A mixed-methods investigation into the user experience of well-being applications

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“A failure is not always a mistake. It may simply be the best one can do under the circumstances. The real mistake is to stop trying. “

B. F. Skinner

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For Paul

First and biggest of thanks to my family – Carol, Jenny, Robert and Len – for their continued support and always believing that we would make it to the end. They stand by me no matter what, and I will be forever grateful.

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Abstract

Mobile technology, including applications, can offer a range of benefits as an intervention delivery method, such as cost-effectiveness and ease of access. Well-being interventions have been developed in order to support people who do not have a diagnosis of mental ill health, but who are still not flourishing or feel fully satisfied with their lives. Mobile technology could be the most suitable way of delivering these interventions, as they can be accessed anonymously by many people as and when they are needed, without using large amount of resources and contact time with mental health professionals. However, mobile technology can only be a successful delivery method if users are engaged with the applications.

This thesis aims to examine the user experience of well-being applications and presents the results of the three empirical studies which aim to investigate the acceptability, usability and implementation of well-being applications, through the framework of the Technology Acceptance Model (TAM) (Davis, 1986) and the Consolidated Framework for Implementation Research (CFIR) (Damschroder et al, 2009). In the first empirical study, relationships from the TAM are validated in a new context of well-being and it is shown that perceived ease of use and perceived usefulness predict attitude towards and intention to use well- being applications, which suggests that the usability of an application can affect how much it is used. In the second empirical study, a prototype application was developed, and a usability test was conducted which showed that it was rated as easy to use and understand. This confers with the results of a comprehensive literature review examining the current investigation into the usability of well- being applications.

In the final empirical study, a series of focus groups was conducted to examine the barriers and facilitators of implementing well-being applications and recommendations for future design and implementation of well-being applications is discussed. All three studies demonstrate the importance of engagement in encouraging technology use. Engagement has been included in an extended model of the TAM as a determinant of perceived ease of use, but the conclusions of this thesis suggest that it may play a more prominent role and should be included more centrally.

Overall, it is concluded that well-being applications offer a delivery method which is attractive to users and easy to use, but that future development should focus on increasing the entertainment and engagement in order to increase adherence. This thesis contributes to future practice by concluding with guidelines for the development, implementation and reporting of mobile technology-based interventions for well and contributes to theoretical knowledge by demonstrating the need to investigate extending the TAM to include a measure of perceived engagement as a predictor of intention to use mobile technology for well-being.

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Thesis Summary

This thesis aims to investigate the user experience of mobile applications for well-being, by using a mixed-methods approach to examine the acceptability, usability and implementation of such applications. Three empirical studies are presented which use the Technology Acceptance Model (TAM) (Davis, 1986) and the Consolidated Framework for Implementation Research (CFIR) (Damschroder et al, 2009) to guide the interpretation of the findings. This summary outlines the chapters included in this thesis which are used to inform the final conclusions.

Chapter 1 presents the background and rationale to this thesis. Mobile technology has several advantages as a delivery method for interventions which are presented here. Specifically, it has several advantages for the delivery of mental health interventions such as anonymity, equality of access and flexibility in order to suit a range of needs. Evidence shows that mobile applications are an effective platform for mental health interventions, but less research has focused on their use for well-being interventions. These interventions can offer support to people who do not show the symptoms of mental ill health but need to work on their well-being to increase flourishing and satisfaction with life. Using mobile applications to deliver these interventions could be beneficial as it would allow people to improve their well-being without costly input from therapists or group interventions. However, mobile applications can only be effective as a delivery method if users engage with them and want to complete the activities or tasks included. This thesis therefore aims to investigate the user experience of well-being applications in order to make recommendations for future research and practice.

Chapter 2 presents two models which will be used to guide the structure and interpretations of the results of the empirical studies. Firstly, the Technology Acceptance Model (TAM) (Davis, 1986) presents an explanatory model of technology use and proposes that perceived ease of use and perceived

usefulness predict attitude towards using a technology, which itself predicts actual usage. This model is useful as it provides explanatory factors for usage which can be increased in order to lead to higher levels of usage. The focus of this thesis in on perceived ease of use, as it concerns the usability, ease of interaction and user experiences of the applications. The other aspect of the TAM, perceived usefulness, concerns the content and the effectiveness of the activities included in the intervention. The Consolidated Framework for Implementation Research (CFIR) (Damschroder et al, 2009) provides factors which can affect the implementation of a new system or intervention, such as the setting of the implementation and the characteristics of the users. This chapter also combines the two models to outline a model specifically for the implementation of technology.

Chapter 3 presents the results of a systematic literature review which investigates the usability of well- being applications. 7 studies were identified which measured usability with either the System Usability Scale (SUS) (Brooke, 1996), the Mobile Application Rating Scale (uMARS) (Stoyanov et al, 2016) or the Client Satisfaction Questionnaire (CSQ) (Attkisson and Zwick, 1982). These studies showed that well-being applications are generally considered easy to use by participants and they received high rating on the usability measures. This suggests a positive user experience for well-being applications which would attract more users. Chapter 4 then outlines the mixed-methods approach taken in the subsequent empirical studies which aim to address the lack of research focusing on user experience identified in the review, including justification for a mixed-methods approach, data sources, proposed analysis methods, and ethical considerations.

Chapter 5 presents an empirical validation of relationships from the TAM in a well-being context. The results of the literature review suggested that well-being applications were easy to use, and the TAM suggests that this should lead to increased usage. Although the TAM has been demonstrated in a range of contexts, no evidence was found for studies which validated the model in a well-being context, which this study aims to address. 170 participants were recruited online to complete a questionnaire which measures perceived ease of use, perceived usefulness, attitude towards using well-being applications and intention to use them. It was hypothesised that the predictive relationships shown in the original TAM (outlined in Chapter 2) would be supported. This hypothesis was shown to be partly true, as perceived usefulness did predict attitude and intention, but fully mediated the effects of perceived ease of use. However, this does show that perceived ease of use has a predictive effect and can lead to increased usage via the indirect effect on attitude, mediation by perceived usefulness. An open question was included at the end of the survey, and thematic analysis was conducted on the responses to this. This analysis indicated that although participants knew that well-being apps could be useful, they weren't entertaining enough to stimulate repeat usage. This suggests that engagement could also be an explanatory factor, although it is not included in the TAM.

Following the supported conclusion that perceived ease of use and usability can lead to increase usage, Chapter 6 presents the development and usability testing of a prototype well-being application which uses a daily diary method to increase optimism. 25 participants used the prototype application and completed the System Usability Scale (SUS) (Brooke, 1996) and the Mobile Application Rating Scale (uMARS) (Stoyanov et al, 2016), and overall the prototype was rated as highly easy to use. However, improvements were suggested in order to make the application more visually appealing and engaging and participants stated that this would make the application more attractive to potential users. This reinforces the conclusions presented in Chapter 5 concerning engagement and entertainment.

In Chapter 7, the implementation of well-being applications was examined using a series of four focus groups consisting of working adults in order to identify the barriers and facilitators of implementation in a workplace setting. Thematic analysis was conducted, and five themes were shown; expected outcomes, previous experiences with technology, flexibility, time pressure and engagement. The results from this study were interpreted using the CFIR, and then used to make recommendations for the implementation and design of future well-being applications in both research and practice. The theme of engagement also corresponds to the results from previous chapters.

Finally, in Chapter 8 the combined results of the studies are discussed, including the strengths and limitations of the research presented. This thesis demonstrates that mobile applications are an acceptable delivery method for well-being interventions and are generally shown to be easy to use, through both the prototype test and the systematic literature review. The validation of the TAM relationships in the new context of well-being suggests that this high level of usability could contribute to increased intention to use, which would allow well-being interventions to reach a larger number of people who could potentially benefit. It is also suggested by the results that an additional factor of engagement could also affect eventual usage of a well-being application. This suggests the mobile applications would be a suitable target for future research into well-being, and in future practice as an intervention delivery method, but that the role of engagement needs further attention in order to provide a complete picture of the motivational factors for using well-being applications.

Chapter 1: Introduction and Background to the Usage of Mobile Applications as a delivery method for Well-being Interventions

Background

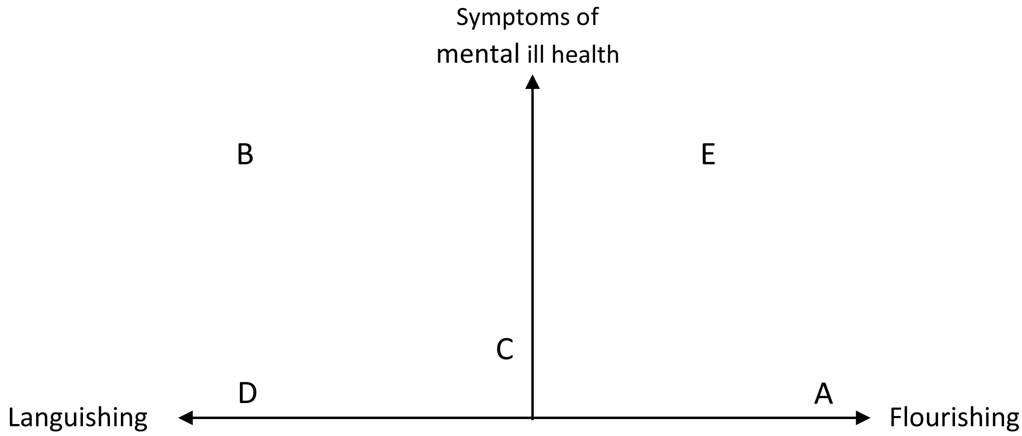
Around ¼ of people in the UK experience mental health issues (McManus et al, 2009) the most common of which are are anxiety and depression (McManus et al, 2016). Estimating the true prevalence of mental health issues is difficult, due to the variation in criteria and method of data collection such as self-reporting, absenteeism and doctor's records. The World Health Organisation has reported that 40% of the world's population show symptoms of depression or have an anxiety disorder (WHO, 2002). It is estimated that 1 in every 10 people will suffer from anxiety or an anxiety related disorder at least once in their life (Ehlers, 1997). This prevalence can also lead to higher associated costs. In an independent Thriving at Work Review (2017) commissioned by the government, it is suggested that mental health costs employers between £33 billion and £42 billion a year and costs the overall economy between £74 billion and £99 billion a year. An online NHS Digital (2018) report stated that the NHS spent £11.6 billion directly on mental health in 2016-2017 and the Chief Medical Officer stated that overall, poor mental health led to a loss of 4.5% GDP (Department of Health, 2014). These estimates combined suggest huge costs for almost everyone as a result of poor mental health.

Well-Being

However, in addition to a high prevalence of poor mental health, there are also a section of people who, despite not showing symptoms of mental ill health, are also not living at their full potential with high life satisfaction. This is termed languishing (Keyes, 2002; 2005). Gloria and Steinhardt (2013) state that people who are languishing are unsatisfied with their lives, find them unfulfilling and show significantly higher levels of stress, anxiety and depression (although not high enough to constitute a mental health diagnosis). Westerhof and Keyes (2010) state that original definitions of mental health relied purely on the absence of psychopathologies and stated that to be mentally healthy was to not be mentally ill. However, it has since been argued that this dichotomy is not the case, and that a lack of mental ill-health is the very minimum expectation of mental health and well-being but does not directly equate to being mentally healthy. Keyes, (2002; 2006; 2014) states that overall mental health is made up of three aspects of well-being; *emotional well-being* which includes happiness and satisfaction, *psychological well-being* which is a longer term happiness with life and with your personality and being able to be responsible and adaptive with positive relationships with others, and *social well-being* which involves a level of contribution to society and to community. The emotional well-being aspect represents a more hedonic, immediate and short-term well-being which is characterised by positive emotions and feelings at the time. Psychological well-being is a longer-term and more stable type of well- being, more closely related to the idea of eudamonia and overall well-being, sometimes at the cost of immediate happiness. Keyes (2005;2007) states that it is most psychologically healthy to have well-being in both forms.

Keyes (2002; 2005) outlines three mental states based on presence or absence of these three aspects of mental well-being; *flourishing* where an individual has high emotional, psychological and social well-being as described above and is the most psychologically health state, *languishing* where an individual has low levels of all three types of well-being and *moderate mental health* which can be a mixture of levels of each aspect of well-being, or moderate levels of all three. These three states apply to people both with and without mental illness. Rather than a traditional view that mental health and mental illness are two ends of single continuum, Keyes (2005) suggests a two continua model, with a continuum for both mental health and mental illness, each with the three stages outlined which was confirmed using factor analysis. The two continua model is demonstrated below in Figure 1.
This structure has also been found in cross-cultural studies (Westerhof and

Keyes, 2008; Keyes et al, 2008) and using a range of measures of both mental illness and mental health (Compton et al, 1996; Headey et al, 1993; Suldo and Shaffer, 2008).



Person A = positive mental health and flourishing (all 3 types of well-being)

Person B = mental ill health and languishing (no well-being)

Person C = occasionally symptoms of mental ill health and moderate mental health

Person D = no symptoms of mental ill health but no well-being so languishing

Person E = frequent symptoms of mental ill health but also has well-being

Figure 1: The two continua model of mental health (Keyes et al, 2005)

Fredickson and Losada (2005) suggested an ideal ratio of positive to negative emotions of 2.9, which in practice is a ratio of 3:1 in favour of positive emotions and propose that this leads to flourishing – such as healthy marriages and successful organisations (Fredrickson, 2009). It has also been shown that a ratio of less than 1:1, where negative emotions are experienced more often than positive emotions indicates depression (Schwartz et al, 2002; Fredrickson, 2009). Fredrickson (2009) states that this ratio can be used as an indicator of well-being, with above 3:1 representing high well-being and flourishing, and between 1:1 and 3:1 representing low well-being and languishing, but not low enough for a diagnosis of depression which would coincide with a ratio of less than 1:1. People who fall into the languishing category have been shown to be more likely to go on to develop illness, both physical and psychological (Kiecolt-Glaser et al, 2002; Gallo and Matthews, 2003). Languishing has also been linked to increased absenteeism and reduced productivity, which has a range of costs for employers and organisations (Penney and Spector, 2005). With the current resources already being stretched by the need for care of mental illness, and the suggestion that languishing can lead to future mental illness, interventions to move individuals higher on the continuum from languishing to flourishing will help to reduce this burden. Helping people to flourish will also increase the number of people living fulfilling lives and experiencing real satisfaction and well-being. One area of psychology which provides more insight into what makes live worth living and how to increase life satisfaction is positive psychology.

<u>Definitions of mental health and well-being</u>

With the increase in interest and research, and the wide range of topics encompassed by the term 'mental health', it is important to define is meant by mental health and well-being, as different terms are used in different areas of psychology, including positive psychology. The World Health Organisation defines mental health as *"a state of well-being in which the individual realises his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully and is able to make a contribution to his or her community"* (WHO, 2004). The idea of mental health being a state is also supported by Galderisi et al (2015) who define mental health as a *"dynamic state of internal equilibrium"*. They suggest that mental health depends on an overall level of well-being, and that is it mentally healthy to feel the full range of emotions, including sadness and negativity in the appropriate context. As stated, Keyes (2002; 2006; 2014) defines mental health as a combination of high levels of emotional, psychological and social well-being. It has been argued that these definitions, and those of Keyes (2005, 2007) are somewhat culturally limited depending on the what counts as a contribution to society and happiness in that cultural context (Murphy, 1978). However, Vaillant (2012) counter-argues that although there might be an element of cultural difference, there are still many common factors across cultures that constitute mental health and well-being at a human level.

Although the literature, particularly around positive psychology refers to positive mental health, the remainder of this thesis will refer to positive mental health as ‘well-being’, mainly meaning subjective well-being which relates to happiness, life satisfaction and fulfilment (Kim-Prieto et al, 2005). The definitions for mental health as described above, include the three aspects of well-being; emotional, psychological and social (Keyes, 2002). The interventions that will be outlined in this thesis, including the example intervention developed and outlined in Chapter 6, focus on building emotional or subjective well-being, with some elements of psychological well-being. As this thesis does not include any measures of social well-being or psychological well-being, it is not a true representation of overall mental health, as the definitions suggest. Therefore, well-being is used to indicate the focus on emotional and subjective well-being and to highlight these differences.

Positive Psychology and its link to Well-Being

Introduction to Positive Psychology

Seligman (2002) states that after World War 1 which led to increased prevalence of mental issues such as PTSD resulting from the traumatic experiences of the time, psychology became a science of healing, using a disease model similar to healing the physical damage caused by war. Seligman (2002) also states that while large strides in curing mental illnesses have been made as a result of the disease model, it does not provide a framework for prevention and that a lack of disease or mental ill health is not enough to constitute happiness or a positive life; more is needed. He states that there are strengths that can act as buffers against the causes of mental ill health, such as courage, optimism, hope, honesty and perseverance. He argues that the study of psychology has overlooked these aspects of human experience, in favour of a concentration on the more negative aspects that can cause mental illness, such as stress and anxiety (Seligman, 2002).

In order to readdress this balance and to focus research on the positive aspects of human experience that can not only prevent mental illness, but also increase positive mental health and lead to flourishing, a new area called positive psychology was suggested. It was first outlined by Seligman and Csikszentmihalyi (2000) in their introduction to the millennial edition of the American Psychologist. They stated that the time had come to re-balance the field of psychology and that the study of positive concepts was important for the development and flourishing of individuals, societies and cultures. They defined positive psychology as the science of flourishing in an ordinary life, by ordinary people, in ordinary situations, and suggested three areas that positive psychology was comprised of; valued subjective experience, positive individual traits and civic virtues (Seligman and Csikszentmihalyi, 2000). Positive psychology has also been defined by Gable and Haidt (2005) as the study of what contributes to optimal functioning.

Based on this, Seligman and Csikszentmihalyi (2000) outlined several aims for positive psychology going forward. They stated that there should be a focus on prevention of mental illness, on using human strengths as buffers, and on positive personal traits, their implications for health and how to foster excellence in all areas. Positive Psychology should also establish how positivity is developed, the contributing factors to positivity, and how these factors can be used to increase well-being, not only to prevent mental ill health, but also to encourage flourishing, life satisfaction and meaning in life.

Aspects of Positive Psychology

Many positive factors which can contribute to well-being have already been identified. One of these is Character Strengths which Park, Peterson and Seligman (2004) define as positive traits that are exhibited in thoughts, feelings and behaviours, and are arguably a large component of what makes up someone's personality. They also suggest that a good character is made up of multiple positive character strengths. To clarify the different character strengths, Park, Peterson and Seligman (2004) designed the Values in Action

(VIA) classification, which outlines 24 positive character strengths grouped into six categories: Wisdom and knowledge, Courage, Humanity, Justice, Temperance, and Transcendence (Park and Peterson, 2006). Character strengths are measured using the VIA Inventory of Strengths (outlined in Park, Peterson and Seligman, 2004) which ranks the strengths people have by how much they associate with them, although each person will have a combination of all strengths in varying degrees. Research has shown that using the character strengths in everyday life, for example someone who has love of learning at the top of their VIA results practicing a new skill every day, can lead to increased life satisfaction (Park, Peterson and Seligman, 2004; Lounsbury et al, 2009; Peterson et al, 2007).

Another example of a positive psychology construct that can contribute to well-being is gratitude, which Emmons and McCullough (2003) state is recognising that a positive outcome for the individual has come as a result of another person, who may have acted without any benefit to themselves, and without regard for whether or not the recipient 'deserves' it. Bertocci and Millard (1963) use a broader definition, stating that gratitude is recognising the value in an experience, which could also include being grateful for things that have not been caused by another person. Gratitude been found to be related to an increase in positive emotions (Walker and Pitts, 1998; Overwalle et al, 1995) and is related to positive affect, as well as vitality, optimism, and negatively related to anxiety and depression (McCullough, 2002). Watkins et al (2003) also found that gratitude was positively related to life satisfaction, positive affect and happiness, and negatively related to depressive symptoms and physical aggression scores.

Forgiveness, which can be seen as opposite but complementary to gratitude, is also an aspect of positive psychology. There are debates around the exact definition of forgiveness (Worthington, 1998) but most include aspects of developing empathy for someone who has perpetrated an injustice (e.g. Doyle, 1999; Enright and the Human Development Study Group, 1996; Gartner, 1988). Witvliet et al (2001) showed that forgiveness led to lower physiological stress responses and greater perceived control over the situation. As well as forgiveness of a perpetrator of an injustice, it is suggested that self-forgiveness can also lead to increased well-being, better mental health and increased life satisfaction (Macaskill, 2012) as well as better physical health (Wilson et al, 2008).

One final example aspect of positive psychology is positive affect which has been defined as how enthusiastic, alert and active an individual is (Watson and Clark, 1988), although it is more commonly accepted to be a measure of current mood and positive feeling or emotions. Greenglass and Fiskenbaum (2009) showed that positive affect was associated with better psychological functioning and Schiffrin and Falkenstern (2012) showed that positive affect is associated with increased social support, more positive health perceptions, increase optimism, increased resilience, and reduced depression and anxiety. Cohn et al (2009) showed that positive emotions predicted an increase in life satisfaction and resilience and Fredrickson et al (2008) showed that meditation increased positive emotions, which in turn led to increased personal resources, which then led to an increase in life satisfaction and a decrease in depressive symptoms. The main mechanism used to explain the impact of positive affect on well-being is the 'broaden and build' theory, proposed by Fredrickson (2001). This theory states that positive emotions broaden the momentary thought-action repertoire and build resources as a result.

Well-being Interventions Using Positive Psychology Techniques

A variety of well-being interventions based on research around some of these aspects of positive psychology have been tested and shown to be effective at increasing a range of outcomes. Burton and King (2004) showed that writing about positive experiences could enhance positive mood. Buchanan and Bardi (2010) showed an increase in life satisfaction after participants had performed acts of kindness to others and acts of novelty. A study by Hurley and Kwon (2011) used an intervention based on savouring the moment and paying attention to the positive to decrease depressive symptoms and negative affect. Emmons and McCullough (2003) demonstrated the effects of a gratitude course on increasing wellbeing and positive affect. Seligman (2005) describes his own research into different intervention methods, covering gratitude and character strengths interventions and demonstrating their success. Finally, using character strengths in new ways was shown to increase engagement, wellbeing and pleasure (Mitchell et al, 2009).

One other intervention which has received a lot of research and popular media attention, is the use of mindfulness meditation, as outlined by Kabat-Zinn (1990). Marianetti and Passmore (2010) defined mindfulness meditation as the development of purposeful awareness, inclusive and authentic attention and non-judgemental acceptance. Kabat-Zinn (2011) states that mindfulness is meditation aiming to increase attention and awareness of the present moment in a non-judgemental way. There are many ways in which to practice mindfulness meditation, but two are the most popular and the easiest to do are the body scan and walking meditation practice (Kabat- Zinn, 1990). A systematic review of the benefits of mindfulness show that it is related to increase well-being and behavioural regulation, and to decreased psychological symptoms and emotional reactivity (Keng et al, 2011). Mindfulness practice has also been linked to decreased anxiety and depression (Hofmann et al, 2010) reduced emotional exhaustion and increased job satisfaction (Hulsheger et al, 2013). Cropley and Purvis (2003) showed that mindfulness was related to reduced job strain. It was also related to increased creativity (Langer and Pier, 1987). There is also evidence that mindfulness can improve interpersonal relationships. Shefy and Sadler- Smith (2006) showed that mindfulness was related to increased interpersonal sensitivity, and Riskin (2004) showed a relationship with increased conflict resolution. Mindfulness Based Stress Reduction Programmes (MBSRs) have been shown to be effective at reducing stress and increasing sleep quality (Klatt et al, 2008). They have also been shown to lead to reduced stress, burnout and anxiety, as well as increased empathy, focus and positive mood (Smith, 2014). Cavanagh et al (2014) state that self-help interventions based on mindfulness are effective, and as self-help interventions can be easy to access and cost-effective, make it an attractive options people to get started with.

The link to Cognitive Behavioural Therapy (CBT)

Cognitive behavioural therapy is a method of modifying cognitive processes and unwanted thought patterns (Hobbis and Sutton, 2005). It was originally developed as a combination of the work of Aaron Beck and Albert Ellis in the 1970s and contains five stages to change thought processes, with the original aim of treating depression (Beck et al, 1979; Ellis, 1979). These stages involve altering and challenging the automatic thoughts which represent our explanations of an event. These explanations are known as attributions and relate to time, context, and cause. Attributions of negative events which are temporary, specific and external reflect that the event was a one-off which would only happen in that specific context, caused by something outside of your control. Attributions which are permanent, pervasive and personalised suggest that everything will always be negative, everywhere you go, because of something bad you did, which is they type of attribution that Beck and Ellis both suggest can lead to depression (Beck et al, 1979; Ellis, 1979).

The five stages of cognitive therapy involve altering these thoughts by recognising them, challenging them, practicing more positive attributions, to distract yourself from negative thoughts and questioning the underlying assumptions. Seligman (2006) uses this therapy to not only decrease negative thoughts, but also to increase optimism. The advantage of using cognitive techniques to increase positive thinking is that it can lead to a long-term or more permanent change (Gielissen et al, 2007; Werrij et al, 2009; Seligman, 2006). Not only do CBT techniques underpin cognitive interventions for depression and anxiety, they also underpin many of the positive psychology interventions described, and therefore CBT techniques be combined with positive psychology interventions to increase effectiveness by both challenging the negative thoughts and building positive replacements (Ingram and Snyder, 2006). The aim of both types of intervention is to introduce behaviour and thought change, and so the techniques can be translated from a CBT approach to a positive psychology intervention.

Mobile Technology as a Delivery Method for Interventions

One of the key factors in the design of interventions is the delivery method. Increasingly, technology is being used as a delivery method for interventions and new programmes both in research and in practice, as it offers many benefits including cost effectiveness (Zurovac et al, 2012) and ease of access (Price et al, 2014). The next section in this chapter will investigate the potential use of mobile technology as a delivery method for resource building interventions. Technology-based interventions use a range of ICT features including the internet, email or SMS to deliver the intervention, which involves an exchange of information between the intervention and the user (Lau et al, 2011). These interventions can involve a range of technology equipment, such as computers, mobile phones or wearable devices. Mobile technology refers to any of these technology-based delivery methods which are portable – mainly mobile phones but also tablet devices and wearable devices such as smart watches.

Mobile technology has seen vast increases in development and usage across every population in the world (Castells et al, 2009). It is estimated that by the end of 2013 there were 1.82 billion smartphones in the world, checked on average around 150 times per day each (Khalaf, 2013) - a number which is expected to keep increasing. Deloitte's Global Mobile Consumer Survey (2017) states that globally, 1.5 million smartphones are sold every day and that 85% of adults and 91% of teenagers now own smartphones, with many using them within five minutes of waking up in the morning. Smartphone usage in older adults is catching up to that of younger generations and is expected to continue to rise, particularly with the design of new apps for a variety of different uses, including online shopping, banking, travel and communication, which will make smartphones even more essential (Deloitte, 2017). This widespread use and its rapid increase have one striking benefit; information can be spread quickly to large numbers of people who are constantly in contact with their devices (Castells et al, 2009). This makes mobile technology and smartphones a leading contender in delivery of information and by extension, of interventions.

Mobile devices can host interventions through several methods, including text messaging, web pages and mobile applications. Mobile applications, or apps, are software which is downloadable to a mobile device and are often more suitable for a mobile format than webpages. Apps are often also able to link to other functions on the devices, such as location, and can often run offline without the need for an active internet connection as is needed to run a webpage. As a result, mobile applications have become increasingly widely used for a huge variety of purposes. It is therefore not surprising that researchers have started to consider them for interventions in a range of health contexts. Mobile applications haven already been successfully tested for many physical interventions, such as smoking cessation (Bricker et al, 2014), increasing physical activity (Hurling et al, 2007), weight management programmes (Morrison et al, 2014), diabetes interventions (Fukuoka et al, 2015; Goyal and Cafazzo, 2013) and management of long-term health conditions (Whitehead and Seaton, 2016). More recently, this focus has also turned to well-being and mental health management, in areas such as mindfulness (Mani et al, 2015), schizophrenia management (Firth et al, 2015) and depression management (Arean et al, 2016). Although this area is less researched than physical health interventions, there is a lot of potential for mobile apps to become successful mediums for psychological interventions, as they offer an alternative delivery method for those who cannot take part in traditional methods like therapy due to barriers such as time restrictions (Bull, 1991). Apps provide ease of access with little travel or interruption (Gonzalez et al, 2005) and remove practical barriers that may interrupt adherence such as transportation or childcare issues (Taylor et al, 2012; Chan et al, 2014).

Benefits of using mobile technology

Mobile technologies, including mobile applications, offer several advantages as a delivery method for well- being interventions. Firstly, using mobile technology can be cost effective, although estimates widely vary depending on method and audience (De La Torre-Díez et al, 2015; Zurovac et al, 2012). The input required to set up a technology-based intervention can be very little, depending on the complexity of the intervention and the standard of presentation. Once they are set up and in place, the addition of new users is very low cost (Zurovac et al, 2012) and maintenance is relatively easy and can be done remotely. They also save costs due to the lack of continued face-to-face input required. At a time when there are a shortage of registered NHS therapists and counsellors for mental health treatment (Care Quality Commission, 2017), it is advantageous to have a method to offer that does not put extra pressure on these services and can reduce staffing costs by providing a first point of contact.

In many cases, there are large waiting lists where people do not receive the help they need due to a wait for an available therapist, which is sometimes 11 weeks or more (Care Quality Commission, 2017). Mobile technology-based interventions could help to reduce this and could be used to provide support during the wait to ensure patients are not left without any help during what can be a very difficult time. As these interventions are not dependent on therapists, this also saves a lot of input from the client, who would not have to travel to the therapist and would not have the same costs involved, either time or money, which may contribute to putting some people off receiving traditional forms of help (Taylor et al, 2012). This also means that those who need immediate help or support do not have to wait for a therapist to become available; sometimes people need help at different times of the day or in different place or may need help immediately in serious cases and mobile devices can provide time-sensitive health information (Ben- Zeev et al, 2013; Harrison et al, 2011).

There are also some populations which would not respond well to face-to-face contact and would prefer a more distanced approach, such as people with autism, or social anxiety who may be put off seeking traditional help (Chan et al, 2014). Mobile technologies can be used in this initial instance to relieve the immediate need for help and can be used to point someone in the direction of where they can find further help, such as links to support phonelines. Another factor related to people not seeking help is the stigma unfortunately attached to getting help, either from people they know or even from themselves (Corrigan, 2004). It may be very difficult for people to admit they need help and could be very intimidating to ask for it and so mobile technology may help to reduce this stigma. It is something that can be kept private, especially as many applications are freely available to download publicly without having to contact medical professionals and without receiving any official diagnosis or treatment plan.

Mobile technology also removes a significant amount of inequality in access to services. As mentioned, people may find it very time consuming, expensive, or just very impractical to make the journey to a therapist. They may not be able to afford the help they need or may have some issues that make it impossible for them to receive help, such as disability. In these cases, mobile technology would remove the barriers to treatment and help a much larger number of people (Chan et al, 2014). Although they require a smartphone and internet access, most people have these or could get access to these and that number is increasing every day (Castells et al, 2009). People with mental health issues are often out of work or on lower incomes but still most (an estimated 72%) use mobile devices (Chan et al, 2014). Chan et al (2014) also state that mobile devices would be suitable for use in low or middle-income countries to help those who are disadvantaged with lower resources. The applications can be made available very cheaply, or even for free to groups that require them and take very little time for someone to set up on their phone. As many people are very familiar with mobile applications, they are easy to use for most people or can easily be taught to others.

Another advantage is that they can be easily adapted for those with a range of disabilities, including hard of hearing or reduced vision, and they do not require any mobility for those who have difficulty. Mobile technology is often used to assist those with disabilities, often more effectively than other methods (Hayhoe, 2015).

Disadvantages

There are some disadvantages to using mobile technology that need to be considered when selecting a delivery method for an intervention. Firstly, the main disadvantage is the lack of social contact as a result of using technology. House et al (1988) state that humans require social interaction, but technology removes opportunity for this and can lead to increased feelings of isolation and being cut off from others (Berry and Lai, 2014). It has been shown that technology can have detrimental effects to mental health, particularly social media (Kross et al, 2013). Although this seems to be the social interaction people require, it lacks the detail of an experience, such as tone, body language and shared experiences (Moock, 2014). Moock (2014) also argues that technology wouldn't be suitable for people with serious mental illnesses, as they are not flexible enough to deal with serious crises when a mental health professional would be needed.

There are also some populations who may not be able to access technology or may not be as comfortable using it such as elderly people, children or transient people (Miller, 2012). There may be some restriction on access to technology by certain populations due to the cost of smartphones and internet plans, although these costs are reducing and technology is becoming available to a wider range of people (Konrath, 2015). Konrath (2015) also states that technological difficulties might also act as a disadvantage and that a technological support package would be needed in order to minimise this. In addition, there are many discussions around privacy and data protection when using technology, especially for sensitive topics such as mental health which requires disclosure of personal information and so security would need to be guaranteed (Miller, 2012). Finally, Moock (2014) states that one of the main problems with mobile technology is that there is a lack of evidence surrounding the effectiveness of such interventions and that research should focus on this area. It is concluded that technology is a strong alternative for traditional therapy methods for people with milder mental illness or those wanting to build positive resources and don't need as much personal input from a therapist, providing there is a strong-evidence base for the interventions and social interactions are maintained (Moock, 2014).

