitative stimuli in this thesis may be an ideal design for mHealth developers to adapt to their apps. Overall, these insights

highlight how important it can be for mHealth app developers to identify designs that are attractive to their specific target users. Design attractiveness is also an important aspect of mHealth app advertising for marketers and is discussed in the next section.

7.4.2 Implications for Marketers

Section 7.4.1 presented arguments for how mHealth app developers should consider using antecedents—including perceived convenience and aesthetics— as well as perceived ease of use and perceived usefulness to increase app usage and prolong app lifecycle among users. The importance of these factors for mHealth marketers is discussed here with recommendations.

Convenience

This thesis found that perceived convenience predicted mHealth app perceived ease of use and usefulness. A major component of app convenience is its availability to users, and apps that are not available to download with ease are not convenient (Jung et al., 2014). Apps that are widely available (e.g., hosted by multiple app stores and dedicated websites) are typically the more popular apps (Larsen et al., 2016). This heightened availability facilitates download. Hence, if an mHealth app is poorly disseminated or people struggle to find it, this poor availability may reduce the perceived convenience of the app. Hence, marketers should ensure that their mHealth apps are easily available through app stores and other platforms where target users are likely to encounter them.

Aesthetics

The Headspace app scores highly on the aesthetics domain of the Mobile App Rating Scale (Mani et al., 2015). Noting that aesthetics predicted mHealth app perceived ease of use and usefulness in the current thesis, the marketing of Headspace provides an example of effective advertising of aesthetics. In fact, users have reported that the appealing advertising of Headspace influenced their initial perceptions and usage of the app (Kellen & Saxena, 2020). Headspace advertisements replicate the app's design and colours closely, using the signature orange sun but few other elements, on a light background (see Figure 7.10). Information Processing Theory suggests that simple designs like this increase certainty (Nasar, 1987). For

apps, this leads to enhanced perceptions of usefulness and ease of use (Ghose et al., 2013). Headspace is one of the most popular mental health apps (Lau et al., 2021). As exemplified by Headspace, mHealth app marketers can create advertising that closely resembles the app's aesthetics that make it distinct from competing apps.

Figure 7.10: Headspace Advertisement for Aesthetics

Ease of Use

Advertising that shows the user and technology interacting in an effortless manner—that is, imagery that shows simple and quick navigation of the app and its features—is highly effective for demonstrating ease of use (Tsai et al., 2016). For mHealth apps, promotional materials can highlight ease of use through scenes where the use of the app does not disrupt the existing habits of the user (Rasul et al., 2021; see Figure 7.11). In this way, target users can see how the app fits in with routines to support the desired health behaviour. Another technique is to show advertising with informative gestures to exhibit a supported experience; for example, *what's new* and *tap to learn more* (Rasul et al., 2021). This technique suggests that the app guides the user through the process to make tasks easier.

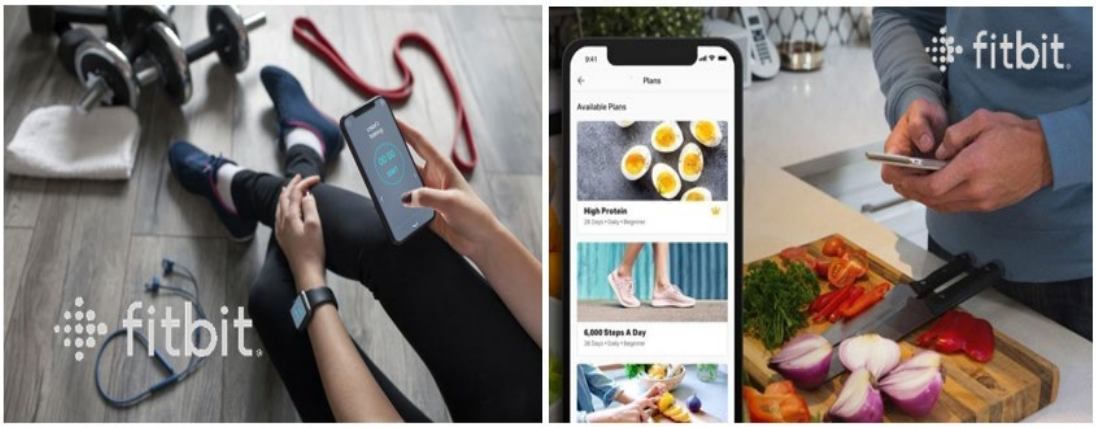


Figure 7.11: Fitbit Advertisements

Usefulness

This thesis showed that perceived usefulness affected both attitude and adoption intention of mHealth apps. Perceived usefulness is a key contributor to mHealth app adoption (Palos-Sanchez et al., 2021). To show that an mHealth app is effective in enabling positive health change, advertising can communicate results from using the app, or some other form of evidence (Gurewitz, 2019). Headspace provides an example of this type of advertising. Headspace has taken a unique approach by quantifying progress in its advertising to show the usefulness of the app. This style of advertising is unique to the Headspace brand and separates it from other competing mental health apps (Gurewitz, 2019; see Figure 7.12).

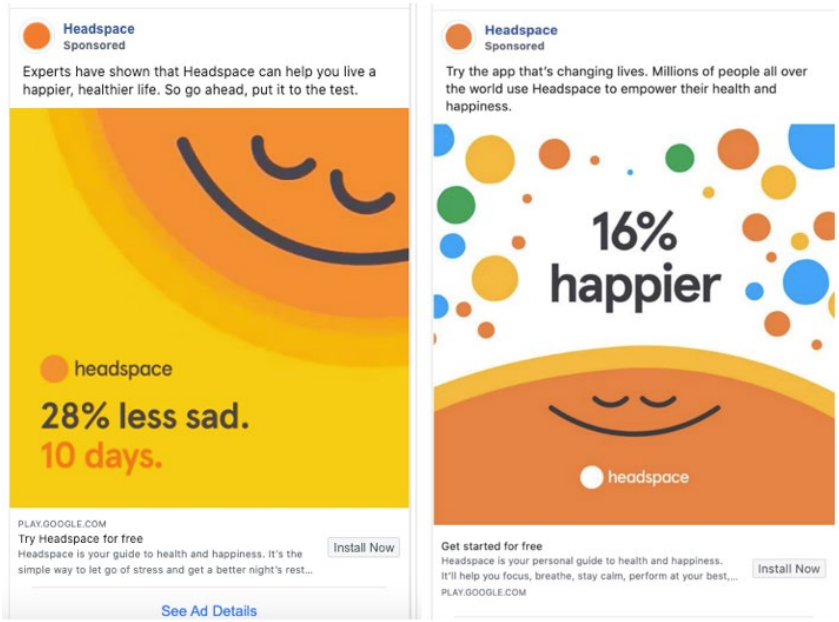


Figure 7.12: Headspace Advertisements for Usefulness

7.4.3 Policy Implications

The samples in this thesis showed some resistance to adopting mHealth apps and reduced familiarity with mHealth. These findings suggest that some practices should be formally put in policy to support like-minded individuals. Policy design should acknowledge the diversity of experiences and challenges that people can encounter when using mHealth apps, particularly those transitioning to apps from traditional treatment services and platforms or those unwilling to transition (Jacob, 2020). Two implications can be seen here. First, policy should allow for more technical guidance and support for less-experienced users. Particularly for clinics that prescribe mHealth apps and support groups for addictions that endorse mHealth apps, clearer guidance and timely assistance should be provided as part of the service. In groups that already provide this service, it typically forms part of a larger digital health coaching program (Tu et al, 2018). Second, it is important that traditional platforms and face-to-face services are not discontinued in place of apps or any eHealth technology (Tu et al., 2021). Healthcare systems should be organised through infrastructure and services that cater to the diversity of technology experiences and allow mHealth and other health technology to operate as support tools.

7.5 Limitations and Future Research

There are limitations to this thesis that provide opportunities for future research. These include generalisability, practical and methodological limitations. First, there are limitations with respect to the generalisability of the findings and insights offered. The research design relies on survey participants to accurately self-report and self-administer surveys (Malhotra & Birks, 2007). With self-reporting, people tend to provide socially desirable responses to questions, which biases the results (Neuman, 2014). This is particularly relevant in research dealing with gamblers, who are known to withhold information about their behaviours and misreport information out of perceived shame (Pulford et al., 2009). The limitation here is that data were provided by respondents who may not have been totally truthful; however, the sample size and strength of the significance values suggests this limitation should not be considered severe. To minimise concerns in this regard, participants at all stages of data collected were assured that privacy and anonymity would be maintained. Further, minimal questions regarding personal gambling behaviour were asked, and the scales used were those

confirmed in the literature as reliable and valid. Future research could overcome this potential problem by conducting observational research of participant behaviours rather than using a self-reporting method.

Another generalisability limitation is the representativeness of the survey sample. The thesis did not consider cultural identities such as ethnicity or race. Gambling behaviours vary across cultures (Raylu & Oei, 2004) as do regulations (Binde, 2005), treatment programs and barriers (Kim, 2012). Further, cross-cultural studies have noted how culture can influence and negate the accuracy of the TAM (Al-Kubaisi & Abu-Shanab, 2021; Arifah & Juniarti, 2021). Future research might overcome this limitation through greater observation of identity, particularly culture. Other factors, such as income (Vuković et al., 2019), health literacy (Cho et al., 2014) and even marital status (Schmidthuber et al., 2020; Shemesh & Barnoy, 2020) are known to influence technology adoption but were not measured here. These concepts and others may be more applicable in other contexts around technology and health conditions. The scope of this thesis restricted the sample and the concepts measured; hence these findings cannot with certainty be assumed fully valid for other mHealth app research. Future research should be more inclusive of participant identity factors.

A practical limitation of this thesis and other studies in mHealth is that they stay at the conceptual stage and do not see development and market trial (see McClure et al., 2016). Researchers should consider conducting clinical trials (see Tsai et al., 2022) to determine the effectiveness of mHealth gambling apps in terms of reducing gambling risk levels and subsequent gambling harm. Although beyond the scope of this technology adoption study, research that seeks and measures reduction in gambling harm in gamblers' environments is critical for consumer wellbeing (Tulloch et al., 2021) and should be considered in future. Furthermore, research could compare the outcomes of clinical trials with expert reviews to determine if the distinct findings from these different investigations align.

There is a methodological limitation to this thesis regarding the use of cross-sectional data. Cross-sectional data provide a snapshot of a single point in time rather than considering an ongoing dynamic process (Bowen & Wiersema, 1999). Research around health conditions, such as gambling, is more susceptible to biases and inaccurate recall, particularly with long-term health conditions (Wang & Cheng, 2020). Unlike cross-sectional research, longitudinal

research can record the necessary data at multiple important points in time. Future research could consider a longitudinal design, which has potential advantages including identification of time-based patterns and reduced recall bias (Kline, 2015).

The final limitation is around the range of antecedents tested in this thesis and how they have been interpreted. The antecedents here do not represent all potential concepts that may drive mHealth app adoption. This poses a theoretical limitation to the research. Hence, this thesis identifies the urgent need for research on a wider range of mHealth app adoption drivers, such as risk aversion (Morosan & DeFranco, 2014), personal attachment (Sultan et al., 2009), connection with device (Gao et al., 2013), perceived value (Iyer et al., 2018) and perceived benefits (Tseng & Lee, 2018). If examined, these antecedents could further extend the applicability of the TAM in marketing research. Further, the concepts included in this thesis could be interpreted and thus measured differently. For instance, this thesis project measured trust as a user's level of trust in apps. A recent study repositioned trust as the consumer's trust in a supplier or brand and found this to be a factor in predicting usage of COVID-19 apps (García-Paucar et al., 2022). Aesthetics is another example of a feature that can be interpreted differently among users. This study measured users' valuations of the aesthetics of the stimuli app, whereas other studies have measured how aesthetics improves technology usability (Cyr et al., 2006). A comparison of these and other different interpretations of trust and aesthetics would provide greater insight into how these antecedents contribute to mHealth adoption.

7.6 Concluding Comments

Despite the ample benefits of using mHealth apps, and their increasing accessibility, their adoption rate is lower than that for other types of app. In addition, the literature on mHealth app adoption takes a narrow theoretical approach. Specifically, empirical research has tended to investigate drivers for their direct influence on mHealth app usage and post-adoption behaviours. Few of these studies have taken a different approach and investigated how these drivers underpin technology adoption theories as antecedents to create a holistic view of the adoption process. Guided by the TAM, this thesis identified and analysed a range of untested antecedents to develop a new model of mHealth app adoption. This thesis and model were developed in a gambling context where gamblers' attitudes and perceptions towards an

mHealth gambling app were tested. However, the findings are relevant for other contexts of mHealth app adoption and can be used to inform future research. Twenty-four focus group participants and 252 survey respondents who were all help-seeking gamblers contributed to the findings. This resulted in a dataset tailored for a unique population of consumers experiencing harm from gambling and actively seeking support to manage their behaviours. Analysis of the qualitative data identified the best functions and design for the concept gambling quit app and presentation of the stimuli at the quantitative stage. The qualitative findings illustrate the importance of mHealth app functionality and design. Analysis of the quantitative data provided support for a number of hypotheses in the thesis. This outcome informed the theoretical findings and practical recommendations.

There are important theoretical findings in this thesis. The first is novel antecedents to the TAM relevant to mHealth app adoption: subjective knowledge and involvement, perceived convenience, personalisation, aesthetics and gamification. Second, though health status severity is shown by conflicting literature to have different effects on technology adoption via moderation, this thesis found no moderation in this context. Third, the thesis found that multi-group testing by splitting the sample according to adoption behaviour (present or absent) or platform product preference (digital or analogue) revealed differences between the direct paths in the model. These findings also demonstrate the need for researchers to test and extend models for fast-moving technology and innovations in ever-changing consumer contexts. Further, the thesis led to creation of a roadmap for mHealth app developers and marketers. To that end, the thesis discusses the findings with practical recommendations for app developers and marketers to embed the antecedents into the creation of mHealth apps and their advertising. Actioning these recommendations is likely to strengthen the lifecycle and dissemination of mHealth apps with the outcome of increasing adoption rates.

Increasing mHealth app adoption is important because of the value that mHealth apps offer on both individual and societal levels. While there are some disadvantages to mHealth, such as assumptions around user capability, data privacy and the risk of apps replacing critical platforms, these apps can provide viable and highly accessible healthcare to individuals for whom other health services may not be available. In particular, mHealth apps support consumer groups that are vulnerable to unhealthy consumption behaviours, such as problem

gambling, and are available on a global scale. For society, mHealth apps are shown to reduce economic expenditure and logistical pressures on public health. From these insights, we come to understand the value of mHealth apps for making positive change. However, the low adoption rate of mHealth apps works against this change. It is this disconnection between the value of mHealth apps and their adoption rates that is key for this thesis to make meaningful contributions. Any research that seeks to improve mHealth app adoption is valuable research. Hence, this thesis contributes to the understanding of mHealth app adoption to create positive change for consumers and society.