Features of Technology Based Interventions

As well as having many practical benefits, mobile technology allows many criteria for successful well-being interventions to be met. Previous interventions have been shown to be successful when they employ short strategies that can be easily delivered in chunks (e.g. Umanodan et al, 2009). It may not be worthwhile to just have meetings with therapists or group meetings for one small objective but minimising the complexity of the intervention makes it easier to understand, less intimidating, less time consuming and generally more manageable. This may contribute towards a greater uptake and upkeep of the intervention. In addition, interventions have been shown to be more effective at improving the desired objective when they are done in multiple short sessions, to allow for sufficient learning and behaviour change to constitute a lasting change (Diedrichs et al, 2015; Chambers et al, 2016). The increased participation and lack of fatigue or boredom from a shorter, more concentrated session may also contribute to these effects.

This provision of shorter, more targeted exercises and interventions is also supported by the ability to offer top ups or booster sessions, which have been shown to supplement learning (Nation et al, 2003). Many interventions benefit from a booster session which can increase the effectiveness or longevity of change (Longabaugh et al, 2001) and mobile applications can be designed to offer these boosters which can be used by the participant at any time. Mobile applications provide a semi-structured framework and a can deliver a reminder for daily practices which will help to build skills and ensure they become part of daily life and make the change long lasting, balancing the advantages of structure with the benefits of flexibility. As they do not need constant input from a therapist or intervention leader, there is not the same pressure for a finishing date or for regularly scheduled sessions, and so participants can continue to complete the intervention as they require it. One-off top-up sessions or follow-ups to examine the upkeep of the skills can also easily be offered through the application.

Recent interventions have also begun to explore the uses of social support and gamification in interventions (McCallum, 2012). Following the rise in popularity of social media and mobile games, including mobile games through social media applications, research has looked at how to include elements of these to make adherence to mobile interventions higher and more sustained. Mobile based interventions can provide the opportunity to include an element of social support through connecting with others online, which has been shown to be beneficial to mental health and wellbeing (Luxton et al, 2011). Mobile technology makes it possible to interact with others, either within the application itself or by linking with social media to share progress and provide support. This would be particularly useful for those already mentioned who may struggle getting to meetings or may struggle with face to face contact and allow them to feel part of a community and let them know that others are experiencing the same things. Some people could also struggle with accessing these types of support when they have full time jobs and other commitments, so a mobile technology-based intervention may be helpful to reduce this time pressure.

Gamification has also been used to encourage participation in interventions and has been shown to have a positive impact on changing health behaviours (Johnson et al, 2016). Gamification is the process by which elements of game playing are introduced to make the intervention more interactive and more enjoyable, usually offering rewards, customisable elements and challenges to complete, which is very suited to a mobile technology platform. Adding these features keeps interest going, encourages continued participation, helps to reduce stigma surrounding the intervention and relieve any fatigue effects from repeated exposure to the intervention. Combining gamification and social support is also effective (Allam et al, 2015). Adding the game elements allow individuals to compete against one another, to share scores and to share rewards, which increases the support for the individual.

Examples of Mobile technology Interventions for Well-Being

These points combined show that there are significant benefits to using mobile technology as a delivery method for health interventions and suggest that future interventions consider technology as a strong option for a delivery method. As stated, one of the most common, convenient and flexible technology-based delivery methods are mobile apps, many of which are already available, targeting both physical and mental health on a variety of topics. However, with the exponential increase in the development and marketing of these apps, more have become available on the app stores and in many cases the effectiveness is not measured as rigorously as with traditional interventions, if at all. As stated, research has already established that mobile applications can be an effective and useful method of delivery for physical health interventions.

To establish the effectiveness of current mental health interventions in app form, Donker et al (2013) carried out a systematic review, including empirical studies of apps which resulted in 8 studies of 5 different apps, focusing on depression, stress and substance abuse. 6 of these studies found reductions in their respective outcome measures including self-reported stress and depressive symptoms, leading the authors to suggest that app-based mental health interventions have potential to be effective in several areas. A review by Payne et al (2015) included a broader range of apps focusing on wider health and found 3 studies that were effective in reducing depression.

These reviews mainly focused on the effectiveness of the apps, and based on this, the next stage was to further analyse these results to try and identify why the apps were effective, and if any of the characteristics of the interventions such as duration, number of sessions and support available, had contributed in addition to the actual intervention technique. However, analysis of this kind was not possible due to the large discrepancies in the quality of reporting. In general, Donker et al (2013) had found that the quality of the included studies was low, with none of the studies meeting all 6 quality criteria used to identify bias, and some studies not including detail on dropout rates, allocation, sequence generation or general characteristics of the methods. Only three of the six effective studies gave enough detail that would allow the study to be replicated with reasonable accuracy. These results, and other extensive literature searching in the area, have highlighted the current problems with evaluation of mobile apps, and with the reporting of empirical studies in this area.

Regulation of Mental Health Apps

One significant concern with the use of mobile applications for mental health that this review exemplifies is the lack of scientific studies being conducted to evaluate the effectiveness of these applications (Nicholas et al, 2015; Firth and Torous, 2015). There are hundreds of mental health applications available on the Apple App Store and the Google Play Store with more being added all the time, and yet a systematic review has only been able to identify 8 scientific studies, most of which were low quality. Karasouli and Adams (2014) also conducted a systematic review to identify theory-driven and evidence-based mental health self-management e-resources and still only found 8 studies which matched these criteria. This suggests that there are hundreds of applications available which have not been scientifically tested. When potential users search for these applications on the relevant store, the information provided to help them decide which to use is heavily influenced by reviews and media hype. Very few of the applications advertised by these stores make any mention of scientific evidence and so users are having to rely on other sources of information to decide whether these applications will be suitable.

With the number of applications available increasing and with apps becoming more easily accessible, formal evaluation is needed to ensure high standards and safety (Fox and Duggan, 2010). A search of the National Institute for Health and Care Excellence (NICE) website who provide guidance on health interventions and developments, returns mentions of only two mental health applications - Sleepio and Deprexis. In fact, the website recommends that further trials need to be done before Deprexis can be fully recommended. The NHS website does contain a list of approved applications which have been independently checked for effectiveness, usability and security (https://www.nhs.uk/apps-library/category/mental-health/). However, there are no regulations to stop those applications that have not been independently verified and which don't use an evidence base or use any psychological theory from being published and downloaded from the stores. In fact, restrictions on apps published on the stores only relate to the technical effectiveness.

There is a distinct lack of any framework for risk assessment with these unregulated applications (Terry and Gunter, 2018). Price et al (2013) outlines several negative effects that this lack of rigorous evidence and verification can cause. Firstly, there can be security and privacy issues with unchecked applications which can involve confidential information that could become at risk if the device is lost, or if data is mined from the application. Patient populations have already raised concerns about this issue (George, Hamilton and Baker, 2009). Price et al (2013) also state that if users download a mental health application and have a bad experience with using it, they could be put off from seeking professional help in the future which could be damaging. Conversely, they may download an application, have a good experience and assume that everything has been made better and then do not address underlying causes or feel the need to continue with the interventions. Concerningly, there are also many applications on the stores which claim to be able to diagnose mental health issues as 'mental health assessments'. This could lead people to seek the wrong treatment and go on to use another application which would have no effects, or the wrong effects. Misleading or incorrect information in either type of mental health application could be highly damaging and could cause or exacerbate existing issues. As Price et al (2013) concludes: "*Just as untested, unregulated health supplements represent potential negative outcomes for physical health care (e.g., using an untested supplement in lieu of effective treatment), the large number of mental health applications available in the marketplace that claim to provide benefit is also potentially problematic. It is unknown what proportion of these applications actually utilizes evidence-based principles and techniques.*" (p.433).

This thesis aims to contribute in a small way to reducing this widespread problem by providing scientific evidence to demonstrate whether mobile applications are suitable as a delivery method for mental health interventions. A much greater amount of scientific evidence will be needed to support the effectiveness of mental health interventions to inform users of the safety of these interventions and to prevent any harm from being done as a result of the trend of mobile applications. Regulations also need to be introduced to prevent the publication of applications which have not been checked for their accuracy and safety. In the same way that incorrect medical advice would be debunked, future efforts should ensure that incorrect mental health information is treated in the same way. Evidence suggests that mental health applications can be effective, and the benefits of the apps that have been rigorously tested should not be lost in a wave of poor or dangerous applications.

User Experience

Although the review by Donker et al (2013) demonstrated that the mental health interventions that have been examined are generally effective, none of these studies included any measure of the user experience with the technology, including the usability or the acceptability of using technology as a delivery method. The usability of a technology should not be overlooked as it has shown to be related to the eventual usage of the technology whereby the more usable the technology is, the more likely people are to view it positively, and to subsequently use it (Davis, 1986; Turner et al, 2010; King and He, 2006). However effective the content of the intervention is at improving well-being outcomes, these benefits cannot be successfully accessed by the target audience if the delivery method is difficult to use and does not provide motivation to stay engaged with the intervention. Previous studies which have looked at the usability of mobile applications for the delivery of interventions have found that they are rated as usable (e.g. McKay et al, 2019; Kizakevich et al, 2018) but these studies are generally descriptive and present the usability as a secondary measure with little discussion of the effects it can have on the overall success of a technology-based intervention. Therefore, this thesis aims to address this gap by conducting a thorough investigation into the overall user experience of well-being applications by assessing the acceptability, usability and implementation of the method, and making recommendations for the future usage of mobile technology in a well-being context based on these findings.

The Current Research Project

Rationale

This chapter so far has highlighted the current prevalence of mental health issues, and the need to take a proactive approach to build positive mental health and well-being in order to both prevent common mental health issues such as depression and anxiety, and to encourage people to flourish and have actively positive mental health. It has been shown that the area of positive psychology encompasses a range of positive mental health constructs which could be built upon in order to increase well-being through interventions. It has also been demonstrated that a cost-effective, flexible and easy to access delivery method for this intervention is needed, and that mobile technology would be a highly suitable method for this. It was then shown that whilst the effectiveness of interventions is often examined in research, the usability and participant experience is often overlooked in these studies, either omitted completely or considered a secondary outcome. As usability has been shown to be linked to the usage of a new technology, this is an important factor which contributes to the eventual success or failure of the new system over time. In order to address these issues, this thesis aims to investigate user experience of technology as a delivery method for well-being interventions using a mixed-methods study. User experience will be examined through three aspects; the acceptability of using mobile technology in this context, the usability of well-being applications and the barriers and facilitators to the implementation of well-being applications. This will allow the suitability of using mobile technology in well-being research and practice to be assessed and recommendations to be made regarding future directions in this area.

The Research Context

In this thesis, two studies are conducted using a sample of the general population as participants. The final study which investigates the implementation of a prototype application, conducts focus groups with a range of working adults. The use of this population aimed to examine the implementation in a workplace context in order to identify the barriers and facilitators salient to this environment. The workplace provides an excellent environment for both the study and practice of positive psychology. With an estimate of 1900 hours per year spent at work (Ramey et al, 2006), work is a large focus in people's lives and can be a main contributor to both stress and satisfaction (Watson, Pennebaker and Folger, 1987). The workplace offers opportunities for flourishing, for positive experiences, enjoyment, growth and meaning. As work takes up so much of many people's lives, the boundaries of work and non-work have become blurred (Grantham, Ware and Williamson, 2007), with many people taking work home, and work has come to shape our personal identity.

Many people define themselves by their occupation and their employer. Jobs no longer attract people with just offers of a higher salary, they are now seen as lifestyle options and need to be fulfilling to attract or retain workers (Barlow, 1999). Research into improving wellbeing helps not only to attract and retain workers, but also helps to increase the amount of effort people give to work and can increase productivity (Fisher, 2003), which provides an incentive for employers to consider positive psychology. The APA has even started to offer rewards for psychologically healthy workplaces (Carlson, 2004), providing further encouragement for employers to implement positive psychology programs. The Sainsbury Centre for Mental Health estimated that if good mental health programmes were introduced in workplaces, the estimated saving could be up to £8billion, even considering the costs of set up (Sainsbury Centre, 2009).

There are several benefits to choosing the workplace as a context for implementation above other contexts. Plotnikoff et al (2005) stated that the workplace gives access to large number of the population through previously established channels of communications. It is also possible to access these populations across a longitudinal period (Blake, 2013) which allows for in depth analysis of effectiveness, acceptability and usability over time, as well as a process evaluation for the implementation process. The workplace has also been nominated as a priority setting for future interventions regarding mental health, both prevention of poor mental health and the enhancement of positive mental health and well-being (WHO, 2010; Department of Health, 2004; 2009; Batt, 2009). This is partly due to the increasing costs of poor mental health in the workplace, especially as a result of long-term stress which is very expensive (Aikens et al, 2014). Poor mental health is the leading cause of workplace absence, as the highest contributor to days lost (HSE, 2009; 2010). In addition to the costs of treatment, there are additional costs in the workplace due to presenteeism, absenteeism and insurance costs (Siegrist, 2001). Considering this documented cost of poor mental health, interventions to build well-being and act as a buffer against poor mental health or workplace stress have great potential to be implemented in the workplace to offer maximum benefits. One of these interventions is the optimism-building intervention described in Chapter 6.

This intervention uses the Three Good Things exercise, developed by Seligman et al (2005) which involves participants writing down three positive things which happened each day, and attributing a cause to them which is global, permanent, and internal, based on the CBT approach outlined previously. Seligman et al (2005) showed that this exercise led to increased happiness and decreased depressive symptoms over 6 months, making it more effective than other positive psychology interventions such as gratitude visits. This intervention is usually completed in a pen and paper format. For the second study in this thesis, this exercise was hosted on a mobile application as an example well-being application to conduct a usability test on. When the application was opened, one question was displayed which asked participants to list either three good things, or to focus on another positive aspect of their lives. Each question included a text box for the answer which would store the responses in a calendar for the users to look back on in the future.

The potential benefits of the intervention delivered by the application apply in the workplace to both the employees and the employer. Firstly, optimism has been shown to be related to more adaptive coping with organisational change (Kumar and Kamalanabhan, 2005) as well as acting as a buffer against time pressure, job insecurity and organisational climate (Makikangas and Kinnunen, 2003). Optimism has also been correlated with increased well-being (Desrumaux et al, 2015), decreased job-related stress, depression and anxiety (Totterdell, Wood and Wall, 2006) and decreased burnout (Chang and

Chan, 2015; Kluemper, Little and DeGroot, 2009; Hayes and Weathington, 2007). It has also been shown to be related to increased self-efficacy (Cotter and Fouad, 2013; Gottschling, 2016) and increased job satisfaction (Jung and Yoon, 2015; Cheng, Mauno and Lee, 2014; Wanberg and Banas, 2000).

These are significant benefits for employees as increased optimism can lead to a better working life, but these will also be beneficial for employers, as a more optimistic workforce would be happier and healthier, which could lead to decreased absenteeism and less time off for poor mental health. In addition to these, there are also several benefits that would encourage employers to invest in building mental health. Firstly, optimism has been correlated with increased creativity and innovative behaviour in workers (Zubair and Kamal, 2015; Michael, Hou and Fan, 2011), as well as increased teamwork and more positive team working behaviours (Lounsbury et al, 2003; Papenhausen, 2010). Optimism has been related to increased engagement (Malinowski and Lim, 2015; Mache et al, 2014) and decreased intention to quit (Armstrong-Stassen, 1994; Siu, Cheung and Lui, 2015), which would lead to decreased turnover and associated costs to the organisation. Finally, there is some evidence that optimism can be related to increased performance (Araujo and Taylor, 2012; Dries and Pepermans, 2007). These potential benefits offer some incentive for employers to invest in building mental health and suggest that the workplace would be an appropriate context in which to investigate the implementation of a mobile technology- based intervention as a possible way of accessing these suggested benefits.

Included Models

In order to provide a structure of the interpretation of the results of the studies included in this thesis and to allow the findings from the three studies to be combined, a framework for the acceptance and usability of technology-based interventions was needed. However, as technology acceptance and the implementation of interventions have previously been considered separately and are very rarely included in the same research project, there was not a model which incorporated both aspects of the introduction of technology and of an intervention. Therefore, two models are included in this thesis, which are the Technology Acceptance Model (TAM) (Davis, 1986) and the Consolidated Framework for Implementation Research (CFIR) (Damschroder et al, 2009). These models are outlined briefly here, and then fully described in Chapter 2, which includes an overall model which integrates the two. The results of each empirical study included in this thesis will be examined and presented in relation to these models.

Technology Acceptance Model (TAM) (Davis, 1986)

One model which demonstrates the importance of the usability of a technology is the Technology Acceptance Model (Davis, 1986), which includes explanatory factors which contribute to the eventual usage of a new technology. The model states that the perceived usefulness and the perceived ease of use of the technology predict the attitude towards the technology, which predicts the intention to use it. This in turn is proposed to predict the actual usage of the technology. The TAM was developed based on the previous motivational Theory of Reasoned Action by Fishbein and Ajzen (1975) and previous Management Information Systems literature. Since its proposal, the TAM has been validated in a range of contexts, such as e-learning (Park, 2009) and telemedicine (Hu et al, 1999). The advantage of the TAM is that is presents a simple explanatory model which includes factors that can be manipulated in order to increase intention to use, and actual usage, which is beneficial for the implementation of a new intervention.

Consolidated Framework for Implementation Research (CFIR) (Damschroder et al, 2009)

The included model for the implementation of the intervention is the Consolidated Framework for Implementation Research (CFIR) (Damschroder et al, 2009), which includes implementation factors that can contribute to the successful implementation of an intervention or organisational change.

Pettigrew and Whipp (1992) stated that the implementation of an intervention was affected by the content, the context and the implementation process itself, and the CFIR includes five domains which cover these aspects. These are the *inner setting* which includes facets such as culture, the *outer setting* which includes facets such as external policies and incentives, the *intervention characteristics* which includes facets such as the design of the intervention and its packaging, the *individual characteristics* which includes facets such as self-efficacy and *process factors* which includes facets such as the planning of the implementation process. The full model is presented in Chapter 2 and the results of the empirical studies are linked to the included factors where appropriate. The CFIR can be used to guide the planning of the implementation of a new intervention and provide factors which can be addressed in order to increase the efficiency or effectiveness of the implementation.

Aims of the Thesis

Following the rationale outlined above, this thesis aims to investigate user perceptions of mobile technology for the delivery of well-being interventions. This is broken down into three aims, which are addressed in the remainder of the thesis using three empirical studies involving a mixed-methods approach. These aims are as follows:

1. To validate pathways from the Technology Acceptance Model (Davis, 1986) in a well-being context, and to investigate the acceptability of mobile applications for well-being.
2. To evaluate the usability of a prototype well-being application.
3. To investigate the barriers and facilitators of implementing a well-being application in a workplace context.

To address these aims, three studies have been conducted, each of which addresses the corresponding aim of the thesis and focuses on one of the aspects of user experience of well-being applications (acceptability, usability and implementation). These studies are each presented in the chapters included in this thesis and the results are synthesised in the final discussion chapter in order to meet the overall objective of this thesis – to present a picture of the user experiences of mobile applications as a delivery method for well-being interventions. The three studies are as follows:

Study 1. *Acceptability*: The first study is a quantitative study which used an online questionnaire to validate pathways from the Technology Acceptance Model in a well-being context and examines several factors which influence the acceptability of well-being applications. This study is outlined in Chapter 5 and is mainly quantitative in nature, but a small qualitative section is included.

Study 2. *Usability*: The second study is a mixed-method study which investigates the usability of a prototype application that delivers an example well-being intervention, the development and testing of which is reported in Chapter 6. This involves a questionnaire which participants completed after using the prototype application, and several qualitative questions about how the application could be improved.

Study 3. *Implementation*: The final study examines the implementation of a well-being application in a workplace context. A series of four focus groups were conducted with working adults from a range of organisations to gain feedback on the implementation in this context and how it could be facilitated. This study is outlined in Chapter 7.

These studies will be run independently and In parallel before the results will be combined in the discussion which will allow triangulation of the conclusions.

Structure of the Thesis

This thesis includes eight chapters, which present the results of three empirical studies using a mixed-methods design:

Chapter 1 has outlined the background to the research project, including the rationale for the focus on enhancing well-being, the potential benefits of using mobile technology as a delivery method for a well-being intervention, the aims of this thesis and the gap it tries to address.

Chapter 2 presents two models to provide a framework for the structure of the studies, and the interpretation of the results. These are the Technology Acceptance Model (TAM) (Davis, 1986) which demonstrates a motivational model for the usage of a new technology and proposes that the two most important factors in the prediction of usage are perceived ease of use and perceived usefulness of the technology. The second model is the Consolidated Framework for Implementation Research (CFIR) (Damschroder et al, 2009) which presents a model of barriers and facilitators for the implementation of interventions.

Chapter 3 presents the results of a literature review which aimed to assess the current research into the usability of mobile technology applications which contained well-being interventions; 7 studies were found which used several different methods to assess usability.

Chapter 4 describes the methods used in the three studies included in subsequent chapters, including the mixed-methods design, the data sources and analysis methods used, the quality criteria of a mixed-methods study and considerations of ethical requirements.

Chapter 5 addresses the first aim of this thesis and describes an empirical study which aimed to validate relationships from the Technology Acceptance Model (Davis, 1986) in a well-being context and to reconfirm the relationships between perceived ease of use, perceived usability, and intention to use. This study is designed to investigate the acceptability of using mobile technology in a well- being context.

Chapter 6 describes the development of a prototype application which contained an example well-being intervention that aimed to increase optimism using a daily diary method. The chapter goes onto describe a mixed-methods usability test of the prototype applications, which assess its usability and suggestions for improvement, which addresses the second aim of this thesis.

Chapter 7 addresses the final aim of the thesis by presenting a qualitative study, which includes a series of focus groups conducted with a sample of working adults, which aimed to investigate the barriers and facilitators of implementation of a well-being application in a workplace context.

Chapter 8 concludes by integrating the findings of the three empirical studies and presenting the results in relation to the Technology Acceptance Model and the CFIR implementation framework. The implications of the thesis are presented, as well as the strengths and limitations of the research.

Conclusions of the Thesis

The thesis finds that mobile technology is accepted as a delivery method for well-being interventions and that this acceptance and usage of the technology is predicted by perceived ease of use and perceived usefulness of the technology. It is also shown that a prototype application was rated as usable by participants, although improvements could be made in terms of visual appeal in order to increase engagement. Five barriers to implementation were presented, which link to the CFIR and can be used to plan a more successful implementation of a well-being application in the workplace. Finally, it is suggested that perceived usefulness and perceived ease of use do not fully explain technology usage, and it is proposed that engagement may also be an explanatory factor. This thesis contributes to future practice by demonstrating support for the use of mobile technology as a delivery method for well-being interventions and by providing evidence-based guidance for their development, testing and implementation. A theoretical contribution is made by demonstrating the need for an extension to the TAM to include engagement or perceived enjoyment and suggests a direct relationship between engagement and behavioural intention.

Chapter 2: Theoretical Models Relating to Technology Acceptance and Intervention Implementation

This chapter presents the two models which are used as a framework for the results of the three empirical studies included in this thesis; the Technology Acceptance Model (TAM) (Davis, 1986) and the Consolidated Framework for Implementation Research (CFIR) (Damschroder et al, 2009). As this thesis is one of the first to combine research into acceptability, usability and implementation of mobile technology in a well-being context, two models were needed as there is not currently one single model which includes all the factors presented here. The TAM explains the factors which affect an individuals' intention to use a new technology, which are perceived usefulness and perceived ease of use. The CFIR includes five factors which can act as barriers or facilitators to the implementation of an intervention which are the inner setting, the outer setting, the intervention characteristics, characteristics of the users, and the implementation process itself. This chapter presents a detailed description of these models and presents a combined model which includes the factors from both models. This combined model can be used to make recommendations regarding the future implementation of well-being interventions delivered through mobile technology, and the results of the three empirical studies in this thesis will be presented in relation to this framework.

The Technology Acceptance Model (TAM) (Davis, 1986)

The Technology Acceptance Model (TAM), developed by Davis (1986) for his PhD thesis, is a theoretical model which aims to explain the factors which lead to a new technology being accepted or rejected by its proposed end users. The TAM, designed to provide a framework for this, was originally tested on new computer systems such as email, information storage and database systems when computers were first being introduced into the workplace in the early 1980s. It aimed to provide a theoretical understanding of user acceptance which could inform both the successful design and implementation of new technologies, as well as provide a framework for user acceptance testing procedures. The model combined previous literature on behavioural motivation to establish the variables which contribute towards acceptance (a behavioural change towards using a certain technology), how these variables are related and how they can be measured.

Theoretical Basis for the Technology Acceptance Model

The main influence was the Theory of Reasoned Action by Fishbein and Ajzen (1975) which demonstrated how attitudes towards a target influenced behaviour. The TAM explains behavioural motivation towards using a new technology using three equations, which combine to give an overall model of the factors which contribute towards the performance of a desired behaviour (in this case, the usage of the technology). The first equation concerns the formation of the attitude towards performing the behaviour, which was built on the expectancy-value model of attitude (Fishbein, 1963). In this equation, attitudes are formed by combining the belief in the consequences of performing (or not performing) the behaviour, with the evaluation of these consequences as positive or negative and how strongly they will affect the individual, weighted by the number of beliefs/consequences. This is based on the principle that attitudes can only be changed by changing the initial beliefs.

1. Consequences (bi) X evaluation (ei) X number of beliefs (n) = attitude (Aact)

The second equation concerns the formation of social influence, in relation to referents and what they think of either performing or not performing the behaviours. This can result in social pressure to perform or not perform the behaviour. Which people act as referents will depend on the behaviour, the individual and the context. The equation states that beliefs about the referent and what they think combined with the motivation of the individual to comply with those perceived beliefs multiplied by the number of salient referents gives an overall social influence variable.

2. Beliefs about referents (nbj) X Motivation to comply (mcj) X number of referents (m) = social influence (SNact)

The final equation combines the attitude term with social influence to lead to the behavioural intention of the individual to perform that behaviour, which in turn results in actual performance. In this equation, attitude and social influence are both weighted (W1 and W2 respectively) which are dependent on the behaviour and can be estimated via multiple regression using the model. It is important to note that intention to perform the behaviour only predicts actual usage when the individual has both the resources and the control needed to perform it.

3. Attitude (Aact) (W1) + Social influence (SNact) (W2) = intention (B1act) = behaviour (B)

The combination of these equations gives the overall model is presented in Figure 2 below.

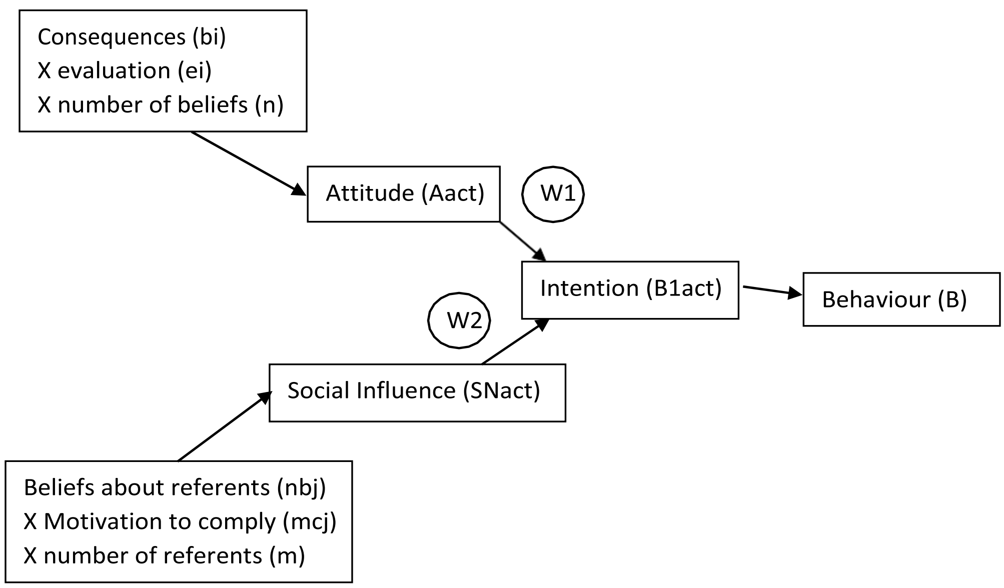


Figure 2: The Theory of Reasoned Action (TRA) (Fishbein and Ajzen, 1975)

The Theory of Reasoned Action was chosen as a strong base for the Technology Acceptance Model as it integrated several previous theories about behavioural motivation. Davis (1986) states that it *"integrates a number of previously disjoint theories concerning the relationships between beliefs, attitudes, intentions and behaviour"* (p21.) This model was also chosen because it used explicit definitions of the variables and clearly operationalised relationships between them. It was also strongly supported both in theory and in applied research where it had been and continues to be used in a wide range of contexts such as the introduction of green technology (Mishra et al, 2014), cyberbullying (Doane et al, 2014) and criminal behaviour (Tuck and Riley, 2017). Finally, Davis (1986) states that the model was chosen as a reference because it was a motivational theory which included external stimuli and provided a basis for the TAM to include design features as an external stimulus which affects motivation.

The TAM contains five main variables; the design features of the technology, the perceived usefulness of the technology, the perceived ease of use, the attitude towards using the technology and the resulting actual usage. These variables are described in the subsequent section, followed by the proposed relationships between them. Behavioural intention is also included as it is often used as a replacement for a measure of actual usage.

1. Design Features

The first variable included in the model is the design features of the technology, which are usually the easiest for the researcher or developer to influence during development. These features can include the content of the technology, it's presentation, additional features, or user interface amongst others. The design will depend on the aim of the technology, the target audience and the resources available to the developers. As the design features can be directly influenced by the developers during the creation of the system, this is one avenue whereby changes can be made in order to increase acceptability and usage. As mentioned previously, the model aims to provide a framework for user acceptance testing early in the development process, when it is still relatively easy to change the design features in order to create a more positive attitude and increase usage.

2. Perceived Usefulness

The summed belief-evaluation term from the Fishbein and Ajzen model (1975) was separated into two main belief factors in the TAM; perceived usefulness and perceived ease of use. The first of these, perceived usefulness, is defined as the *"degree to which a person believes that using a particular system would enhance his or her performance"* (Davis, 1986). It can be argued that this relates more strongly to the content of the technology and it's intended purpose, rather than the presentation features. This perception will depend on the aim of the technology, on its target audience, and the context in which they are working. This could also be affected by how the technology is presented to potential users and how it is marketed and promoted.

3. Perceived Ease of Use

The second belief variable is perceived ease of use, which is defined as the *"degree to which a person believes that using a particular system would be free of effort"* (Davis, 1986). This aspect relates to the presentation and the design features, such as how easy the system is to navigate, how clear the instructions are, whether the buttons are easy to find and how easy the technology is to understand. The TAM proposes a causal relationship between perceived ease of use and perceived usefulness, where perceived ease acts as a predictor. One explanation for this is that when people perceive a technology as easy to use and are confident with using it, they also see it as more useful because it can take less time to achieve a desired result (Martin-Baranera et al, 1999). For example, information sharing software which is straightforward to understand and helps someone find a document very quickly would be perceived as useful by someone who is busy and needs to find documents regularly. If they system was difficult to use, it may take longer than the original method which didn't use technology. As both perceived ease of use and perceived usefulness were first introduced in this model, there were no previously validated measurements for them. Davis (1986) designed questionnaires to measure them from existing literature around similar variables which used different terminology and validated them in the first stages of model development.

4. Attitude

In the TAM, perceived usefulness and perceived ease of use predict attitude towards using the technology which is defined as the *"degree to which an individual evaluates and associates the target system with his or her job"* (Davis, 1986) or a positive or negative feeling towards performing a behaviour (Ajzen and Fishbein, 2000). These attitudes included in the TAM are in respect to performing a behaviour, rather than the object or technology itself i.e. their attitude towards using the technology. In initial validation of the TAM (Davis, 1986), attitude was measured using a questionnaire developed by Fishbein and Ajzen (1980).

5. Usage

The attitude towards performing a behaviour is proposed to directly influence the actual performance of the behaviour, which in this context is the usage of the technology. In the TAM "usage" is a repeated, multiple-act behaviour criterion specific to target, action and context. For example, usage of a mobile application every day at work with the aim of increasing well- being. To be considered full usage, it must be used regularly for its intended purpose, in the context it was designed for. Therefore, the technology must be used regularly as part of their tasks and fully incorporated into their routines to count as true usage. This multiple-act criterion of repeated behaviour can make it difficult to measure actual usage in user acceptance testing for a new technology, as it would require a longitudinal design if the technology was just being introduced in the study. Davis (1986) measured actual usage in an organisation where the systems had already been implemented and participants could objectively state how often they used the systems as part of their jobs.

6. Behavioural Intention

Attitude also affects usage indirectly through behavioural intention, which is often used as a proxy measure for usage when follow-ups are not possible. Behavioural intention is defined as the *"subjective probability that an action will be performed"* (Fishbein and Ajzen, 1975, p. 288), where the probability is stated by the user who makes a judgement about their own likelihood to perform the behaviour or use the technology.

These factors are combined in the Technology Acceptance Model in four stages, as shown in Figure 3 below. The first stage is the design features, which influence the cognitive response (perceived usefulness and perceived ease of use) which leads to an affective response (attitude) resulting in a behavioural response of using technology. Several relationships between the involved factors were proposed. Firstly, it was hypothesised that the design features would directly influence both perceived usefulness and perceived ease of use. Secondly, it was suggested that perceived ease of use would affect perceived usefulness. Both factors were causally linked to the attitude towards the behaviour, which finally leads to actual usage. Each relationship has associated weightings and error terms in the model and the relationships are recursive, with no reciprocation (Davis, 1986).