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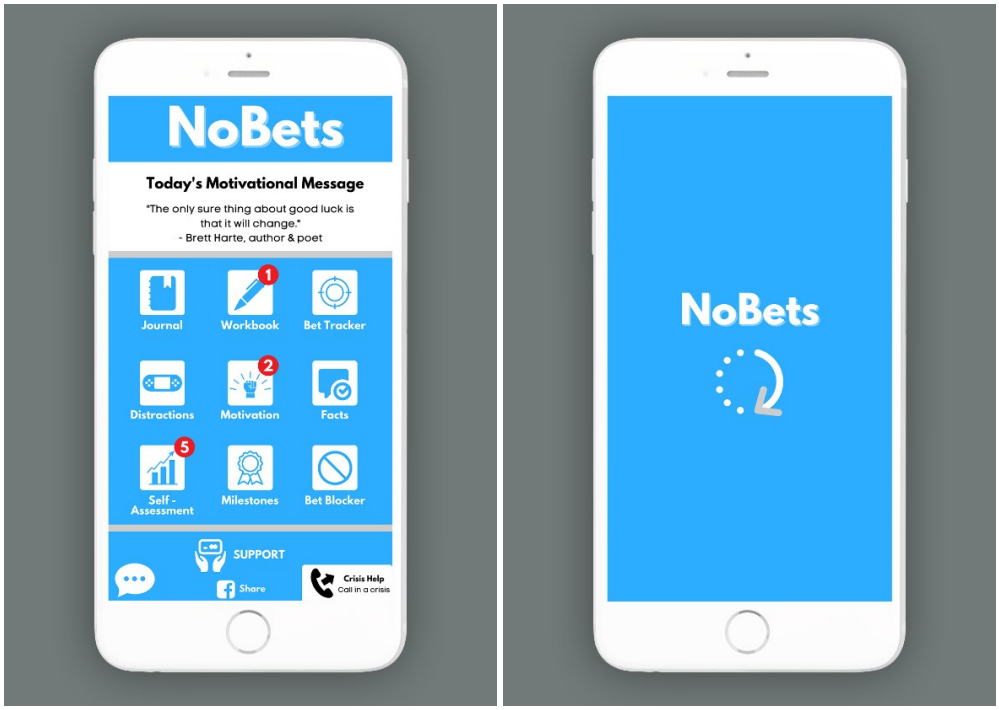
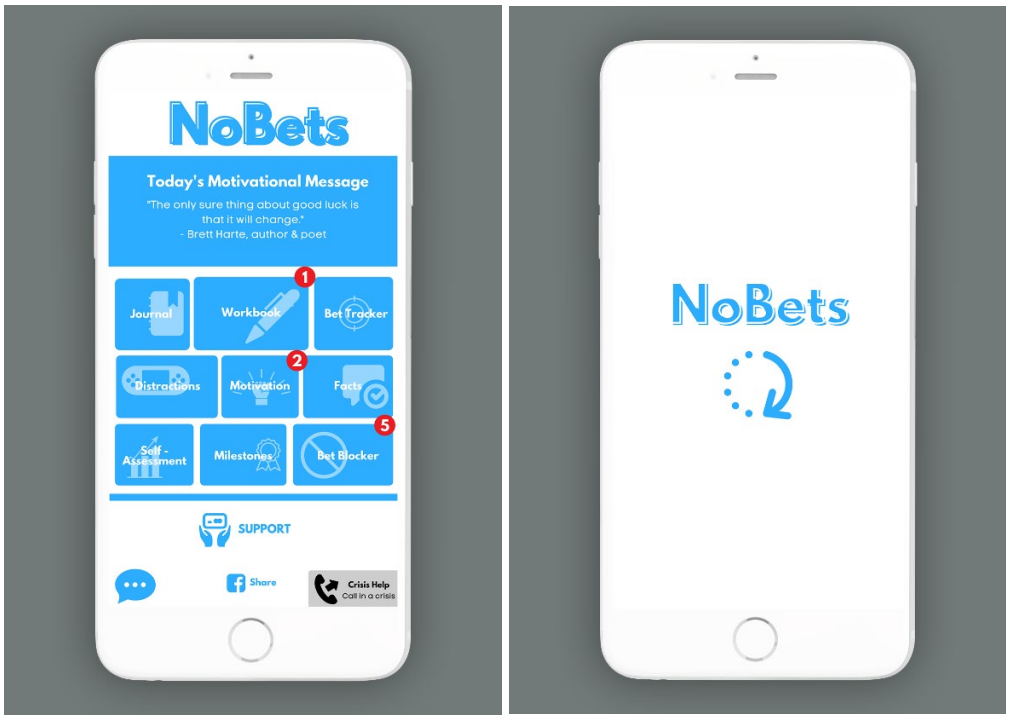
Appendices

Appendix A: Stimulus Design Styles

White on Blue Background



Blue on White Background



Yellow on Purple Background

Red, Green and White

Appendix B: Focus Group Stimuli

This function is called **Milestones** and focusses on your achievements. It rewards you for achieving timeframes of not gambling. You report daily to help make you more accountable for your time and money. You are rewarded for achievements with trophies, and timeframes are customisable.

Milestones also lets you choose if you want to share your trophies on social media to let others know what you have accomplished.

Image 1) a list of trophies that have been achieved and you can choose to share on social media

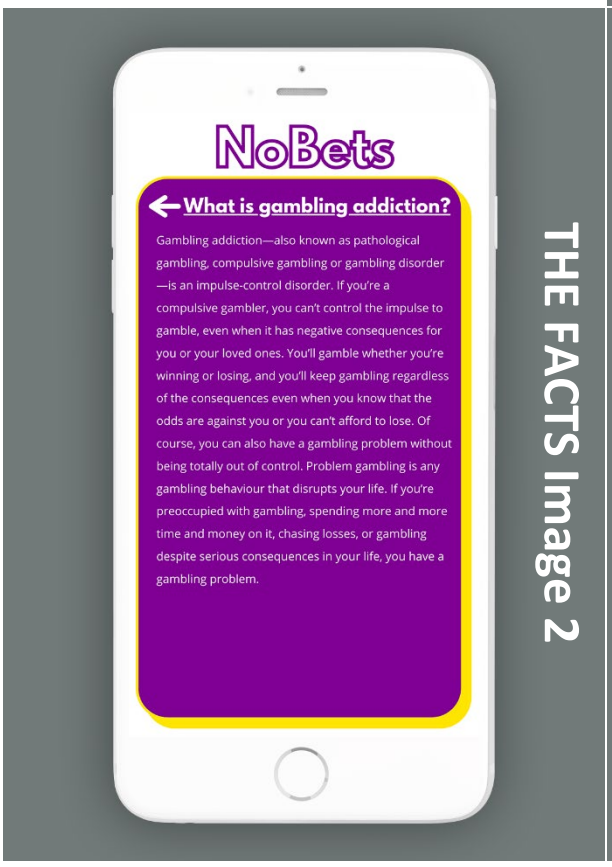
Image 2) a list of timeframes that haven't been reached yet

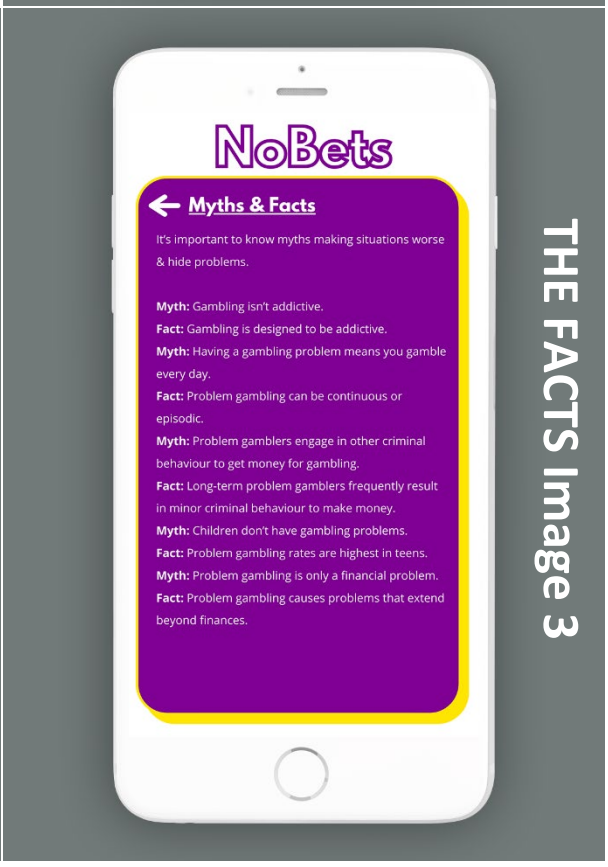
The function is called **The Facts** which is an information database on the behaviours, risks and symptoms surrounding gambling. The Facts includes useful information on a range of different topics, such as clinically defining gambling addiction, goal setting tips and tricks and identifying signs of addiction.

Image 1) a list of the different information topics

Image 2) an example of the topic, 'What is gambling addiction?' which gives clinical definitions

Image 3) an example of the topic, 'Myths & Facts' which clarifies truths and lies around gambling addiction



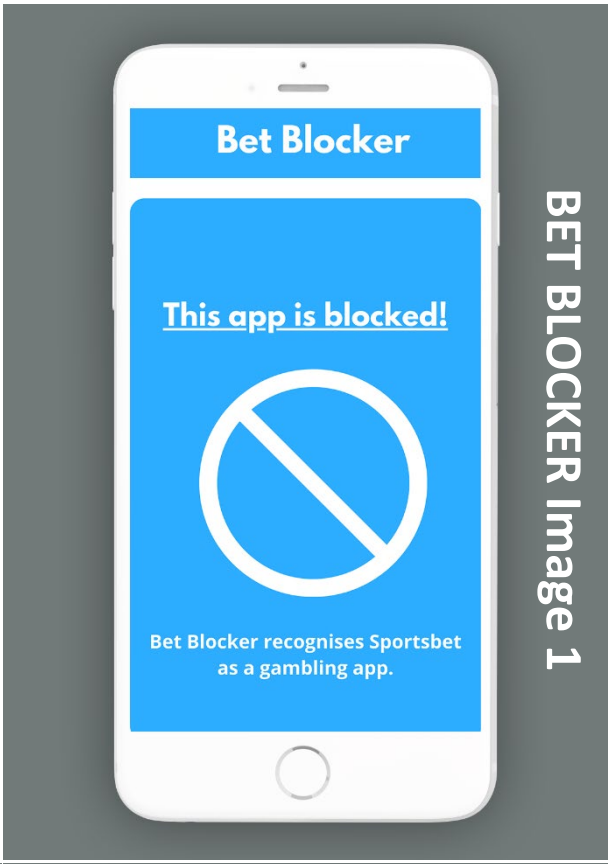


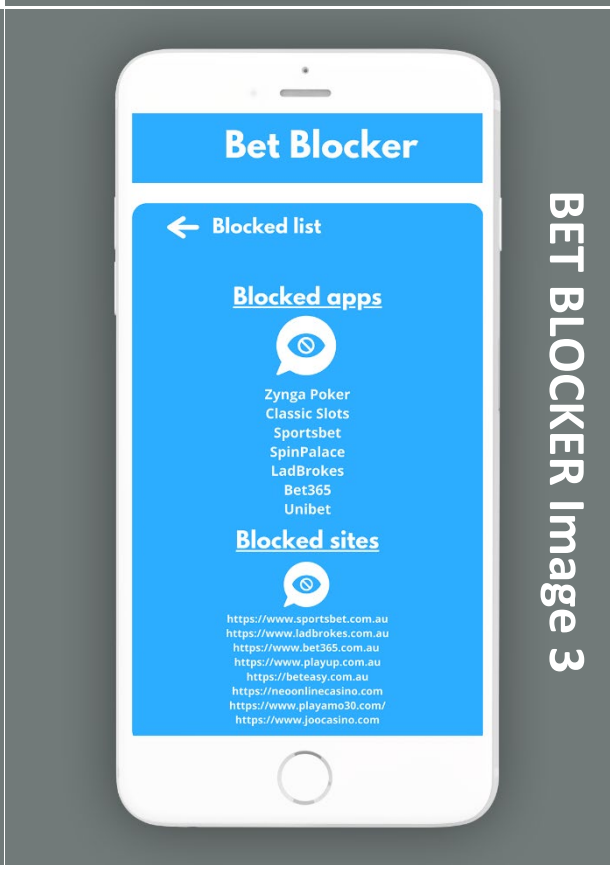
This function is called **Bet Blocker** which is easy-to-use and non-invasive. You can set Bet Blocker to block your device from accessing gambling websites and apps. The app has a default list of known sites and apps, and you can also add website sites and apps to this list. This function prevents you from impulsively deleting the app by delaying uninstallation.

Image 1) Bet Blocker recognising the Sportsbet app and stopping access

Image 2) Bet Blocker recognising a casino website and stopping access

Image 3) An example list of blocked apps and sites





This function is called **Support** which is a directory of gambling support community groups and welfare organisations. These contacts offer 24/7 support through phone, chat and face-to-face services. Some are gambling specialists while other groups offer broader support to gamblers and their families.

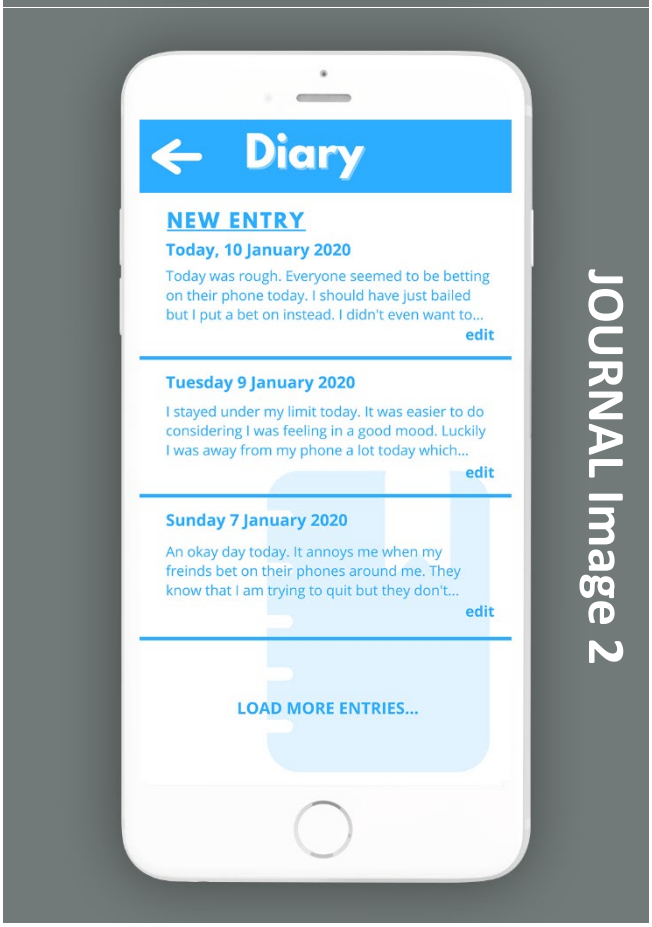
Image 1) the contact list of community groups and welfare organisations in the directory

Image 2) an example of the contact page of an Australian welfare group

This function is called **Journal** which you can use to make regular journal entries about your progress or record a diary about your journey. There are four main benefits to journaling through change; 1) prioritise problems and goals, 2) recognise and track betting triggers, 3) identify self-defeating thoughts, and 4) provide a private outlet self-expression. There are four features which are different types of journal entries; 1) diary, 2) reflection, 3) gratitude and 4) goals.