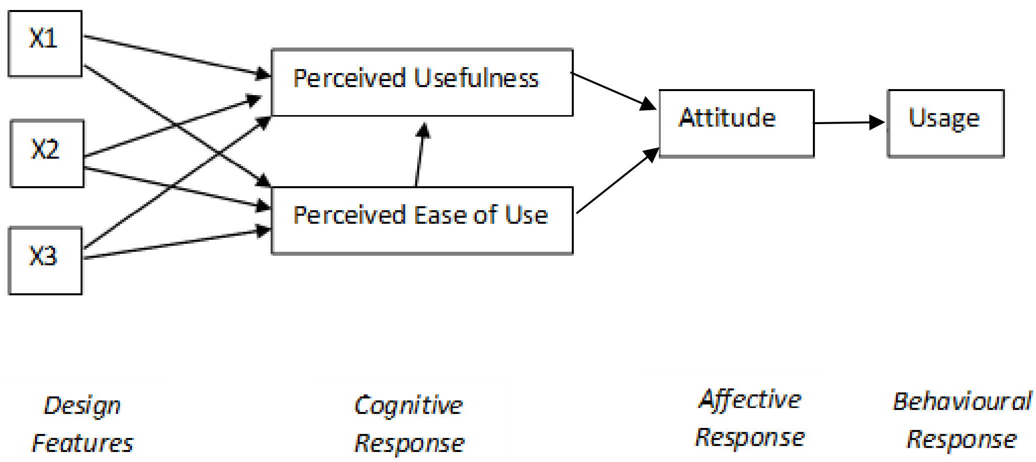


Figure 3: Technology Acceptance Model (Davis, 1986)

<u>Adaptations from the Theory of Reasoned Action (TRA) (Fishbein and Ajzen, 1975)</u>

The Technology Acceptance Model makes several adaptations to the original Fishbein and Ajzen model (TRA) (1975). Firstly, the TRA model uses a single independent variable as the summed belief-evaluation term for attitude (Aact) whereas the TAM represents two belief terms separately as perceived ease of use and perceived usefulness. The TAM also proposes a causal link between these two variables whereby ease of use predicts perceived usefulness. Secondly, the original model uses an evaluation term which each belief is multiplied by, but no evaluation term is included in the TAM. This is because each term is positive and would not add anything to the explanatory power of the model (Bagozzi, 1981; 1982).

There are two further components which are included in the TRA model but are left out of the TAM, which are the subjective norm component and the behavioural intention component. Davis (1986) argues that during the user acceptance testing procedures, participants would have few reference points for social norms and that including this is any measurements could force them to guess incorrectly and distort the model. Additionally, they would also not have enough time to fully form a behavioural intention and so that term is not included in the theoretical model of the TAM. However, in many studies involving the TAM, it is not possible to directly assess actual usage due to the testing situation and so a measure of behavioural intention is used as a proxy. This is due to the large amount of evidence to show that behavioural intention reliably leads to actual usage (e.g. Tarhini et al, 2013; Sumak et al, 2011; Shih and Huang, 2009). Therefore, although behavioural intention is not used as a separate factor in the original TAM, it is used interchangeably with actual usage in subsequent research and is important to consider (e.g. Shroff et al, 2011; Alharbi and Drew, 2014).

There is evidence to suggest that the TAM is a better model for predicting technology related behaviour than the TRA. Igbaria et al (1997) states that the TAM is a more powerful explanatory model than the original TRA model in this context and is easier to use and implement. In addition, a narrative review of 145 papers conducted by Yousafzai et al (2010) suggested that TAM was a strong explanation for technology acceptance and was a better predictor of usage of new technology than either the Theory of Reasoned Action or the Theory of Planned Behaviour.

Importance of the Model

The importance of this model comes from the impact it can have on how technologies are developed and tested. People cannot access the benefits from even the most effective and useful of technologies if they are not motivated to use it and do not make it part of their habits and routines. People who engage with an intervention regularly often find it to be more effective (Diedrichs et al, 2015; Chambers et al, 2016). Many studies and development protocols focus on the objective performance and do not fully consider the subjective element of attitudes and attractiveness to users (e.g. the review by Donker et al, 2013) or how this affects their likelihood to interact with the technology. The TAM explains which factors contribute towards ensuring that the technology is used and is therefore an essential component when designing new technology, to ensure that users are motivated to engage so they can receive the intended benefits.

One of the main focuses of the TAM was also to provide a framework for how user acceptance testing could be carried out in order to properly assess the acceptance of the technology before it is given a full pilot trial, which can often by expensive and time consuming. It was shown that people can form motivations and attitudes from a brief exposure to a new technology (Davis, 1986), and so once this has been examined, changes can be made earlier in the testing process to ensure that the new technology is received well and actually used. This then allows for more efficient direction of resources, which could lead to a better product overall which is both effective and widely used.

Support for the Model

Empirical Validation Study 1 (Davis, 1986)

The original thesis validated the proposed model with two studies (Davis, 1986), both of which used a questionnaire design and were analysed using structural equation modelling. The first validation study aimed to empirically test the proposed model structure and to validate the new scales for perceived usefulness and perceived ease of use developed for the model from previous literature. The attitude measure used was adapted from a previously validated measure from Ajzen and Fishbein (1980) and actual usage was measured with two items. 112 employees from IBM's Development Laboratory completed the questionnaire in reference to two technology systems already used in the laboratory; an electronic mail system and a file editor. Five relationships were hypothesised:

H1. Attitude would predict actual usage

H2. Perceived usefulness would predict attitude

H3. Perceived ease of use would predict attitude

H4. Perceived ease of use would predict perceived usefulness

H5. Design features would predict both usefulness and ease of use

Firstly, the newly developed scales for perceived usefulness and perceived ease of use were shown to be valid but were subsequently reduced to 6 items each to only include the positively worded items. They had a pooled Cronbach's alpha of >0.90 and were therefore deemed reliable. Following this, all the proposed hypotheses were shown to be correct and were supported by the questionnaire results. In addition to the proposed relationships, a direct effect of design features on attitude was shown, as well as a direct effect of usefulness on actual usage. This additional effect of usefulness on usage implies that perceived usefulness was overall more influential than perceived ease of use. Ease of use was also shown to influence attitude both directly, and indirectly through perceived usefulness. It is suggested that usefulness results from a cognitive sum between the benefits of technology and the costs, and that ease of use can contribute as either a benefit if easy, or a cost if more difficult. Once initial support for the model was shown and the measure were validated, a second questionnaire study was carried out to confirm, which is described below, also from Davis (1986).

Empirical Validation Study 2 (Davis, 1986)

The second validation study included in the thesis aimed to further validate the model, to validate a videotape system for presenting new technology, to compare the two systems used (Pendraw – a software for drawing visual aids and Chartmaster – for creating numerical charts), and to explore extensions to the model. This was also presented in the original thesis (Davis, 1986). As this study involved a user acceptance trial in which the participants would be testing a new technology they hadn't previously seen or used, behavioural expectation (or behavioural intention) was used as a substitute for actual usage, where participants made an estimation of whether they felt they would use the technology in the future. The argument for this was that technologies should be tested on potential users who may accept or reject a new technology not just those who already use a technology or who are required to use it as part of their job.

In this study there were five hypotheses relating to the validation of the model:

H1. Attitude and usefulness would both predict behavioural expectation

H2. There would be no direct effect of ease of use on behavioural expectation

H3. Usefulness and ease of use would both directly predict attitude

H4. Perceived ease of use would predict perceived usefulness

H5. Design features would directly affect both usefulness and ease of use, but not directly predict attitude or behavioural expectation

40 MBA students completed the questionnaire in 4 groups counterbalanced for the different presentation groups being assessed for the effectiveness of a videotape presentation system. The participants received 45 minutes of hands-on demonstration and then completed the questionnaire, which gave 80 complete responses, as each participant answered the questionnaire in relation to the two different systems. Again, using a structural equation modelling analysis, all the hypotheses were supported, and all relationships were shown as expected, including the previously shown increased role of perceived usefulness (Davis, 1986).

<u>Other Studies</u>

An exhaustive review carried out by Lee et al (2003) who presented many studies which supported the Technology Acceptance Model and demonstrated its significance. They state that the findings from the original Davis (1986) studies have been replicated across a variety of technologies and that the relationships have consistently been significant (e.g. Adams et al, 1992; Davis, 1993; Sambamurthy and Chin, 1994; Subramanian, 1994). Overall, they presented 74 studies that demonstrate a relationship between perceived usefulness and behavioural intention and 58 studies which showed the relationship between perceived ease of use and behavioural intention. In addition to a literature review, they also conducted a survey with 32 leading researchers in the field and found positive impressions from them, with the many expressing that the TAM has provided a solid foundation and research structure that is easy to follow and understand for this area.

A systematic review by Turner et al (2010) examined 79 studies from 73 articles to assess whether the relationships included in the TAM were as strong with actual usage as an outcome measure, rather than behavioural intention which despite not being included in the original TAM model, is used much more frequently. They used a vote counting meta-analysis method to combine the results from these studies and found significant support for the TAM, using both behavioural intention and actual usage as outcome variables. 57 studies examined the relationship between perceived usefulness and actual usage, 50 studies looked at the relationship between ease of use and actual usage, and 35 studies showed a relationship between behavioural intention and actual usage. They show that behavioural intention predicts actual usage much more strongly than the direct effect of perceived usefulness or perceived ease of use on actual usage. Given the TAM's development from the TRA (Fishbein and Ajzen, 1975), and the demonstrated relationship between attitude to intention to usage, this can be expected. It was also demonstrated that TAM variables predict subjective measures of actual usages more strongly than objective measure of usage (Turner et al, 2010).

Another meta-analysis, by King and He (2006), included 88 published studies which investigated the TAM variables. They show that the perceived usefulness and behavioural intention measures are highly reliable and that the correlations between the variables are strong. This demonstrates support for the model but suggests that there is evidence to support the inclusion of more factors. This review further supports the increased role of perceived usefulness through indirect relationships in the model. Finally, it suggests that students can be used as surrogates for professional users of technology as their response profiles and confidence intervals are very similar. They showed that the usefulness to behavioural intention relationship and the ease of use to usefulness relationship had similar coefficients in each of the samples, but that the samples showed different coefficients for the ease of use to behavioural intention relationship. They found that the confidence intervals of the student sample and the professional sample significantly overlapped, and they conclude that this can act as a justification for using students as surrogates for a professional sample when one cannot be accessed (King and He, 2006).

Marangunić and Granic (2015) conducted a systematic review of studies since the development of the TAM and presented the results of 85 publications which are either reviews of TAM literature, extensions to the original TAM or support from the TAM in different contexts and applications. They suggest that while progress is continually being made and support is shown for the TAM, new factors are being continually found to have an effect of the core variables, and this indicates that there is more research to be done going forward to clarify these potential new relationships. Finally, Legris, Ingham and Collerette (2003) conducted a review of 22 studies related to the TAM. They used a meta-analysis to show support for the model but suggested that it requires extensions and the inclusion of more factors in order to increase its explanatory power, as they suggest that there are several problems with the research methods used which limit it. These are the reliance on student samples (particularly self-report samples) and that most of the research was limited to office automation software. They recommend that making changes to the research process, by examining different populations and different software may strengthen support for the model further.

The Technology Acceptance Model in different contexts

In addition to this support, studies have also validated the TAM in a range of contexts, including across different cultures and with different target technologies. A narrative review of 145 papers conducted by Yousafzai et al (2010) states that the TAM holds strongly across contexts, times, cultures and situations. This is further supported by studies such as Straub, Keil and Brenner (1997) who showed the validity of the TAM in Japan, the USA and in Switzerland. Teo, Luan and Sing (2008) showed that in a comparison of Singapore and Malaysia, perceived ease of use and perceived usefulness are still significant determinants of technology usage, but that there were differences between the cultures in these perceptions. This was supported by McCoy, Everard and Jones (2005) who found that in Uruguay the model was still valid and the expected relationships shown but stated that culture was not a factor previously included in the model and should be taken into consideration. Zakour (2004) proposed six potential variables that could be included in the TAM as cultural indicators which are individualism vs collectivism, power distance, masculinity vs femininity, uncertainty avoidance, monochromic vs polychromic time and high context vs low context cultures. As well as in different cultures, the validity of the TAM has been demonstrated with a wide variety of different target technologies including social media usage (Evans et al, 2014), online shopping (Gefen et al, 2003), online banking (Pikkarainen et al, 2004), e-learning (Park, 2009), telemedicine (Hu et al, 1999) and e-government initiatives (Lin et al, 2011). Currently, no evidence has been found that validates the TAM in a well-being or mental health context; a gap which this thesis aims to address.

Extensions to the Model

Since the initial Technology Acceptance Model was presented in 1986, there have been many subsequent elaborations and attempts to extend the model to include other factors in order to increase the explanatory power of the model, as suggested in the previous research outlined. King and He (2006) group these modifications into four general categories; prior factors, the inclusion of other theories, contextual factors and alternative consequences. Prior factors that have been included in some versions of the model include previous usage of technology (Oh, Ahn and Kim, 2003), previous experience (Venkatesh and Morris, 2000) and computer literacy and self-efficacy (Davis and Venkatesh, 1996). Aspects of other theories have been included, such as the subjective norm component initially not included (Hardgrave et al, 2003), a measure of involved risk (Featherman and Pavlou, 2003) and trust (Gefen, 2004). Contextual factors have also been incorporated such as gender and culture (Huang, Lu and Wong, 2003; Straub, Keil and Brenner, 1997). The alternative consequences looked at were mainly around actual usage; the comparison with behavioural intention has previously been discussed.

<u>TAM2 (Venkatesh and Davis, 2000)</u>

One of the main extensions has been a development of the TAM2, initially included in the original thesis (Davis, 1986), and subsequently extended further by Venkatesh and Davis (2000). In this version of the model, several determinants of perceived usefulness have been added - result demonstrability, output quality, job relevance, subjective norm, image, experience and voluntariness. Figure 4 below shows this proposed extension to the TAM.

Result demonstrability has been defined by Moore and Benbasat (1991, p.203) as "*tangibility of the results of using the innovation*" and refers to how apparent the benefits of using the technology are. If a new system is useful, but in a non-obvious way, new users may initially perceive it to be less useful as it is not immediately clear what the pathway to the benefits are. Output quality refers not only to the proposed benefits of the new system, but how well it completes the tasks and the standards of the output produced as a result of use and had previously been shown to increase perceived usefulness

(Davis et al, 1992). When choosing between multiple systems or when there is not much difference in the effort required between using a technology or not, the user is likely to choose the method which leads to the highest quality outcome. Job relevance refers to how applicable the system is to the users' job role and requirements (Venkatesh and Davis, 2000).

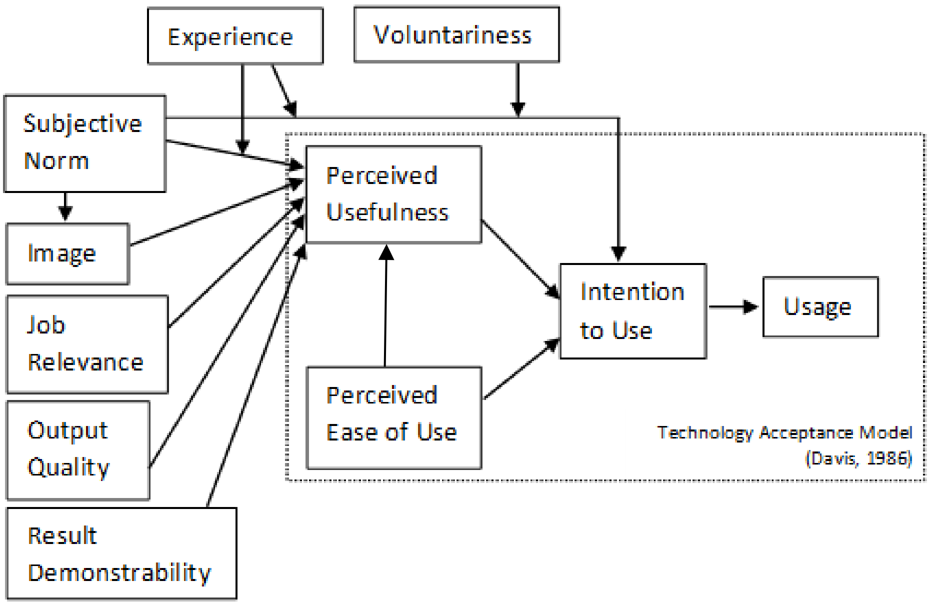


Figure 4: TAM2 (Venkatesh and Davis, 2000)

The next proposed determinant of perceived usefulness in TAM2 is subjective norm, which was originally a direct determinant of behavioural intention in the Theory of Reasoned Action (Fishbein and Ajzen, 1975) and the Theory of Planned Behaviour (Ajzen, 1991) but was not included in the TAM. As previously outlined, empirical comparison of the models found that subjective norms did not predict behavioural intention above perceived usefulness or perceived ease of use (Davis, 1989). However, Hartwick and Barki (1994) found that subjective norm was a determinant of behavioural intention in mandatory usage of technology, but not in voluntary usage. Therefore, it was included in TAM2 and it was hypothesised that subjective norm would have an effect on intention over and above the TAM variables in a mandatory setting, but not in voluntary usage. As a result, voluntariness was also included in TAM 2 as a moderating factor. Subjective norms are often important as they can affect a person's image - people follow these norms in order to maintain a favourable image (Kelman, 1958). In TAM2, image is defined as "*the degree to which use of an innovation is perceived to enhance one's... status in one's social system*" (Moore and Benbasat, 1991, p.195). It is hypothesised in the model that image would influence perceived usefulness, and that subjective norm would have an effect on image.

The final new variable included was experience of using the system. It was suggested that the influence of subjective norm would decrease as experience of using the system increased (Hartwick and Barki, 1994). They argue that when a user has little experience on which to form their own beliefs they must rely on the beliefs of others, but when their experience increases and they are able to form their own judgement, the subjective norms and the opinions of others become less influential. This suggests that experience would have a moderating effect on the relationship between subjective norm and perceived usefulness, in both mandatory and voluntary settings. It was hypothesised that the determinant factors of result demonstrability, output quality, job relevance, subjective norm and image would all have a positive effect on perceived usefulness, that voluntariness and experience would moderate the relationship between subjective norm and perceived usefulness, and that subjective norm would have a positive effect on image. These relationships are shown in Figure 4 above.

In order to test these hypothesised relationship, four longitudinal studies were conducted (Venkatesh and Davis, 2000). Each study included around 50 employees from different sectors including manufacturing and financial services and involved different systems appropriate to their job roles. In two of the studies the usage of the new system was voluntary and in the other two studies usage was mandatory. Questionnaires adapted from previous measures were delivered after initial training on the system, one month after training, and three months after training. Self-reported use of the system was measured at the one month and three month follow ups, and measured again five months after implementation of the system. The pooled results of the four studies support all the hypothesised relationships, including the moderating effects of experience and voluntariness. Additionally, the original TAM relationships were also supported, including the relationship between intention to use and self-reported usage. TAM2 extends the original TAM by including determinants of perceived usefulness, and by demonstrating the role of subjective norm above the effects of perceived usefulness in a mandatory setting.

Determinants of Perceived Ease of Use (Venkatesh, 2000)

A further extension of the original TAM was a similar model to TAM2 which included determinants of perceived ease of use. The additional variables it included were grouped into anchors and adjustments, based on behavioural decision theory which suggests that anchoring and adjusting are a widely used heuristic for decision making (e.g. Northcraft and Neale, 1987). When there is a lack of specific information about a system because it is novel, users rely on general information that serves as an anchor and then make adjustments as new information is gained, whilst still relying on these anchors. Specifically when using a new technology system, users will use their previous experiences and opinions on general computer usage as an anchor, before making system specific adjustments as their experiences grows. This is similar to the role of subjective norm in TAM2, where it is relied upon heavily when there is no other information but its influence decreases as the user gains their own experiences of the system. This use of anchors suggests that when there is little direct experience to judge how easy to use a new system is, there may be a common set of determinants of perceived ease of use. The model of these determinants proposed by Venkatesh (2000) suggests that the common anchors are computer self-efficacy, perceptions of external control, computer anxiety and computer playfulness. The adjustment factors are the perceived enjoyment of using the system and the objective usability. Figure 5 below shows the proposed model of the determinants of perceived ease of use.

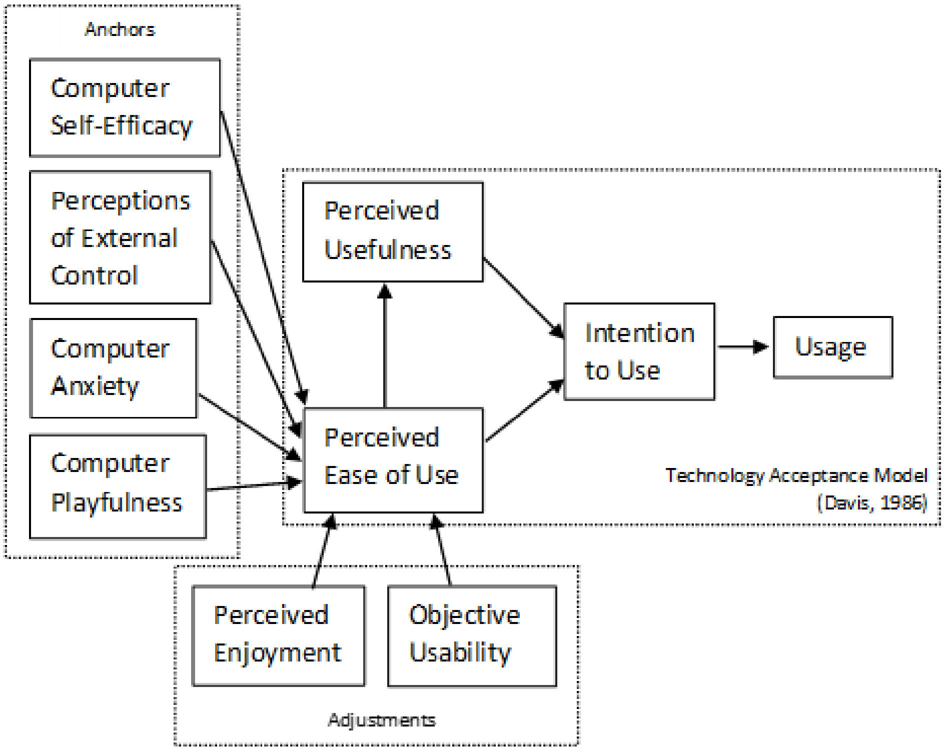


Figure 5: Theoretical model of the determinants of perceived ease of use (Venkatesh, 2000)

Computer self-efficacy refers to the assessment made by an individual of their confidence and capabilities in using computers in a range of situations (Marakas et al, 1998). It has been shown the lead to more positive perceptions of IT (Venkatesh and Davis, 1996) and increased use of IT (Compeau et al, 1999). Conversely, computer anxiety refers to the fear around using computers, such as a loss of data, an intrusion of privacy or of making mistakes while using IT (Sievert et al, 1998). There is evidence which demonstrates that computer anxiety is dynamic and can change depending on dispositional and environmental factors (Marakas et al, 2000). There is also evidence to suggest a reciprocal relationship between computer self-efficacy and computer anxiety. When anxiety increases, self-efficacy decreases, but if self-efficacy is increased, it can reduce anxiety (Bandura, 1977).

Perceived control is the user's perception of the availability of knowledge, resources and opportunities required for the to perform the behaviour of technology use and this perception is often more important than actual control (Ajzen, 1991). It was added to the Theory of Reasoned Action (TRA; Ajzen and Fishbein, 1980) to form the Theory of Planned Behaviour (TPB; Ajzen, 1985), but as the TAM was based on the TRA before the development of the TPB, perceived control was not included in it. Control has been found to effect behavioural intention and performance of behaviour in a range of settings (Ajzen, 1991). Application of the TPB in a technological context has also provided support for the role of perceived control (Mathieson, 1991; Taylor and Todd, 1995). Based on this evidence, perceived control has been included as a determinant on perceived ease of use in this model, reflecting relationships suggested by the TPB. The final anchor is computer playfulness, which represents an intrinsic motivation to use the system which relates to the satisfaction gained from usage itself rather than an external reward (Vallerand, 1997). In the TAM, extrinsic motivation is included as perceived usefulness and the function that the user gets out of the system, but no form of intrinsic motivation was previously incorporated. In previous research, computer playfulness has been considered as an intrinsic motivation and is defined as *"the degree of cognitive spontaneity in microcomputer interactions"* (Webster and Martocchio, 1992, p.204). People who have an interest in computer technology and show higher level of computer playfulness are more likely to use the system just for the sake of it or to have a play around with the functions. It is suggested that they underestimate the difficulty of use because they are enjoying the process of discovering a new system and so it was hypothesised that there would be a positive relationship between playfulness and perceived ease of use (Venkatesh, 2000).

The adjustment factors included in the model of determinants are perceived enjoyment and objective usability. As experience of using the system increases, computer self-efficacy and computer anxiety will continue to be determinants of perceived ease of use but may be adjusted based on the objective usability of the system, which reflects the actual difficulty of completing tasks using the system. The second adjustment is perceived enjoyment, which relates to the anchor of computer playfulness. When users have little experience with a system, they may get intrinsic motivation from exploring a new system and the novelty of playing with the new technology. As usage increases, the enjoyment gained from the system coming from the entertainment rather than the novelty will influence perceived ease of use. Perceived enjoyment related to how enjoyable using the system is, independent of any impact on performance or tasks (Davis et al, 1992). Over time, computer playfulness will become less impactful as perceived enjoyment becomes more dominant.

The relationships hypothesised in this model are shown in Figure X above. In order to test these, three longitudinal studies were carried out; Study 1 including 70 employees of an electronic store using a new helpdesk system, Study 2 including 160 employees in a real estate business who were using a new property management system and Study 3 including 52 employees from a financial services business who were using a new payroll application (Venkatesh, 2000). A questionnaire was developed, tested for reliability and validity and then delivered to participants at three time points, following a similar procedure to the validation of TAM2. The results demonstrated strong support for the hypothesised relationships, and for the overall model of anchors and adjustments as determinants of perceived ease of use. The anchor of computer self-efficacy was found to be the strongest determinant, even after repeated usage of the system.

<u>TAM3 (Venkatesh and Bala, 2008)</u>

Having outlined the determinants of perceived usefulness and perceived ease of use, the next stage was to combine these factors into an overall model to extend the original TAM, known as TAM3 (Venkatesh and Bala, 2008). As well as combining the determinant factors into a single model, they also proposed a cross-over effect regarding the role of experience using the system, which influences several relationships shown in TAM2 and the determinants of perceived ease of use model. There are three new relationships suggested in the model; it is proposed that experience of using the system will affect the relationship between computer anxiety and perceived ease of use, the relationship between perceived ease of use and perceived usefulness, and between perceived ease of use and behavioural intention. The combined model for TAM3 is shown in Figure 6 below, with the new proposed relationships highlighted.

To test the TAM3 model, including the new relationships hypothesised, four longitudinal studies were conducted, each of which contained between 40 and 50 participants from different organisations who were being trained on a new IT system relevant to their jobs. A questionnaire was developed to measure all factors included in TAM3 using validated items from previous research. Actual usage was measured as part of the questionnaire by asking respondents to estimate how much time they spent using the system each day. Data was collected at 4 time points - the questionnaire and usage were measured after initial training, after 1 month of using the system and 3 months after implementation and usage was measured again at 5 months after implementation.

The results show support for the determinants of perceived usefulness in TAM2, including the moderating effect of experience on the relationship between subjective norm and perceived usefulness. Experience also moderated the relationship between perceived ease of use and perceived usefulness, which was a new relationship in TAM3. Further support was demonstrated for the determinants of perceived ease of use as expected, with the anchors being significant at all time points, and the adjustments being significant at Time 2 and Time 3, as experience of using the system had increased. Experience was found to moderate the relationship between computer anxiety and perceived ease of use, which was also a new relationship in TAM3. None of the determinants of perceived usefulness were found to predict perceived ease of use, or vice versa. Support was also shown for the original TAM relationships, with perceived usefulness being the strongest predictor of behavioural intention. Perceived ease of use was found to be significant at Time 1 and Time 2, but not at Time 3, which suggested a moderating effect of experience.

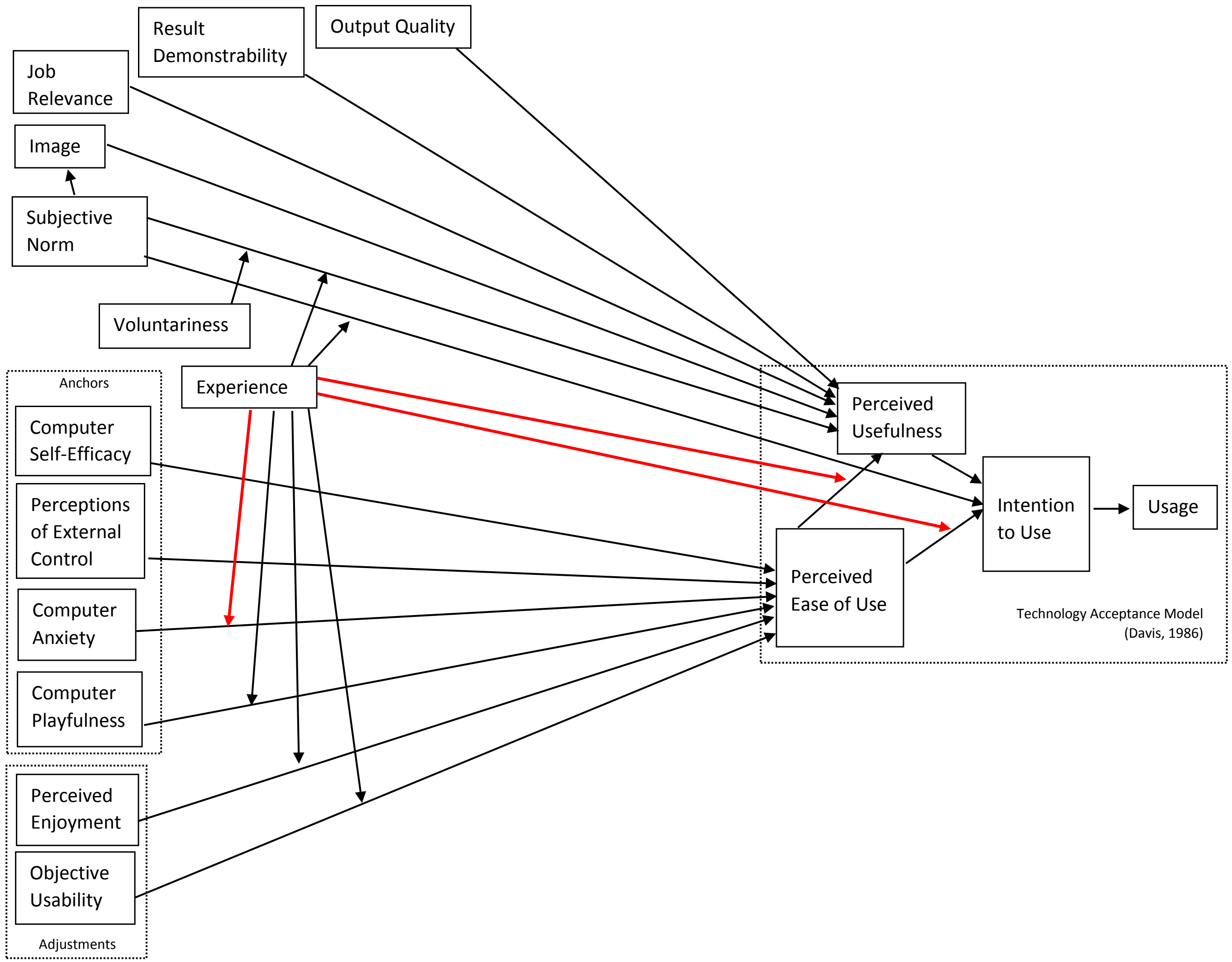


Figure 6: TAM3 (Venkatesh and Bala, 2008)

This was confirmed as the influence of perceived ease of use was shown to decrease as a result of greater experience, which was the final new relationship proposed by TAM3. Therefore, all relationships suggested in the model were shown to be supported by the pooled study results which confirms the value of extending the TAM to include both sets of determinants.

Unified Theory of Acceptance of Use of Technology (UTAUT) (Venkatesh et al, 2003)

Finally, the TAM has also been integrated with other similar theories in the area to create an overall theoretical model known as the Unified Theory of Acceptance and Use of Technology (UTAUT) which was developed by Venkatesh et al (2003). This model attempts to synthesise aspects of the Technology Acceptance Model (TAM), the Theory of Planned Behaviour (TBP), the Theory of Reasoned Action (TRA), the Motivational Model, a combined TBP/TAM, the Model of PC Utilization, Innovation Diffusion Theory (IDT), and Social Cognitive Theory (SCT). It hypothesises that performance expectancy, effort expectancy and social influence predict behavioural intention which, combined with facilitating characteristics, leads to performance of behaviour or actual usage. These factors are influenced to varying degrees by age, gender, experience and voluntariness of usage. There are distinct parallels between this model and the TAM, with performance expectancy encapsulating perceived usefulness and effort expectancy representing perceived ease of use. The terms in the UTAUT are designed to combine the definitions of similar constructs across the different included theories in order to bring together the research into a unified theory. A review of existing literature around this unified theory was conducted by Williams et al (2015) who found 174 relevant papers which examined the model over more than 98 different technology systems. The review found support for the predictive relationship between performance expectancy and behavioural intention and between behavioural intention and actual usage, but states that more research is needed into the other relationships. They also highlight some methodological weaknesses to be improved in future investigation, including a reliance on cross-sectional data and self-report measures of actual usage.

Criticisms of the Model

Although the TAM is an attractive theory due to the simplicity of the original model and its applicability to research (Lee, Kozar and Larsen, 2003), there are several criticisms aimed at the model, yet to be addressed. Chuttur (2009) states that these criticisms fall broadly into three main categories; problems with the methodology of research using the TAM, problems with the variables and relationships included in the model, and problems with the underlying theoretical framework that was used in the model development. Firstly, much of the research investigating the relationships included in the TAM use self-reported data to measure variables such as behavioural intention, rather than an objective measure of system use (Legris, Ingham and Collerette, 2003; Yousafzai, Foxall and Pallister, 2007; Maruping et al, 2006). However, it can be argued that because the TAM includes variable such as attitudes and perceptions, that there is no truly objective way in which to measure them. As these variables are highly subjective in nature, a self-report measure is the only appropriate way to measure them.

In addition, many studies use student only samples which limit the generalisability of findings to other contexts (Lee, Kozar and Larsen, 2003). It has also been stated that the majority of studies investigate the TAM in relation to use of a system when it is entirely voluntary, and usually in a hypothetical research situation, with very little research on the model in relation to the mandatory use of systems (Yousafzai et al, 2007). For example, in the workplace systems use is often required with few or no alternatives (Lee et al, 2003). However, this was investigated by Brown et al (2002) who researched the TAM in relation to a mandatory system and found that perceived ease of use was a more important predictor that perceived usefulness, in direct contrast to voluntary systems where the reverse is the case (Davis, 1986). Finally, it has been suggested that in research settings the TAM is simply measured as a variable and not used as an explanatory model to make recommendations regarding implementation of new technologies to increase the acceptance (Bashange, 2015).

There have also been criticisms surrounding the variables and relationships included in the TAM. As stated, several of the variables, such as behavioural intention, are highly subjective measures and it can be argued that they should be replaced with objective equivalents (Maruping et al, 2006). However, due to the inclusion of variables such as attitude, an objective measure would be either impossible or inappropriate as there is no 'correct' or 'true' attitude to have. Problems have also been suggested with the perceived usefulness factor. Hsu and Lu (2004) state that perceived usefulness would not be relevant in all situations, such as when gaming technology is used for entertainment. They state that in this context, the technology is not perceived as 'useful' as it is not performing a function or helping to complete a task but is being used for relaxation and enjoyment. Other models have been proposed which include this hedonic element such as the Hedonic-Motivation System Adoption Model (HMSAM) (Lowry et al, 2013) which could have better explanatory power in this context than the TAM. As well as changing existing variables, it has also been suggested that the TAM does not include enough explanatory factors. Zahid et al (2013) argued that the model did not consider age or education level which would affect user perceptions of technology.

However, with the extensions presented (e.g. Venkatesh and Davis, 2000; Venkatesh and Bala, 2008; Venkatesh, 2000) more determinant explanatory factors have been added. It can be argued that there are now such a multitude of extra included factors that there is no longer a single TAM and that the research picture is now complicated and crowded. There is not an agreed model which incorporates all factors suggested in a clear model which can be as easily applied to research as the original TAM. In the model proposed in Venkatesh and Davis (1996) the design features component of the Davis (1986) version has been replaced with an 'external variables' component in order to encompass the determinants later included. Although it is important to include further variables in order to increase the explanatory power of the model, no consensus has been reached on which should be included or how influential they would be.

There is also a lack of clarity regarding the effects of making technology use compulsory and how this affects technology acceptance, which is particularly relevant to a workplace context where some process may require compulsory use of technology. Venkatesh et al (2003) showed that perceived usefulness is an important predictor of technology acceptance in both a mandatory and voluntary context. However, research suggests that its relative importance to perceived ease of use can change depending on the context. In a voluntary context such as the initial research by Davis (1986), perceived usefulness is the more important predictor of use, but in a mandatory setting, perceived ease of use has been shown to become more important (Brown et al, 2002). This was supported by Chen et al (2012) who showed that perceived ease of use predicted IT continuance when it was introduced as a mandatory requirement.

There is some evidence to suggest that making the usage of technology in the workplace compulsory may have negative effects on its acceptance. Junglas et al (2014) showed that IT empowerment predicted future usage of the IT systems and Lee and Park (2008) showed that a perceived loss of control (such as the removal of choice) led to a negative effect on user satisfaction. Voluntariness is included as a variable in the TAM3 model (Venkatesh and Bala, 2008) but the full effect of mandatory use is not fully clear, but it highly important, especially when considering introducing technology systems into a context such as the workplace, where all employees need to be on board with a system to gain the maximum benefits. There are also issues with privacy and security of information related to compulsory use which need to be considered in greater detail. Privacy, or the lack of it, may contribute to the effect of making a system mandatory and could be included in future versions of the Technology Acceptance Model.

Finally, as demonstrated throughout this chapter, there are several instances where the findings of studies contradict each other, further adding to the complexity of the research picture. In Davis (1986) perceived ease of use was shown to directly affect attitude towards using, but in subsequent studies, the effect of perceived ease of use has been indirect, through perceived usefulness (Venkatesh and Davis, 2000). Overall, more research is needed to resolve the contradictions and provide clarity on which variables should be included, in a clear way to make the model more applicable to practice as well as research.

Despite these criticisms, the TAM still provides a powerful explanatory model for understanding the perceptions that lead to technology usage and includes factors than can be manipulated in order to increase intention to use, which has practical relevance. As the study presented in Chapter 5 aims to validate the TAM relationships in an entirely new context, it was decided to focus on validating the key relationships proposed by Davis (1986) and so the original TAM variables of perceived usefulness, perceived ease of use, attitude and intention to use will be included. Some of the variables included in the suggested TAM extensions may also be relevant in this context, but in order to ensure clarity and rigor, it was important to validate the original model first.

Consolidated Framework for Implementation Research (CFIR) (Damschroder et al, 2009)

The second model used in this thesis is the Consolidated Framework for Implementation Research (CFIR) (Damschroder et al, 2009). One of the focuses of this thesis is to examine the implementation of mobile technology-based interventions. An intervention can only be effective if it used by the target audience, and this involves an acceptance of the delivery method and an engagement with the intervention. Burnes et al (2004) found that two out of every three interventions that organisations try to implement fail. There are many factors that can explain this, with several being context specific, and a framework is needed to provide some coherence and direction to this area to help to refine implementation and increase success rates. In order to relate the findings of the studies to future usage of technology as a delivery method and to make recommendations related to practice as well as theory, it is important to consider the implementation of the intervention during its' development and testing. The process of implementation is related to its acceptance and can affect whether an intervention is used regularly enough to have an impact on the desired outcomes. Therefore, the results of each study presented in this thesis will be examined in the context of implementation and how these findings can lead to more efficient and effective implementation of future interventions delivered by mobile technology.

The Consolidated Framework for Implementation Research (CFIR) was developed by Damschroder et al (2009) who pulled together constructs previously shown to affect implementation into one model. Implementation is defined as a process of assimilating a new intervention or process into the workplace (Rabin et al, 2008) and the increased usage and skill of a new method over time (Klein and Sorra, 1996). While much focus may be given to the development and content of the intervention, and to a lesser extent to the evaluation, the process of implementing the intervention is crucial to its success. In the sense of the CFIR, 'framework' is also used to mean a professional consensus of related constructs but does not specify the direction of the relationships (Kitson et al, 2008). This framework can be used to explain the factors which contribute towards successful implementation of an intervention, and it can be used during planning the implementation of an intervention in order to make it more effective.

In order to generate the CFIR, implementation theories were gathered that were either based on a synthesis of the literature, or on a large-scale study (Damschroder et al, 2009). This was a continuation of Greenhalgh et al's 2004 synthesis of 500 studies that facilitated the move from research into practice and showed how interventions could move from being effective in a research setting to successful in an organisation. Successful interventions are a result of an interaction between the content, the context and the implementation process (Pettigrew and Whipp, 1992) and the CFIR aims to include factors related to each of these. The five domains included are the intervention characteristics and content, the outer setting, the inner setting, the characteristics of the individuals participating, and the implementation process itself, as shown in Figure 7 below. The aim of combining these factors, outlined in this section, was to provide a structure for approaching complex interventions and to guide future implementation in a more coherent manner (Damschroder et al, 2009).

1. *Intervention Characteristics*

The first major domain is the characteristics of the intervention or change itself and includes eight related constructs. The first of these is the source of the intervention, such as whether it has been internally or externally developed, the trustworthiness, and the motivations of the people driving the changes. The second is the strength and quality of the scientific research evidence which shown that the intervention is effective, and the third is the perception that the change will lead to an advantage to the users; these two can be linked together as the perception of advantage can be affected by the evidence available. Next is how adaptable the intervention is and how well it can be modified to suit different needs, followed by the complexity of the intervention, how well it is designed and presented and the costs of introducing it. Finally, the last construct is trialability, which is the ability to test the intervention out in a small scale, and to undo the changes resulting from the intervention if needed (Feldstein and Glasgow, 2008).

2. *Outer Setting*

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The second major domain is the outer setting, which includes the economic, political and social context the organisation resides in. The first construct in

the outer setting domain is patient needs and resources. The CFIR was developed in a healthcare context, but for other areas or sectors, this could be adapted to stakeholder or customers' needs and resources where applicable. This construct highlights that these needs should be clear and should be a central focus of the organisation. It has been shown that patient focused organisations implement healthcare change more effectively (Shortell et al, 2004). The second construct in this domain is cosmopolitanism, which refers to the level at which the organisation is networked, and the level of social capital it possesses through these networks (Brehm and Rahn, 1997). The next outer setting construct is peer pressure from other organisations to change the way they operate, which is related to the final construct of external policies and incentives to change, such as rewards or increased reputation.

3. *Inner Setting*

The third major domain is the inner setting and internal context of the organisation. This is closely related to the outer setting domain and there may be overlap between the two. Constructs in the inner and outer setting may be on different levels in different organisations and even within the same organisation. The first related construct categorised as inner setting is the structural characteristics of the organisation, including the size and hierarchy. Size, age, maturity and specialisation have all been shown to affect implementation (Greenhalgh et al, 2004). The second construct is networks and communications within the organisation, and interpersonal relationships that may affect change such as leadership, as well as quality of communication from management to employees.

The next construct is the culture of the organisation, including the norms and values that underly its operation. Many interventions are superficial to the organisation and fail because they do not tap into these underlying values, or they fail to change these values where necessary (van Eijnatten and van Galen, 2002). Another construct is the implementation climate within the organisation, which contains six sub-constructs; the tension for change and how urgently change is needed, the compatibility between the values attached to the intervention and the users own values, the relative priority of the intervention, the organisational incentives and rewards, the clarity of the goals and the focus of feedback relating to them, and extent to which the organisational culture encourages learning and development. The final construct is readiness for implementation, which covers leadership engagement and support of the changes, the available resources to support the change and the access to clear information about the interventions, its aims, and how exactly it will work for each person.

4. Individual Characteristics

The fourth major domain is the characteristics of the target audience of the intervention. As stated by Greenhalgh et al (2004), people are not just passive recipients of an intervention – they are active and can influence the success as much or even more than other factors. These individual characteristics can have effects at the individual level, but they can also be aggregated and have an effect at the team level (Lukas et al, 2007). The first construct is knowledge and beliefs about the intervention, how important it is and how likely they are to use it, which can be affected by the inner setting of the organisation with regards to the clarity of communication, and by the intervention characteristics themselves. The second construct is self-efficacy, which refers to the individual's belief that they are competent and can achieve the goals of the interventions. The third is the individual state of change, which is the openness of an individual to change, and the stage they are in in relation to increased usage of the intervention. The next construct is identification with organisation, which involves organisational commitment, work attitude and engagement. Finally, there are other personal attributes mentioned including tolerance of ambiguity, motivation and innovativeness, which are included but have a much smaller focus.

5. <u>Process</u>

The final major domain is the implementation process itself, which often includes multiple processes running simultaneously at different levels in the organisation (Pettigrew and Whipp, 1992). These processes will often need to be evaluated and adapted throughout the course of implementation and should remain flexible. The first construct in this domain is planning the implementation process to increase effectiveness. These plans should include stakeholders needs, strategies for different target groups, clear communication through correct channels with all the necessary information, and continuous thorough evaluation. Plans may also include training for employees before an intervention starts, small trial runs or incremental implementation. This is related a further construct in this section of the model, which involves executing this plan effectively.

The next construct is engaging the users which is often overlooked - one way to do this is by using implementation leaders (Pronovost et al, 2008). These leaders are responsible for being role models and encouraging usage of the intervention. They can be opinion leaders who have a formal influence on attitudes through expertise, an externally appointed leader such as a consultant, a ‘champion’ from amongst the employees who may have informal status, or an internally appointed leader, possibly a manager. The final construct in this domain is reflecting and evaluation the process and the quality of implementation. The evaluation can take a variety of forms but should be specific, measurable, attainable, relevant and timely (SMART) (Brach et al, 2008).

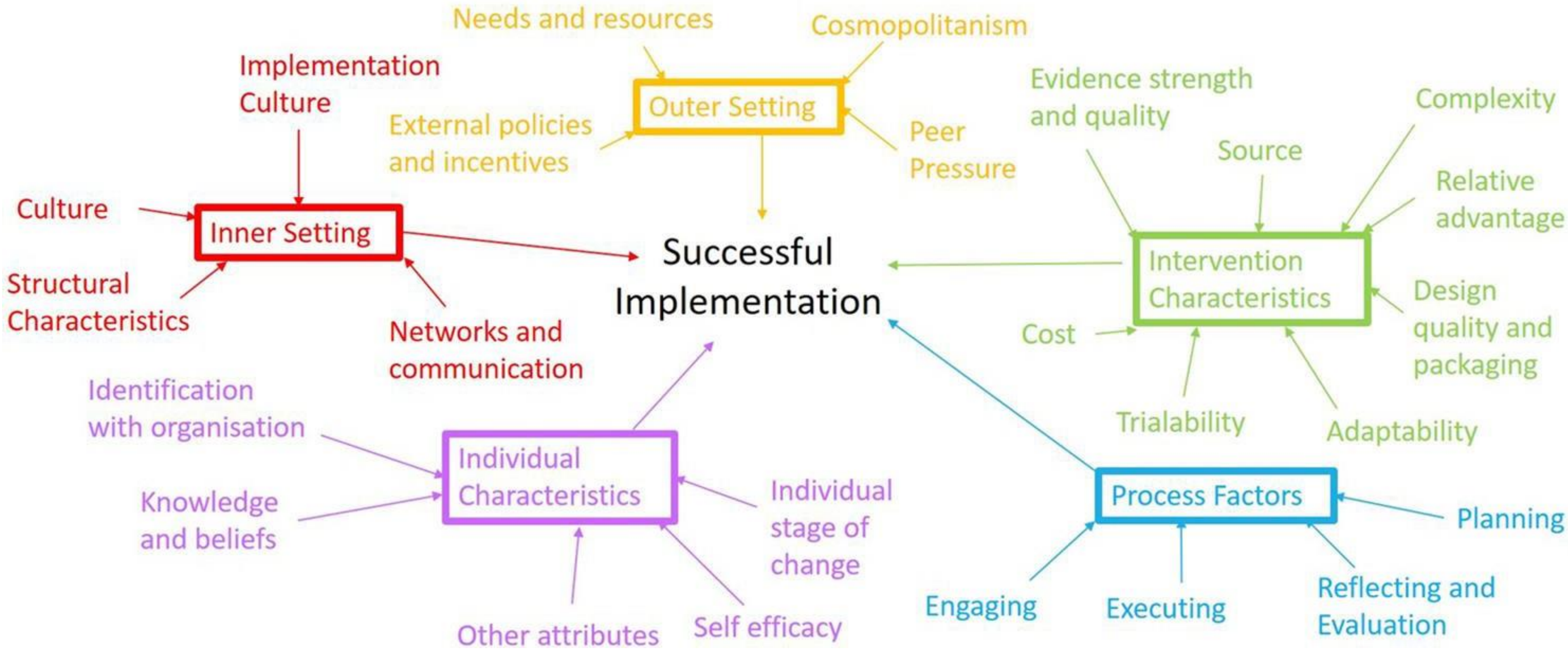

Figure 7: Consolidated Framework for Implementation Research (CFIR) (Damschroder et al, 2009)

This framework has been used in several studies to provide insight into the implementation of the intervention. Kirk et al (2015) showed in a systematic review of 26 studies that the framework has been applied to a variety of studies, representing a variety of methods, settings, contexts and objectives. They recommend that although the framework can be highly useful, it needs to be used throughout the implementation process, not just at the end once implementation has come to an end. Breimaier et al (2015) had similar conclusions; they stated that the framework was helpful, valuable and easy to use but that more specific definitions are needed for some of the constructs. The framework has been used more specifically in some areas to identify potential barriers to implementation, or to identify why an intervention failed to become rooted in an organisation. Damschroder and Lowery (2013) analysed a weight management intervention, and using the framework, found that 10 out of 31 constructs distinguished between high and low implementation effectiveness. Lash et al (2011) assessed the literature on substance use disorder continuing care interventions and identified lack of communication and information as a barrier. This evidence shows the framework can be used in a practical sense to inform practice and implementation research.

Pawson et al (2005) states that to be used effectively, there should be a list of constructs out of which the most relevant can be selected for measurement, depending on the context and the intervention. The CFIR provides this framework of constructs that acts as a basis to select appropriate measurements. In particular, it is most effectively used as a tool to support situational analysis, as it captures the complexity of implementation and helps to provide a structure to simplify this complexity and make it easier to put into practice (Ilott et al, 2013). Fredriksson et al (2014) states that the CFIR can be used to guide interviews and focus groups to identify barriers to implementation at the start of the process and to form recommendations based on this. The framework also provides a platform to promote synthesis of findings in implementation research on a clear and translatable level, which will make it easier to find common themes in research, to identify what is supported and what needs to be the focus of future research (Mendel et al, 2008). To conclude, the CFIR acts as a starting point for an implementation process and gives clarity to a hugely complex area by providing a structure of constructs to consider throughout the process of implementation, to eventually increase uptake and longevity of an intervention.

Combined Model

While the CFIR concerns the implementation of general interventions, it can be linked with the TAM to create a combined model that can offer explanatory factors for the successful implementation of technology-based interventions, shown in Figure 8. In this combined model, the TAM can be considered part of the individual characteristics factor of the CFIR, as it concerns individual perceptions of the technology and motivations for usage. Many of the features in both models can be connected. For example, the perceived usefulness of the application would be affected by the communication surrounding the implementation, the implementation culture and the process of the implementation. Perceived ease of use could be affected by the individual’s knowledge and beliefs surrounding technology and their self-efficacy. The design features of the intervention such as the evidence strength and quality could affect the perceived usefulness, and the complexity, adaptability and design quality could affect the perceived ease of use. The relationships between these models is reciprocal. The use of technology as a delivery method also affects the cost, adaptability, design quality and packaging and the complexity of the intervention. As well as the factors from the CFIR affecting the perception of technology, the perceptions, and the resulting attitudes will either lead to increased or decreased usage of the technology, which will affect the implementation of the intervention overall.

Figure 8: Combined TAM and CFIR Model

Bashange (2015) criticised the TAM by stating that the model is generally only used as descriptive, with little connection to the implementation of technologies in the future. This combined model offers a framework for the TAM to be used in making such recommendations and shows that implementation literature and models can be adapted in order to explain the successful implementation of technology-based interventions with the aiming of making recommendations in order to facilitate implementation of future interventions.

Conclusion

The Technology Acceptance Model (TAM) (Davis, 1986) presented a theory which explains the usage and acceptability of new technology. It states that the design features of the technology influence the perceived usefulness and perceived ease of use of the technology. These two variables predict the individual's attitude towards using the technology, which in turn predicts the actual usage. It was also suggested that the perceived ease of use would predict the perceived usefulness of the technology. In order to increase the usage, the design features can be manipulated to increase the perceived ease of use or perceived usefulness. Empirical evidence has been presented to show support for this model. As the model was proposed in the 1980s, much of the original research to support the theory was based on the introduction of software to increase workplace efficiency, such as database software or chart building software. Subsequently, the model has been validated in a range of contexts, including the acceptability of telemedicine and health information technology (Hu et al, 1999). It has not currently been validated in a mental health or well-being context, and Chapter 5 in this thesis presents the results of an empirical validation study which aims to provide validation of the TAM relationships in this context.

The CFIR (Damschroder et al, 2009) provides a comprehensive model which includes five factors relating to the context, content and process of the implementation of an intervention which can affect its overall success or failure. These factors are the inner setting, the outer setting, the intervention characteristics, the individual characteristics of the users and the implementation process. They act as barriers or facilitators for implementation and can be considered during the planning phase of implementation. This demonstrates that the advantage of the framework is its applicability to practice. The TAM can be combined with the CFIR to provide more detail related to the intervention and individual characteristics factors and the CFIR provides a framework in which the results of research into the TAM can be translated into recommendations for practice.

The remaining chapters in this thesis present the results of a literature review which assesses the current state of research into the acceptability and usability of mobile technology as a delivery method, followed by the results of three empirical studies; the validation of TAM relationships in a well-being context, the development and usability testing of a prototype well-being application, and a qualitative study investigating the acceptability and implementation of well-being applications in the workplace. The results of the studies will be analysed in relation to the combined TAM and CFIR model and will be linked to these factors where appropriate in order to make recommendations for the future usage of mobile technology for well-being.

Chapter 3: A Systematic Review of the Acceptability of Technology-Based Interventions for Well-Being

Abstract

The first stage in this analysis of user experience is to assess the current position of the literature, to examine what methods are currently being used to assess usability, what theories of acceptability they relate to and their findings and conclusions. To do this, a systematic review was carried out to establish the current methods for and frequency of examining participant acceptability and usability of mobile applications using positive psychology or cognitive behavioural change techniques to increase well-being. The review aimed to investigate how many studies included acceptability or usability as an outcome measure, the methods used for assessment and any common findings across the studies. The PsycINFO, Medline and Web of Science databases were searched and initially 456 results were found, 21 of which met the inclusion criteria for the review and examined mobile applications in a mental health context. 7 of these studies included a measure of acceptability or usability. The four measures used in these studies were the System Usability Scale (SUS) (Brooke, 1996), the Mobile Application Rating Scale (uMARS) (Stoyanov et al, 2016), the Client Satisfaction Questionnaire (CSQ) (Attkisson and Zwick, 1982) and general questions completed by users of the applications. Although these measures provide support for the usability and acceptability of mobile applications for the delivery of mental health interventions, very little is investigated in terms of ways to encourage people to use these applications, ways to decrease drop out and ways to increase motivation to stay engaged. These studies also lack an underlying theory which could help to explain participant motivation for both engagement and continuing use. The conclusions of this review suggest that a more thorough approach is needed to examine usability, with relevance to both theory and practice to allow these findings to be used to improve future applications.

Rationale

Since the introduction of mobile applications in 2008, the frequency and variety of applications has increased exponentially (Deloitte's Global Mobile Consumer Survey, 2017). Mobile applications are being used for a variety of health-purposes including dieting, smoking cessation and increasing exercise. As outlined in Chapter 1, they are now also being used for mental health purposes, to deliver a range of interventions which aim to increase mental health and decrease stress amongst other objectives (Luxton et al, 2011). With the wide range of apps and the accessibility for both consumers and developers, it is important that health-related apps maintain their evidence base. Reviews have suggested that some apps are effective at increasing well-being with a demonstratable evidence base (Donker et al, 2013). Using mobile apps as a delivery method for mental health and well-being interventions offer several benefits, including reduced costs, easier access and more confidentiality, which may attract users (Chan et al, 2014). Although more research is now being done to ensure the effectiveness and credibility of applications, the potential benefits can only be accessed if the apps are accepted and used by the target audiences who need to be motivated to stay engaged with the intervention and need to find them easy to set up and use.

This review aims to establish how many studies are investigating the acceptability and usability of mobile applications for well-being, and what the current findings are in this area. It examines studies which conduct usability testing on applications designed to increase well-being or positive mental health using behavioural change techniques in healthy adults. This thesis aims to investigate the use mobile application for well- being in the general population in order to increase well-being rather than to decrease symptoms of mental ill health, to make suggestions on how to address this gap in support. People with mental health issues can still improve their well-being and positive mental health, (e.g. Keyes, 2002; 2005) but they might find it more difficult to get started, and depending on the severity of their symptoms, may need to address these before they can concentrate on well-being. For this reason, studies were included which used samples of psychologically healthy adults.

For this review, studies have been included which use either positive psychology or cognitive behavioural methods to increase well-being. As shown in Chapter 1, many positive psychology-based interventions use cognitive techniques to create lasting behaviour change, such as challenging attributions included as part of the Three Good Things exercise for optimism (Seligman et al, 2005). Due to the variations in terminology used in well-being, mental health and positive psychology, it may be that relevant interventions could be missed if only positive psychology terms were included. Relevant interventions may use cognitive behavioural techniques to achieve the same aim as a positive psychology intervention and would be equally useful to the research aims. In order to provide a comprehensive review, applications using both positive psychology and cognitive behavioural techniques were therefore included. Additionally, usability can be measured in a variety of ways, and as it is sometimes considered a secondary measure, there might not be a reference to it in the title or abstract of the study. In order to conduct a thorough literature search, usability was not included as either an exclusion or inclusion criteria in the initial search. Once articles were found which referenced a behaviour change application for well-being, they were hand searched for usability measures, and studies which included any measure of usability or participant experience was included in the final review.

Objectives

This review was carried out in order to answer three main research objectives:

1. To summarise the scope and nature of research which examines any aspect of usability or acceptability of mobile applications which deliver interventions aimed at improving mental health

2. To identify which methods such studies employ to measure usability or acceptability

3. To identify common features or factors established by these studies which affect usability or acceptability of mobile applications as a delivery method for mental health interventions

Method

This review was carried out following the PRISMA guidelines and checklist for systematic reviews reported by Moher et al (2009).

Search Terms

Table 1 below shows that search terms used for the review. Terms that are preceded by a star are keywords identified and used by the database for categorising articles. Search terms within columns were combined with the Boolean operator OR and then the three columns were combined using the AND function. As stated, no search terms for acceptability or usability were included in the initial database search.

Table 1: Search terms used for a literature review to identify mobile application used to deliver well-being interventions

Technology	Intervention	Mental Health
*Mobile Technology	*Response to Intervention	*Mental
*Mobile Learning	Intervention.mp.	Health
*Mobile Applications	*Intervention	*Well Being
*Mobile Health	positive psychology.mp.	*"Quality of
*Mobile Devices	*Positive Psychology	Life"
*Mobile Phones	*Cognitive Behaviour	wellbeing.mp.
	Therapy	*Coping
	*Cognitive Therapy	Behavior
	Cognitive behavioural	
	therapy.mp.	
	cbt.mp.	

	*Health Behaviour
	*Behaviour Change
	behaviour change.mp.
	*Behaviour Therapy

Inclusion and Exclusion Criteria

Population: Studies were included if they contained a sample of healthy adults. Studies were excluded if they contained children or youth samples, or if they included participants with clearly stated mental health issues.

Intervention: Studies were included if they analysed a mobile application which aimed to increase some facet of mental health through either positive psychology or cognitive behavioural therapy-based behaviour change techniques. Studies were excluded if the target of the mobile application was physical health such as healthy eating and exercise, or if the intervention was delivered using a webpage or through text messaging rather than an application. Studies were also excluded if they were aimed at a population with a specific medical condition and aimed to increased wellbeing related to symptoms or condition management.

Control: No reference to control groups was made in these criteria, as the focus was the usability rather than the effectiveness.

Outcome: Studies were included in the first sift if they measured a change in any aspect of mental health (including wellbeing, quality of life and coping behaviour). From these results, studies were then included in the final review if they contained any measure of participant acceptance of the technology, usability, engagement or satisfaction. Any measure of these would warrant inclusion in the final sample.

Study Type: All study types were included in this review.

Search Strategy

Using these search terms, three databases were searched for relevant studies; a keyword search of PsycINFO, a title and abstract search of Medline and a title search of Web of Science. In total, 456 results were initially found. The inclusion and exclusion criteria were then applied to these results, firstly on the titles and abstracts available. The remaining studies were then assessed on the full texts where available, and the inclusion criteria again applied. 21 studies were found that examined mobile applications which delivered a mental health intervention based on positive psychology or cognitive behavioural therapy-based behaviour change techniques. 7 of these studies included a measure of participant acceptability, usability, engagement or satisfaction and were included in the final analysis. A PRISMA diagram for this process is shown below in Figure 9.

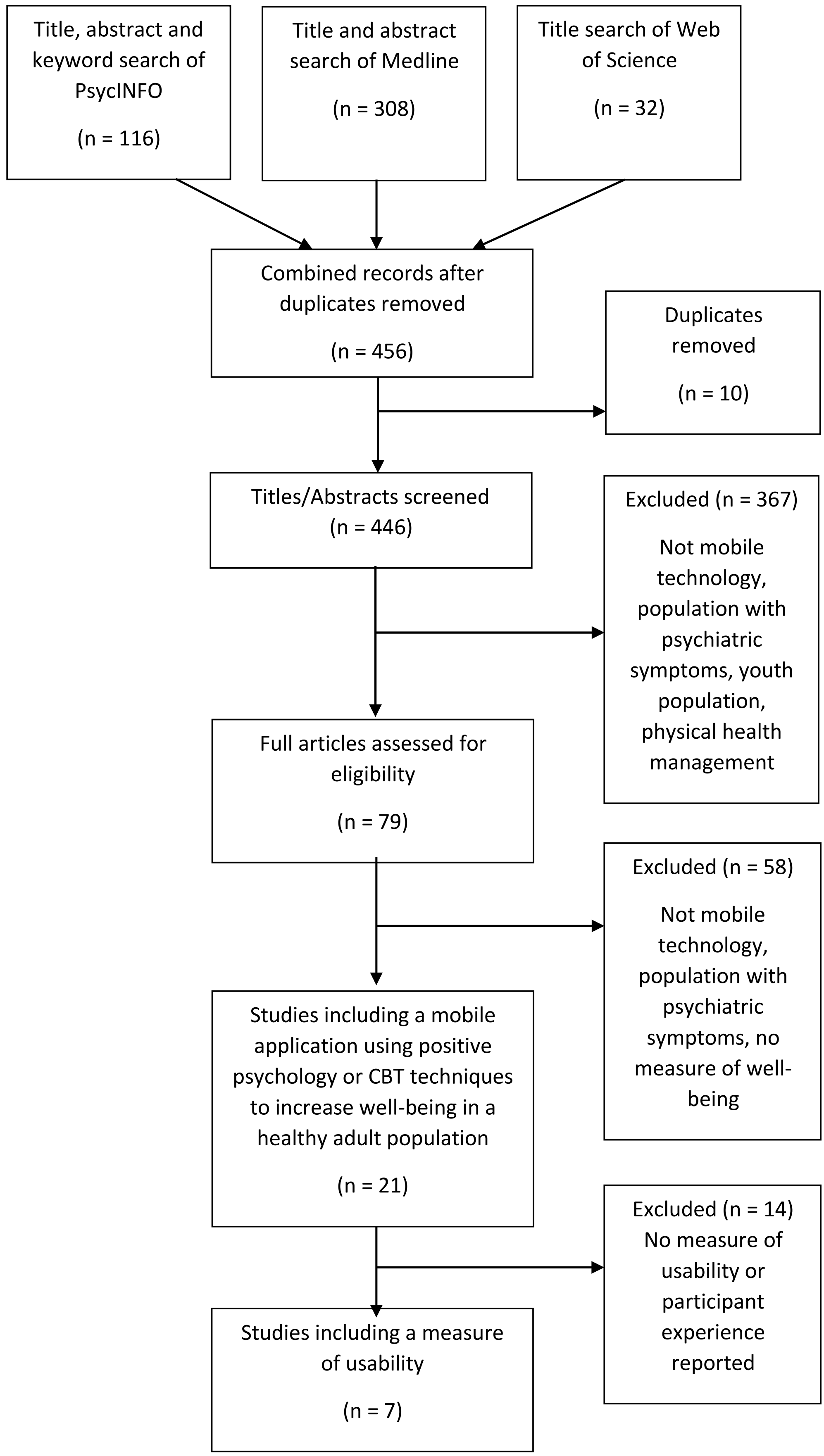

Figure 9: PRISMA flow diagram for a systematic literature review

Results

Data Extraction

Data from each of the studies identified in the review was extracted using the Cochrane (2014) data extraction form for RCTs and non-RCTs. This form contains data extracted regarding the study characteristics, the participants included, the intervention and control groups used, the outcome measures, the risk of bias in the study, the resulting data and analysis of the results. A narrative approach was used to synthesise the findings due to the heterogeneity of the methods and the nature of the results found in the studies. Based on the second research question, which states that this review aims to identify which methods are currently being used to assess usability and acceptability, this heterogeneity was expected from the data.