Image 1) the four different features or journal types to explore and their descriptions—diary, reflection, gratitude and goals

Image 2) an example of diary entries

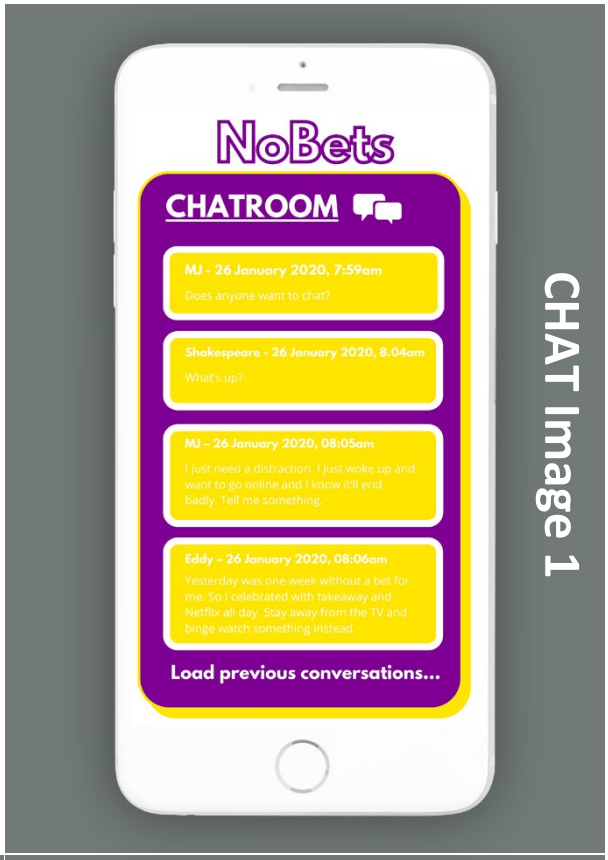


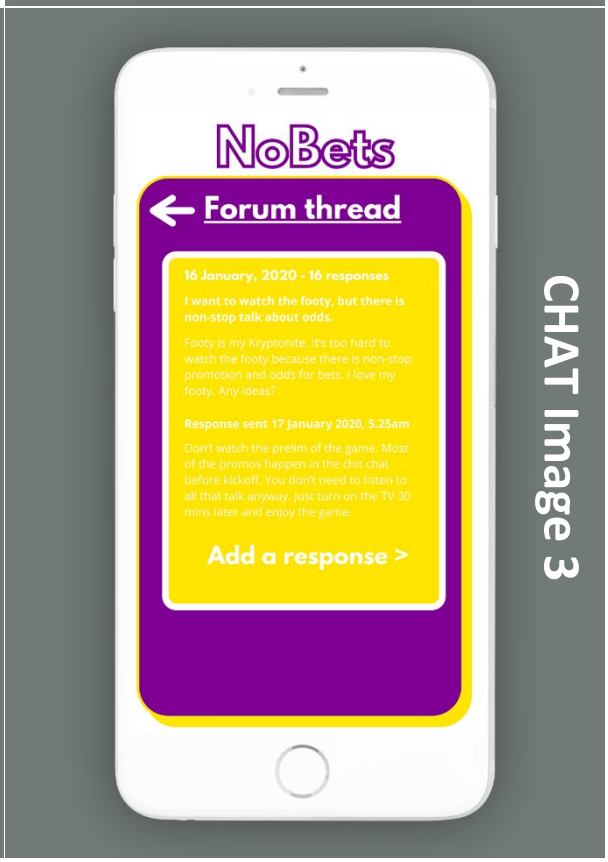
This function is called **Chat** which you can use to anonymously connect with other people using the app who might be sharing your experiences. The first feature is a private and secure chat room dedicated to app users only and is an open space to talk with peers. The second feature is a forum where you can post questions, topics and issues to create dedicated discussion threads or contribute to other threads.

Image 1) an example conversation in the 24/7 chat room

Image 2) an example of forum threads that people have created

Image 3) an example discussion in a forum thread



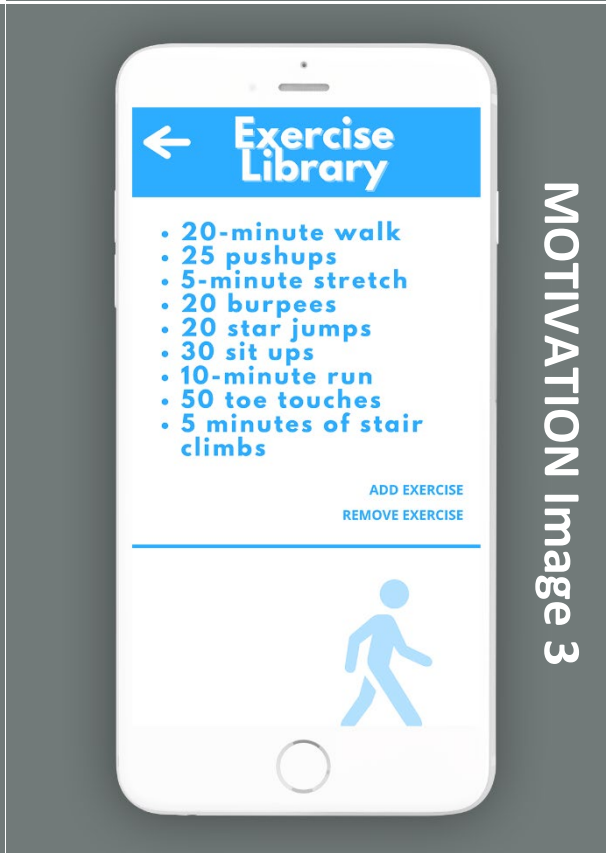


This function is called **Motivation**. It has three main features that offer snippets of motivational support. The first feature displays a daily motivational quote or message on the home screen. The second feature hosts a library of lived experience stories of past gambling issues. The third feature uses the benefits that exercise has for people managing addictions. It is an exercise library that can generate simple exercises to get you moving—you can also customise the exercise library to suit you.

Image 1) the three main features and their descriptions

Image 2) the exercise generator suggesting an exercise

Image 3) the app's default exercise library

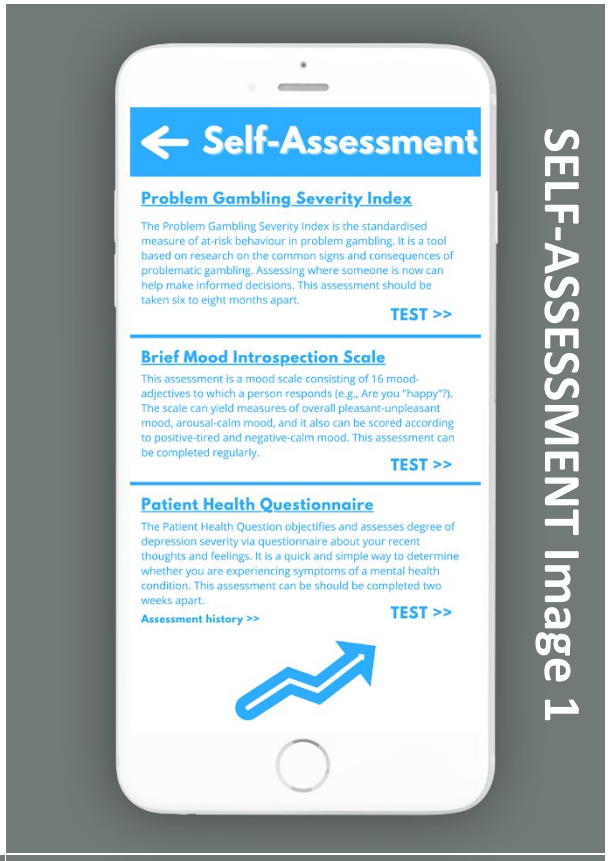


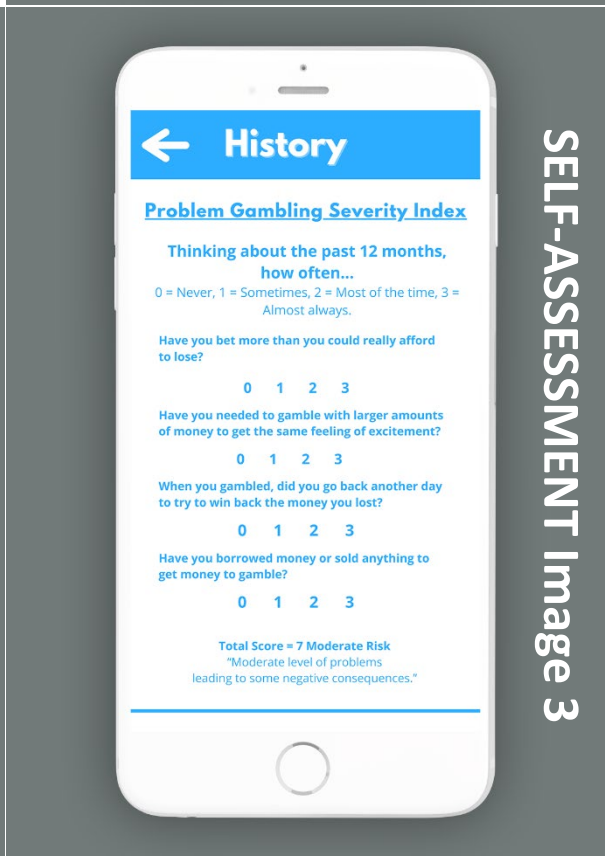
This function is called **Self-Assessment** which has three features to record and assess actions and feelings surrounding gambling and mental health.
The first, measures how severity of gambling. The second, performs a general mental health screening. The third, gives a real-time mood status report. Self-Assessment stores a history of results and shows progress over time.

Image 1) the three features and their descriptions

Image 2) an example history of mental health screenings, their scores and outcomes

Image 3) an example of the gambling severity measure



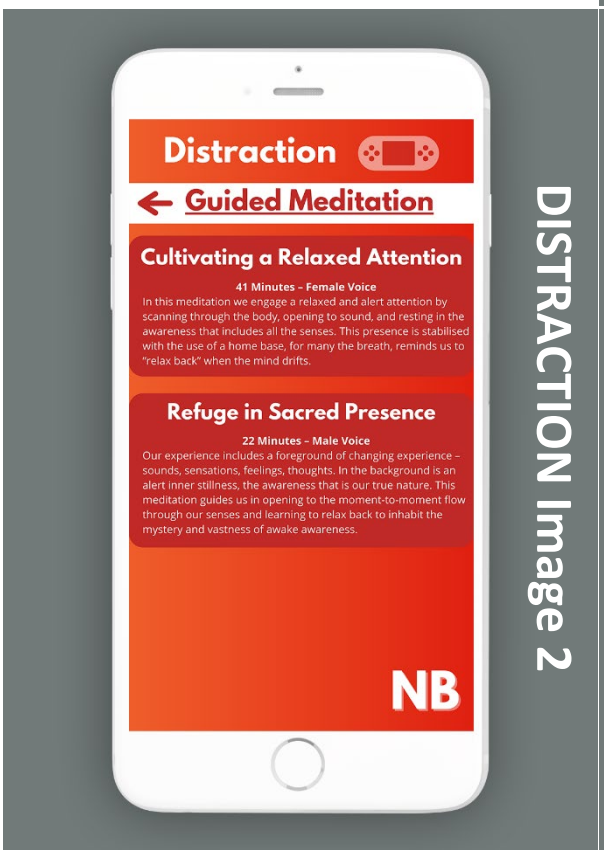


This function is called **Distraction** which you can use for drawing attention and thoughts away from gambling. There are three features to this function. The first feature is guided meditation audios for mental calm and concentration. The second feature is mindfulness audios to help control thoughts of gambling. The third feature contains fun brain training games that use your attention and keep your hands busy.

Image 1) the three features of the function and their descriptions

Image 2) some example guided meditation audios and their descriptions

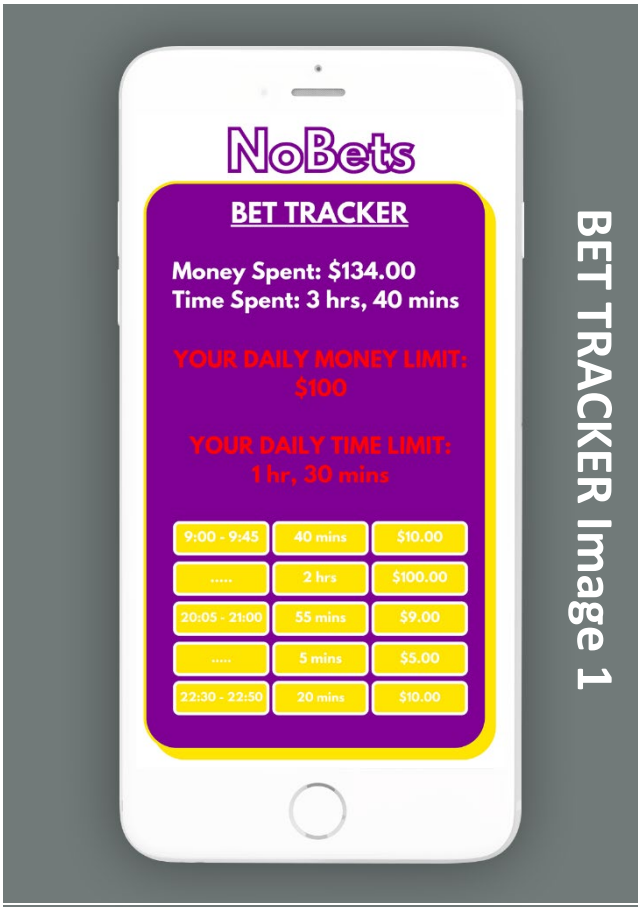
Image 3) different categories of brain games and their descriptions

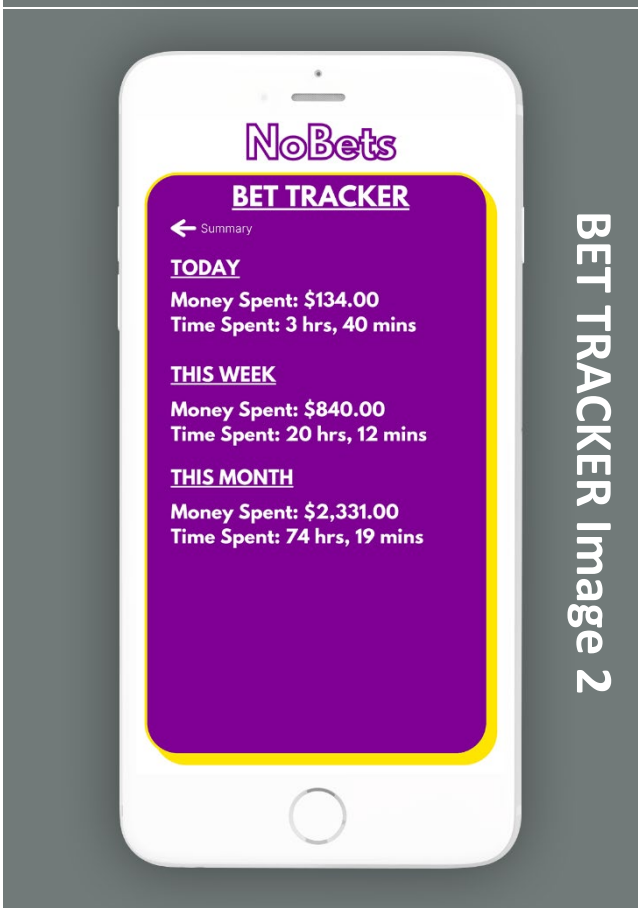


This function is called **Bet Tracker** which you can use to keep a record of time and money spent on gambling. Having these long-term and short-term records help people to be more accountable for their spendings. You can also set personal daily time and money limits that alert you when you reach your daily limit.