Study characteristics

Six of the studies reported on the effectiveness of an application which aimed to increase mental health in some way, and each study reported on a different app. The final included study presented a report on a range of applications which were downloaded by the researchers and the usability was examined, but no effectiveness study was conducted. Sample sizes varied between studies from 31 participants to 508 participants. Participants were predominantly white, female and young in many of the studies, but full details of participant characteristics were not included clearly in each study. Other population factors such as occupation is unknown. The samples were made up of a self-selecting population who had volunteered to take part in a study to test a mobile application for well-being or mental health. Target outcomes of the studies included measures of depression, stress, anxiety and mental health, with additional outcome measures dependent on the target of the app. Study duration ranged between one week to two months. A table presenting the study characteristics are included below (Table 2).

Measures used to assess Usability

1. System Usability Scale (SUS) (Brooke, 1996)

The System Usability Scale (SUS) (Brooke, 1996) is a 10-item measure of usability. Example questions include "*I felt very confident using the system*", and participants respond using a 5-point Likert scale, from strongly disagree to strongly agree. A calculation is used to weight the positively and negatively worded questions, which gives a final score of between 0 and 100 for each system. Bangor et al (2008) suggest that a score of 72.75 is considered good, and a score of 85.58 is considered excellent. The full scale is included in Appendix D. The scale has been validated and shown to have strong internal consistency with an alpha of 0.91 by Bangor et al (2008) who state that the scale is highly robust with strong psychometric properties. Results on the SUS have been correlated with task success (Kortum and Peres, 2014).

2. The User Mobile Application Rating Scale (uMARS) (Stoyanov et al, 2016)

The User version of the Mobile Application Rating Scale (uMARS), is a 20-item measure designed for users to evaluate their experiences with mobile applications (Stoyanov et al, 2016). Each question is presented as a statement regarding the usability of the application, and participants choose which of the five responses best reflects their opinion. Response 1 is the most negative, and Response 5 is the most positive, so a higher score on the uMARS reflects a more usable application. The overall scale contains five subscales; Engagement, Functionality, Aesthetics, Information and Satisfaction. Some of the subscales are included in the usability test presented in Chapter 6, so example questions are available in Appendix D. The overall scale has been shown to be highly valid, with an alpha of 0.90, and the subscales showed similar internal consistency (Stoyanov et al, 2016). It was also shown in this study that the scale had high test-retest reliability over 3 months, and an acceptable reading standard was required so it was accessible to most adults. The scale has also been validated in different cultures and including translations into Spanish (Payo et al, 2019) and Italian (Domnich et al, 2016).

The uMARS has been previously used with healthcare applications (e.g. Adam et al, 2018).

3. <u>Client Satisfaction Questionnaire (CSQ) (Attkisson and Zwick, 1982)</u>

The Client Satisfaction Questionnaire was originally an 18-item measure developed by Attkisson and Zwick (1982) but has since been used in a variety of lengths, the most common of which is the 8-item measure (CSQ-8). The full CSQ-18 has been validated and shown to have high internal consistency with estimates of an alpha value of around 0.91, and similar results have been shown for the shorter CSQ-8 (Attkisson and Zwick, 1982). Example items include "*How satisfied are you with the amount of help you have received?".* Participants respond to this using a 4-point Likert scale, where 1 is quite dissatisfied and 4 is very satisfied. The resulting overall score on the CSQ-8 therefore ranges from 8 to 32, with a high score representing high level of satisfaction with the target. Attkisson and Greenfield (1995) state that overall, all forms of the scale have good psychometric properties and but that the CSQ-8 is the most used because it is shorter but still highly valid. The scale has also been validated across cultures and has been translated into a range of languages including Dutch and Spanish (DeBrey, 1983; Roberts et al, 1984). The CSQ has previously been used to assess satisfaction with mental health services (e.g. Copeland et al, 2004) and medical care (e.g. Matsubara et al, 2013).

4. <u>General Questions</u>

Several of the studies included some general questions relating to usability or participant experience, either in conjunction with a validated scale, or by themselves. These questions were generally not reported in detail, and the questions themselves were not included. The results were reported descriptively as a small secondary measure.

Table 2: Characteristics of the studies identified in the systematic review

Study	Participants	App	Study Duration	Effectiveness Measures	Usability Measures	Effectiveness Results	Usability Results	Quality
Krafft et al (2019)	35 help-seeking individuals and 63 university students	Acceptance-Commitment Therapy matrix	4 weeks	Depression, Anxiety and Stress Scale (DASS) (Lovibond & Lovibond, 1995); Mental Health Continuum-Short Form (MHC-SF) (Keyes, 2005); Valuing Questionnaire (VQ) (Smout, Davies, Burns, & Christie, 2014)	System Usability Scale (SUS) (Brooke, 1996); additional questions based on previous ACT studies (e.g., Levin, Haeger, et al., 2017); App Usage	Significant reductions in distress and anxiety over time. Increases in progress toward values on the VQ.	Participants either used the app very regularly, or just once. The scores on the SUS were 82.92 and 72.08 for differed conditions, and for the additional questions the mean score was 4 which represents participants slightly agreeing that the application was usable. Technical difficulties were reported as the main problem with the app.	Weak

Study	Participants	App	Study Duration	Effectiveness Measures	Usability Measures	Effectiveness Results	Usability Results	Quality
Bakker and Rickard (2018)	198 users who had voluntarily downloaded the application from the app store	MoodPrism	30 days	Patient Health Questionnaire 9–Item (PHQ-9) (Kroenke et al, 2001); Generalised Anxiety Disorder Scale 7-Item (GAD-7) (Spitzer et al, 2006); Warwick-Edinburgh Mental Well-being Scale (WEMWBS) (Stewart-Brown and Janmohamed, 2008); Emotional Self-Awareness Scale – Revised (ESAS-R) (Kauer et al, 2012); Mental Health Literacy Questionnaire (MHLQ) (Reavley and Jorm, 2011); Coping Self-Efficacy Scale (CSES) (Chesney et al, 2006); Social Desirability Scale (SDS) (Reynolds, 1982)	Mobile Application Rating Scale (uMARS) (Stoyanov et al, 2016)	The average MARS score was 27.03. App engagement predicted a reduction in depression and anxiety scores, and an increase in mental well-being.		Moderate

Study	Participants	App	Study Duration	Effectiveness Measures	Usability Measures	Effectiveness Results	Usability Results	Quality
McKay et al (2019)	Behaviour Change Applications downloaded from the Apple App Store or Google Play store; 275 physical activity, 23 healthy eating, 27 mental well-being, 14 tobacco, 5 alcohol	Names not included	Cross-Sectional Evaluation	App Behaviour Change Scale (ABACUS) (McKay et al, 2019) which uses 21-item instrument that reports high percentage agreement, Krippendorff alpha, interrater reliability, and high internal consistency to measure behaviour change potential	Mobile Application Rating Scale (uMARS) (Stoyanov et al, 2016)	Mental well-being apps had the second highest score on the ABACUS of 8.7 out of 21. Most of the well-being apps identified included rehearsal or practice alongside daily activities (23/27, 85.2%)	Mental well-being apps scored the highest on the MARS with an average score of 3.26 out of 5, and the highest on the individual scores for accuracy of design (4.17), performance (3.78), target group (3.75), gestural design (3.64), layout (3.6), graphics (3.53), quality (3.43) and quantity (3.05) of information, visual appeal (3.35), interest (2.67), credibility (2.64), visual information (2.5), and entertainment (2.28).	N/A

Study	Participants	App	Study Duration	Effectiveness Measures	Usability Measures	Effectiveness Results	Usability Results	Quality
Kizakevich et al (2018)	31 civilian participants (9 completed the SUS)	PHIT for Duty (Personal Health Intervention Toolkit) which includes health screening, health educated and cognitive behavior change modules for reducing stress, improving sleep, and reducing alcohol use.	Ranging from 7 to 14 days (4 participants completed the SUS after 14 days and 5 completed the SUS after 28 days)	Post-Traumatic Stress (PTSD7) (Breslau et al, 1999); PTSD Checklist Military Version (PCLM) (Weathers et al, 1993); Generalized Anxiety Disorder (GAD7) (Spitzer et al, 2006); Personal Health Questionnaire Depression Scale (PHQ8) (Kroenke et al, 2009); Insomnia Severity Index (ISI) (Bastien et al, 2001); Pittsburgh Sleep Quality Index (PSQI) (Buysse et al, 2000); alcohol use (AUDIT- and AUDIT-C) (Babor et al, 2001; Bush et al, 1998)	System Usability Scale (SUS) (Brooke, 1996); brief questionnaire of app features with Likert scale ratings ranging from 1 to 5 (very hard to very easy); comments on system usability, technical performance, and suggestions for improvements via a debriefing questionnaire	The study focused on validating the measures and comparing the online method with the paper version, so effectiveness was not measured.	The app was rated as generally highly usable, with an average score of the Likert questions of 4 out of 5 (rated as easy to use). The average SUS score over the 9 users who completed it was 85 out of 100, with a standard deviation of 12. A correlation between online and paper methods was 0.87 for the outcome measures listed.	Strong

Study	Participants	App	Study Duration	Effectiveness Measures	Usability Measures	Effectiveness Results	Usability Results	Quality
Mak et al (2018)	508 adults from the general Chinese population (349 participants completed the follow up)	Living with Heart – mindfulness, self-compassion training and cognitive behavioural education	4 weeks with 28 daily sessions lasting 10-15 mins. Measures taken pre-intervention, post-intervention and at a 3 month follow up.	World Health Organization 5-item Well-Being Index (WBI) (WHO, 1998); 6-item Kessler Psychological Distress Scale (K6) (Kessler et al, 2002); Mindful Attention and Awareness Scale (MAAS) (Brown and Ryan, 2003); 13 items from the Self-Compassion Scale (SCS) (Neff, 2003); 6 items from the Depressed Mood and Anxiety Subscales of the Affective Control Scale (Williams et al, 1997); 9-item Discomfort with Ambiguity subscale from the Need for Closure Scale (Kruglanski et al, 2013)	Chinese version of the 8-item Client Satisfaction Questionnaire (CSQ) (Attkisson and Zwick, 1982); Amount of sessions unlocked (out of a total of 28)	All 3 interventions shown an increase in mental well-being and reduce psychological distress. Mindful awareness was also improved in all three groups.	All 3 interventions showed similar levels of satisfaction. 90.2% stated that they received the learning that they wanted and 87.4% were satisfied with the app in general. Age and education affected attrition with older and less-educated people more likely to complete the sessions.	Moderate

Study	Participants	App	Study Duration	Effectiveness Measures	Usability Measures	Effectiveness Results	Usability Results	Quality
Heber et al (2019)	264 German employees with elevated symptoms of stress (Perceived Stress Scale-10 ≥22). Mainly recruited from a large health insurance company. (Participants were excluded if there was a risk of suicide or any psychiatric symptoms)	iSMI: (seven sessions and a booster session 4 weeks after training completion). Session1 was psychoeducation, sessions 2 and 3 were problem-solving, sessions 4, 5 and 6 were emotion regulation and session 7 was planning for the future. After each session an e-coach provided some written feedback to increase motivation and adherence.	7 weeks with 1-2 sessions per week with a 6 month and 12 month follow up	Perceived Stress Scale – 10 (PSS-10) (Cohen et al, 1983); Center for Epidemiological Studies' Depression Scale (CES-D) (Radloff, 1977); Insomnia Severity Index (ISI) (Bastien et al, 2001); anxiety subscale of the Hospital Anxiety and Depression Scales (HADS-A) (Hermann-Lingen et al, 2011); Penn State Worry Questionnaire, Ultra Brief Version-past week (PSWQ-PW) (Stoeber and Bittencourt, 2002); Short Form 12 (SF-12) PH (physical health) and MH (mental health) (Ware et al, 1996); Emotional Exhaustion subscale of the Maslach Burnout Inventory (MBI-EE) (Maslach et al, 1986); Utrecht Work Engagement	Client Satisfaction Questionnaire (CSQ-8) (Attkisson and Zwick, 1982); reasons for dropout	Significant reductions in perceived stress were shown post-intervention and at the 6 month follow up. Effects were also shown on the secondary outcomes of mental health, work-related health and stress related skills.	On average, participants complete 5.70 out of 7 sessions. 9 people reported reasons for discontinuing the iSMI which were lack of time (4/9), lack of motivation (3/9), technical problems (1/9), and dissatisfaction with the intervention (1/9). 92.2% of participants were mostly or very satisfied with the programme.	Moderate

Study	Participants	App	Study Duration	Effectiveness Measures	Usability Measures	Effectiveness Results	Usability Results	Quality
Heber et al (2019) (cont.)				Scale (UWES) (Schaufeli et al, 2002); psychological detachment subscale of the Recovery Experience Questionnaire (REQ-PD) (Sonnentag and Fritz, 2007); absenteeism and presenteeism via the German Version of the Trimbos and Institute of Medical Technology Assessment Cost Questionnaire for Psychiatry (TiC-P-G) (Hakkaart-van Roijen et al, 2002); Emotion Regulation Skills Questionnaire (ERSQ-27) (Berking and Znoj, 2008); general distress, using the Emotion Specific Version (ERSQ-ES-GD) (Ebert, Christ and Berking, 2013)				

Study	Participants	App	Study Duration	Effectiveness Measures	Usability Measures	Effectiveness Results	Usability Results	Quality
Van Emmerik et al (2018)	191 experimental participants and 186 control participants in the Netherlands	VGZ Mindfulness Coach which including 40 mindfulness exercises and mindfulness education	8 weeks until post-test and 20 weeks from baseline for a follow-up	Dutch version of the Five Facet Mindfulness Questionnaire (FFMQ) (Baer et al, 2006; De Bruin et al, 2012); Dutch version of the World Health Organization Quality of Life assessment, short version (WHOQOL-BREF) (Trompenaars et al, 2005; WHOQOL-Group, 1998); Dutch version of the General Health Questionnaire-12 (GHQ-12) (Goldberg and Williams, 1988; Koeter and Ormel, 1991); Self-actualization was assessed with a Dutch version (van Emmerik et al, 2018) of the Short Index of Self-Actualization (SISA) (Jones and Crandall, 1986)	General questions about the usability, quality of the voice-over, and clarity and usefulness of content, as well as length and frequency of use.	The intervention condition shows a significant differed in mindfulness above the control version. Effects were also shown on general health and quality of life.	All 11 questions received average scores of over 4 out of a maximum 5, showing that the app was clear, easy to understand, useful, comfortable to use, and satisfactory overall for participants. 16 out of 50 participants who completed the follow-up were still using the app at that time.	Weak

Results of individual studies

1. Krafft et al (2019):

Krafft et al (2019) examined the effectiveness and usability of a mobile app delivering an Acceptance and Commitment Therapy matrix intervention. Their participants were made up of two samples; 63 university students who were incentivised to take part with a credit system and 35 help-seeking individuals. Both samples of participants showed moderate levels of depression, stress and anxiety before the study. Participants received an interactive online tutorial before using the app, researchers made regular check ins if people had not logged into the app, and optional weekly summaries of progress were made available. Two versions of the app, a simple and a complex version, were compared against a waitlist control group, which participants were randomly allocated to. Outcome measures were depression, anxiety, stress, mental health, a valuing questionnaire, app usage, the System Usability Scale and further questions regarding the satisfaction of using the app, which were taken 4 weeks after baseline.

Both versions of the app showed decreases in depression and anxiety but no effect on positive mental health. An acceptable standard of user engagement was set at a 50% response rate to notifications, which was around 70 check-ins. For the simple version, usage was all or nothing, with participants either checking in very few times, or most of the time. 50% of participants in this condition met the engagement threshold. In the complex version 40% of participants met the response level but were more clustered around it. High satisfaction was reported for the application with a mean result of 82.92 for the System Usability Scale. Following the guidelines by Bangor et al (2008) this result falls close to the excellent mark. Finally, participants rated the app highly on questions about satisfaction, enjoyment, helpfulness and ease of use. The main barrier to engaging with the app was reported to be a lack of spare time to complete the exercise, and not seeing the notifications.

2. Bakker and Rickard (2018):

The next included study was Bakker and Rickard (2018) who examined MoodPrism, a mobile application which acted as a mood diary. 198 participants used the application for 30 days and completed measures of physical health, anxiety, mental well-being, emotional self- awareness, mental health literacy, coping self-efficacy and social desirability. Any participant scoring too highly on social desirability (above 8) was excluded due to the possibility of deception. Participants also completed an app engagement scale which was based on the Mobile App Rating Scale (uMARS). The study examined the effect of app engagement on changes in mental health as a result of the intervention. It was shown that engagement predicted changes in depression, anxiety and mental well-being, mediated by emotional self-awareness. This suggests that the greater the engagement with the app, the more effective it will be at increasing mental health. It was also shown that people with higher baseline mental health literacy showed better adherence to the study and completed more days using the app.

3. Kizakevich et al (2018):

The next study by Kizakevich et al (2018) presented the results of a trial of PHIT for duty, a mobile application for serving members of the US Armed Forces which was designed to act as prevention against serious mental problems for those with subclinical symptoms. The ‘PHIT For Duty’ (Personal Health Intervention Toolkit) application was developed following a series of focus groups with American soldiers which identified prevalent health problems in the forces and investigated the attitude towards using mobile technology to deliver an intervention to help post-deployment. The resulting intervention developed contains behavioural education, mindfulness and health information. Usability testing was carried out with 31 civilian participants who used the application for between one and two weeks. After use, they were asked to rate the application from 1 (very difficult to use) to 5 (very easy to use). 9 participants also completed the SUS after using the application for between two and four weeks. Participants found the application generally very easy to use, with an average score of 4.5 out of a possible 5 and rated the self-report measures included in the application as easy to use, again with an average score of 4.5 out of 5. The average score on the SUS completed by 9 participants was 85, which was reported to be in the 95th percentile of overall scores on the SUS. This suggests that the PHIT for duty application scores higher most of other applications tested using the scale, demonstrating that it is highly usable. No details regarding the subscales of the SUS were reported.

4. Mak et al (2018):

The next included study by Mak et al (2018) examined three mobile application-based programmes for mindfulness, self-compassion and cognitive behavioural education. All three programmes were delivered through one app called Living with Heart. Participants were randomly allocated to a programme, each of which contained 28 daily sessions, divided into 4 weekly blocks with the exercises for each week being released together. 508 Chinese participants were recruited, mainly through social media, and were asked to complete the World Health Organization 5-item Well-Being Index (WBI) and the Kessler Psychological Distress Scale (K6). Participants in the mindfulness condition were also given five items from the Mindful Attention and Awareness Scale (MAAS) and participants in the self-compassion programme were given 13 items from Self-Compassion Scale. These measurements were taken at baseline, post-test and at a 3-month follow-up. Usability of the application was assessed using the Chinese version of the 8-item Client Satisfaction Questionnaire (CSQ). The results showed that mental well-being increased significantly in all conditions, with no significant difference between conditions. Similarly, there was a significant decrease in psychological distress in all conditions, but no effect of condition. 79.9% of respondents rated the application as good or excellent on the CSQ, with 90.2% stating that they received the service they were expecting and 87.4% indicating that they were satisfied with the app in general. Most of the questions regarding satisfaction were concerned with the content and the help received in this study.

5. Heber et al (2016):

In a study by Heber et al (2016), 264 participants were allocated to either a mobile app or web-based intervention for elevated stress. Participants were German employees, selected from their workplace if they scored highly (>22) on the Perceived Stress Scale (Cohen et al, 1983). People were excluded from participation if they were suicidal or showed any psychotic symptoms. The app-based intervention was the iSMI GET.ON Stress intervention; a programme targeted to employees which contained psychoeducation, problem solving, emotion regulation and goal setting, and involved feedback from an e-coach to increase adherence and motivation. Participants were asked to complete 1 or 2 sessions a week for 7 weeks. Outcome variables were measured at baseline, at the end of the 7-week trial, and at 6-month and 12-month follow-ups. These measures were perceived stress, as measured by the Perceived Stress Scale (PSS), depression, using the Centre for Epidemiological Studies' Depression Scale (CES-D), emotional exhaustion using the Maslach Burnout Inventory subscale, engagement using the Utrecht Work Engagement Scale and emotional regulation and general distress using the Emotion Regulation Skills Questionnaire (ERSQ). Participant experience of using the app was measured using the Client Satisfaction Questionnaire (CSQ-8). The results showed that the app-based version led to a significantly larger decrease in perceived stress than the web-based version at both the post-test measure and the 6-month follow up. 92.2% or participants stated that they were satisfied with the application (either very satisfied or mostly satisfied on the CSQ) and indicated that they would both use the intervention again and recommend it to someone else.

6. Van Emmerik et al (2018):

The next included study was conducted by van Emmerik et al (2018) who conducted a trial in the Netherlands of a mindfulness-based intervention app called the VGZ Mindfulness Coach. 221 adult participants were allocated to either the experimental condition where they used the app over a maximum of 8 weeks or a waitlist control. The VGZ Mindfulness coach app contains a 5-week mindfulness program which involves a selection of over 40 audio exercises, such as breathing exercises, visualisation exercises and guided meditations, developed in consultation with a mindfulness expert. The outcome variables were measured at baseline, at the end of the 8-week trial and at 20 weeks post-baseline as a follow-up measure. These variables were Mindfulness, Quality of life, Psychiatric symptoms, and Self-actualization. After using the app for the 8 weeks of the trial, participants were also asked several questions about their experiences with using the app. The results showed that the VGZ Mindfulness Coach was effective at increasing mindfulness, at decreasing psychiatric symptoms and at increasing quality of life. Overall, participants rated the app very positively. Participants used the apps for nearly 4 weeks on average, with many using it daily across that time. 16 out of the 50 participants who responded to the 20-week follow up reported that they were still using the application. The app was rated as comfortable to use, clear, useful and easy to understand. They also indicated that they were satisfied with the application and that they would recommend it to others.

7. McKay et al (2019):

Finally, McKay et al (2019) conducted a review of behaviour change apps which aim to make a positive lifestyle change. These apps included health related behaviours such as smoking cessation, reducing alcohol consumption, healthy eating, exercise and increasing mental well-being. The apps were downloaded, tested by the researchers and rated using the uMARS scale and the ABACUS scale as a measure of behaviour change potential (McKay et al, 2019). 27 applications were found that used behaviour change techniques to increase mental well-being. These apps were given the highest rating on the uMARS out of the types examined overall with an average score of 3.26 out of a possible 5. They also scored the highest average on many of the components including accuracy of design, performance, layout, graphics, quality and quantity of information, visual appeal, interest, credibility, visual information, and entertainment. Mental well-being apps also showed the second highest potential for behaviour change, with an average score of 8.7 out of a possible 21.

Quality Assessment

The quality of the included studies was assessed using the Quality Assessment Tool for Quantitative Studies (Effective Public Health Practice Project 2007; reported in Evans et al, 2015), as recommended in the Cochrane Handbook (2014) (Section 21.4). This checklist includes analysis of the selection bias in the participants, the study design chosen, the possible confounding variables and how they are dealt with, the blinding of both participants and researchers, the validation of the measures used and the attrition rates in the study, in order to provide a rating of strong, moderate or weak for overall quality. The tool also includes the Quality Assessment for Quantitative Studies Dictionary which provides guidance on how to score these sections, and how to weight the overall quality score, including advice on terminology. The detailed results of this assessment are shown in a table in Appendix A, and the overall quality score for each study is included in Table 1 above. The quality assessment could not be used on McKay et al (2019) as it conducted a usability test on applications downloaded by the researchers and contained no participants. Of the remaining studies, two were considered weak, two were considered moderate and one was considered strong. A study can only be rated as strong in the assessment if it rated as strong on all sections. The weaknesses of the studies included in this review were mainly a lack of detail in the reporting, particularly around the blinding of participants and researchers and the description of attrition rates, rather than the study design itself. All studies used strong measures and a suitable design for the research questions, with appropriate samples and suitable data analysis.

Synthesis of results

Objective 1:

Out of 21 studies that examined a mobile application-based intervention which aimed to increase mental health and well-being, 7 of these measured any form of acceptability and usability. This shows that less than 40% of studies included participant experience as an outcome measure, and when it was included it was often as a secondary outcome measure behind effectiveness of the intervention. The apps included in the studies had a range of targets including mindfulness, stress reduction and psychoeducation. All studies aimed to increase positive mental health, but all also aimed to reduced mental health symptoms, which were usually the main outcome measured. Most studies involved an intervention period of around 4 weeks, and while several included follow-up measures post-intervention, these were generally within a month or two, and the use of the applications beyond the intervention was generally low. Only one study (Kizakevich et al, 2018) included details on user involvement during the development process, and any contribution they made to ensuring the app was suited to the context.

Objective 2:

The most frequently used method of measuring participants acceptance or usability was to include a validated usability questionnaire, details of which were outlined in an earlier section. 2 studies utilised the System Usability Scale (SUS) which is a standardised measure to identify how easy a system is to use and how participants found using the technology, independent of the intervention itself. 2 studies used the MARS app engagement scale which similarly establishes system usability and 2 studies used the Client Satisfaction Questionnaire (CSQ) although this scale is not specifically for use with technology and was mainly used to establish satisfaction with the intervention, rather than the delivery method specifically. The final method used in the remaining study was general questions on participant experiences, but no further detail was included on what these questions focused on, or their exact wording. Other studies also included some extra questions in addition to the validated questionnaires, but there is also a lack of detail surrounding these additions, and interpretation was basic.

Objective 3:

Overall, these usability measures indicate that these mobile applications have generally high levels of usability, across the different measures. Where qualitative responses were used, participants reported favourably on their experience using mobile application for the delivery of mental health interventions. Both studies which used the SUS as a measure of usability showed an average score above the acceptable level, which demonstrates that they are highly usable if not excellent. McKay et al (2019) showed that well- being applications were rated as more usable than any other type of behaviour change application, suggesting that the methods used in these studies are attractive to participants and implies that future applications should be modelled on these examples to ensure high usability. Bakker and Rickard (2018) showed that engagement with an application can increase its effectiveness, which shows the important role of usability in providing the intended benefits, and the importance of usability for the design of technology-based interventions.

Discussion

Summary of evidence

This review aimed to investigate the current frequency and methods used for assessing the acceptability and usability of mobile applications which used positive psychology or cognitive behavioural techniques to increase mental health outcomes. Three databases were searched which gave an initial selection of 456 studies. The inclusion criteria were then applied which gave 21 studies that examined a mobile application which used positive psychology or CBT for mental health. Of these studies, 7 papers included a measure of acceptability or usability. These included 6 studies into the effectiveness of an application and one review of apps currently available for public download. The measure of acceptability and usability included the System Usability Scale (SUS) in 2 studies, the MARS (uMARS) engagement scale in 2 studies, the Client Satisfaction Questionnaire (CSQ) in 2 studies and general usability questions. These results from these measures concur that mobile applications are generally seen as acceptable and easy to use. However, these findings are specific to each application and cannot currently be generalised beyond this context.

The measures used are very much tied to the individual system or application as it is presented at the time, and only establish how easy the system it to use. They do not include much information about how participants can be encouraged to use the system in the future, or what motivates people to seek out this kind of technology, in order to increase uptake or prevent drop out. These measures depend on rating the usability of the application retrospectively and are contextually bound to that application so unless the same application is used in the future, the results are not widely generalisable. The findings were represented descriptively, with no recommendations made based on the results to increase usage or improve participant experience. Given that the TAM states that usability can predict usage of a new technology (Davis, 1986), it implies that increased usability can lead to increased usage and acceptance, which is associated with greater adoption (Rose et al, 2005). Usability testing has been more widely used in relation to health apps, and in this context, the results of usability studies are being used to inform future design of mobile applications, and to provide recommendations for future improvements to increase participant usability, use of the app or its effectiveness (e.g. Velez et al, 2014; Arsand et al, 2012; O'Malley et al, 2014). Using mobile technology for well-being is a relatively new area (all studies identified are recent) and it is important to ensure that this area follows the example from healthcare and uses the usability information to make continual improvements, to ensure that the benefits offered by the interventions are being accessed effectively.

Additionally, the methods used are overwhelmingly quantitative. This also contributes to the descriptive nature, as no further insight for future improvement is presented. Rose et al (2005) suggest that a qualitative approach to usability can help to focus attention on user tasks and goals to provide more detail. In the studies identified by this review, there is little or no investigation into the motivation behind using the application, or behind maintaining usage outlined. Particularly following the results of Bakker and Rickard (2018), who showed that engagement lead to greater changes in mental health outcomes, investigation into how to increase engagement may lead to greater benefits from future applications. No studies investigated factors which may influence engagement such as computer literacy (Venkatesh, 2000), which may be affected by the sample demographics. The use of qualitative measures in combination with the quantitative methods shown in this review could help to provide the detail needed to make recommendations for future development in order to increase usage.

Links to the TAM and CFIR

Although none of the studies included in this review directly linked their findings with theories of usability and technology acceptance, there are links to both the TAM and the CFIR. Firstly, usability is shown in the TAM by perceived ease of use, which predicts perceived usefulness and attitude towards using the technology (Davis, 1986). This suggests that high level of usability should lead to high level of usefulness and positive attitudes towards using the technology, which result in increased usage. As the studies included all showed that the mobile applications for well-being they examined were rated as usable by the participants, and suggested positive attitudes towards them, this would imply that they are more likely to show a higher level of usage. This suggests that mobile applications for well-being are seen as an acceptable delivery method that would be used by that target audience and would therefore encourage more people to use the application and receive the benefits.

The results of this review can also be linked to the CFIR. As participants in all studies presented in this review rated the apps as highly usable, this suggests that they contain high quality design and presentation which is a facet of the Intervention Characteristics factor in the CFIR. Another facet in this factor is complexity and the results of the included studies suggest that as participants found the apps generally easy to use and understand and were all able to effectively use the apps show that the apps are not overly complex. The CFIR proposes that interventions which are well-designed and presented without being overly complex will be implemented more smoothly and effectively and will generally be more accepted by the target audience. Additionally, the usability of the apps can also be connected to the self-efficacy facet of the Individual Characteristics factor of the CFIR. If individuals find an application easy to use and indicate that they feel confident in using it, as included in the System Usability Scale (see Appendix D), it implies that they feel high levels of self-efficacy in relation to using the app. The CFIR suggests that high levels of self-efficacy using a system can contribute to its effective implementation.

Limitations

Although this review used relatively broad search terms in order to catch as many relevant results as possible, there are many different terms used in the mental health area and so some relevant articles may have been missed.

Many of the search terms are also database keywords and so it may be possible that some articles were incorrectly coded and also missed, as well as unpublished studies, such as studies which showed no effects of the intervention or dissertations. There is large variation in sample sizes and the overall samples were predominantly white, female and young which affects the generalisability of the study results. Additionally, the level of detail in the reporting of the studies differed greatly. Some studies provided enough detail for replication and fully explained the acceptability and usability results, whereas others briefly mentioned this aspect of the study, with no elaboration. This made it more difficult to fully analyse the results, to look for commonalities or to establish any barriers or facilitators to engagement from these current studies and was therefore reflected in the quality assessment.

Implications

This review shows that although there is a movement towards analysing the acceptability and usability of mobile application for mental health interventions, it is still much less considered than outcome measures relating the effectiveness, as shown by the proportion of studies included in this review out of those who included relevant applications. The potential benefits offered by such interventions is dependent on the usability, as it has been shown that higher levels of usability contribute towards technology adoption (Rose et al, 2005; Davis, 1986) and engagement (Bakker and Rickard, 2018). This review suggests that currently, studies measuring acceptability and usability are limited, use mainly quantitative methods and are very restricted by context as they are only relevant to the exact application being examined. The studies included in this review reported their findings descriptively and did not use them to provide any suggestion as to motivation to use the technology, engagement or acceptance, as shown in usability tests with other types of application. Future research would benefit from using these findings to make recommendations to advise the design or improvement of applications. There should also be a focus on establishing further contextual details to indicate which interventions are suited to mobile applications and what features encourage people to use them. This review also highlights the lack of recommendations based on the acceptability of the technology. In all studies, the acceptability and usability of the technologies were presented as descriptions, with no implications presented. This further demonstrates the need to link this research with implementation models to make recommendations in order to increase usage and facilitate implementation for large-scale usage of the applications.

Conclusion

A systematic literature review was conducted with three aims; to summarise the scope and nature of research which examined the usability of well-being applications, to identify the methods used to measure usability or acceptability and to identify common features or conclusions established by these studies. 7 studies were identified by the search which used the System Usability Scale, Mobile Application Rating Scale, Client Satisfaction Questionnaire and additional general usability questions to measure usability and participant experience. Overall, all applications included in the review were rated as usable and participants indicated that they found them easy to use, clear to understand and that they found the overall experience satisfactory. Although these are positive results, no study discussed these findings in relation to improving the acceptance, or the effects on the usage of the application. It is recommended that future studies use the results of a usability test to make suggestions for improvement to impact on the future design of well-being applications.

The previous literature has shown that mobile applications are rated as easy to use participants, but little research has focused on how this contributes to the user experience as a whole or how it ca be used in order to increase acceptance and encourage usage. Following on from the conclusion of this review, the remainder of this thesis presents three empirical studies which aim to address the gap in the literature found by this review, by connecting usability with other aspects of the user experience – acceptance and implementation.

Chapter 4: Methodology

This thesis presents the results of three studies which aim to investigate the acceptability, usability and implementation of mobile technology as a delivery method for well-being interventions. The studies included are as follows:

Study 1. Acceptability: The first study is a quantitative study which used an online questionnaire to address the first aim of this thesis; to validate pathways from the Technology Acceptance Model (Davis, 1986) in a well-being context, and to investigate the acceptability of mobile applications for well-being. This study is outlined in Chapter 5 and is mainly quantitative in nature, but a qualitative section is included.

Study 2. Usability: The second study is a mixed-method study which addresses the second aim of this thesis which was to evaluate the usability of prototype well-being application - the development and testing of which is reported in Chapter 6. This involves a questionnaire which participants completed after using the prototype application, and qualitative questions about how the application could be improved.

Study 3. Implementation: The final study addresses the third aim of this thesis which was to investigate the barriers and facilitators of implementing a well-being application in a workplace context. A series of four focus groups were conducted with working adults from a range of organisations to gain feedback on the implementation in this context and how it could be facilitated. This study is outlined in Chapter 7.

This chapter presents the full details regarding the methodology for these studies, including an outline of the mixed-methods approach, the data sources for each study including a rationale for the involvement of users during technology development, the strategies for data analysis and a discussion on ethical considerations.

Mixed methods design

Explanation of mixed methods design

These studies utilise both qualitative and quantitative data sources and analysis and is therefore considered a mixed-methods study, which is defined as *"research in which the investigator collects and analyses data, integrates the findings and draws inferences using both qualitative and quantitative approaches or methods in a single study"* (Tashakkori and Creswell, 2007, p.4). The studies included in a mixed-methods research design should be investigating aspects of the same phenomenon or situation (Bryman, 2012; 2015; Maxwell, 2005) and must be integrated at some point in the research process in order to synthesise the findings and create a complete picture of the investigation (Johnson and Onwuegbuzie, 2004). The main advantage of using a mixed design is that it provides more information from different perspectives of the same topic, which creates a fuller picture (Greene et al, 2001). This can contribute to a better understanding of reality and complex situations (Mack et al, 2005).

One criticism of a mixed methods approach is that it tries to combine two opposing research paradigms. Creswell (2014) states that qualitative data analysis follows a constructivist paradigm which posits that there is no single reality; reality is instead constructed in the context through an interaction between parties, the researcher included and interactively linked with research participants (Manhas and Oberle, 2015). On the other hand, quantitative data involves observation and measurement of phenomena (Creswell, 2013) which are objectively true across contexts (Johnson and Onwuegbuzie, 2004; Moser and Kalton, 2017). In this type of research, the researcher themselves has no influence of the outcome if it is objectively true (Tashakkori and Creswell, 2007).

The attempted combination of the two opposing ideals is one of the main discussions in the area of mixed-methods research (Greene, 2008). Some argue that the two approaches are fundamentally incompatible due to the differences in paradigm (Cameron and Molina-Azorin, 2010). However, as mentioned, it can be countered that the differences in the approaches are the exact reason a mixed-methods study is advantageous – because it combines the two, often on an equal footing to give a more rounded research conclusion, with the disadvantages of each paradigm being countered by the advantages of the other.

A model was proposed by Johnson et al (2007) (shown below in Figure 10) which demonstrates the continuum between qualitative and quantitative research and shows where a mixed-methods approach fits into this. The mixed-methods approach has been termed as the third methodological movement (Tashakkori and Teddlie, 2003) which represents a pragmatic approach that assimilates the constructivist and interpretivist paradigms of qualitative and quantitative research respectively (Johnson, Onwuegbuzie, & Turner, 2007). The continuum below shows that mixed-methods can be weighted towards either qualitative or quantitative and choose one approach to be dominant or can be a pure mixed methods study where the two approaches are given equal weighting in the overall conclusions. Regardless of weighting, as soon as the two methods are combined, it is considered a mixed-methods study (Bryman, 2015; Leech & Onwuegbuzie, 2009). In this thesis, the two approaches are given equal weighting overall, although certain studies have a weighting to quantitative methods (Study 1 and Study 2) or are fully qualitative (Study 3). In the conclusions these approaches will be combined and considered equally to form an overall picture.

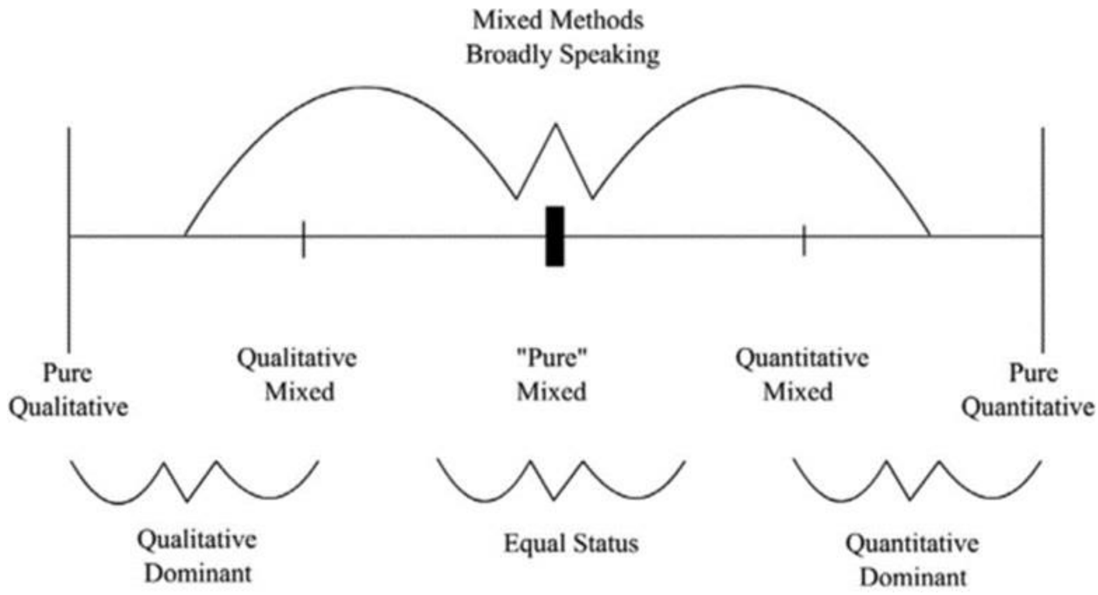

Figure 10: Qualitative-Quantitative Continuum (Johnson et al, 2007)

Quality criteria

One important aspect to consider when combining qualitative and quantitative methods is the quality criteria for both approaches and ensuring that both methods of data collection and analysis are generated to an equally high standard. As a mixed-methods study incorporates two very different approaches to data collection and analysis, it would be very difficult to have one clear set of quality criteria that was suitable for both elements. It has therefore been suggested that the traditional methods for quality control for each method is used for the respective parts of the study (Bryman, 2015; Winter, 2000). For quantitative studies, the traditional quality criteria are statistical measures such as reliability and validity, which are assessed through statistical analysis once the data has been collected (Neuman, 2016; Lacity and Janson, 1994). For qualitative studies, the traditional quality criteria are factors that need to be maintained and considered throughout data collection, such as trustworthiness and rigour (Houghton et al, 2013; Golafshani, 2003). Tracy (2010) outlines eight steps to ensure quality in a qualitative study which are that the research;

- *Worthy topic* – has a topic which is relevant and interesting with timely significance
- *Rich rigour* – has data with rich and detailed descriptions resulting from appropriate samples
- *Sincerity* – includes self-reflection and transparency
- *Credibility* – contains plausible, persuasive and trustworthy analysis
- *Resonance* – includes transferable and empathetic findings
- *Significant contribution* – makes a contribution to theory, in practice or morally
- *Ethical* – considers and deals with ethical issues
- *Meaningful coherence* – uses appropriate methods and analysis to achieve its aims

It has been suggested that although these criteria may initially seem opposing due to the differences in method, there are parallels between them that help to bring them together to be combined into a mixed-methods study. Lincoln and Guba (1985) suggest that there are similarities between the criteria, which are expressed in different language depending on the paradigm and methodology. They state that credibility in a qualitative sense is equivalent to internal validity in a quantitative method, that transferability is equivalent to external validity, dependability is equivalent to reliability and confirmability is equivalent to objectivity. Several overall quality criteria for a mixed-methods study have also been suggested by Bryman, Beeker and Sempik (2008), who state that the overall study and methods used must be relevant to the research question (Edmonson and McManus, 2007), the methods must be transparent (Bryman, 2012) and that the overall conclusions must contain the fully integrated results of both aspects of the mixed methodology (Creswell and Tashakkori, 2007; Teddlie and Tashakkori, 2010). It is suggested that these criteria be used alongside the traditional methods of quality control outlined above (Greene, 2008), in order to support the move from two distinct studies with a different paradigm and different methodology, to a true mixed-methods study of high quality.

Data Sources

Sampling Strategies

Two sampling strategies were used to identify participants suitable for the included studies. For Study 1, a snowball sampling strategy was used and for Study 2 and Study 3, a convenience sample was used. In a snowball sampling method, an initial cohort of participants is recruited to take part and they either recommend other participants to the researcher or pass on the appropriate survey to their contacts and acquaintances. As each participant passes on the research to others, the total sample grows larger and larger, which has been likened to a snowball growing as it rolls down a hill (Wasserman et al, 2005). A convenience sample has been defined as "*a type of non-probability or non-random sampling where members of the target population that meet certain practical criteria, such as easy accessibility, geographical proximity, availability at a given time, or the willingness to participate are included for the purpose of the study"* (Dornyei (2007) in Etikan et al (2015), page 2).

As both strategies are non-random, they have similar advantages and limitations. The main limitation of both methods is that the resulting sample is not truly representative of the target population. Etter and Perneger (2000) showed that the characteristics of a snowball sample were different from an equivalent representative sample of the same target population. This could be because in both snowball and convenience samples there are connections between the participants and they are likely to come from a similar geographical areas or backgrounds, and have similar characteristics (Emerson, 2015; Erickson, 1979). The consequence of limited representativeness is that the conclusions can only safely bye generalised within the parameters of the tested sample and not to the whole population (Robinson, 2014). Etikan et al (2015) also suggest that outliers could have a greater effect on the results of a less representative sample.

There are, however, significant enough advantages to these methods to give them value. Atkinson and Flint (2001) suggest that a large enough sample generated using these methods would mitigate some of the issues of representation and generalisation. Etter and Pernerger (2000) showed that snowball sampling led an increased response rate which could help ensure large enough sample sizes for robust analyses and more confident generalisation. In many cases, non-random sampling might be the most appropriate strategy due to resources and practical constraints. Hendricks, Blanken and Adriaans (1992) suggest that there are a range of practical advantages to these methods. They are affordable and easy, and participants are readily available (Etikan et al, 2015). Atkinson and Flint (2001) state that these methods are economical, efficient and effective, and that especially with snowball sampling, there is an increased sense of trust in the research as it has come from a trusted source rather than a stranger. This is particularly important in research on potentially sensitive topics such as mental health.

There are also some disadvantages to fully randomised sampling which strengthen the argument for other alternatives. A randomised sample involves selecting out participants from the total population which will give a true representation of the population characteristics. However, the participants selected may not be contactable or they may not want to participate which would affect the sample characteristics and its representativeness (Karney et al, 1995) and so a truly representative sample is highly difficult to achieve. Like Etter and Perneger's (2000) findings that a snowball sample is not representative, Braver and Bay (1992) found that self-selection caused the sample characteristics in a randomised sample to be less representative. Given the effort and resources required for a fully randomised sample, and the possibility that it would still not be representative, it can be concluded that while randomised sampling is theoretically the best option, it may be highly impractical.

This was the case for the studies presented in this thesis. Study 1 used a snowball sample in order to generate a larger sample size to make the analysis more robust, and Studies 2 and 3 used a convenience sample for practical purposes. Therefore, as Robinson (2014) states, care must be taken with the generalisation of the findings of these studies, and they must be interpreted within the parameters of the sample characteristics.

User Involvement

The samples used in the three studies are made up of potential users of a well-being intervention delivered through mobile technology. This type of sample was chosen in order to involve actual users of the target intervention at several stages during the design process to gain their opinions on the design of the technology, the usage of technology as a delivery method, the implementation of such an intervention and how people could be encouraged to use the finished product in order for the benefits of the intervention to reach a wide audience. The main aim of including users into the design process is to develop usable systems that are successful, accepted by the target audience and work effectively for them (Gould and Lewis, 1985; Karat, 1997) by gaining an understanding of their needs and expectations (Pagano et al, 2013). This can involve several different methods, varying in terms of the level and stage of involvement as well as who is involved.

One method is to consult end-users during the development of the technology (Noyes et al, 1996), which can be done in several different ways including focus groups, workshops and prototype testing. Kujala (2003) suggested that this is most effective form of user involvement and is influential to the success of the intervention when carried out in the early stage of development, at a stage when making changes is still relatively easy. However, user involvement is still highly important throughout the development process. Involvement in the final stages of development, testing and the implementation of the technology can lead to increased adherence to the new system (Killikelly et al, 2017). In addition, usability and acceptability tests should be carried out on the final product with a sample of end users, in order to assess functionality at all stages of the process and to check for any final changes that can be made before implementation in order to get the best possible results (Killikelly et al, 2017).

There are several proposed benefits to including users in the development. Damodaran (1996) outlined five main benefits which were improved quality of the finished product, a reduction in costly failures, increased acceptance by the end-users, increased understanding of the technology and how to use it and an increase in decision making within the organisation by the participants. An increase in decision making is suggested to give users more autonomy and a sense of being listened to and valued in their organisation. Further support for a proposed increased understanding of the technology comes from Dray and Karat (1994) who showed that participant involvement during development led to a reduction in the amount of training required to use the technology, and from Reed (1992) who found that less support calls were made when users had been involved in the development. Both findings suggest a reduction in associated costs and complexity of set-up and running. Baroudi et al (1986) found that user involvement also increased eventual system usage. Finally, Nielsen (1993) found that users may ask questions and think of suggestions that researchers would not have considered and offer a valuable perspective during development that cannot be gained from any other method.

These benefits have been further supported by several systematic reviews which demonstrate a relationship between user involvement and an overall “successful” system (Harris and Weistroffer, 2009; Hwang and Thorn, 1999). A more recent systematic review by Bano and Zowghi (2015) found that 52 out of 87 identified studies showed that participant involvement had led to a more successful system. They showed several benefits including increased system satisfaction, increased system acceptance and usage, greater perceived relevance to the end users, improved quality of the final product with less failures, and a greater sense of democracy in the workplace. They did identify some challenges associated with user involvement, which included conflict between groups, a lack of resources, a lack of management support and a lack of expertise amongst the users. They suggested that there are several factors which could contribute to some studies included in the review not demonstrating a positive link between user involvement and system success and stated that the identification of the right type of users, the research methodology chosen, the degree and level of user involvement and the different types of systems being developed could all contribute to the conflicting findings. It is still clear that user involvement can provide numerous benefits when designing a system, but this review suggests that care is required when planning this stage to ensure the maximum benefits are gained. Bano and Zowghi (2015) conclude that it is not enough to simply include users in the involvement, but that this process needs careful management with clearly defined objectives, target user population and level of involvement.

Overall, the aim of using potential end users of the technology as participants in the studies presented in the remainder of this thesis was to allow them to be involved in the early stages of development, to ensure that the technology being developed was suitable for the population and would be accepted for the purposes of delivering a well-being intervention, and to foresee any issues with implementing the technology in a workplace context. It is expected that this involvement would lead to a technology-based intervention that would be more widely used and accepted if it was to be implemented as a finished product, allowing the maximum number of people to access the potential benefits, as well as making the implementation and development more efficient and effective.

Quantitative

The quantitative data collected was gathered from two surveys; the Technology Acceptance Model validation questionnaire reported in Chapter 5 and the Usability study reported in Chapter 6. Both questionnaires were hosted on an online survey platform (onlinesurveys.ac.uk) which is a website approved by the University of Nottingham for data collection. An overview of the data collection methods used are presented below. Further details are included in subsequent chapters and the full measures are included in Appendices C and D.

Online survey

The first quantitative survey was the Technology Acceptance Model Validation survey, which is described in full detail in Chapter 5. This was an online survey which gathered 170 responses. Sheehan (2002) stated that there are three methods for distributing an online survey; sending the respondents the whole questionnaire in an email, sending respondents the link to an online survey platform in an email and placing a request for respondents on a website designed to recruit research participants. A combination of two of these strategies was used for this survey – distributing the link to an online survey via email and social media and placing an advertisement on participant recruitment websites. This strategy was chosen in order to maximise the number of potential respondents reached. Regardless of recruitment methods, all participants completed the questionnaire on the online survey platform. Most participants were recruited through contacts on social media where they were sent the link to the online questionnaire and asked to take part if they were willing. This was seen to be the most effective recruitment method used, as many of the participants replied to these messages confirming that they had taken part.

There are several documented advantages to using the internet to host and distribute research surveys. Firstly, online surveys are more cost-effective and can collect data at a greater speed than face-to-face or telephone interviewing (Duffy et al, 2005; Heiervang and Goodman, 2011). As they are much faster, it allows a greater number of potential participants to be reached in the same time, which can often lead to an increased overall response. They can be more convenient for participants as online measures can be completed at a time and location which suits the respondents, making them more likely to complete it (Duffy et al, 2005). Using an internet-based survey platform also allows questionnaires and surveys to be more flexible and interactive which may appeal to participants or be more suitable for the research aims (Taylor, 2000). For example, they allow more diverse question types and response formats which can easily be modified (Evans and Mathur, 2005). Finally, the internet can make data collection more responsive as it allows the researcher to make changes to the data being collected if more information is required, to change the target population in order to create a more representative sample or to change recruitment strategy in order to generate more responses. The researcher will have all the data available immediately after completion and can conduct investigative analysis throughout data collection (Wilson and Laskey, 2003). This means that any issues that arise with the measures can be resolved quickly without causing major interruption to data collection.

There are also some disadvantages to this method which need to be taken into consideration. Firstly, it has been suggested that internet-based distribution gives a reduced response rate by percentage than face-to-face or paper-based data collection. Handwerk, Carson and Blackwell (2000) show a difference in response rate of over 7% between pencil-and-paper and online measures, in favour of pencil-and-paper. However, using the internet to distribute the questionnaire allows more potential respondents to be contacted, and so even with a reduced percentage of responses, the overall number of respondents could be higher. In addition, for the participant recruitment in this thesis, several strategies were employed in order to increase response rate. Participants were contacted using personalised invitations sent to contacts which has been shown to increase responses (Sanchez-Fernandez et al, 2012). The questionnaire was also designed to be clear, concise and easy to access and understand (Evans and Mathur, 2005; Shannon et al, 2002).

It has also been stated that the internet leads to a lack of sample control by the researcher (van Selm and Jankowski, 2006) and less choice by the researcher about who takes part; although inclusion criteria can be specified, there is no way of checking that these are being adhered to. As there are no restricting inclusion criteria in this online study, this was not a concern in this context. Finally, Asan and Ayhan (2013) stated that although internet access and use is becoming increasingly common and widespread, potential respondents who don't have internet would be excluded from participating and therefore this method does not give everyone equal chance to take part. As this survey was about technology acceptance and required some very basic technological literacy, those who didn't have regular access to internet may struggle to take part and answer some of the questions. It can be argued that the opinions on acceptance from those who don't currently use technology would be equally important and could provide useful insight into how people can be encouraged to start using new technology, such as mobile applications for well-being. This is one of the limitations to using a self-selecting sample where participants elect to take part once they have seen the advert. People who are not interested in using technology for well-being may not be interested in completing the questionnaire.

Usability study

The second phase of quantitative data collection was the Usability study, presented in Chapter 6. This involved questionnaire responses also gathered using the online survey platform, which resulted in 25 responses. For this study, participants were approached at a summer science education event held at the University of Nottingham and invited to participate by the researcher. If they agreed, they were given a hands-on demonstration of a prototype version of an application which contained an example well-being intervention, and then handed a tablet device with the questionnaire loaded on a webpage for them to complete. Due to the restrictions for adding new applications to the respective online stores, to complete the study without face-to-face contact and using a fully online methodology, participants would have had to download a separate file to their device in order to run the application to conduct the usability test on their own devices. Due to concerns regarding privacy and data security, it was decided that this might deter participants from taking part and it would be better to show them the application already loaded onto a device. Therefore, a face-to-face recruitment method was used in this study, to allow the researcher to show participants the prototype application and to be able to respond to any technical difficulties that may interrupt the testing, although none occurred. Although this study was conducted with face-to-face recruitment, the questionnaire was still delivered online in order to maintain continuity. As stated, using online data collection makes the data instantly available and allows the researcher to transfer the data to other programmes for analysis quickly and easily if needed. For this reason, the measures were still given to that participants in an online format. The application, more details about the usability test and the results are presented in Chapter 6.

Qualitative

Focus Groups

There are two sources of qualitative data used in the included studies. The first is a series of four focus groups which were conducted with a range of employees from different organisations to gain their opinions on the use of mobile technology for the delivery of well-being interventions, and suggestions they had about increasing engagement with such initiatives. Focus groups were used in this study as they are one main way in which to involve users in the research process (e.g. Iliffe et al, 2010; Clarke et al, 2011; Simonsen and Robertson, 2013). A focus group has been defined as an "*organised discussion*" (Kitzinger, 1994) whereby the researcher or convenor will guide the group with some questions or discussion points, but the interaction within the group is the most important aspect (Morgan, 1997). For this reason, focus groups are often more effective at generating new ideas and insights than interviewing, as participants can work together and bounce off each other in the discussion. Focus groups are also a way to gain more opinions using less resources, as they take less time than individual interviews, but still lead to a high-quality outcome. Focus groups are also good for gaining a degree of consensus around a topic (Morgan and Kreuger, 1993) and allowing the researcher to find out which issues or points are the most salient to that group (Morgan, 1988).

There are some potential disadvantages to a focus group design, which need to be considered when selecting it as a method and planning the discussion itself. Firstly, in many cases (including this project) the participants will be self-selecting and therefore may not be representative of the intended sample (Morgan, 1998; Reed and Roskell-Payton, 1997). Although there is no way around this, as participants cannot be forced to attend, it is important to bear in mind when forming conclusions. In some cases, participants may have felt compelled to attend by their managers or by others in the group and so it must be made clear that participation is voluntary and that no one has to offer an opinion if they prefer not to. Although in many cases, focus groups will bring together participants with things in common, it is also possible to get a group that is too varied and conflict can arise as a result of differing opinions (Bloor et al, 2001). It may be useful to have some indication of the background of participants beforehand to assess whether they may be a clash of opinion. In this case, it may again be more beneficial to use individual interviews. Researchers should also be prepared for conflict and be prepared to intervene is necessary. Participants can be offered an individual interview after the focus group if there are further comments they wish to make.

It has been argued that in focus groups, due to the range of opinions and the restraints of a group setting, only surface information is gathered (Powell and Single, 1996). However, in an exploratory study such as this, a shallower but wider range of information can be more useful at this stage, to gain a consensus of opinion that can be further explored later using individual interviews if necessary. Finally, there are some considerations to be made regarding the impact of the researcher on proceedings. Focus groups are typified by the group discussion and should remain a discussion rather than a targeted interview. The researcher must allow space of interaction, or the main benefit of a group situation is lost. Questions should also not be targeted at specific participants and everyone should be given equal chance to engage (Frey and Fontana, 1991). After the data has been gathered the researcher also has an impact on the data analysis, even if they intend not to. The background and personal opinions of the researcher will influence the analysis, even if they are using an inductive method uninformed by previous research. Although this cannot be avoided, it is important to recognise this as a limitation and where possible, it may be advantageous for more than one researcher to be involved in analysis to moderate this influence.

Balancing these benefits with the considerations noted, it was determined that with careful design, focus groups would be the most effective method of gaining user input in the design of the application. It was expected that the group discussion would bring up any issues with the proposed application, its implementation and its acceptance by users. The findings generated from these groups can be used to inform future application development and the planning of the implementation of interventions using technology as a delivery method. This could help to make the process more efficient and effective, by taking the issues raised in the focus groups on board in order to make the technology more acceptable, more useful and better fitted to the context, which will increase usage and the overall uptake, and allow the potential benefits of the intervention to reach the whole target audience.

Open Questions

In addition to the qualitative data gathered from the focus groups, further qualitative data was gained using open questions at the end of the Technology Acceptance Model Validation questionnaire (Chapter 5) and the Usability questionnaire (Chapter 6). One open response question was included in the Technology Acceptance questionnaire which asked participants if they had anything else they wanted to add in respect to the use of technology for well-being interventions. This question was included as the topic of the questionnaire involved mental health; it was decided that it would be suitable to offer participants space to include any extra details not included in the questionnaire in order to conduct fully ethical research. Five questions were included in the Usability questionnaire which asked about how the prototype application could be improved, and any changes participants would like to make to the application in order to encourage people to use it. These questions were included to gather a wide scope of opinions and to allow participants to share any relevant suggestions. The literature review presented in Chapter 3 shows that this method of including several qualitative questions has been previously used in usability research (e.g. Krafft et al, 2019). It was decided to combine the open questions with the validated scales in order to gather high quality data, but also to capture any opinions missed by the questionnaire.

<u>Data Analysis</u>

Several strategies of data analysis were used, which are outlined in this section. Onwuegbuzie and Leech (2006) suggested seven steps that researchers can use during analysis of a mixed-methods design. These are: (1) data reduction to reduce the dimensionality of the data using methods such as Principle Component Analysis, (2) displaying the data visually, (3) data transformation of qualitative into quantitative or vice versa, (4) data correlation, (5) consolidation of the two types of data to from a new data set comprised of the two sources, (6) data comparison to compare and contrast the qualitative and quantitative aspects and (7) data integration where the two data streams are combined in a discussion or conclusion. According to Greene et al (2001) these steps can either occur in a parallel or concurrent fashion. Due to the research questions and methods used in this thesis, most of these steps were not applicable, such as data reduction, data transformation or data correlation. In this analysis, the qualitative and quantitative data sources were used to answer independent research questions but were then integrated in the conclusions to give an overall picture of the acceptability of mobile technology, following parallel data analysis of the two data types, the strategies for which are outlined below.

Quantitative

The results of the Technology Acceptance Model Validation questionnaire were analysed initially using regression analysis and then using mediation analysis in order to confirm the expected relationships as shown in the Technology Acceptance Model, using the PROCESS macro in SPSS. This analysis and the resulting conclusions are outlined in Chapter 5. The results of the Usability questionnaire were examined and are presented in Chapter 6. As the questionnaire is descriptive and assesses the level of Usability regarding a specific prototype, no statistical analysis methods were used.

Qualitative

Thematic Analysis

The results of the qualitative data, both the focus groups and the results of the open question at the end of the Technology Acceptance questionnaire, were examined using thematic analysis. This is one of the most commonly used methods of qualitative analysis (Guest, 2012) and is suitable for use with focus group transcripts, interview transcripts and written work such as letters or statements. Braun and Clarke (2006) outlined thematic analysis as a process of identifying patterns or themes within a data set. In this sense, a theme is defined as "*data grouped around a main issue*" (Brink and Wood, 1997) and can be useful for interpreting the underlying factors in a data set and showing commonalities between different perspectives or experiences. Braun and Clarke (2006) argue that thematic analysis is an essential qualitative method, as it provides core skills that can be applied to other methods in the future and underpins other qualitative analyses.. Due to this, it has been argued that thematic analysis is not a method in its own right but is incorporated in other distinct methods (e.g. Ryan and Bernard, 2000), although others maintain that it is a separate method with its own framework and advantages (Braun and Clarke, 2006; King, 2004; Nowell et al, 2017).

Benefits

There are several benefits to using a thematic analysis approach to qualitative data analysis, over other methods such as grounded theory, ethnography or phenomenology. Firstly, thematic analysis is an accessible method, and can be easier to follow than other methods as there are less prescriptions to consider (King, 2004). This method is also flexible and can be applied to different data sets, different participants and can take into account multiple theories (Braun and Clarke, 2006). Despite its ease of access and flexibility, thematic analysis still provides a rich and detailed picture of the data, can highlight differences and similarities across data sets and reveal unexpected insights (Braun and Clarke, 2006; King, 2004) and can capture intricacies in the data (Guest, 2012). Finally, thematic analysis allows themes to emerge from the data, and can be a heavily data driven process, using evidence from the qualitative data gathered in order to derive the themes with minimum influence from previous theories or knowledge (Saldana, 2009).

Potential Disadvantages

There are also some potential disadvantages to the thematic analysis method, which should be taken into consideration. Guest (2012) stated that in some cases, there may be reduced reliability as different researchers may see different themes in the data, which leads to inconsistencies and a lack of replicability. However, it is still a very data-driven analysis method (Saldana, 2009) which should reduce these issues, as the themes arise from the data and there should be clear evidence to support each theme. If there were any queried points, the clear process used, following the steps outlined in this section, would help to justify the themes selected. Another proposed disadvantage by Braun and Clarke (2006) suggests that the thematic method does not include any analysis of language usage and the nuances of language, intonation, hesitations etc. Conversation analysis (Sacks, Schegloff, and Jefferson, 1974; Schegloff, Jefferson, and Sacks, 1977) is one qualitative data analysis method which would take these details into account, but it is highly time and resource consuming. It was decided that in this context, the nuances of language were not as crucial to the subject matter and that there were no benefits from this type of analysis in comparison with the costs. Therefore, it was decided thematic analysis was the most suitable method to use to analyse the focus group data.

Method

Nowell et al (2017) stated that although thematic analysis has been outlined in the literature (e.g. King, 2004), and the benefits described, there was no agreement on the exact process and steps required for a rigorous and trustworthy thematic analysis, especially in comparison to other qualitative analysis methods. The process of this thematic analysis followed the six phases presented by Braun and Clarke (2006), which are:

Phase 1 – Familiarising yourself with the data

Phase 2 – Generating initial codes

Phase 3 – Searching for themes

Phase 4 – Reviewing themes

Phase 5 – Defining and naming themes

Phase 6 – Producing the report

These six phases aim to provide a clear framework for thematic analysis that is easy to follow and meets Lincoln and Guba's (1985) criteria for trustworthiness, which are credibility, transferability, dependability, confirmability and audit trails. It is highlighted however, that although these steps are provided to increase clarity, thematic analysis is an iterative process whereby the researcher may need to move back and forward between the different phases and that data collection, analysis and report writing may occur concurrently and may depend on each other in a non-linear fashion (Creswell et al, 2007).

Once the data recordings had been transcribed, they were listened to again to note any initial emerging ideas and relevant points, which is considered an important stage in analysis (Riessman, 1993). Then greater familiarity with the data was achieved through repeated reading before the codes were generated. The codes were generated in a two-stage process; an inductive and data-driven manner, with minimum influence of previous theories or research prior to interpretation (Boyatzis, 1998) followed by a more deductive process using the previous literature on implementation to corroborate the findings. This approach was taken in order to gain the maximum detail from the comments and to ensure that no essential themes were missed. This is similar to the combination approach taken by Fereday and Muir-Cochrane (2006) who suggest that using dual approaches represents rigor in analysis. Each comment or response was firstly condensed into its key message and then these key words or phrases were grouped where possible into clusters. In several cases some of these clusters appeared to be related and were then grouped together under an overarching theme.

Ethical Considerations

The studies presented in this thesis received ethical approval from the University of Nottingham under the Division of Psychiatry and Applied Psychology Research Ethics Committee, after relevant ethical issues were presented and addressed. The letters confirming this approval are included in Appendix B. In order to gain this approval, the studies must also adhere to several British Psychological Society Ethical Guidelines which cover human research (BPS Code of Ethics and Conduct, BPS, 2009; Code of Human Research Ethics, BPS, 2010). Particularly in respect to the online delivery method of the questionnaire and the topic of the research, there are several ethical aspects which require further consideration, and are outlined in this section.

Data Protection

The data gathered through online recruitment has been generated and stored following the BPS Ethics Guidelines for Internet-Mediated Research (BPS, 2013). All data generated as a result of the studies (both internet and face-to-face data collection) is only available to the researchers and will be stored securely in accordance with the Data Protection Act (1998). The University of Nottingham's data policy is to store the data securely for seven years, after which it shall be destroyed. Throughout this time, no identifying details have been stored alongside the data, in order to preserve confidentiality and anonymity. The two online questionnaires (Technology Acceptance Model Validation and Usability) were hosted on a secure online platform (onlinesurveys.ac.uk) which also stores a copy of the research data. This site is approved by the University and regularly used by researchers for internet-mediated research.

Privacy/Confidentiality

Participants were assured in every study that their responses would be anonymous and confidential at all times. Only demographic data relevant to the research was collected and no identifying information was held. For the online questionnaires, participation was completely anonymous, as individuals could complete the questionnaire without informing anyone that they had done so. Participants in the focus groups were employees recruited from organisations and would know others who were in that group and who had chosen to participate. They would also hear responses and opinions from others in the group. Although the focus groups were audio recorded, no identifying details were recorded and anything the participants stated that may indicate where that they were from or who they were was removed from transcription and not included in the data for analysis. The demographic details collected for these participants were purposely more ambiguous in order to increase anonymity, as many of these individuals are or know employees of the University of Nottingham and might be able to be identified by specific demographic details. Anonymity was especially important to maintain in this study as some participants chose to disclose their own experiences with mental illness and treatment, and so extra efforts were taken in order to ensure their confidentiality. Participants in these groups were recruited on an entirely voluntary basis and were given the opportunity to contact the researcher if there was anything they wanted to add with complete confidentiality outside of the focus group setting.