Image 1) an example of a daily limit for time and money and their record for the day

Image 2) an example record of time and money spent on gambling



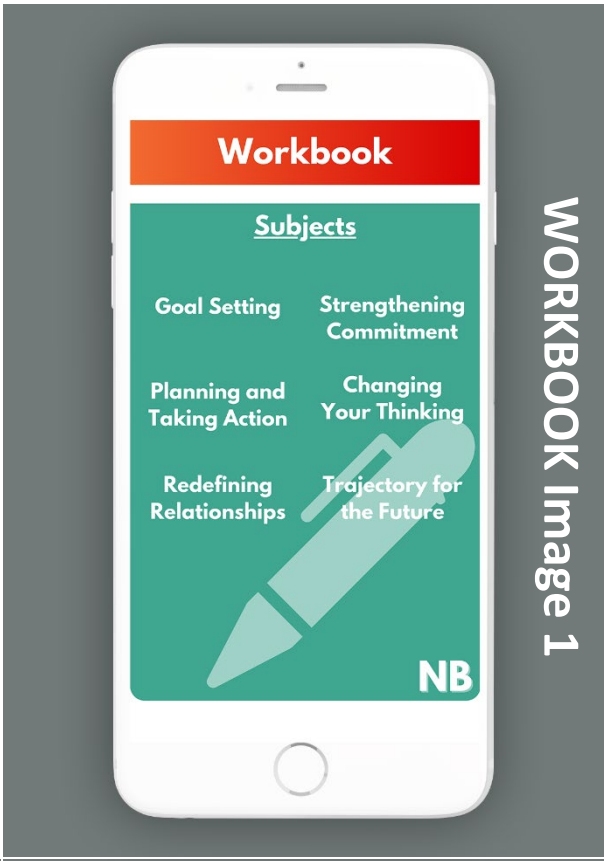


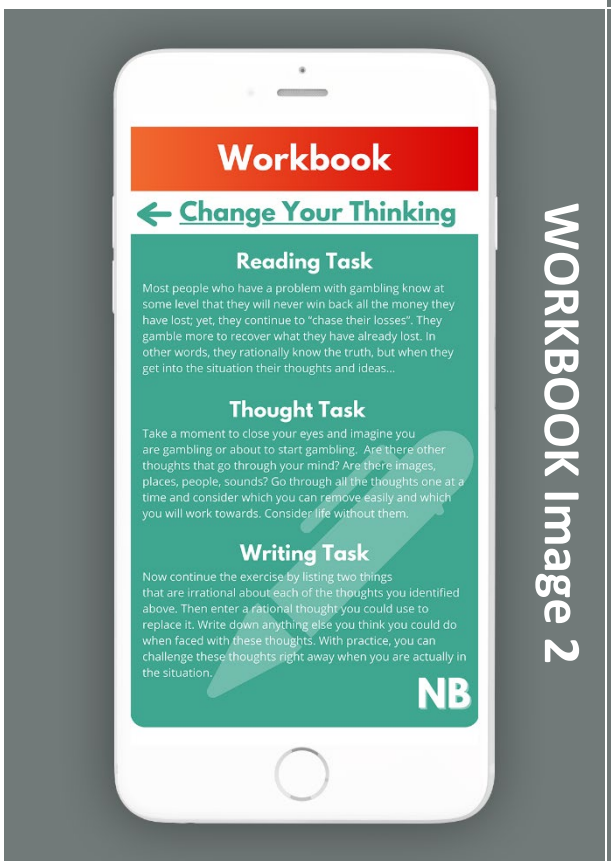
This function is called **Workbook** which provides therapy-based study exercises. You can learn techniques for self-control through reading and writing tasks developed to address gambling addiction. Example subjects include strengthening commitment, planning and taking action and changing your thinking. **Workbook** gives you the choice to share on social media when you have finished subjects.

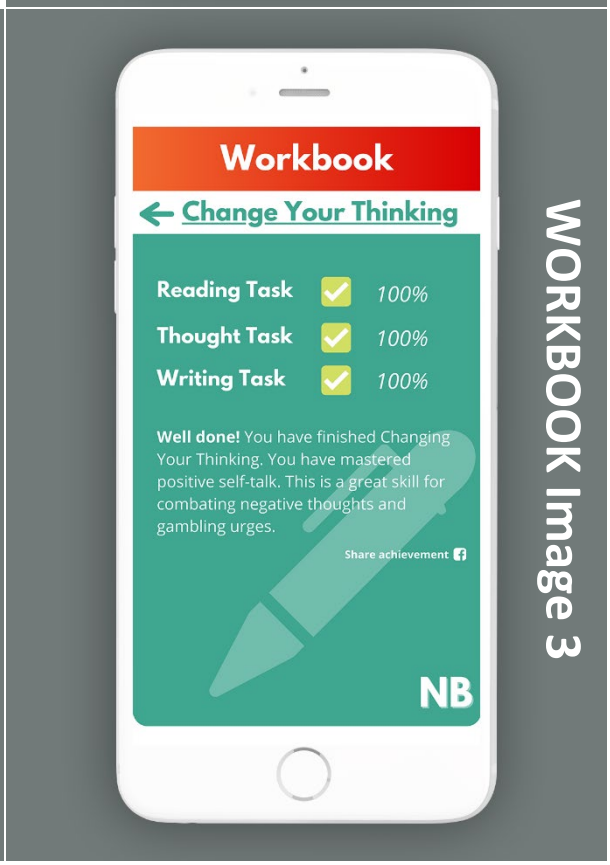
Image 1) the subjects that are available in Workbook

Image 2) descriptions of the different tasks in a 'Change Your Thinking'

Image 3) an example of a completed subject and the option to share on social media

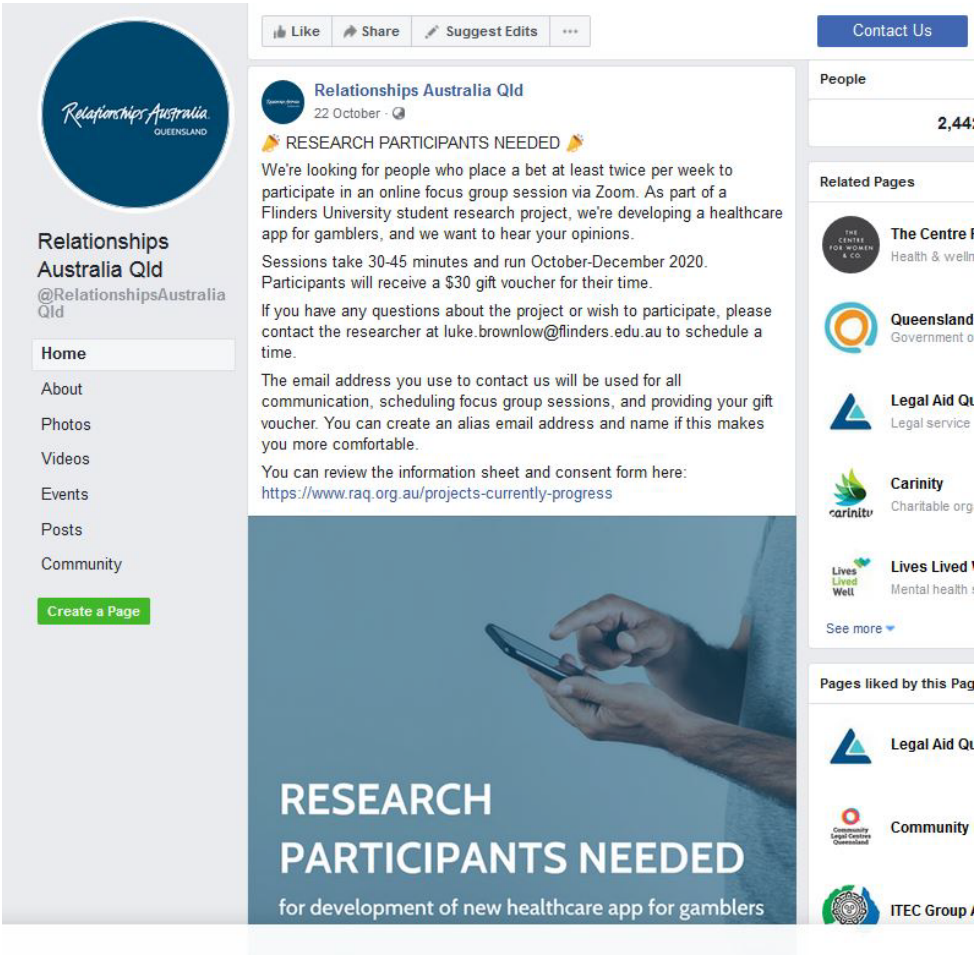




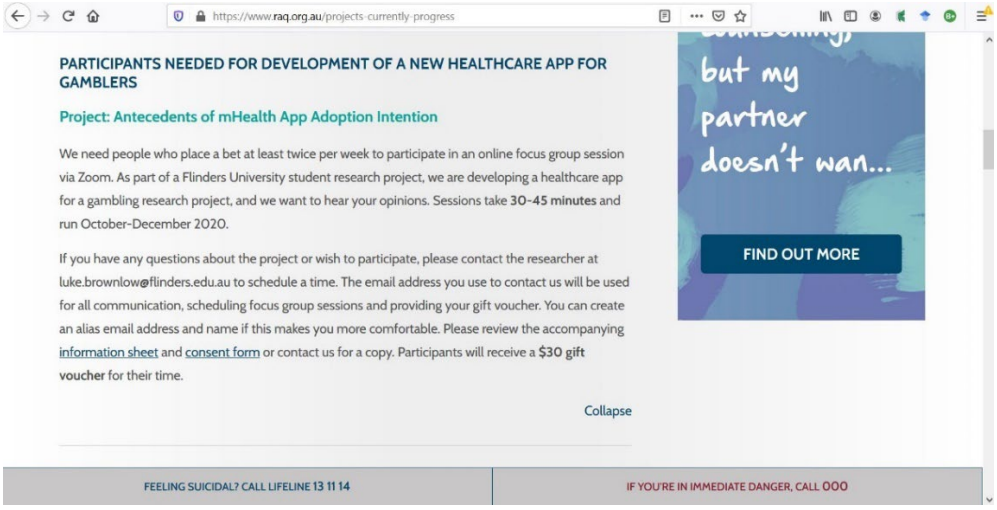


Appendix C: Promotion of Focus Group Sessions

Relationships Australia Facebook Promotion of Focus Group Sessions



Relationships Australia Website Promotion of Focus Group Sessions



Appendix D: Focus Group Consent Form

Focus Group Participant Consent Form

Project Title: Antecedents of mHealth App Adoption Intention

1. I have read the attached Information Sheet and agree to take part in the research project.
2. I have had the project, so far as it affects me, fully explained to my satisfaction. My consent is given freely.
3. Although I understand the purpose of the research project, it has also been explained that involvement may not be of any benefit to me.
4. I have been informed that, while information gained during the study may be published, I will not be identified, and my personal results will not be divulged.
5. I understand that I am free to withdraw from the project at any time; however, it will not be possible to withdraw information provided up to that point.
6. I understand that the focus group session will be audio recorded.
7. I am aware that I should keep a copy of the Information Sheet.
8. I have been given the opportunity to ask questions and receive answers to my satisfaction.
9. I understand participation is voluntary and I can choose not to respond to questions if I wish.
10. I understand that while all information will be treated with the strictest confidence, that anonymity cannot be guaranteed due to the nature of focus groups.

Participant Name: _____ Signature: _____ Date: _____

Appendix E: Focus Group Information Sheet

Focus Group Participant Information Sheet

Project Title: Antecedents of mHealth App Adoption Intention

This research is being undertaken to gather opinions about a mobile application for people to modify their gambling behaviour for any reason. You will be asked questions about your attitude towards mobile apps in healthcare and what factors you think are important for a gambling app. You will be shown a series of images of an app we are designing and asked questions. The session should take no more than 45 minutes, and you will receive a $30 ColesGroup and Myer eVoucher at the end of the session for your participation. You may use a non-identifying email address for all communication and also create a pseudonym and cover your face for the sessions if that makes you more comfortable.

The focus group session will be recorded and direct quotations from the session may be used in the research publications with pseudonyms used instead of your real names. This information will only be accessed by the research student and thesis supervisors. The focus groups will be transcribed into text and securely stored at the University campus. Participation is entirely voluntary. You can withdraw from the session at any point; however, it will not be possible to withdraw any information you provided up to that point. Please be aware there is a risk that that topic may elicit anxiety and/or emotional distress for some, and a list of free and confidential helplines and support groups has been provided.

This research project will be conducted in accordance with the NHMRC National Statement on Ethical Conduct in Human Research available from www.nhmrc.gov.au. For further

information, please contact the PhD student and lead researcher, Luke Brownlow at Flinders University on luke.brownlow@flinders.edu.au. Alternatively, you can contact the research project supervisors, Roberta Crouch | roberta.crouch@flinders.edu.au (08) 8201 2046 and Svetlana De Vos svetlanadevos@aib.edu.au (08) 8212 8111. Should you have any concerns about this research project, you can contact the Flinders University Human Research Ethics Committee at human.researchethics@flinders.edu.au or (08) 8201 3116. *Ethics Project Number: HEL2621-2. Ethics Approval Date: 7/10/20*

Appendix F: Gambling Support Information with Contacts for Participants

Do I have a problem with gambling?

If you can answer 'yes' to any of the following questions, your gambling may start to become a problem. Do you: Spend more money and time than you intend to on gambling? Feel guilty and ashamed about your gambling? Try to win back your losses? Miss important things like family time, work, leisure activities or appointments because of gambling? Think about gambling every day? Have arguments with friends and family about your gambling? Lie or steal to get money for gambling? Get into debt because of gambling?

How do I know if I am in danger of developing a gambling addiction?

It's sometimes hard to know if your gambling is getting out of hand. A common reaction is to minimise it or deny that it's causing harm. Some people may hide the gambling or start to lie about how much time and money they are spending on it. You might say to yourself "I enjoy this, it's just my way of relaxing" or "I'll stop when I have the next big win" or "It makes me forget my worries" or "I can stop whenever I want". These are all forms of denial.

What can I do?

There are many things you can do to prevent gambling problems building up and to get things under control. These activities have worked well for many people: 1) Talk to someone you trust about your gambling. This will be a first step in finding the best way forward to cut down or stop. 2) Call a helpline. They can talk to you confidentially or send out self-help tools and information. 3) Contact a gambling help service. Just one session with a professional counsellor can help you assess your situation and set up a plan to suit your needs. 4) Have a close friend as an ally who will check in with you and support you to stick to your plan. 5) See a financial counsellor to look at money going 'in' and 'out' so you can decide if the balance is right and get help to manage any debts. Details of support services that you can contact free of charge are provided below.

Contacts

Gambling Helpline Australia Call 1800 858 858 www.gamblinghelponline.org.au	Lifeline Australia Call 13 11 14 or Text 0477 13 11 14 www.lifeline.org.au
St. Vincent de Paul Society 1800 VINNIES (1800 846 643) https://www.vinnies.org.au	Gamblers' Financial Counselling Helpline Call 1800 007 007 www.ndh.org.au

Appendix G: Human Research Ethics Committee Approval Notice

HUMAN RESEARCH ETHICS COMMITTEE APPROVAL NOTICE

Dear Mr Luke Brownlow,

The below proposed project has been **approved** on the basis of the information contained in the application and its attachments.

Project No:	2621
Project Title:	Antecedents of mHealth App Adoption Intention
Primary Researcher:	Mr Luke Brownlow
Email:	luke.brownlow@flinders.edu.au
Approval Date:	07/10/2020
Expiry Date:	30/12/2020

Please note: *Due to the current COVID-19 situation, researchers are strongly advised to develop a research design that aligns with the University's COVID-19 research protocol involving human studies. Where possible, avoid face-to-face testing and consider rescheduling face-to-face testing or undertaking alternative distance/online data or interview collection means. For further information, please go to https://staff.flinders.edu.au/coronavirus- information/research-updates.*

RESPONSIBILITIES OF RESEARCHERS AND SUPERVISORS

Participant Documentation

Please note that it is the responsibility of researchers and supervisors, in the case of student projects, to ensure that:

- all participant documents are checked for spelling, grammatical, numbering and formatting errors. The Committee does not accept any responsibility for the above mentioned errors.
- the Flinders University logo is included on all participant documentation (e.g., letters of Introduction, information Sheets, consent forms, debriefing information and questionnaires – with the exception of purchased research tools) and the current Flinders University letterhead is included in the header of all letters of introduction. The Flinders University international logo/letterhead should be used and documentation should contain international dialling codes for all telephone and fax numbers listed for all research to be conducted overseas.
- the HREC contact details, listed below, are included in the footer of all letters of introduction and information sheets.

This research project has been approved by the Flinders University Human Research Ethics Committee (Project Number 2621). For more information regarding ethics approval of the project the Executive Officer of the Committee can be contacted by telephone on 8201 3116, by fax on 8201 2035 or by email human.researchethics@flinders.edu.au.

Annual Progress / Final Reports

In order to comply with the monitoring requirements of the *National Statement on Ethical Conduct in Human Research 2007 (updated 2018)* an annual progress report must be submitted each year on the anniversary of the approval date for the duration of the ethics approval using the HREC Annual/Final Report Form available online via the ResearchNow Ethics & Biosafety system.

Please note that no data collection can be undertaken after the ethics approval expiry date listed at the top of this notice. If data is collected after expiry, it will not be covered in terms of ethics. It is the responsibility of the researcher to ensure that annual progress reports are submitted on time; and that no data is collected after ethics has expired.

If the project is completed *before* ethics approval has expired please ensure a final report is submitted immediately. If ethics approval for your project expires please either submit (1) a final report; or (2) an extension of time request (using the HREC Modification Form).

For student projects, the Low Risk Panel recommends that current ethics approval is maintained until a student's thesis has been submitted, assessed and finalised. This is to protect the student in the event that reviewers recommend that additional data be collected from participants.

First Report due date: 7 October 2021

Modifications to Project

Modifications to the project must not proceed until approval has been obtained from the Ethics Committee. Such proposed changes / modifications include:

- change of project title;
- change to research team (e.g., additions, removals, researchers and supervisors) changes to research objectives;
- changes to research protocol;
- changes to participant recruitment methods; changes / additions to source(s) of participants;
- changes of procedures used to seek informed consent; changes to reimbursements provided to participants;
- changes to information / documents to be given to potential participants;
- changes to research tools (e.g., survey, interview questions, focus group questions etc); extensions of time (i.e. to extend the period of ethics approval past current expiry date).

To notify the Committee of any proposed modifications to the project please submit a Modification Request Form available online via the ResearchNow Ethics & Biosafety system. Please note that extension of time requests should be submitted prior to the Ethics Approval Expiry Date listed on this notice.

Adverse Events and/or Complaints

Researchers should advise the Executive Officer of the Ethics Committee on 08 8201-3116 or human.researchethics@flinders.edu.au immediately if:

- any complaints regarding the research are received;
- a serious or unexpected adverse event occurs that effects participants;
- an unforeseen event occurs that may affect the ethical acceptability of the project.

Yours Sincerely,

Andrea Mather

on behalf of

Human Research Ethics Committee Research Development and Support human.researchethics@flinders.edu.au P: (+61-8) 8201 3116

Flinders University
Sturt Road, Bedford Park, South Australia, 5042 GPO Box 2100, Adelaide, South Australia, 5001

http://www.flinders.edu.au/research/researcher-support/ebi/human-ethics/human-ethics_home.cfm

ResearchNow
Ethics & Biosafety

Flinders University Research Development and Support — Proactively supporting our Research

Dear Mr Luke Brownlow,

We are pleased to advise that the requested modifications to the below project have been approved on 15 January 2021.

Project ID: 2621

Project Title: Antecedents of mHealth App Adoption Intention

Chief Investigator: Mr Luke Brownlow

Expiry Date: 31/03/2021
Application Link: https://researchnow-ethics-forms.flinders.edu.au/Project/Index/2040

You can access the application in the ResearchNow Ethics & Biosafety system via the Application Link above.

Please don't hesitate to contact the Ethics & Compliance Office if you have any questions.

Regards,

_____

Mr Hendryk Flaegel

Research Development and Support
human.researchethics@flinders.edu.au
Flinders University
Sturt Road, Bedford Park, South Australia, 5042
GPO Box 2100, Adelaide, South Australia, 5001

http://www.flinders.edu.au/research/researcher-support/ebi/human-ethics/human-ethics_home.cfm

Appendix H: Relationships Australia Approval Notice for Data Collection

Dear Luke,

I am contacting you on behalf of the Relationships Australia Queensland (RAQ) Manager of Research and the Research Advisory Working Group (RAWG) in regards to your project titled 'Antecedents of mobile healthcare application acceptance: Opportunities to alleviate gambling harm through digital intervention'. I am pleased to inform you that your recruitment request has been accepted subject to registered HREC approval. Upon receiving HREC approval, we will be working internally to set up the recruitment process on the RAQ Facebook and research website page. Please note, RAQ does not take responsibility if this recruitment process does not produce many responses. Attached is a summary of the RAWG decision and actions.

Please note that a part of your responsibility as a researcher collaborating with RAQ you will be required to have regular communication with us. Please complete the following:

- Annual progress report on 22/09/2021 (if applicable).
- Final report when the research is complete and the results are ready for dissemination.

This summary will be for dissemination by the RAQ research team to internal RAQ staff who have helped recruit into the research. Please note that we request to view publications arising from research projects using only/ mostly RAQ data prior to submission for journal publications as we are keen to understand and learn from the results and the interpretations arising from the research. The Chair of the RAWG will liaise with the co-authors around the implications of the results for RAQ and discuss how RAQ may consider quality improvement activities as a result of the research outcomes.

Please also notify us if you make any changes to your research protocol. I have attached the three relevant RAWG templates to this email.
Please do not hesitate to contact us if you have any questions about the above process or documents.

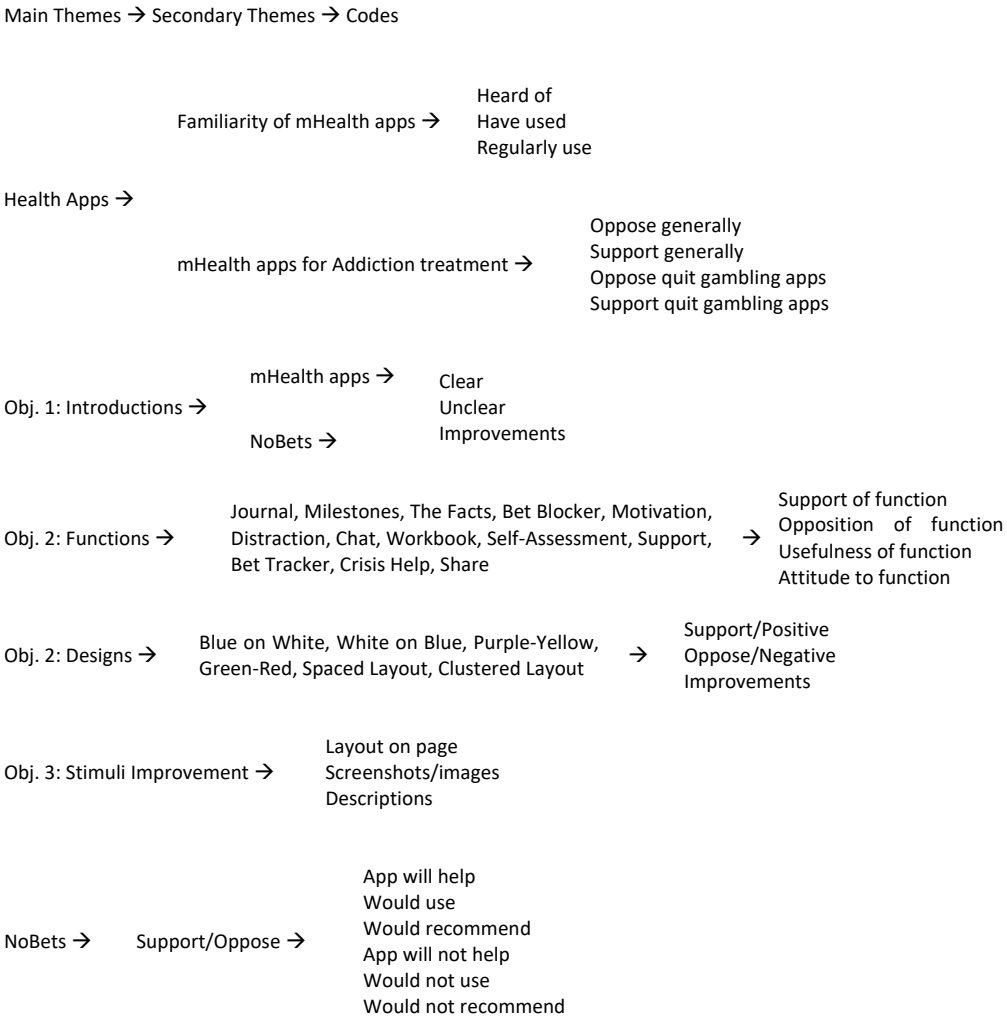
Kind regards,
Jelena

Jelena Milic
Research Officer

1300 364 277
www.raq.org.au

Phone 07 3423 6980
Email jmilic@raq.org.au
Address 6/107 Miles Platting Road, Eight Mile Plains, QLD 4113
Post PO Box 4435, Eight Mile Plains, QLD 4113

Appendix I: Qualitative Analysis Codes



Appendix J: Additional Quotations from Focus Group Sessions

Frequency of Use

Male participants

'I have struggled to use health apps in the past because they are hard work. They are just so laborious, so I eventually stopped.' → *'I have stopped using calorie tracking apps because it's so painful to keep entering stuff in.'* → *'I have used meditation apps in the past, but I don't use them now because they weren't any use to me.'* → *'AnyTime Fitness workout. Probably only use that once every three weeks.'* → *'I only have MyFitnessPal.'* → *'I don't have any [health] apps on my phone. I'm not interested in them.'*

Female Participants

'I use Moon and Smiling Minds on a daily basis.' → *'The other app I have is Fit Bit. It came with my Fit Bit watch. I used it quite regularly to monitor heart rate, steps and sleeping.'* → *'I use Calm. It really helps me with my anxiety and getting to sleep at night.'* → *'I have apps for my weight… I have Tom Tom for fitness… I also have Brain Keeper… Headspace helps me meditate and manage anxiety. I Have Fit Bit… I have Woman's Flow… I also have Diet… I have another one called Zombie Run which is a fun way to exercise. I have the app, Calm.'*

Addiction Intervention

'I think it's possible.' → *'I do agree with this. I think that people probably can if they're highly motivated themselves to achieve success.'* → *'I think it would work for some people.'* → *'Yes and no, because it would come down to how badly they want to treat their addiction. It would come down to the individual.'* → *'It depends on how laborious it is to engage with this. I have stopped using calorie tracking apps because it's so painful to keep entering stuff in. It just took too much time.'* → *'I'm sceptical. It may help, but I think seeing a psychologist would probably help more, and I think they should be designed by psychologists, especially those specialising in addiction. I'm not certain how effective it would be.'*

Gambling and mHealth

Familiarity with App

'I had heard of it through advertisements in toilet cubicles at pubs. That's where I have seen it.' → *'I know about these apps because there are posters inside TABS and restaurants I have eaten at where they have had gambling such as races, dogs and so forth'.*

Platform Feedback

'I think people need to find what works for them when it comes to treating an addiction. I think in app could work for some people.' → *'No[t aware]. But I think these apps would be popular because people who use apps a lot and gamble a lot would have that overlap interest to use them.'* → *'Now that I think about it it's not a bad idea. Because people are using apps to gamble so perhaps having an app to stop people from gambling.'*

Journal Function

'It's not my style but other people do it. For most people to journal you have to be in a certain frame of mind to be able to do that. The hard thing is to remember and think about what to say in a moment.'

Different Journal Types

One participant stated, *'I think journal is good. It presents well. [Is] nice and clear. I like the idea that some people can use a diary and that it's clever that you broke them up into diary, reflection and goals. They would be too much to try and fit all in together. I like that you can make it date specific and see what you did on specific days. Good that you can go back and see what happened on days and see what your triggers were.'* Likewise, another agreed stating, *'I understand it. I think it's a fantastic idea to have different types. The idea of documenting the day [by] reflecting on a specific event or situation. Gratitude is a great way to keep people present in the moment and to really understand what they have. I think being able to see your goals and track them visually and in a very easy place is a lot more attainable. I think journaling would be a really great way to help people remain mindful and remain on task.'*

Milestones

Winning

'I understand it and think it's a good idea. I think a lot of gamblers are seeking rewards especially when they're trying to change the behaviours. I think a milestone could feel like a bit of a win and tie into the gambling scenario of wanting wins.'

Countdown

One participant observed, *'The only thing I don't see is how many days you have done in a row. There is a big gap between 30 days and 60 days so maybe you need a progress bar to show how you are going.'*

The Facts

'I think it is a brilliant concept. It's a lot of reading, but I really, really like it. It is a wake-up call for someone dealing with the problem when they try and trick themselves that it's not a problem. There is so much information online that it's good for them to access good information they know where to find straight away.' One participant made a clever observation that this content is unchanging and non-interactive. *'This is not my preferred section because once you read it, you've finished using it. It doesn't do anything else, but still I think this is a good idea to have reliable information about quitting gambling in the app because people who can't afford therapy might read all sorts of crazy shit online about quitting. I like the way it is broken down into some topics.'*

Bet Blocker

Available Function

'You can already use this in some betting apps, but betting apps don't make it too easy or user-friendly. They try and make it a bit more complicated to use because they don't want to block themselves. Even if you did this, you can just use their website on your computer anyway.'

Support

'That is a great idea. I think this is a wonderful idea in terms of stopping people from easily being and access those apps and websites that cause the issues.'

Motivation

Exercise Generator

'I think if people live a sedentary life already, they would have no interest in this function. If they're not into exercise and fitness, then they won't use that part.' → *'One thing I did not get is when it says exercise generator. This seems very mathematical. I feel like if I click on that I might get a maths problem or something academic to do.'*

Motivational Message and Lived Experience

'I like that it's the part of the app that provides reinsurance that you made the right decision to work on the gambling addiction, and it'll provide that through a motivational quote or a story of someone on a similar path or the same journey.'

Distraction

Brain Games

'I think the games for me would be something that would distract me.' → *'I like the idea of brain games. I think it's a good way to control gambling. I think some people might find it*

more helpful than others. → *'I like the idea of having different brain games to help keep away from gambling. Maybe memory games might help people to learn to memorise cards and people who are addicted might see that as a gambling game.'*

Meditation and Mediation

'Guided meditation might not be my cup of tea, but other people might like it. That might be a good way for some people to relax and be distracted from gambling. → *'I think this is a really good section to have an app. It's important to take that thought process away from gambling and put it towards something else. I think it's good to take the power of their mind away from the gambling and put it onto something else. People who are really addicted for years need to learn to switch off thoughts like this.'*

Chatroom

Privacy

'If they still need assistance, they do get the Support function to help them talk to somebody about it that they wouldn't feel comfortable with talking to a friend. They might feel more willing to share with somebody they don't know which is when they would use this instead.' → *'I think the potential lies in the users being connected as well. Support doesn't always come from services but from other users. People can still recognise you because you might share something about yourself or tell a story that people already know bout.'*

Self-Assessment

Difficulty

'I feel like they would think that is too much reading. I think Self-Assessment is a really good tool and from a health professional's point of view but not for the average person. You would need a professional to show you how to do it first.'

Input

'They might do it a couple of times but not follow up.' → *'If I am to see a page like that I would instantly disengage. I wouldn't want to put that much thought into it. I want it to be quick and accessible.'*

Dishonesty

'I think Self-Assessment would be [the] least useful. I think it would be helpful for some people but not necessarily the majority because you have to be accountable and honest, and I am not sure that some people are willing to confront that side of themselves.'

Workbook

Writing Task Difficulty

'I think it's a good idea to find hobbies and tasks to distract your mind from gambling. But again, I think that's up to personnel strength of will to go through with those exercises, but it seems easier to just put a bet on.'

Supplement

One participant commented, *'I think it would be effective for some people with gambling addiction. The only hesitation I have would be similar to self-accountability to continue to do the exercises, but I think if it's something done in the interim between singing a psychologist, it would be very helpful for self-accountability.'*

Bet Tracker

Criticism

'I believe that this is kind of pointless if you are trying to stop gambling. Why set up a budget for yourself? I think that if people want to stop gambling, they need to go cold turkey in the first place. Don't feed the habit slowly, just stop it altogether.'