Self-determination

Informed consent was obtained for every participant in these studies, either through a paper consent form for the focus groups, or by clicking to agree to continue as part of the online studies. Participation in any of the studies was entirely voluntary and those who chose to take part were reminded that they could withdraw at any time throughout the course of the study, or have their data removed subsequently by contacting the researcher. In addition, none of the questions were compulsory, so participants could decline to respond to one question without having to withdraw from the whole study if they chose. At every stage, participants were also provided with contact details for the researcher in case of any problems or if they wanted to add anything further. A small incentive was provided by offering the chance to enter a draw for a gift card upon completion of the Technology Acceptance Validation questionnaire, which was granted ethical approval.

Issues with sensitive topics

Although the primary focus of this research is to establish the acceptability and usability of mobile technology for the delivery of an intervention, this intervention is mental health based and so the ethics of asking for this information must be considered. As the intervention involves building well-being, participation is open to any individual, regardless of their mental health situation. Participants were not asked to disclose any details about their own mental health, although some participants in the focus groups felt comfortable enough to share this information in an anonymous way. All of the small number of participants who did disclose information that indicated they had mental health issues also stated that they had previously or were currently seeking help for the issue, and no serious concerns were raised that would warrant intervention by the researcher. The questionnaires used in the studies were all pre-existing measures that were approved by the Division of Psychiatry and Applied Psychology Ethics Committee and contained no questions that were considered triggering or upsetting to participants. Additionally, if a participant was uncomfortable with a question, they could either leave it out, or withdraw from the study at any time. Finally, in all studies participants were given the opportunity to speak to the researcher if they had any concerns regarding their mental health or well-being, or concerns about the research, and signposting was available if needed.

The Remainder of the Thesis

This chapter has presented the methodology used in the three empirical studies presented in the remained of this thesis. As stated, these studies use a mixed-methods approach to investigate the acceptability, usability and implementation of mobile applications to increase well-being. The data sources, analysis methods and ethical considerations have been described. Chapter 2 previously presented the Technology Acceptance Model (Davis, 1986) and the CFIR (Damschroder et al, 2009), which provide a framework for the thesis and a structure for interpretation of the study results. Chapter 3 included the results of a literature review which aimed to investigate the current research concerning the usability of well-being applications. Seven studies were identified which used a range of quantitative methods to assess usability and found that well-being applications are rated as usable and participant friendly, but no recommendations were made in order to use these results to inform future application development. In the remainder of this thesis, Chapter 5 presents the results of a questionnaire study to validate relationships from the Technology Acceptance Model (Davis, 1986) in a well-being context, and to confirm the predictive influence of perceived ease of use on attitude and intention to use well-being applications. Chapter 6 outlines the development of a prototype well-being intervention which uses a daily diary method. A usability test was conducted on this prototype with 25 participants and it was found to be easy to use, but recommendations were made to improve the appearance and make it more engaging to attract users. Chapter 7 investigates the implementation of a mobile application for well-being in a workplace context, using focus groups to establish the barriers and facilitators to implementation. The three studies were conducted independently and in parallel, which allows triangulation of the conclusions. Finally, in Chapter 8 these results are discussed in conjunction and used to form recommendations for the future design and implementation of well-being applications. The strengths and limitations of the studies are also discussed. It is concluded that mobile applications are accepted as a delivery method for well-being interventions, that they are highly user friendly, but that design needs to ensure they are engaging and attractive.

Chapter 5: Study 1: Regression Analysis of TAM pathways in a Well-being Context; The relationships between Perceived Ease of Use, Perceived Usefulness, Attitude and Intention

Abstract

Chapter 2 outlined the Technology Acceptance Model (TAM) (Davis, 1986) which proposes an explanatory model for the usage of a new technology and states the perceived ease of use and perceived usefulness predict attitudes towards using the technology and eventual usage. This model has been validated in a range of contexts, but no evidence has been found to show its application to a well-being context. This chapter outlines a questionnaire-based study which aims to validate the TAM in a well-being context. It was hypothesised that the relationships shown in the original model would be supported. 170 adults recruited using an online recruitment strategy completed a questionnaire focused on well-being applications which included measures of perceived ease of use, perceived usefulness, attitude towards well-being applications and intention to use. It was found that all relationships shown in the original TAM were supported. It was also shown that perceived usefulness and attitude both mediated the effects of perceived ease of use on intention to use. The results of this study suggest that high levels of usability (ease of use) and perceived usefulness can lead to more positive attitudes and increased intention to use well-being applications.

Aims

This chapter outlines Study 1 which uses a mainly quantitative approach to investigate the first aspect of user experience, Acceptability, and addresses the first aim of this thesis which is:

- To validate pathways from the Technology Acceptance Model (Davis, 1986) in a well- being context, and to investigate the acceptability of mobile applications for well-being.

A quantitative approach is used to validate the model pathways and to demonstrate the acceptability of mobile applications for well-being. A quantitative section is also included to provide further detail on the acceptability and user experience of these applications.

<u>Method</u>

<u>Participants</u>

In total, 170 participants completed the survey. Of these, 110 were male (64.7%), 58 were female (34.1%), one person indicated that they would prefer not to say, and one did not respond to this question. The age of participants varied from 18 years old to 73 years old, with an average age of 44 years old. The majority of participants by percentage were between 38 and 62 years old. A wide variety of occupations were represented in the sample, including lecturers, psychologists, accountants, HR professionals, sales assistants and students. 52.1% of participants had never used a mobile application aimed at mental health before, 21.9% had used them very occasionally, 18.3% used them sometimes, 5.3% frequently and 2.4% stated that they used them very regularly. Of those who had used an application for mental health before, the most commonly used was Headspace, which is an application for guided meditations. A table of participant demographics is included in Appendix C.

<u>Measures</u>

The questionnaire used in this study was developed by Hu et al (1999), and includes measures of perceived usefulness, perceived ease of use, attitude and intention to use. Hu et al (1999) stated that one advantage of the TAM was that it had a well-validated measurement inventory (Davis, 1989; Mathieson, 1991; Segars and Grover, 1993). They used this previous literature to establish preliminary measures to use in their study to validate the TAM for telemedicine (Davis, 1989; Mathieson, 1991; Davis, Bagozzi and Warshaw, 1989). As they were applying this model in a new context, they re-examined the face validity and content validity of these measures by showing the questions to three subject specialists. Once these validities had been established, the items were put into a random order, and half of them were negatively worded. This final questionnaire was again checked with the subject experts. The instrument was then pre-tested to establish its reliability and construct validity (Straub, 1989). 35 physicians from different hospitals completed this pre-test, and acceptable results were found with high levels of co-variance between variables and acceptable Cronbach's alpha results of 0.7 or above for all sections - perceived usefulness, perceived ease of use, attitude and intention to use.

Once the validity had been shown in the pre-test, this measure was used in the full study where the questionnaire was completed by 408 physicians. Approximately one fifth of respondents were female, the average age of respondents was 34.7 years old and the respondents had 9.4 years of post-clinical experience on average. Once again, reliability was analysed using Cronbach's alpha, which was found to be above 0.7 for all variables. Although this was lower than previous studies using the same items, the result was still above the acceptable level as stated by Nunnally (1978). Factor analysis was also conducted on these results, and four factors were identified, which matched the four factors expected in the measure.

In this study, demographic questions were included before the items in the questionnaire, which were age, gender and occupation. Participants were also asked whether they had used mental health and well-being applications before and asked to indicate which they had used or heard of, although this was not a compulsory question if they preferred not to answer. At the end of the questionnaire, an open question was included which asked the respondents if there was anything further they wanted to add about their experiences with using well-being applications, and a free-response text box was included. It was felt that as the topic, mental health and well-being, was potentially sensitive and often elicits strong opinions that it would be suitable for people to have a space to elaborate if they desired.

Procedure

Study participants were recruited mainly using a snowball sampling method where participants were invited to take part and to pass the study details onto other connections who may also be interested in participating. The effects of using this method were outlined in Chapter 3, but it was selected for use in this study as it allowed a greater number of potential participants to be accessed with limited resources. The questionnaire was put onto an online survey platform (onlinesurveys.ac.uk) and participants were recruited online using several different methods in order to access the greatest response rate. Firstly, the link to the online survey was put on several participant recruitment boards which offered credits or points in exchange for a completion of the questionnaire. These sites can also work on a reciprocal exchange where researchers can host their surveys by completing other surveys on the site. The questionnaire was also advertised on social media and sent to contacts on social media sites. Many of these contacts completed the questionnaire and shared with other people who would be interested in mental health and well-being research. If the participants were interested in taking part in the study, they followed the link to the questionnaire hosted on the online platform, which participants could then complete.

Ethical Considerations

Information for participants was included on the first screen of the online questionnaire, which outlined why the data was being collected and their participant rights such as withdrawal, confidentiality and anonymity. The information is shown in Appendix C. Participants were invited to continue with the survey if they gave consent, or to exit the questionnaire at any time if they no longer wanted to participate. Participants were informed that it would not be possible to withdraw once they had fully completed the questionnaire, as their data would be fully anonymised. This anonymisation was carried out by the online platform, so the researcher had no access to any information about the participants other than what was provided in the questionnaire. Once data collection was complete, a spreadsheet of anonymised data was downloaded from the online platform and was stored in accordance with data protection procedures outlined in Chapter 3. Although the questionnaire focused on usage of wellbeing application rather than personal experiences of mental health, it was still possible that individuals could have mentioned such experiences in the open question. In line with the duty of care of the researcher, these comments were checked but no mention of mental ill health or distress was present.

Results

Descriptive Statistics

Firstly, the data was imported into SPSS and formatted for analysis by reverse-coding the negatively worded questions were reverse-coded. After this, the total scores for each of the measured variables (perceived usefulness, perceived ease of use, attitude and intention to use) were compounded from the original questions. This gave each participant four scores to be included in the analysis. The descriptive statistics for these variables are presented below in Table 3.

Table 3: Descriptive Statistics by Variable

Variable	N	Min. Total	Max. Total	Avg. Total	Std. Dev.	Item Avg.
Usefulness	169	10.00	30.00	22.34	4.44	3.72
Ease of Use	168	12.00	30.00	22.92	3.13	3.82
Attitude	169	3.00	15.00	11.47	2.23	3.82
Intention	170	10.00	25.00	18.63	2.84	3.12

Assumptions

The data was then checked to ensure that it meets the assumptions for parametric tests and for regression, as stated by Berry (1993) and reported in Field (2009), who makes suggestions on the correct tests to use to examine each assumption, which have been followed here.

Normal Distribution

The first assumption which needed to be met was the normal distribution of the data. This has been checked using several different methods and the results were combined in order to give a more confident analysis. Firstly, histograms and Q-Q plots were produced in SPSS for the four variables (usefulness, ease of use, attitude and intention), in order to provide a visual check for normality. In all cases, these diagrams showed that there was an overall normal distribution for the three variables. These plots are included in Appendix C. Following this, the diagnostic statistics of skewness and kurtosis, as well as the Z-scores for each, were produced and examined, included in Table 4 below.

Field (2009) states that Z-scores above 1.96 are significant at the $p>0.05$ level and represent a non-normal distribution. Usefulness, Attitude and Intention all show significantly non-normal distributions according to these scores. Also included in the above table are the results of the Kologorov-Smirnov and Shapiro-Wilks tests for normality. Again, these tests are significant in all results, which would suggest a deviation from a normal distribution. However, Field (2009) also states that with larger sample sizes, significant values arise from very small deviations from normality and so it is best practice to examine these values alongside other measures, and in conjunction with visual plots, such as the histograms and Q-Q plots already examined and described above (shown in Appendix C).

Table 4: Normality test scores by variable

Variable	Skewness	Skewness S.E.	Skewness Z-score	Kurtosis	Kurtosis S.E.	Kurtosis Z-score	K-S Stat.	K-S Sig.	S-W Stat.	S-W Sig.
Usefulness	-0.527	0.188	-2.803	-0.064	0.374	-0.171	0.135	0.000***	0.967	0.001**
Ease of Use	-0.065	0.188	-0.346	0.089	0.374	0.238	0.096	0.001**	0.981	0.020*
Attitude	-0.730	0.188	-3.883	0.944	0.374	-1.952	0.150	0.000***	0.945	0.000***
Intention	-0.465	0.188	-2.473	0.370	0.375	-1.240	0.098	0.000***	0.973	0.002**

*$P < 0.05$

**$p < 0.01$

***$p < 0.001$

Influential Cases

In order to assess whether there were any outliers or influential cases that may be affecting the normal distribution of the data, and would affect the subsequent data analysis, several tests were performed. Firstly, box plots were created for the three variables, which identified several potential outliers through visual examination, which were cases 18, 42, 136 and 147. These box plots are also included in Appendix C. In order to establish whether any of these cases were true outliers and needed to be removed or transformed, further tests were carried out. Two measures of influence were calculated; Cook’s distance and Mahalanobis’ distances, the results of which are presented in Table 5 below.

Table 5: Results of distance tests for influential cases

	Minimum	Maximum	Mean
Cook’s Distance	0.000	0.014	0.006
Mahal. Distance	0.102	13.473	2.988

Cook and Weisberg (1982) suggested that values of Cook’s distance greater than 1 would represent an influential case. For Mahalanobis’ distances, it is suggested that values over 15 would represent a potentially disruptive case. Out of the potential influential cases listed above, only one case was above these recommendations which was case 18 with a Mahalanobis distance of 24.57, but an acceptable Cook’s distance of 0.004. The results of these tests suggest that no cases are disproportionately influential and would skew or affect the analysis and so no cases needed to be removed as outliers. As some cases are more extreme than others, they have adjusted the distribution very slightly, but based on the visual plots, the normality assumption can also be considered as met.

Normally Distributed and Independent Residuals

Over and above the importance of the predictor variables being normally distributed, is the importance of ensuring that the residuals are also normally distributed. A P-P plot was created in SPSS, charting the Observed Values against the Expected Values of the Standardised Residuals. This plot shows a diagonal line with the data clustered along this line which shows a normal distribution of residuals. These diagrams are also included in Appendix C. A Durbin-Watson test is used to assess the independence of residuals and is carried out as part of the regression analysis itself. These values will be presented in the tables containing the regression co-efficients for each stage of the analysis.

Linearity/Homogeneity of variance/Homoscedasticity

In order to assess the assumptions of linearity, homogeneity of error variance and homoscedasticity, scatterplots were created charting the Standardised Predicted Values against the Standardised Residuals, which are included in Appendix C. As the residuals are randomly scattered around zero in a linear fashion, this suggests that the linearity assumption is met. The shape of the cluster of data points also suggests that both the homogeneity of variance and the homoscedasticity assumptions have also been met, in line with guidance from Field (2009).

Multicollinearity

Two methods were used to assess the potential for multicollinearity. Firstly, a correlation matrix was the variables was created, as shown in Table 6.

Table 6: Correlation Matrix

		Usefulness	Ease of Use	Attitude	Intention	Age
Usefulness	Corr.	1	0.671	0.879	0.559	0.068
	Sig.	-	0.000***	0.000***	0.000***	0.387
Ease of Use	Corr.	0.671	1	0.682	0.802	-0.038
	Sig.	0.000***	-	0.000***	0.000***	0.634
Attitude	Corr.	0.879	0.682	1	0.497	0.037
	Sig.	0.000***	0.000***	-	0.000***	0.635
Intention	Corr.	0.559	0.315	0.497	1	0.100
	Sig.	0.000***	0.000***	0.000***	-	0.202
Age	Corr.	0.68	-0.038	0.037	0.100	1
	Sig.	0.387	0.634	0.635	0.202	-

*$p < 0.05$
**$p < 0.01$
***$p < 0.001$

Age was also included in this matrix in order to assess any effects that might be present. It is often assumed that younger people have more exposure to technology and may be more familiar and comfortable with using it, which would suggest an effect on Perceived Ease of Use and Intention to Use. There are no significant effects which indicate that age is not statistically related to Perceived Usefulness, Perceived Ease of Use, Attitude or Intention to Use. This implies that age is not a factor which would affect the acceptance of mobile technology for mental health and wellbeing.

The matrix shows that the variables are quite highly correlated with each other and so collinearity tests were included in the subsequent regression analyses. In all cases, the Variance Inflation Factor (VIF) was 1.00 and the

Tolerance (1/VIF) level was also 1.00. Myers (1990) suggests that a value of less than 10 is acceptable for a VIF measure and Menard (1995) states that a Tolerance of less than 0.2 should be a cause for concern and indicates multicollinearity and the results in the following tables show that these parameters have been met. Based on these tests, although the measures are highly correlated, no strong multicollinearity is indicated.

Sample Size

Field (2009) states that there are several rules of thumb for the minimum sample sizes required in regression analysis but notes that many oversimplify. He recommends the guidelines by Green (1991) which state that if the aim is to test the individual predictors in a model (by using the beta values as in the following analysis), then the minimum sample size should be more than 104 + *k*, where *k* is the number of predictors. In this study, there are four predictors in the model (Perceived Usefulness, Perceived Ease of Use, Attitude and Intention to Use) and so the minimum sample size would be 104 + 4 = 108. 170 participants were included in this study, which is considerably more than these guidelines suggest, which gives confidence that the sample size is large enough to detect the correct effect.

Simple Regressions

Having ensured that all appropriate assumptions were checked and shown to have been met, linear regression analyses were carried out on the data in order to assess any potential predictive relationships. Following the expectations from the previous literature outlined, the following was hypothesised:

H1. Perceived Usefulness would significantly predict Intention to Use

H2. Perceived Ease of Use would not significantly predict Intention to Use

H3. Attitude would significantly predict Intention to Use.

H4. Perceived Usefulness would significantly predict Attitude.

H5. Perceived Ease of Use would significantly predict Attitude.

H6. Perceived Ease of Use would significantly predict Perceived Usefulness

In order to test these hypotheses, six simple linear regressions were carried out. The results of these analyses are presented in Table 7 below.

Table 7: Simple Regression analyses of TAM relationships

IV	DV	B	S.E. Beta	Stand. B	t	Sig.
Usefulness	Constant	1.601	20.423			
	Attitude	0.441	0.019	0.879	23.738	0.000***
	Constant	10.364	0.936			
	Intention	0.358	0.041	0.559	8.703	0.000***
Ease of Use	Constant	0.587	1.891			
	Usefulness	0.951	0.082	0.671	11.634	0.000***
	Constant	0.356	0.935			
	Attitude	0.486	0.040	0.682	12.011	0.000***
	Constant	12.045	1.554			
	Intention	0.287	0.067	0.315	4.281	0.000***
Attitude	Constant	11.356	1.001			
	Intention	0.634	0.086	0.497	7.404	0.000***

*p < 0.05
**p < 0.01
***p < 0.001

All results were highly significant which demonstrates support for five of the hypotheses and shows that Perceived Usefulness was positively associated with Intention to Use and Attitude, Attitude was positively associated with Intention to Use and Perceived Ease of Use was positively associated with Perceived Usefulness and Attitude, supporting the original conclusions of Davis (1986). However, in this study, there was also a significant relationship between Perceived Ease of Use and Intention to Use, which was not included in the original Davis (1986) model and so Hypothesis 2 was unsupported.

Multiple Regressions

Following these initial conclusions, further regression analyses were carried out to continue to investigate the model structure. In the original TAM (Davis, 1986) no direct effect of Perceived Ease of Use on Intention to Use was shown. As the present study has indicated this possible relationship, multiple regressions were carried out in order to assess the added variance explained as a result of each predictor, and to further examine the relationships between Perceived Ease of Use and Intention to Use. A hierarchical method was chosen as Field (2009) states that this is a suitable method when the entry order is clear from previous work. In this case, the literature states that Attitude is the main predictor of Intention and so should be entered as Block 1 into the analysis, with Perceived Usefulness as Block 2, due it it's direct effect of Intention to Use in the original TAM, and Perceived Ease of Use as Block 3, to investigate the unexpected relationship to Intention to Use. The results of this analysis are presented in Table 8 below. This table shows significant predictive effect of Perceived Usefulness on Intention to Use as expected but in this case shows that the predictive effect of Perceived Ease of Use on Intention to Use is now non-significant. This suggests, in concordance with first previous studies, that the effect of Perceived Ease of Use on Intention to Use may be indirectly through Perceived Usefulness as a mediator, as it is not adding any predictive value to the model above the effects of Perceived Usefulness.

Table 8: Multiple Regression analysis of the TAM relationships (Model 1)

Model		B	S.E. Beta	Std. B	t	Sig.	R^2	ΔR^2	F	ΔF
1	Constant	11.282	1.014				0.249	0.249	54.595***	54.595***
	Attitude	0.641	0.087	0.499	7.389	0.000***				
2	Constant	10.500	0.992				0.305	0.065	37.388***	15.415***
	Attitude	0.042	0.174	0.032	0.239	0.812				
	Usefulness	0.342	0.087	0.531	3.926	0.000***				
3	Constant	11.783	1.363				0.308	0.008	25.682***	1.187
	Attitude	0.105	0.179	0.082	0.584	0.560				
	Usefulness	0.368	0.089	0.571	4.136	0.000***				
	Ease of Use	-0.113	0.082	-0.123	-1.368	0.173				

DV = Intention to Use

*$p < 0.05$

**$p < 0.01$

***$p < 0.001$

Mediation Analysis

In order to confirm that this could be the case, the potential for a mediating effect was analysed. One of the most established methods for mediation analysis was proposed by Baron and Kenny (1986) who stated three equations which, if all three were present, indicated a mediation effect. There are four steps to demonstrating these three equations which involves testing the relationships between the independent variable (X), the dependent variable (Y) and the potential mediator (M). In this case, X is Perceived Ease of Use, Y is Intention to Use and M is Perceived Usefulness.

In the equation Baron and Kenny (1986) outlined, a significant relationship between X and Y is required, called path c. This was shown in the simple regression model whereby Perceived Ease of Use and Intention to Use were related with a standardised beta value of 0.315, which was significant with p <0.001.

Following this, Equation 2 states that a significant relationship is also needed between X and M, called path a. This was also shown in the simple regression analysis with Perceived Ease of Use and Perceived Usefulness showing a relationship with a standardised beta value of 0.671, significant with p <0.001.

In the third equation, the mediating variable (M) which is Perceived Usefulness must be related to Y which is called path b. In the simple regression analysis, Perceived Usefulness was significantly related to Intention to Use with a standardised beta value of 0.559 (p <0.001). These paths and which variables they connect are shown in Figure 11 below.

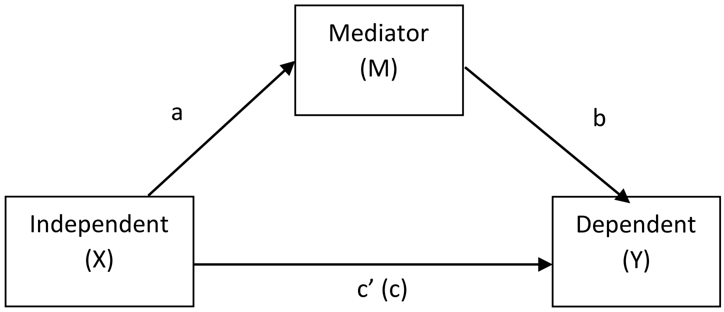

Figure 11: Mediation model pathways

In the final step, the relationship between X and Y (Perceived Ease of Use and Intention to Use) must become insignificant when the mediator (Perceived Usefulness) is included in the regression model. This was shown in the multiple regression model. When Perceived Usefulness was added into Model 3, the relationship between Perceived Ease of Use and Intention to Use became non-significant with a standardised beta of -0.123 ($p = 0.173$).

James et al (2006) state that if the X to Y relationship reduces but stay significant then partial mediation has been shown, but if the X to Y relationship becomes non-significant with the addition of the mediator into the regression model, then full mediation has been shown. In this study the relationship between Perceived Ease of Use and Intention to Use became non-significant and so full mediation was suggested. In addition to the mediation effect of Perceived Usefulness, a mediation effect of Attitude was also suggested by the regression analysis results, when the variables were entered into the model in a different order to test for further indications of mediation. As stated, the relationship between Perceived Ease of Use and Intention to Use was significant in the simple regression analysis, included as Model 1 in Table 9 below, but became insignificant when Attitude was included in Model 2. This suggests that Attitude also fully mediates the effect of Perceived Ease of Use on Intention to Use.

Table 9: Multiple Regression analysis of the TAM relationships (Model 2)

Model		B	S.E. Beta	Std. B	t	Sig.	R^2	ΔR^2	F	ΔF
1	Constant	12.040	1.560				0.99	0.99	18.206***	18.206***
	Ease of Use	0.288	0.067	0.315	4.267	0.000***				
2	Constant	11.774	1.429				0.250	0.150	27.292***	32.862***
	Ease of Use	-0.041	0.084	-0.045	-0.490	0.625				
	Attitude	0.680	0.119	0.529	5.733	0.000***				
3	Constant	11.783	1.363				0.321	0.071	25.682***	17.102***
	Ease of Use	-0.113	0.082	-0.123	-1.368	0.173				
	Attitude	0.105	0.179	0.082	0.584	0.560				
	Usefulness	0.368	0.089	0.571	4.136	0.000***				

DV = Intention to Use

*$p < 0.05$

**$p < 0.01$

***$p < 0.001$

In order to confirm these potential mediation effects, a further mediation analysis was conducted using the PROCESS macro in SPSS to calculate the indirect effect (PROCESS was downloaded from http://processmacro.org/index.html). This macro uses a bootstrapping method with bias-corrected confidence intervals (MacKinnon, Lockwood and Williams, 2004; Preacher and Hayes, 2004). The 95% confidence interval in this study was obtained using 5000 bootstrap resamples (Preacher and Hayes, 2008). The beta values presented in the results of the macro analysis are the unstandardized betas, in contrast to the regression model above which uses standardised betas. The direct effect of Perceived Ease of Use to Intention to use was shown above to be significant with a co-efficient of 0.315 (p<0.001). It was then shown using the macro, that Perceived Ease of Use was positively associated with Perceived Usefulness (B = 0.951, t(166) = 11.634, p <0.001), and that Perceived Usefulness was positively associated with Intention to Use (B = 0.408, t(166) = 7.285, p<0.001). It was also shown that the indirect effect (path c) was significant (B = 0.388, CI = 0.272 to 0.499). This confirms the mediating role of Perceived Usefulness on the Perceived Ease of Use to Intention to Use relationship. In addition, as this direct relationship (path c') became non-significant (B = -0.100, t(166) = - 1.263, p = 0.209, this demonstrates a full mediation effect. This mediation model is shown in Figure 12 below.

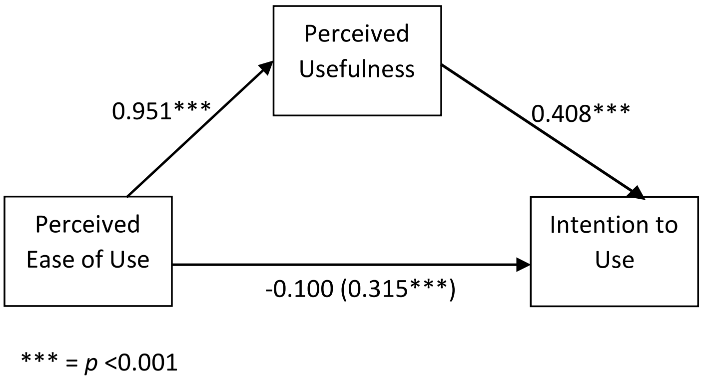

Figure 12: Mediation Model for the effect of Perceived Usefulness on the relationship between Perceived Ease of Use and Intention to Use

In order to examine the potential effect of Attitude as another possible mediator, the analysis using the PROCESS macro was repeated. The results demonstrated that Perceived Ease of Use was positively associated with Attitude (B = 0.486, $t(166) = 12.011$, $p<0.001$), and that Attitude was positively associated with Intention to Use (B = 0.676, $t(166) = 5.724$, $p <0.001$). It was then shown that in this case, the indirect effect was also significant (B = 0.328, CI = 0.206 to 0.470). The relationship between Perceived Ease of Use and Intention to use again became non-significant (B = -0.041, $t(166) = -0.485$, $p = 0.628$), which suggests another full mediation effect. This mediation model is shown in Figure 13 below.

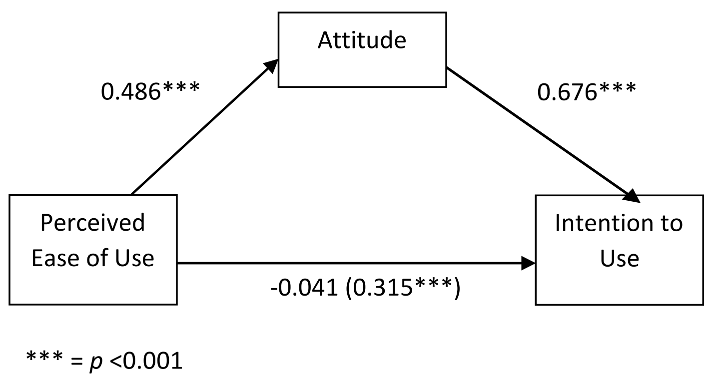

Figure 13: Mediation Model for the effect of Attitude on the relationship between Perceived Ease of Use and Intention to Use

These results concur with the original TAM model (Davis, 1986) who did not show a direct effect of Perceived Ease of Use on Intention to Use. Overall, the combination of the simple regression analysis, multiple regression model and the indication of a full mediation effect on the relationship between Perceived Ease of Use and Intention to Use demonstrate support for the TAM in a well-being context. Although further research is required to further investigate these relationships, the mediation effects and to examine any additional variables that the TAM extensions outlined in Chapter 1 include, this analysis clearly shows that Perceived Ease of Use and Perceived Usefulness affect the

Intention to Use a well-being application. Additionally, it has been demonstrated that Perceived Ease of Use predicts Perceived Usefulness, which suggests that increasing the usability and making applications easier to use should result in increased perceptions of usefulness and an eventual increase in usage.

Quantitative Conclusions

170 participants completed an online survey about their perceptions and attitude towards well-being applications, with the aim of validated the Technology Acceptance Model in a new context, and to show that the Perceived Ease of Use of the applications influenced the eventual Intention to Use. Six simple regression analyses were conducted, a multiple regression model was generated, and the step for a mediation analysis ware followed. The results of these analyses lend support for the Hypotheses 1, 3, 4, 5 and 6, in line with the original Technology Acceptance Model (Davis, 1986) and showed that Perceived Usefulness predicted both Attitude and Intention to Use, Perceived Ease of Use predicted Perceived Usefulness and Attitude, and Attitude predicted Intention to Use. Hypothesis 2, also based on this original study was supported as although Perceived Ease of Use initially predicted Intention to Use, it was found that this was a fully mediated relationship through the effect of Perceived Usefulness and Attitude.

Research outlined previously has shown that intention to use reliably predicts actual usage, showing support for the full TAM as outlined in Chapter 2. Once the theoretical model has been validated, the next stage was to introduce qualitative data to further investigate the acceptability of technology from an end-user perspective. At the end of the online survey, an open-response question was added which allowed participants to add any further comments regarding their opinions or experiences of using well-being applications. These comments and the results of a thematic analysis are presented in the remainder of this chapter.

Open Question

Of the 170 participants who completed the survey, 75 included a response to the final question, which gave them space to add anything further. Answers ranged from a few words long to a small paragraph mostly containing opinions on how important it was to focus on mental health, and how suitable technology was for this purpose. The contents of these responses were already transcribed, as participants had typed out their comments into the response box on the online questionnaire. Although the responses were fully anonymous it was possible to match them with some demographic data using the participant codes provided by the survey platform. A full list of participant demographics and a full transcription is included in Appendix C. Of the 75 participants who responded, 53 were male and 22 were female. Ages ranged between 21 and 73 years, with an average age of 47 years. Represented occupations included student, accountant, television producer and an army medic.

Qualitative Data Analysis

As stated, the qualitative data was generated using an open-response text box, which asked participants who completed the survey whether they had any additional comments. Thematic analysis, described as the process of identifying patterns or themes in a qualitative data set (Braun and Clarke, 2006), was then conducted on these responses. The process of this thematic analysis followed the six-phase process presented by Braun and Clarke (2006), which are:

Phase 1 – Familiarising yourself with the data
Phase 2 – Generating initial codes
Phase 3 – Searching for themes
Phase 4 – Reviewing themes
Phase 5 – Defining and naming themes
Phase 6 – Producing the report

These phases provide structure and clarity on how to begin a thematic analysis, but the process should be iterative to allow the researcher to move between steps as needed, to return to previous steps and to work on steps simultaneously when appropriate. Data collection, analysis and report writing may happen concurrently and be interlinked in a non-linear fashion (Creswell et al, 2007), which gives a higher quality and more responsive analysis that is data driven.

Firstly, the responses were read through carefully and any initial emerging ideas and relevant points were noted, which is considered an important stage in analysis (Riessman, 1993). The responses were then read through several times more in order to gain familiarity with the data. Following this, the codes were then generated in a two-step process. The first stage was an inductive process with minimum influence from previous theory or literature to reduce possible bias (Boyatzis, 1998). This was followed by a deductive stage where previous literature was examined and incorporated to support the themes and ideas generated by the analysis. One example of this approach is the combination method used by Fereday and Muir-Cochrane (2006) who suggest that using dual approaches represents rigor in analysis. It also ensures that the data analysis is robust and initially helps to remove biases whilst keeping the support and guidance of previous theory. Where appropriate several themes could be reasonably grouped together in the later stages of analysis or following previous literature and so subthemes have been used when necessary. A detailed discussion of thematic analysis, including its advantages and limitations is outlined in the Methodology (Chapter 4).