Hard Work

'Are people betting then inputting this information themselves? I think when people gamble, they can easily lose time and time can slip away.' → *'I don't think people will go back and forth to the app to enter their spendings, and they won't remember how much they have spent.'*

Dishonesty

'I don't know how that information gets there and if they could manipulate that information to look better.'

Support

Accessibility

One participant summed up this discussion, *'I think the idea of being able to find the support groups all together in one spot like this so you can talk to real people. It's better than having to Google them when you don't even know their names or what they do. Talking to people seems more helpful than trying to do something by yourself. Particularly the free services because we all can't afford psychology. You can have more of a connection to somebody rather than trying to do it solo via the app.'*

Crisis Help

One participant presented this perfectly. *'I like that Crisis Help is at the bottom. When you just snap under pressure, you need to be able to find help ASAP and talk it out. It is important to*

have someone to talk to when you are learning how to quit because you don't know what else to do with your hands yet. But, it should be some sort of brand... like a sponsor. Whether that is the Green Zone Government or Queensland health or something like that. I think that would make it look more professional. It should have a stamp to have an affiliation with a reliable organisation.'

Share

No Support

'I like that there is a share achievement option. I think that is a good idea to normalise mental health issues and addiction. I think the good idea to share positive progress with mental health.' → *'Those who do speak out about it try to encourage it. So, hosting and showing examples about how to encourage progress might turn that journey into something more positive.'*

Privacy

'Not keen on the Facebook share button. To make this public… And, I don't think I agree with that.' → *'It also says that you can post on social media which is an interesting idea. I wonder how many people want to do that. Maybe some people would be really proud of the progress, but I feel like the majority would not want to advertise their gambling addiction.'*

Colours

Blue on White

'I just really like the blue and white. It looks professional.' → *'I like the white background with blue writing the most.'*

After seeing the stimuli, one participant reasoned, *'I think a darker blue is preferrable. You can't clearly see the image.'*

Red and Green

'The red and green are too harsh together. They get your attention really quickly and it reminds me of a supermarket grocery. I feel like I'm looking at Woolworths or Coles specials.'
'A little bit of feedback would be to steer away from orange, red and deeper blue is because they look like sports betting apps.'

Purple and Yellow

'I feel like the colours are too in your face. It is screaming 'wake me up'. I definitely don't like the colours. The font is all right. It's not for me. I don't like it. Title in purple at the top looks silly.'

For example, '*It has a feeling of movement like a sports app.'*

Layout

Spaced

I like the layout of the boxes on home screen one and two because they are all the same size. It relies on reading without having my attention dragged around'.

Boxed

'Those boxes seem to be all different sizes and not following a pattern I find that a bit off-putting.'

Verdict on App

Platform

'I think a phone is the right device because it's so easy to get access to.' → *'I think it's a good idea because gambling has the technology aspect anyway.'* → *'I think a phone is the best device because everyone has a smart phone and it easy access.'*

Barriers

'I think it would only suit some people, more so the younger generation.' → *'I believe from a generational view I would have trouble dealing with it. I would wonder just how successful it would be in older people.'*

Future Direction

'Look… I would have to see the evidence behind it before I recommended in a professional capacity. I'm a nurse, and I understand that you need some people to test it and have some guinea pigs and run a trial. I think it also needs some professionals to review the app'.

'I think you should run this app and go for it, there is only one way you can which is to go for it and see how it popularises and get feedback through the app by giving people the option to give feedback directly to you. This might make the app stronger. People might have good advice how to use the app after they beat their addiction and what works for them or even tell you how to make this better.'

Support

'I think the app is a good start for someone who is personally looking for a way to control or quit.'

One comment reflects this effectively, *'I wasn't sure at first but after seeing all these functions, I think it's a great idea. I think there are probably a lot of people with a gambling addiction, and the more they promote these sorts of apps the more they would be used.'*

Supplement

'I think there should be many ways that people can treat an addiction which includes using apps, community forums, social media as well as government regulations. I think apps are definitely going to help.' → *'I don't think it should replace therapy or other treatments. I think it could be one entry point for several points. I think it would suit only some, but it shouldn't replace therapy. I think is important to have a multitude of ways for people to understand the gambling addiction and determine what works for them.'* → *'Obviously, it can't replace therapy. Being accountable to a person is more important than being accountable to an app. Unless it can connect you to a person.'* → *'I don't think it would replace therapy or other public treatments. I think it would be complementary to what is already available. I think an app is a 24/7 coach that they have at their disposal to help curb the need to gamble. I think of mobile phone the right device because most people are hooked up to their phone all day every day.'*

Appendix K: Stimuli Amendments

App Function Amendments

Function	Amendments
Workbook	Text descriptions shortened as longwindedness caused disengagement
	Share link was removed with Share function
Distraction	Text description shortened as longwindedness caused disengagement
	Audio lengths shortened as original lengths appeared too time consuming
Journal	Heading was changed from *diary* to *reflection* to match text description of features
Milestones	Share link was removed with Share function
	Timeframes of achievements were shortened as the number of days for achievements and times between achievements were intimidating
	A counter of days abstained was introduced as another reward system
Bet Blocker	A tool within the function to modify the block lists was added to make it appear easier to use
Support	Text description shortened as longwindedness caused disengagement
Crisis Help	The button was rewritten to outline the action of the button and the availability of the helpline to clarify functionality

App Design Amendments

Function	**Amendments**
Workbook	Colour scheme changed to dark blue on white
	Exercises given distinct boxes to clarify that they are separate
	NB initials spelled out for clarity
	Watermark made subtler as it was distracting from the text
Distraction	Colour scheme changed to dark blue on white
	NB initials spelled out for clarity
	Game descriptions bolded
Journal	Watermark made subtler as it was distracting from the text
Milestones	Colour scheme change to dark blue on white
	NB initials spelled out for clarity
	Badge given colour as it was too subtle
The Facts	Colour scheme change to dark blue on white

Function	Amendments
	Font size increased for ease of reading
	Pairs of myths and facts separated to emphasise the pairing
Bet Blocker	Colour scheme change to dark blue on white
	List style of blocked content changed to grid style as it presented too long
Support	Colour scheme change to dark blue on white
	Watermark made subtler as it was distracting from the text
Crisis Help	Colour scheme change to dark blue on white
Chat	Colour scheme change to dark blue on white
	Dates removed from chatroom to emphasise the temporariness of posts
	Boxing style for chatroom removed to present conversational communication

Appendix L: Groups Contacted for Recruitment

	Organisation		
1.	ACT Gambling and Racing Commission^	30.	Open Arms^
2.	Alliance for Gambling Reform^	31.	Problem Gambling SA^
3.	Anglicare^	32.	Relationships Australia NSW^
4.	ANZMH^	33.	Relationships Australia NT^
5.	Arab Council Australia^	34.	Relationships Australia QLD*
6.	Australia Counselling^	35.	Relationships Australia SA^
7.	Bet Safe^	36.	Relationships Australia TAS^
8.	Bethany Community Support^	37.	Relationships Australia VIC -
9.	Better Health Channel-	38.	Lifeline SESA*
10.	Beyond Blue^	39.	Lifeline TAS^
11	Blue Voices^	40.	Lifeline Central VIC and Mallee*
12.	Centrecare^	41.	Lifeline WA^
13.	Family Gambling Help*	42.	Mission Australia^
14.	Gamble Aware^	43.	Relationships Australia WA^
15.	Gamblers Anonymous Australia^	44.	SHARC^
16.	Gamblers Anonymous Australia NSW/ACT^	45.	Smart Recovery*
17.	Gamblers Anonymous Australia QLD/NT^	46.	The Salvation Army^
18.	Gamblers Anonymous Australia SA-	47	Lifeline QLD^
19.	Gamblers Anonymous Australia TAS^	48.	Grief Line-
20.	Gamblers Anonymous Australia VIC^	49.	Wesley Mission^
21.	Gambling Help NSW *	50.	Reach Out^
22.	Gambling Help Online^	51.	Lifeline ACT-
23.	Gambling Impact Society NSW^	52.	Lifeline Darling Downs^
24.	Gambling Support Program (TAS)^	53.	Lifeline Northern Beaches^
25.	GamCare^	54.	Lifeline NT ^
26.	Victorian Responsible Gambling Foundation*	55.	Uniting Communities (Lifeline Adelaide)^
27.	Health Direct^	56.	Lifeline Southwest VIC^
28.	Lifeline Aus^	57.	Lifeline Gippsland^
29.	Relationships Australia Canberra and Region^		

Note: * accepted invitation, - rejected invitation, ^ no response

Appendix M: Estimation of the Error Functions, Lower Bound Sample Size for a Structural Equation Model and Normal Distribution Cumulative Distribution

Error function:

$$\operatorname{erf}(x) = \frac{2}{\sqrt{\pi}} \int_0^x e^{-t^2} dt$$

Lower bound sample size for a structural equation model:

$$n = \max(n_1, n_2)$$

where:

$$n_1 = \left[50 \left(\frac{j}{k} \right)^2 - 450 \left(\frac{j}{k} \right) + 1100 \right]$$

$$n_2 = \left[\frac{1}{2H} \left(A \left(\frac{\pi}{6} - B + D \right) + H + \sqrt{\left(A \left(\frac{\pi}{6} - B + D \right) + H \right)^2 + 4AH \left(\frac{\pi}{6} + \sqrt{A} + 2B - C - 2D \right)} \right) \right]$$

$$A = 1 - \rho^2$$

$$B = \rho \arcsin\left(\frac{\rho}{2} \right)$$

$$C = \rho \arcsin(\rho)$$

$$D = \frac{A}{\sqrt{3 - A}}$$

$$H = \left(\frac{\delta}{z_{1-\alpha/2} - z_{1-\beta}} \right)^2$$

where *j* represents the number of observed variables, *k* is the number of latent variables, *ρ* is the estimated Gini correlation for a bivariate normal random vector, *δ* is the anticipated effect size, *α* is the Sidak-corrected Type 1 error rate, *β* is the Type 2 error rate and *z* is the standard normal score.

Normal distribution cumulative distribution function:

$$F(x; \mu, \sigma^2) = \frac{1}{2} \left[1 + \operatorname{erf} \left(\frac{x - \mu}{\sigma \sqrt{2}} \right) \right]$$

where *μ* is the mean, *σ* is the standard deviation and *erf* is the error function.

Appendix N: Online Survey

Hello and Welcome!

The purpose of this research project is to understand people's opinions about mobile 'apps'. Specifically, 'apps' designed to help people change their betting behaviour. You will also be asked about a little about your betting habits in general. Participation is voluntary and confidential. There are no risks to you and you may exit at any time. The survey will take approximately 15 minutes to complete. **To thank you for your time, you will receive a $20 ColesMyer gift voucher for completing the survey. Your gift voucher will not be linked to your answers any way to ensure your privacy. By clicking 'next' you are consenting to participating in this survey and confirm that you are 18 years of age or older.** *This research project has been approved by the Flinders University Social and Behavioural Research Ethics Committee in South Australia (Project number 2621). For queries regarding the ethics approval of this project please contact the Executive Officer of the Committee via telephone on +61 8 8201 3116 or email human.researchethics@flinders.edu.au*

Click the below link to download the information sheet and informed consent details.

Information sheet and consent final

queries regarding the ethics approval of this project please contact the Executive Officer of the Committee via telephone on +61 8 8201 3116 or email human.researchethics@flinders.edu.au

Click the below link to download the information sheet and informed consent details.

Information sheet and consent final

Q1 How old were you on your last birthday?

Q2 Do you identify with a specific gender?

- ○ Male
- ○ Female
- ○ LGBTQ+
- ○ I'd rather not say
- ○ Other _____

Q3 Reflecting on your gambling activities over the last 12 months, please reflect on the following statements.

Q3a Have you bet more than you could afford to lose?

- ○ Never
- ○ Sometimes
- ○ Most of the time
- ○ Always

Q3b Have you needed to gamble with larger amounts of money to get the same feeling of excitement?

- ○ Never
- ○ Sometimes
- ○ Most of the time
- ○ Always

Q3c Have you enjoyed your gambling overall?

- ○ Never
- ○ Sometimes
- ○ Most of the time
- ○ Always

Q3d Have you gone back another day to try to win back the money you lost?

- ○ Never
- ○ Sometimes
- ○ Most of the time
- ○ Always

Q3e Have you borrowed money or sold anything to get money to gamble?

- ○ Never
- ○ Sometimes
- ○ Most of the time
- ○ Always

Q3f Have you had positive experiences gambling overall?

- ○ Never
- ○ Sometimes
- ○ Most of the time
- ○ Always

Q3g Have you felt that you might have a problem with gambling?

- ○ Never
- ○ Sometimes
- ○ Most of the time
- ○ Always

Q3h Has gambling caused you any health problems, including stress or anxiety?

- ○ Never
- ○ Sometimes

- ○ Most of the time
- ○ Always

Q3i Have people criticised your betting, or told you that you had a gambling problem, regardless of whether or not you thought it was true?

- ○ Never
- ○ Sometimes
- ○ Most of the time
- ○ Always

Q3j Has your gambling caused any financial problems for you or your household?

- ○ Never
- ○ Sometimes
- ○ Most of the time
- ○ Always

Q3k Have you felt guilty about the way you gamble, or what happens when you gamble?

- ○ Never
- ○ Sometimes
- ○ Most of the time
- ○ Always

Q4 Please tell us about how you enjoy gambling the most.

- ○ Online (computer, tablet, phone)
- ○ Using machines, games or bookies at venues or events, such as pubs, casino or race events.
- ○ Both, I have no preference

Q5 This next section asks you about your opinions and usage of 'apps' in general. Please tell us how much you 'agree or disagree' with the following statements.						
Strongly Disagree	2	3	4	5	6	Strongly Agree
I feel confident about my knowledge of 'apps'.						
I know how to judge the quality of 'apps'.						
I use apps extensively.						
I feel confident when I use 'apps'.						
Among my friends, I'm considered a bit of an 'app' expert.						
I have a strong interest in 'apps'.						
'Apps' are important to my lifestyle.						
'Apps' save time.						
'Apps' are convenient to use.						
Using 'apps' in an efficient way to do things.						
I trust 'apps' are reliable.						
I think 'apps' are secure.						
I trust 'apps' to do the job right.						
'Apps' should have information specific to me.						
'Apps' should be customised to my needs.						
I only want to receive useful information from 'apps'.						

Q6 Now, we'd like to ask you about your experience using health 'apps' in particular

How often do you use a health oriented 'app' in your everyday life—Including 'apps' for exercise, dieting, mental health, illness, meditation, etc?

	Never	2	3	4	5	6	Every day
On average, I use at least one	○	○	○	○	○	○	○

type of health 'app'...							

Q7 In this section, we would like your feedback on an 'App' we're designing to help people modify their gambling habits when they want to—It's called "NoBets". Here is the 'home screen'. Please take a look at the nine buttons you see below that represent the nine major functions of the 'App'. Next, we will ask you your opinions regarding what they do.

Q8

Here you will see a brief description several functions on the 'App', along with a 'screenshot' of what the function looks like in action. We'd like your opinions regarding the usefulness of these functions.

(see Appendix P: Survey Stimuli *for stimuli)*

Q9 **Journal** function. This allows you to keep track of your goals, reactions to betting triggers and supports your self-expression.

	Strongly Disagree	2	3	4	5	6	Strongly Agree
I think this function is useful.	○	○	○	○	○	○	○

Q10 This is the **Milestones** function. This function rewards you for achieving timeframes without gambling with trophies and positive messages.

	Strongly Disagree	2	3	4	5	6	Strongly Agree
I think this function is useful.	○	○	○	○	○	○	○

Q11 **The Facts.** The Facts is a gambling information database on a range of topics, such as goal setting tips and tricks and myths and facts.

	Strongly Disagree	2	3	4	5	6	Strongly Agree
I think this function is useful.	○	○	○	○	○	○	○

Q12 **Bet Blocker**. Bet Blocker stops your device from accessing gambling websites and apps.

	Strongly Disagree	2	3	4	5	6	Strongly Agree
I think this function is useful.	○	○	○	○	○	○	○

Q13 **Distraction.** Distraction draws attention and thoughts away from gambling with meditation, mindfulness and brain games.

	Strongly Disagree	2	3	4	5	6	Strongly Agree
I think this function is useful.	○	○	○	○	○	○	○

Q14 **Chat.** Chat connects you with others using the app through a private chatroom discussion forums with topics about quitting gambling.

	Strongly Disagree	2	3	4	5	6	Strongly Agree
I think this function is useful.	○	○	○	○	○	○	○

Q15 **Workbook.** This function provides help exercises through reading and writing.

	Strongly Disagree	2	3	4	5	6	Strongly Agree
I think this function is useful.	○	○	○	○	○	○	○

Q16 **Support Groups.** This function is a directory of support and welfare groups to contact online and in person.

	Strongly Disagree	2	3	4	5	6	Strongly Agree
I think this function is useful.	○	○	○	○	○	○	○

Q17 **Crisis Helpline.** This function connects you with a 24/7 gambling helpline.

	Strongly Disagree	2	3	4	5	6	Strongly Agree
I think this function is useful.	○	○	○	○	○	○	○

Q19 This next section asks about your opinions on our new 'App'. Please tell us how much you 'agree or disagree' with the following statements. This new 'App'..						
Strongly Disagree	2	3	4	5	6	Strongly Agree
Has attractive screen designs (colours, boxes, etc.)						
Looks professionally designed.						
Looks and feels visually appealing.						
Looks enjoyable: people would probably use it a lot.						
Seems fun: people will want to use it.						
Gives rewards, so people would probably use it.						
Would be easy to get it to do what I want.						
Would be difficult to become be skilful with.						
Would be easy to use.						
Would be useful for quitting/changing gambling.						
Can probably improve unwanted gambling behaviour.						
Can probably improve the ability to control gambling.						
Would make quitting/controlling gambling easier.						

Q20 I think this new 'App'.

Strongly Disagree	2	3	4	5	6	Strongly Agree
Is, overall, a good 'app'.						
Is unpleasant.						
Would be beneficial to people.						
I plan to use an app like this to manage my gambling at some point.						
In the future, I intend to use this type of 'app'.						
I predict I will use an 'app' like this eventually.						

Q21 We can recommend a free, high-quality 'app' like this for you to manage your gambling. Are you interested in knowing more?

- ○ Yes, give me the link to the 'app' at the end of the survey.
- ○ No thanks, I am not interested.

Q22 Lastly, we'd like to know what you think of what we've called this new 'App' - "NoBets"

	Strongly Disagree	2	3	4	5	6	Strongly Agree
I like the name "NoBets".	○	○	○	○	○	○	○

Q23 Here are some of the other names we considered for our new 'App', including NoBets. Please tell us which name you prefer from this list or present your own if you can suggest a better name. (please pick your favourite from the list below).

- ○ NoBets
- ○ Quit Buddy
- ○ Quit Gambling
- ○ Health Pocket Pal
- ○ Gambling Recovery
- ○ Stop Betting
- ○ Other (please tell us your suggestion)

These last questions will help us develop this 'App' for people.
Q24 What is your highest qualification?

- ○ did not complete secondary school

- ○ secondary school
- ○ trade or TAFE certificate
- ○ bachelor's degree
- ○ master's degree or higher

Q25 Please tell us about your employment situation?

- ○ Full time
- ○ Part time
- ○ Casual
- ○ Retired
- ○ Student
- ○ Unemployed
- ○ Other _____

Q26 What is your approximate annual household income?
Q27 **Do you have any final comments to add to your responses? Your feedback is highly valued!**
Click **Finish** to claim your voucher.

Thank you for participating in this survey. Your contribution will help others in the fight to reduce harm from problem gambling.

If you require any support, Gambling Help Online provides free, anonymous support for anyone affected by gambling in Australia. Chat counselling, email support and self-help services are available.

Website: https://www.gamblinghelponline.org.au/

Phone:1800 858 858

Online Forum: https://forum.gamblinghelponline.org.au/

Blog: https://www.gamblinghelponline.org.au/blog

For those of you who are interested in knowing more about the GT app, you can access the

information below. Clicking on the link will open the webpage in a new internet window.

https://www.gamblingtherapy.org/en/gambling-therapy-presents-gt-app

Please note that vouchers will be distributed after all the responses have been collected and the survey officially closes. Thank you for your patience.

Appendix O: Online Survey Information Sheet and Consent Form

SURVEY INFORMATION SHEET

Project Title: Antecedents of mHealth App Adoption Intention

What follows is a series of questions about apps and your perceptions around them. Specifically, we are looking at apps that people can use to modifying their own gambling behaviour. There are also some questions about you and your behaviour around gambling. This online survey is open to anyone in Australia over 17 years old that gambles regularly. There is no risk to you personally, participation is voluntary, personal identifying information will not be recorded and any information that you provide will be confidential. Your answers will be accessible only to the researcher and project supervisors. Your answers will be kept only at Flinders University on a secure cloud-based storage system. At no stage will your responses be printed. Your responses will be deleted following the compulsory five-year storage period. Please remember that no identifying information about you will be collected during the survey.

Participation should take no more than 20 minutes and is entirely voluntary. You can withdraw from the survey at any point by closing your browser. You can only complete the survey once, so you are encouraged to complete the survey in a quiet, private and secure place where you will not be interrupted and have sufficient time. The more information that you provide, the better the findings of the research project will be. If the survey upsets you or makes you feel uncomfortable in any way, you will be given a list of support contacts at the end of the survey. Your responses to some preliminary questions in the survey will determine your eligibility to participate.

This research project will be conducted in accordance with the NHMRC National Statement on Ethical Conduct in Human Research (https://www.nhmrc.gov.au/about-us/publications/national-statement-ethical-conduct-human-research-2007-updated-2018). For further information, please contact the PhD student and lead researcher, Luke Brownlow at Flinders University on luke.brownlow@flinders.edu.au. Alternatively, you can contact the research project supervisors, Professor Roberta Crouch | roberta.crouch@flinders.edu.au 08 8201 2046 and Dr. Svetlana De Vos | svetlanadevos@aib.edu.au 08 8212 8111. Should you have any concerns about this research project, you can contact Flinders University Human Research Ethics Committee on 08 8201 3116 human.researchethics@flinders.edu.au. *Ethics Approval Number: HEL2621-2.*

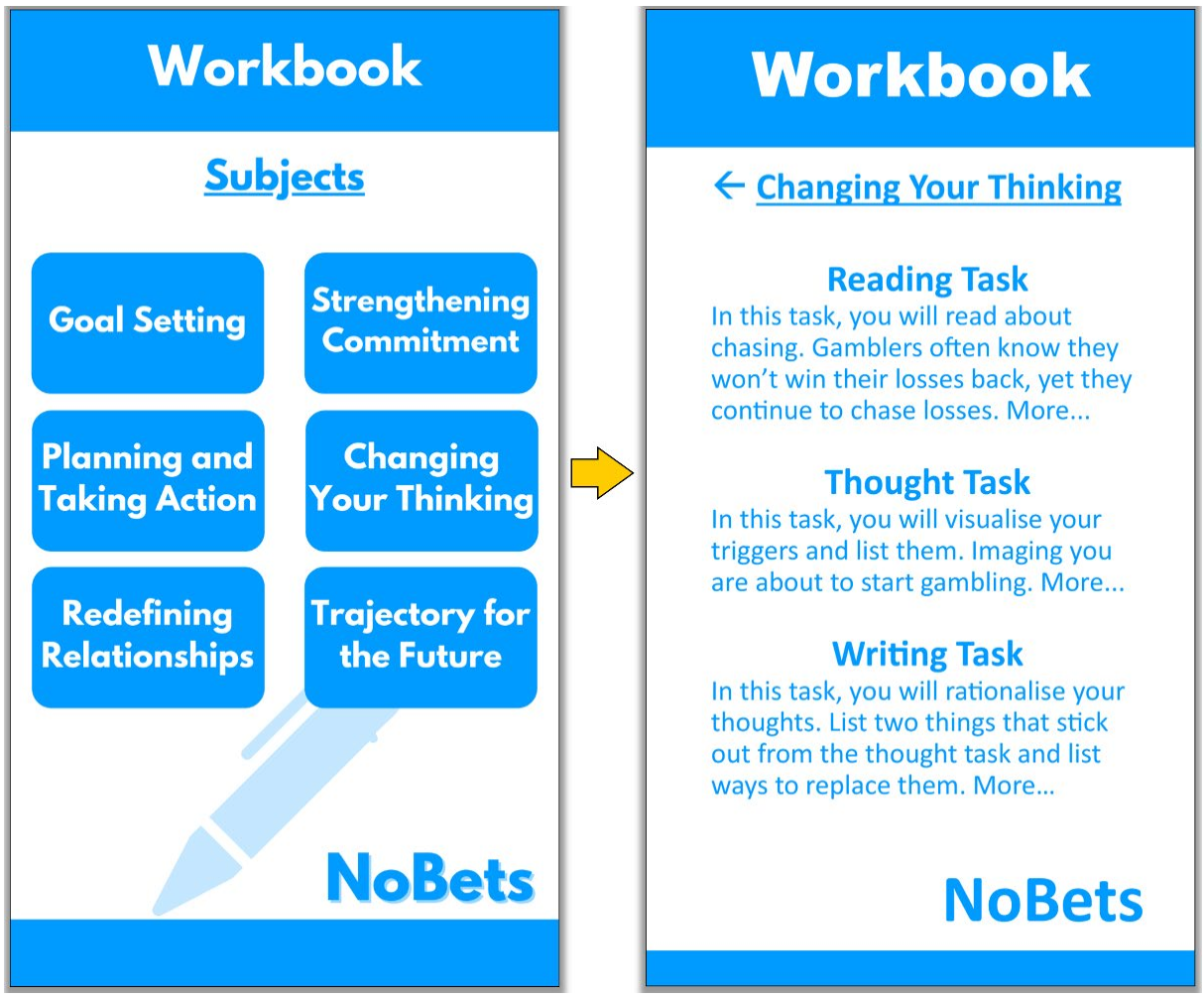
SURVEY PARTICIPATION CONSENT

By giving my consent to participate in this survey, I understand and agree to the following statements:

- I understand that I may not be eligible to complete the survey based on my responses.
- I am 18 years of age or older.
- I have read the information about the survey and agree to take part in the research project.
- I have not already completed this survey.
- The research project has been fully explained to my satisfaction.
- I understand that I will not be identifiable if I participate in this study.
- I understand that I am free to withdraw at any time.
- I have had the opportunity to ask any questions about the survey and research project.

Appendix P: Survey Stimuli

Survey Stimulus—Workbook

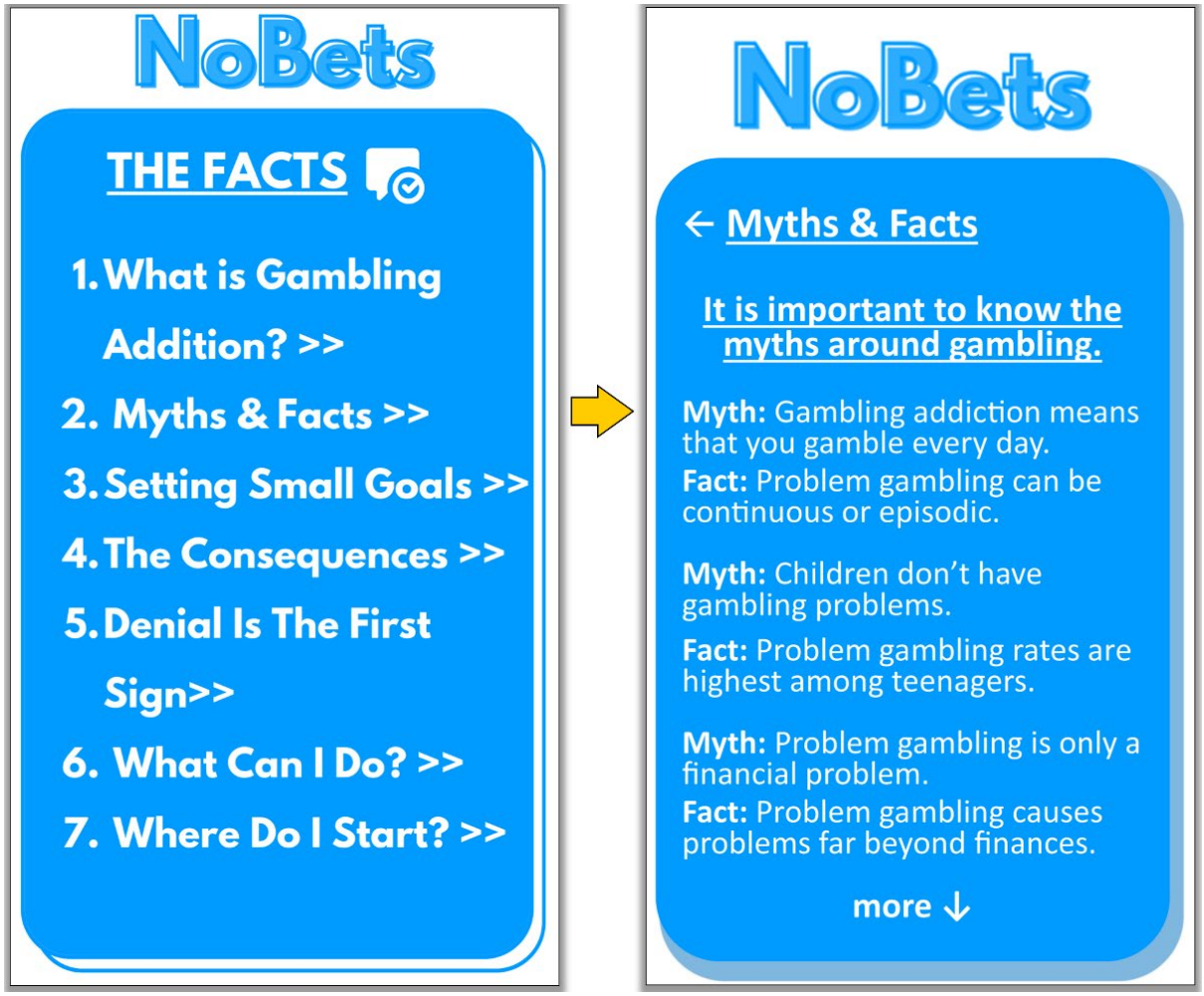


This function is called Workbook which provides therapy-based study exercises. You can learn techniques for self-control through reading and writing tasks developed to address gambling addiction. Example subjects include strengthening commitment, planning and taking action and changing your thinking. Workbook gives you the choice to share on social media when you have finished subjects.

Image 1) the subjects that are available in Workbook

Image 2) descriptions of the different tasks in a 'Change Your Thinking'

Survey Stimulus—The Facts



The function is called The Facts which is an information database on the behaviours, risks and symptoms surrounding gambling. The Facts includes useful information on a range of different topics, such as clinically defining gambling addiction, goal setting tips and tricks and identifying signs of addiction.

Image 1) a list of the different information topics

Image 2) an example of the topic, 'Myths & Facts' which clarifies truths and lies around gambling addiction

Survey Stimulus—Support Groups

This function is called Support which is a directory of gambling support community groups and welfare organisations. These contacts offer 24/7 support through phone, chat and face-to-face services. Some are gambling specialists while other groups offer broader support to gamblers and their families.

Image 1) the contact list of community groups and welfare organisations in the directory

Image 2) an example of the contact page of an Australian welfare group

Survey Stimulus—Milestones

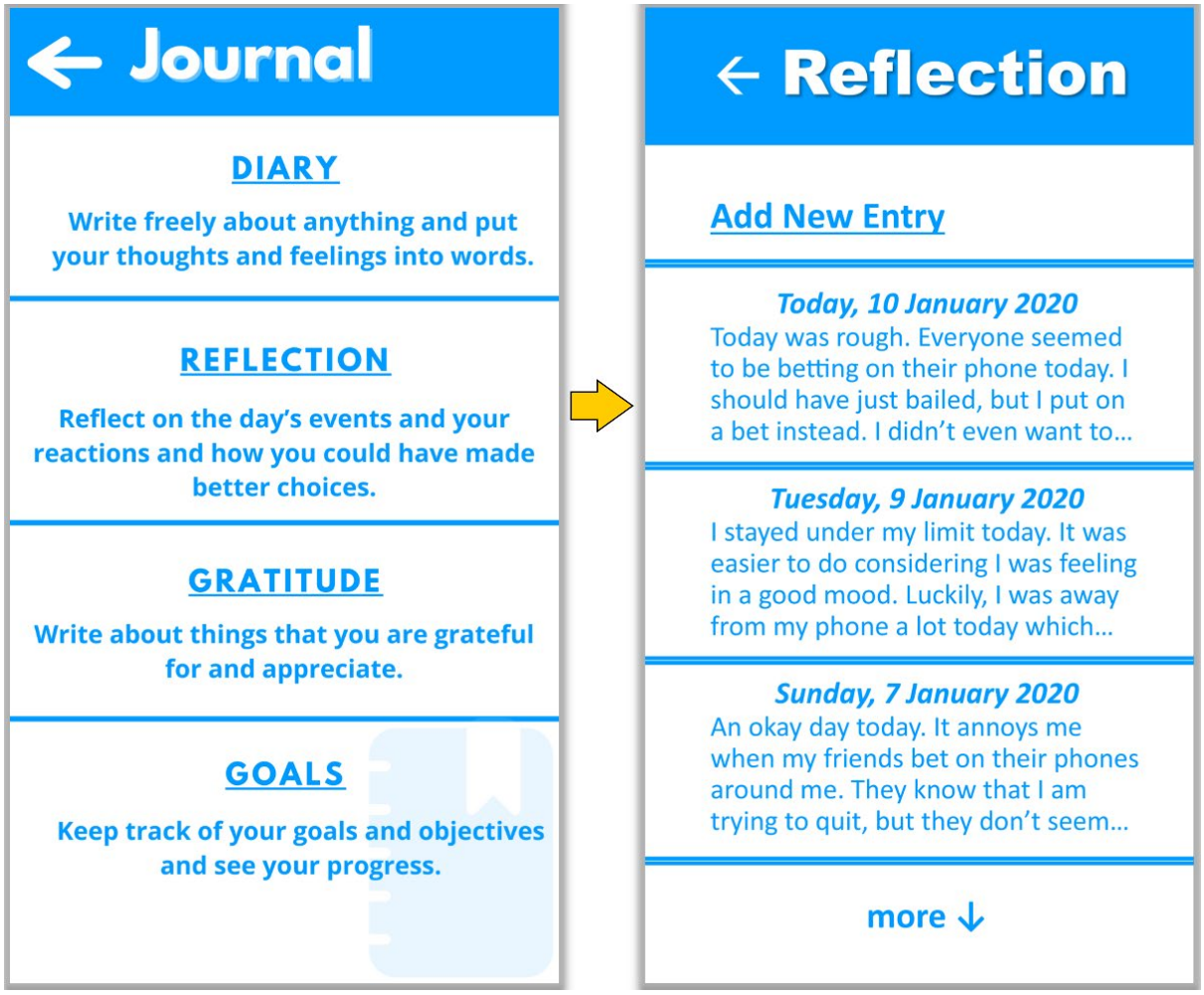
This function is called Milestones and focusses on your achievements. It rewards you for achieving timeframes of not gambling. You report daily to help make you more accountable for your time and money. You are rewarded for achievements with trophies, and timeframes are customisable.

Milestones also lets you choose if you want to share your trophies on social media to let others know what you have accomplished.

Image 1) a list of trophies that have been achieved and you can choose to share on social media

Image 2) a list of timeframes that haven't been reached yet

Survey Stimulus—Journal

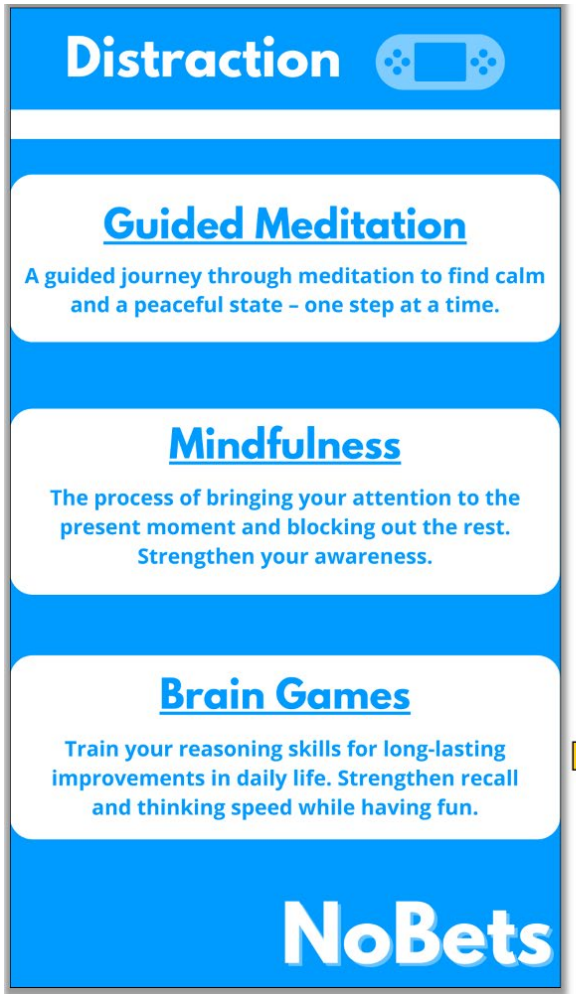


This function is called Journal which you can use to make regular journal entries about your progress or record a diary about your journey. There are four main benefits to journaling through change; 1) prioritise problems and goals, 2) recognise and track betting triggers, 3) identify self-defeating thoughts, and 4) provide a private outlet self-expression. There are four features which are different types of journal entries; 1) diary, 2) reflection, 3) gratitude and 4) goals.

Image 1) the four different features or journal types to explore and their descriptions—diary, reflection, gratitude and goals

Image 2) an example of diary entries

Survey Stimulus—Distraction



This function is called Distraction which you can use for drawing attention and thoughts away from gambling. There are three features to this function. The first feature is guided meditation audios for mental calm and concentration. The second feature is mindfulness audios to help control thoughts of gambling. The third feature contains fun brain training games that use your attention and keep your hands busy.

Image 1) the three features of the function and their descriptions

Image 2) different categories of brain games and their descriptions

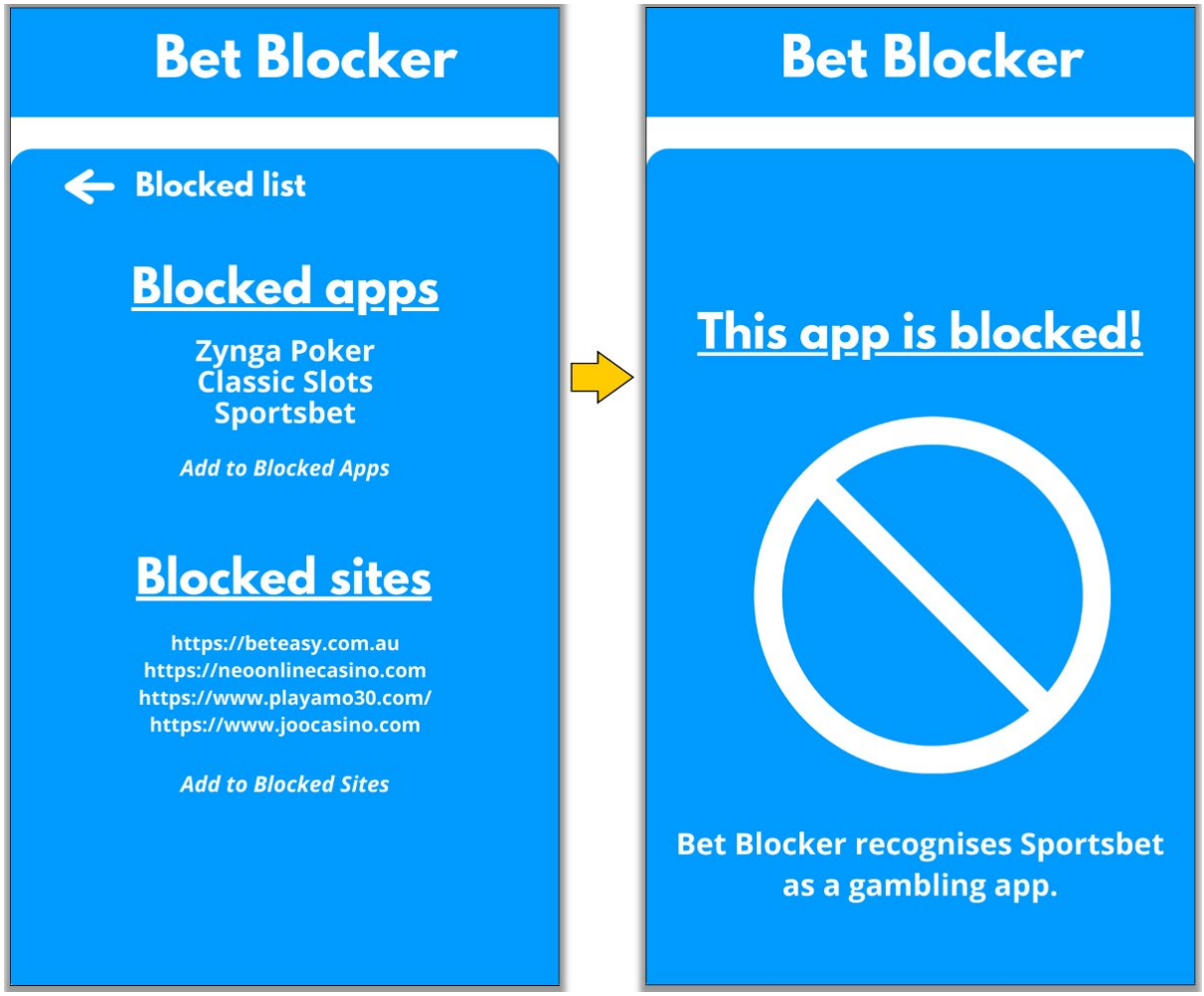
Survey Stimulus—Crisis Helpline

This function is called Crisis which links you with a 24/7, completely anonymous gambling helpline. This app accesses the call settings of your mobile phone to make an immediate call to 1800 Gambling Help, an Australia gambling support group staffed with trained counsellors and treatment specialists.

Image 1) shows you the Crisis Helpline icon on the dashboard

Image 2) the screen which confirms that you want to make the call with one click.

Survey Stimulus—Bet Blocker

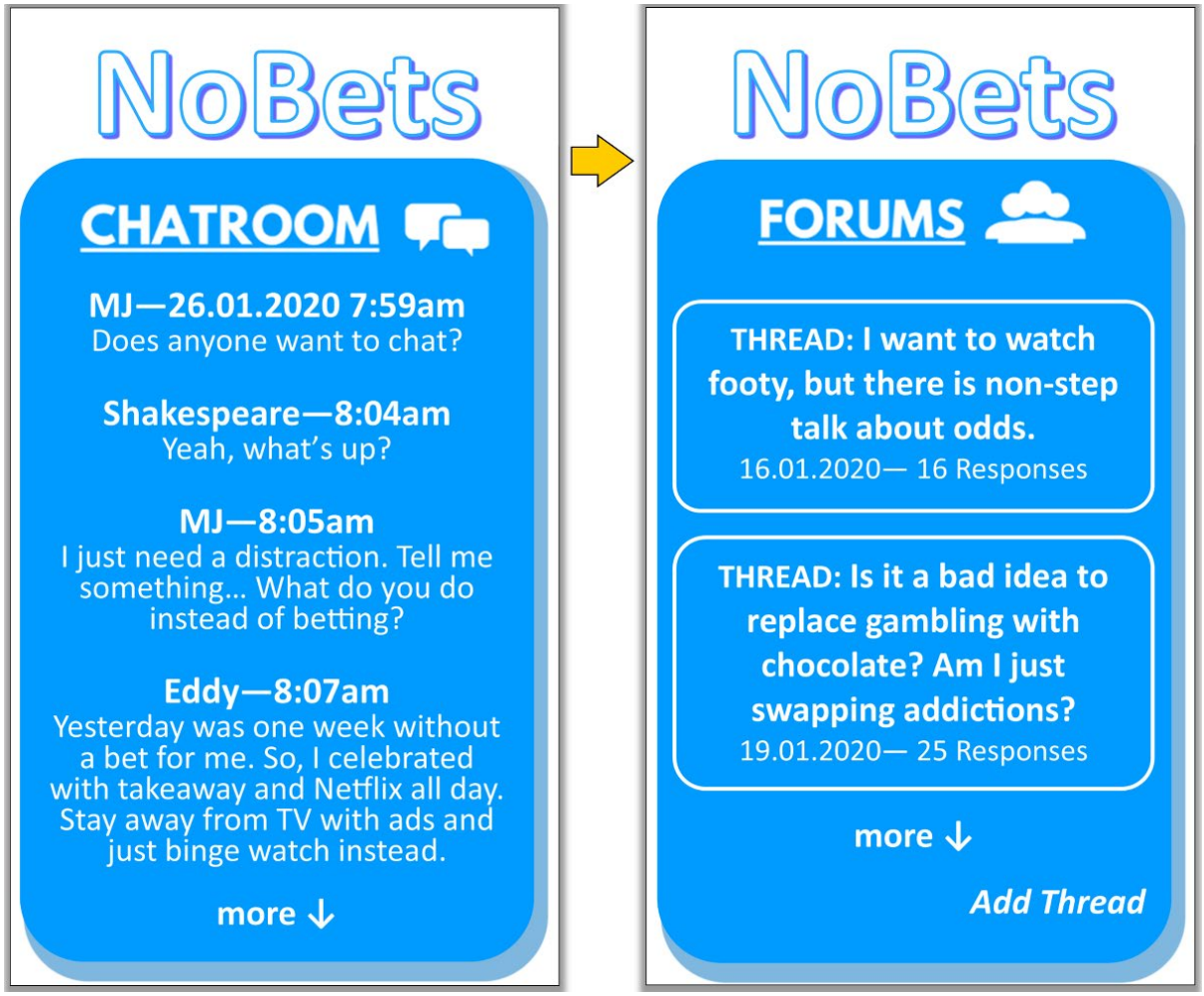


This function is called Bet Blocker which is easy-to-use and non-invasive. You can set Bet Blocker to block your device from accessing gambling websites and apps. The app has a default list of known sites and apps, and you can also add website sites and apps to this list. This function prevents you from impulsively deleting the app by delaying uninstallation.

Image 1) An example list of blocked apps and sites

Image 2) Bet Blocker recognising the Sportsbet app and stopping access

Survey Stimulus—Chat



This function is called Chat which you can use to anonymously connect with other people using the app who might be sharing your experiences. The first feature is a private and secure chat room dedicated to app users only and is an open space to talk with peers. The second feature is a forum where you can post questions, topics and issues to create dedicated discussion threads or contribute to other threads.

Image 1) an example conversation in the 24/7 chat room

Image 2) an example of forum threads that people have created