The thematic analysis conducted identified four themes from the data, the structure of which are shown in Figure 14 below and described in detail in the following section.

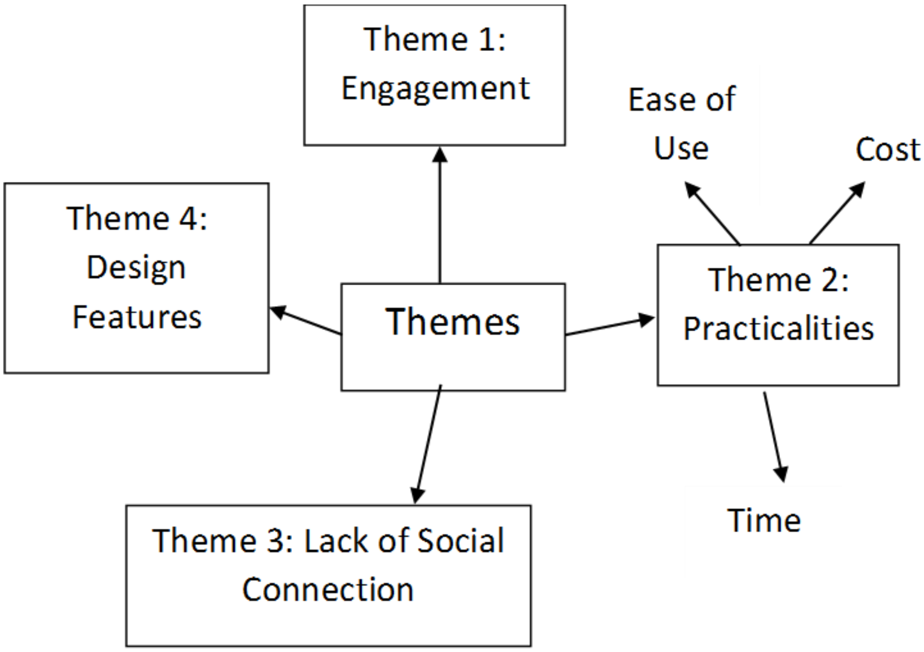

Figure 14: Themes identified by the thematic analysis conducted on the responses to an open question from the measure used in Study 1

Results

Theme 1: Engagement

Engagement

The first theme identified was regarding the difficulties with staying engaged with the application long enough to get into a routine, to use the applications on a regular enough basis to see a difference and to make using them a habit. Participants indicated that even if they had the initial intention to download an application, they failed to keep using it over time. This theme represents that discord between the intention to use the application, and even the behaviour of downloading it, with the repeated usage, and suggests that engagement could be a key factor in explaining this difference. One respondent stated:

"[I] Don't use them very routinely, have never managed to stick to the habit of using them, but I like to keep a few on my phone as a "backup" or safety net for when I'm feeling low" [P2]

Another participant recognised that there was difficulty in remembering to use an app even if it was found to be helpful. This further demonstrates that the initial intention to do something they know to be beneficial, might not be enough to encourage them to keep using the application beyond the initial interest. They said:

"I've found guided meditation very useful. I also used an app designed to record gratitude- I think this was very useful but I didn't keep in the habit of using it." [P68]

This statement contradicts the relationships included in the TAM and suggests that even though perceived usefulness might be high, that alone is not enough to encourage usage. Several of the respondents acknowledged that apps delivering interventions or well-being exercises needed to be used on a regular basis to make a difference, but that it was still hard to get into routine and make it a lasting habit. One person recognised that they lacked the motivation to make this happen and stated:

"I am aware that such apps should be used routinely, but I lack motivation so maybe if there was some incentive to use it regularly that would be beneficial." [P12]

This awareness was also shown by another respondent who thought that using an app as a delivery method might encourage habit formation. They said:

"I think they are useful tools. The automated rhythm of an app or other software can start the habit of small changes to routine which contribute to an overall improvement in wellbeing and mental health." [P38]

This was also mentioned by a second respondent who thought that applications were better for using more routinely and thought that they were:

"More suited to regular use than dipping in and out" [P10]

This suggests that although one of the benefits of using mobile technology as a delivery method is that it is flexible and would be suited to dipping in and out, that sometimes this might actually be detrimental, as participants have less motivation to stick to the application and to use it regularly. Other respondents also recognised that well-being was something that needed to be worked on over time to show effects, and that if they didn't use the applications continually, then they could lose the benefits they had gained. One said:

"They are great when you get the chance to use them, but if you forget then you won't be able to sustain the positive effects that you had initially." [P26]

Another "*found them to be effective when used but do not use routinely*" [P21]

This suggests that even applications which are shown to be effective in a research setting would not be useful to the audience if they are not used regularly. The challenge for development is to then create an application which does encourage repeat use, in order to keep the benefits maintained. One respondent summarised that they felt that the benefits were only as a result of effort put in and maintained practice and stated that:

"at the end of the day, it's like everything else, you only get out what you put in" [P56]

In contrast to the participants who did find positive effects but still struggled to form a habit of using the apps, one respondent found that because they didn't see any immediate effects, they were not motivated to continue using the application. They stated that they were:

"Pretty indifferent. Basic concept but did not do much over a short period so stopped using." [P44]

Several respondents also commented on the fact that using such applications sometimes felt like a chore and something that they felt they should do rather than something they enjoyed. One person commented:

"I try wherever possible to allocate myself time without distractions so I can use my Headspace app. I have also found it beneficial I try to use the same time of day more often, so the routine becomes second nature rather than chore like" [P61]

The sense of using such applications being a chore was echoed by a second participant who agreed that they struggled to use the applications, even if they were beneficial. They said:

"I personally found that I wouldn't keep using them routinely - even when I might have needed them. The mindset I was in found it more of a chore than beneficial." [P1]

This again demonstrates that other factors are needed in addition to perceived usefulness in order to encourage sustained usage. By suggesting that the completion of the activities on the app was a chore, it suggests that even though it might be seen as necessary, it was not enjoyable and that this lack of enjoyment contributed to a lack of usage. One participant suggested an explanation for why they were didn't stick to using the applications regularly and suggested that:

*"I think it is too tempting to immediately start using other apps that are less helpful and instead waste time "[*P51]

This suggests that the applications they have had contact with have not been engaging enough to keep their attention, especially when there are lot of other apps available, such as games and social media. This would link to previous comments on gamification, and the need to make apps visually appealing and engaging in order to keep interest.

Practicalities

The second factor identified in the analysis was the practicality of applications and a delivery method, which has been separated into three subthemes of Cost, Time and Ease of Use. This theme demonstrates the possible benefits of using mobile technology as a delivery method. Overall, the examples in this theme show that mobile technology is generally viewed as a positive and helpful method for delivery, that people would view favourably.

Cost

The first subtheme, and the most frequently mentioned practical aspect was the cost of applications. Participants suggested that they would find a free resource very attractive and that they would be encouraged to used it but would be put off if the application was expensive or charged extra for different levels of activity or intervention. One respondent stated that:

"The success and impact of well-being apps are very much dependent on the application software, usability and costs." [P4]

Some applications, such as Headspace, offer free versions as a trial with some limited features, and the option to pay a monthly fee for the full services. One respondent mentioned their experience with these applications and the effectiveness of the different versions available. They stated said:

"I generally find them very relaxing if you pay for additional features. The free versions severely limit their effectiveness" [P8]

This subtheme is an important consideration, particularly in the implementation stage. A final participant stated that the cost of an application would affect their decision to use an application or not and that:

"[The] cost of such applications may prove to be prohibitive. Would need to be low cost or free for me to consider using one." [P25]

That this was explicitly mentioned suggests that this subtheme is highly salient and can contribute to the success or failure of the implementation. It also suggests to designers and developers that applications should be kept low cost wherever possible, which will affect the design choices made. However, in relation to the previous theme of engagement, there would have to be a balance between the entertainment features of the app, the graphics it uses and the level of interaction, with the overall cost to participants.

Time

Another practicality mentioned was finding time to use the applications, which may be linked to the previous comments on struggling to form a habit and may also explain why people didn't use them regularly. One respondent stated:

"As with all apps finding time to use them is the challenge" [P39]

One participant thought that the timing was one of the advantages of using technology because it was more flexible. They stated that:

"They're helpful as long as you can tap in and out of them at your own leisure" [P22]

This subtheme can also be linked to the previous theme of engagement, as increasing the entertainment value of the application could encourage people to spend their time on the app, over and above other offerings such as social media. Increasing the entertainment also acts as a '2 in 1' where people feel like they have spent their time on something fun, but also received a benefit from it.

Ease of Use

Finally, one participant who mentioned their own mental health issues, stated that technology was a more suitable delivery method for them practically, especially when they were struggling and needed something to fill the gap in care and provide some form of help. They said that:

"During worse phases of depression, I struggle to do any activities at all and often my phone is the only thing I have energy to look at, and sometimes the apps can be a helpful /comforting distraction to help pass some time." [P2]

These comments suggest that technology would be a suitable delivery method to offer people, and may be beneficial for those who are short on time or who cannot access other forms of intervention easily, providing that they are kept low cost, with everyone able to access the same level of intervention. Consideration would need to be given as to whether some cost would encourage people to keep up the habit and stick with using an application, versus whether a cost would be off-putting. This could also be related to engagement, as people might be willing to pay a small cost for an application that is engaging and entertaining, similar to games that are currently available on application stores.

Lack of Social Connection

The next theme identified was the lack of a social element to technology and that this could be a disadvantage to the method. Several respondents mentioned that they felt that technology as a whole was limited by the lack of social support and that the functions of app are limited by not providing social support. Many people indicated that they didn't want online methods to replace contact with others, which they recognised was important for mental health. One respondent stated:

"They are helpful in learning techniques like mindfulness, but one cannot use them to share feelings." [P5]

One participant mentioned that relying on technology alone would lead to increased isolation, which would negatively affect well-being, rather than supporting it. They said that:

"I have reservations about their use as I believe that many people (particularly young people) could end up relying on apps to feel better, which could be isolating, and isolation is one of the main enemies of well-being. People should be encouraged to have real contact with others leaving their phones beside, to share their worries with their friends and to ask for help when they need. I agree on that apps can be a good supplement, but I don't know whether people are starting to believe that all solutions may come through their mobile phones." [P7]

In general, respondents did not feel that technology was a better method alone versus face to face contact and that they would prefer to stick to traditional methods of professional help. One respondent said:

"Overall I think they're a poor substitute for getting proper face-to-face help" [P17]

However, it is not indicated whether this refers to building well-being, or to seeking help for mental health issues. There was also no detail provided as to what would constitute acceptable face-to-face help. In agreement, another stated:

"talking to people close to me and professionals would be my preferred route to assisting my mental well-being" [P60]

This suggests that respondents felt that mobile technology would not be as effective as face-to-face contact, which may be due to the lack of clarity around applications, where they have come from, the theory behind them and the input of psychologists or counsellors in the design. One respondent thought that technology could act as support when they weren't able to get face to face contact, but implied that apps would not be the first or only point of contact. They stated that apps were:

"Good when can't get to see counsellor or friends" [P9]

This was supported by several other respondents who recognised that there were benefits to applications but that they would be best used as a supplement for face to face contact or other forms of help. One person stated:

"I think apps can be useful but can't replace human interaction" [P66]

This was supported by another response, which stated that professional help was preferable to using apps. It said:

"I believe these applications will have some use; however, it shouldn't replace appointments with a professional mental health worker." [P72]

One participant stated that this may be because it lacks certain skills and training that mental health professionals have and that although there are advantages, technology is still lacking in certain areas. They said that:

"I do think people to people is best because it is more flexible (reacting to what is being heard). AI may be helpful, but it still can't 'sense' things in people." [P26]

This could suggest that mobile applications could be used in conjunction with other services, or that they should include ways to connect with other through online contact or social media, or signpost to places where social support would be available in order to access both the practical benefits of online interventions, as covered in the previous theme, with the benefits of social support. One final point raised was that technology can also introduce unwanted social contact, such as online bullying. Although this is more of an issue with social media, it is important to be aware that this happens and although there are advantages to online social support, such as a reduction in isolation, there can still be negative effects. The participant stated:

"I do find tech is a double-edged sword as the overuse of tech such as Facebook Instagram etc can I feel be risky with the potential to be bullied harassed and judged" [P55]

Overall, it is suggested that technology doesn't provide the social support people would prefer and that they would still want to have the support of professional face-to-face contact if they needed mental health support. It was suggested that technology and apps could act as a supplement for therapy or other methods of help and that it would be suitable during times when contact wasn't available. It may be beneficial to include some signposting in a well-being application where people could either reach professional support or social support to bolster their well-being.

Design Features

The next theme identified was about the design features of the apps and suggestions for how the design of apps could be made better in order to encourage people to use them and stick to using them. This theme would be highly relevant to the future development of applications, and again links to the theme of engagement. Well-designed applications should be engaging and responsive to the audience and encourage repeat usage. This theme specifically relates to the presentation of the application, how clear and easy it is to follow and the user experiences. One respondent stated that the design of the app is very important and that even apps with helpful aims might not be used. They said:

"Just because it's a well-being app with good intentions doesn't mean it was well designed." [P62]

Another participant mentioned their own experiences with different applications, and stated that experiences could vary between them and that the design, usability and appearance affected the opinions of the app. They extended this to the helpfulness and implied that the helpfulness was affected by the design. They stated they felt the:

"Ability to use and helpfulness depends on the application - some user interfaces are horrible, some very nice." [P67]

This links to the Technology Acceptance Model, and the proposed relationship between design features and Perceived Usefulness, which is another term for the perceived helpfulness of the application. This anecdote shows this relationship from the experience of the respondent. However, it again suggests that perceived usefulness alone is not enough to explain usage, as even useful applications can have poor, off-putting design.

One participant stated that the design of the technology should be flexible without overloading people. They state that the flexibility of the time commitment was a benefit of technology but that reminders can be overwhelming. They said:

"They're helpful as long as you can tap in and out of them at your own leisure. Regular notifications can create greater anxiety" [P22]

Another respondent also agreed that it was important not to overload the demands. They claim that keeping the content simple would be beneficial. They said:

"Simplicity and minimum effort is key…. Links to further information, tips and support channels all in one place would also help… Too much time spent staring at digital interfaces can have adverse impacts on mental well-being, so interactions need to be efficient." [P45]

This links to the previous comments on the time constraints. One way of reducing time pressures and encouraging people to keep using the apps would be to keep the requirements simple and not overload people. Overall this theme, and the links to previous themes identified in the analysis suggest several factors which could inform the design of future applications. According to these results, they should be well-designed applications that are quick and simple to use, engaging and entertaining, contain or link to an aspect of social support, and be low-cost.

Discussion

Regression analysis was conducted on the results of an online questionnaire which measured perceived ease of use, perceived usefulness, attitude toward using well-being applications and intention to use well-being applications. It was hypothesised that the relationships shown in the original TAM (Davis, 1986) would be replicated, and the analysis confirmed these hypotheses to be true. Perceived ease of use was shown to be associated with perceived usefulness, and both perceived usefulness and perceived ease of use were related to attitude and to intention to use. Mediation analyses were also conducted to investigate an unexpected relationship between perceived ease of use and intention to use. It was shown that both perceived usefulness and attitude fully mediated this relationship. Support was shown for the original structure of the TAM (Davis, 1986).

Thematic analysis was conducted on the results of an open question where participants were asked for any further comments they wanted to make at the end of a questionnaire. Four themes were identified from the quotes; Engagement, Practicalities, Lack of Social Connection and Design Features. Participants stated that they struggled to get into the habit of using the applications, even if they found them to be effective, or knew that they would be beneficial if they were used regularly. They also stated some practical elements which should be considered when designing a well-being app, such as the cost. This was related to the Design Features theme which covered the need for a well-designed app with simple and efficient content. Several respondents stated that they would prefer to seek professional face- to-face help to work on their mental health and well-being and felt that technology could be used as a supplement or additional service, but that social contact was still necessary.

The results of this study can be related to both the Technology Acceptance Model and the CFIR. The practicalities theme relates strongly to the perceived ease of use element in the TAM. In this study, the comments related to the practicality of using mobile technology for well-being, including cost, time and ease of use were generally positive, suggesting that the technology would be perceived as easy to use in comparison with face-to- face methods. The engagement theme was also related to perceived usefulness in this study but highlighted a criticism of the TAM. Participants in this study stated that even though they knew the application would be useful, it was not enough to keep them engaged with the application and that something more was needed to ensure repeated usage. This offers support for the criticism of Hsu and Lu (2004) who state that perceived usefulness does not account for entertainment. From the comments produced by the open question, participants agreed that some form of entertainment was needed in order to interest people on using the application. One way of adding entertainment to an application is gamification which has been defined as using game-like aspects in a non-game setting (Deterding et al, 2011). The aim of including these features, such as challenges, tasks, leader boards and game-like graphics, is to increase engagement with the application, which often have an underlying educational aspect, and motivation to use them (Flatla et al, 2011; Shneiderman, 2004). The inclusion of engagement as an explanatory feature for technology usage is further covered in the Discussion (Chapter 8).

There are also several links to the CFIR, although as no specific context was given in this study and the question was very open, the responses were mainly related to the design features and intervention characteristics facet of the model. In particular, the practicality theme identified in this study reflects the characteristics included in the CFIR, such as cost and adaptability which the model suggested lead to more successful implementation. This element could also be linked to individual characteristics, as what might be easy and suitable for one person to use might not suit another and so the individual characteristics of the user will have an effect on how this is perceived. The engagement theme is also strongly linked to the design features of the application but can be linked to the individual characteristics through individual state of change. Although participants recognised that this type of app could be useful, they still struggled with regular use and this may be because it is useful but not essential to them, based on their own circumstances and current well-being. Finally, there is a connection between these findings and the outer characteristics factor in the CFIR. The framework suggests that peer pressure can act in a positive way in order to increase uptake, but these findings show that a lack of social connection could be a barrier to usage and may lead to unsuccessful implementation. Participants stated that they were concerned by the lack of social interaction and that this may be a reason why they would use other methods to increase their wellbeing.

Limitations

There are several limitations with the study design which are important to consider when interpreting or generalising the findings. Firstly, a cross-sectional study design was used where participants completed the survey only once, at a set time point. The main criticism of this method is that because data is only collected at one time point, there is no way to confirm causation of an effect of one variable on another (Carlson and Morrison, 2009). The only way to confirm a causal relationship is to measure variable across multiple time points in a longitudinal study, but these are expensive, time consuming and can be affected by participants dropping out of the study in subsequent measurements, which is a concern with longitudinal studies and provides an advantage to using a cross-sectional design (Levin, 2006). In this case, as the survey was filled out anonymously by online participants it would be very difficult to ensure that the same participants were completing the questionnaire at follow-up. Although a cross-sectional design was more suitable for this study due to the practical constraints, it is important to note that the results may have been different if the questionnaire had been conducted at a different time point.

In addition, a snowball sample was used, which could have led to a slightly less representative sample of the population (Emerson, 2015; Erickson, 1979). Therefore, it can also be said that the results might be slightly different had a different sample been used. These limitations affect the generalisability of these results. One further limitation is that participants had a wide range of previous experience and understanding of what a well-being application was. Verkasolo et al (2010) suggests that the TAM is most effective when used in relation to a specific technology system, which would imply using the questionnaire to ask about experience and attitude towards a named application. Due to the practical limitations of the study it was not possible to use a specific application and so participants were instructed to answer about their general impression of well-being applications. It is therefore possible that the results would be different for each specific application and again, generalisations must be done with this in consideration. However, this effect on generalisation of these limitations is partly counteracted as the results from this study concur with the results of other studies on the same topic, conducted at different times and with different participants.

Finally, there are limitations to the use of regression to analyse the relationships in the model. Maxwell (1975) states that it is highly improbable that a model tested would include all of the necessary variables in order to fully predict the outcome, as so every model will be missing some factors. There may also be issues with the measurements used for the variable which affect the eventual analysis - for example, if the measures are not accurate or if they are too highly correlated. Maxwell (1975) suggests that these issues can call in question the validity of the tests of significance used, which was supported by Morris (1981) and Jeon (2015). Regression analysis also relies on the relationship between the variables being linear (Field, 2009) which cannot always be assumed. Even when a relationship has been shown to exist, regression cannot guarantee that the relationships is causal or eliminate the possibility that other variables may be involved which could provide a better explanation for the effect (Jeon, 2015). In this study, the assumptions required for regression analysis were checked and shown to be met. Previous research had shown the relationships in the model to be linear and has used regression analysis with success. It was important to use similar methods in order to provide some comparability of results. It was therefore decided that regression should be used to investigate these relationships.

Conclusion

An empirical study was conducted to assess the validity of the TAM in a well-being context. 170 participants completed an online questionnaire which measured perceived ease of use, perceived usefulness, attitude and intention to use well-being applications. It was hypothesised that the relationships from the original TAM would be supported in this new context, which was found to be true, with the exception of a direct predictive relationship between perceived ease of use and attitude. Mediation analysis in this study showed that both perceived usefulness and attitude mediate the effect of perceived ease of use on intention to use. These findings suggest that higher levels of perceived ease of use would lead to increase perceived usefulness, increase attitude and eventual increase usage.

An additional open question was included at the end of the questionnaire, which 75 participants responded to. The resulting data was thematically analysed and suggested that participants view mobile technology as a delivery method for well-being interventions which offers a practical way to access the intervention. However, it is suggested that this may not be enough to keep people using the application over time and that it needs to be engaging as well as useful and provide some social connection or interaction in order to increase usage. These conclusions suggest that future applications for the delivery of well-being interventions should be low-cost, be quick and simple to use, contain or link to an aspect of social support and be engaging and entertaining. These findings are supported by factors shown in the CFIR model and suggest that while the apps are viewed as easy to use, that perceived usefulness may not be enough to explain repeated use and suggest that engagement could act as another contributing factor to technology usage.

Overall, the results of this chapter demonstrate support for the TAM in a new context and show that perceived ease of use and perceived usefulness predict attitude and intention to use. The qualitative results suggest that an additional factor of engagement may be present and may also lead to increase usage.

Chapter 6: Study 2: The development and a mixed-methods usability test of a prototype well-being application

Aims

This chapter outlines Study 2 which uses a mixed-methods approach to investigate the second aspect of user experience, usability, and addresses the second aim of this thesis which is:

- To evaluate the usability of a prototype well-being application.

In this study, a prototype well-being application was designed and developed, and a mixed-methods usability test was conducted, which included quantitative assessment of the usability of the prototype, and qualitative feedback on how it could be improved for a more positive user experience.

The results of the previous chapters have demonstrated that the relationships from the Technology Acceptance Model are valid in a well-being context, including that perceived ease of use and perceived usefulness predict intention to use the technology. The qualitative results from Chapter 5 suggest the need for entertainment and engagement to increase usage of a well-being application. The literature review in Chapter 4 showed that the most frequent methods of measuring usability are the System Usability Scale (SUS) (Brooke, 1996) and the Mobile Application Rating Scale (uMARS) (Stoyanov et al, 2016), and showed that well-being applications are generally rated as highly usable and easy to understand. In order to further investigate the effects of perceived ease of use, a usability test was conducted on a prototype well-being application. This chapter outlines the development of this prototype including its initial functionality testing, followed by a usability test with 25 participants who completed the SUS and the uMARS. The prototype application was found to be highly usable, which supports the previous research outlined in Chapter 4, but indicated that improvements needed to be made in terms of engagement and visual attraction, which concurs with the qualitative results in Chapter 5. The results are discussed in relation to the TAM and the CFIR.

This study, incorporating the development and testing of the application, was conducted following a methodology specifically concerning research relating to Information Systems (IS), which includes mobile technology and applications, called the Design Science Research Process (DSRP). This process was developed by Peffers et al (2006), using a synthesis of a developments in the IS area. IS refers to the technology, the people and the processes included in the whole system, and therefore Information Technology (IT) and its creation falls under this term. The DSRP provides a six-step framework for research involving the development of a new information system, where the outcome of the research is the design and evaluation of the IT artefact - in this case, a mobile application. The six steps of the process and how they are included in this study are presented below.

1. *Problem identification and motivation*: The problem and the need for a new technology was outlined in Chapter 1, including the rationale for the use of mobile technology as a delivery method and the potential advantages of a well-being intervention delivered using this method.

2. *Objectives of the solution*: The current IT artefact being developed aims to provide a usable platform for the delivery of a prototype well- being intervention.

3. *Design and development*: To meet this objective, a new application was designed and created as an original IT artefact. The full development process is outlined in the first half of this chapter, including the development of the content, the iterative creation process and the initial functionality testing.

4. *Demonstration*: This stage involves demonstrating how well the system works. In this study, a usability test was carried out, following the mixed-

methods approach reported in Chapter 4. A sample of 25 respondents completed this test, the results of which are presented in detail in the second half of this chapter. It was found that this application was rated to be easy to use but that improvements could be made in terms of appearance and engagement levels. These results are presented in relation to the Technology Acceptance Model.

5. *Evaluation*: It is important to compare the results of this demonstration to the objectives set out for the solution to assess whether the created artefact (the application) meets the needs outlined. As participants rated the application as easy to use, it was deemed that the objectives of creating a usable platform had been met. However, recommendations for improvements were made which could increase the engagement with the application.

6. *Communication*: The final stage of the DSRP is to clearly communicate these steps in a clear and logical order, which relates to the need for replicability and clarity in psychological research. This was met by including the full details outlined in the remainder of this chapter.

<u>Development</u>

The following sections outline the development process for the creation of the prototype well-being application. This application uses a daily diary method where users are asked to complete one short exercise per day, based on positive psychology techniques to increase optimism and positive thinking. The choice of the content, the iterative coding approach taken to develop the application and the technical testing conducted to ensure that the application worked as expected are outlined below.

Operating System

The first stage was to select an operating system the run the app on, and to identify whether it was possible to run the app on multiple operating systems to increase the number of people who could access the application. The most frequently used operating systems are Android (Google), IOS (Apple) and Windows. All three of these options were considered. It was initially decided to exclude Windows for the first testing stages, as it is not as frequently used as Android or IOS and the number of apps available on this system are comparably few. It was decided that Android or IOS would be more convenient, more accessible, and reach a greater number of people for testing.

Both Android and IOS have quality standards that need to be met for any apps using the systems. They also have different methods of distribution based on these standards. The main route by which people download apps are through the stores; Google Play Store for Android and the Apple App Store for IOS. For an app to be eligible to be included on the Apple App Store and available for public download, there is an evaluation process whereby it must meet a set of minimum testing standards. As this is a pilot test of an app, it does not currently meet all of these criteria, and would need to go through a lengthy process to be listed, which would be time and resource consuming. Android applications also have a set of quality criteria for listing on their Play Store. However, apps using Android are also available as an independent download. Distributing the app in this way is much quicker and allows the testing which the stores would require to be conducted with actual users. Due to these practical considerations, and the restraints of time and resources, it was decided to initially limit the app to Android. Although this does limit people who can access the app to those who have Android devices and who have the download link, it was expected that the prototype would still be accessible for testing purposes if this platform was used. Once the initial testing is done, it may be possible to expand the access and to create a version using other operating systems in order to run further tests.

Iterative Coding Approach

A basic outline application was coded using the Android operating system, as the first stage in an iterative coding process. This involved setting out the initial requirements for the code, which in this case was the content of the intervention, presented in a straightforward and easy to understand way for participants. An iterative coding approach allows the programmer to start with an outline application to check functionality and then build up complexity and add elements, continuously testing to ensure proper functioning throughout. Specific elements can then also be isolated, tested, and the impact checked before the next element is added. This gives flexibility and allows for the app to be modified in response to any changes to the design throughout the process. This ensures that the most robust and the best version of the app possible will be sent for user acceptance testing.

Testing

Throughout each stage of the app development and the iterative coding process, the code was extensively tested by the programmer before the final version was ready for user acceptance testing. This testing involved working through the program logic to ensure all routes were complete and that data was correctly updated at the appropriate points in line with a data flow diagram that lays out the flow and process of the code. To do this, the system was seeded with data to reflect a specific starting point and then the application was run in test mode to track code execution and data updating. Once this was complete, the layouts of the screens were checked on several devices in both portrait and landscape orientations, to ensure the all participants were viewing the same screens clearly with no errors. After this, the code was run on several different Android operating versions, which were KitKat, Lollipop, Marshmallow and Nougat; the most recent versions of the system at the time, which covered most Android users. As the functionality within the operating system changes with each update, it is difficult to have a program that is fully backwards compatible, particularly further back than

KitKat. At this time, it was decided that these four versions of the system were enough to make the app available to most Android devices currently being used and was suitable for a prototype test. Finally, a short user acceptance testing stage was completed, where the application was tested from start to finish by eight people who used the application every day for two weeks, using different devices and systems, to ensure that the experience was the same for all users, that the app was robust and free of errors, and that the participant flow was as intended.

Content

Well-being can be considered part of positive psychology and represents the ideal state the constructs of positive psychology such as resilience, flow and meaning in life should lead to. This implies that interventions based on positive psychology constructs could lead to increased well-being. There are several interventions related to positive psychology which have already been shown to lead to increased well-being such as mindfulness programmes (Kabat-Zinn, 1990), writing about positive experiences (Burton and King, 2004) and practicing gratitude (Emmons and McCullough, 2003). The advantages of these interventions are that they can be practiced by a wide range of people as they don't require any specific initial skills, they can be completed in any location at any time so are flexible and adaptive depending on the individual and require few resources to get started including little intervention from a practitioner or teacher. This makes them widely applicable to a range of target audiences in a range of contexts and can lead to an intervention which would be suitable to deliver benefits to a wide range of people.

Positive psychology interventions also help to fill a gap in the current provisions for mental health care. As described in Chapter 1, working on mental health issues can be resource intensive, and so building positive well-being has been overlooked in favour of helping those with serious issues. As positive psychology interventions for well-being are not as resource intensive, they can help to fill this gap so that therapist care can be directed to those in need, whilst people without mental ill health can still receive support to build their mental health and well-being. In addition, building well- being through positive psychology interventions has been shown to prevent future mental ill-health such as depression and anxiety (McCullough, 2002; Watkins et al, 2003; Schiffrin and Falkenstern, 2012). Current mental health provisions offer help once people have been diagnosed with anxiety, depression or another mental health issue, and positive psychology interventions can help to fill the gap in service before this becomes the case. There is evidence to suggest that positive psychology interventions are also highly suitable to be delivered through mobile technology and have been shown to be effective when presented in this way (Mak et al, 2018; van Emmerick et al, 2018; Bakker and Rickard, 2018). These factors combined suggest that positive psychology interventions would be the most suitable content for a well-being application.

The positive psychology literature was searched for established interventions which aimed to increase positive resources and to build mental health using behaviour change techniques, particularly by building optimism and positive expectations. There are a range of benefits that an increase in optimism can lead to, such as increased well-being (Desrumaux et al, 2015; Herero and Extremera, 2010) and decreased depression and stress (Liu et al, 2013; Morris and Long, 2002). It has also been positively correlated with positive affect, and negative correlated with negative affect (Gonzalez- Herero and Garcia-Martin, 2012; Hochwarter and Thompson, 2010). Positive correlations have also been shown with life satisfaction (Gonzalez-Herero and Garcia-Martin, 2012) and self-esteem (Makikangas and Kinnunen, 2003; Makikangas, Kinnunen and Feldt, 2004). As well as positive mental health, optimism has also been related to increased self-reported health (Atienza, Stephens and Townsend, 2002).

Several previously validated interventions aiming to increase optimism were found, which were adapted to be included in this mobile application. The interventions that were included were chosen as they were the most suitable for adaptation for a mobile technology delivery format, didn’t require extensive instruction or involvement from the researcher before the users could get started and involved clear activities that were easy for the participants to understand. A daily-diary method was used, where users were given one question a day from the list of interventions to complete. This method was chosen as it suited the activities in the interventions included, which are detailed below. The interventions all use questions which get the user to think about their experiences in a reflective fashion in order to highlight the positive aspects, and so a diary method allows this space for reflection. Most people will be a familiar with the idea of recording experiences in a diary and would therefore already be accustomed to or accepting of this method.

Self-Guided Interventions

The activities chosen, outlined below, were also included as they allowed the intervention to be self-guided which allows individuals to have autonomy over their own well-being, and to choose to take part in the intervention without any required input from others, such as GP or therapist recommendation. Individuals can take part in the intervention without having to discuss it with anyone or disclose their participation if they would rather keep it private. There is evidence to support the effectiveness of self- guided interventions, which shows that they are equally effective in many cases to group interventions, or interventions which involve contact with a practitioner. Mitchell et al (2009) showed the effectiveness of a self-guided intervention on improving the cognitive component of well-being. Many of the current self-guided interventions are aimed at depression and anxiety; Titov et al (2013) and Cuijpers et al (2011) showed the effectiveness of some of these interventions. Owen et al (2005) demonstrated the effectiveness of a self-guided programme for an internet-based coping group for early stage cancer survivors, and Possemato et al (2011) showed a reduction in PTSD symptoms in veterans. The effective use of these interventions in similar areas suggests that they can be used to increase optimism and suggests they would be a suitable format to use for this intervention. Many of these previous interventions were also technology based.

Three Good Things

One main positive psychology intervention found that targets optimism is the Three Good Things exercise, first described by Seligman et al (2005). This technique involves the participant recording three things that went well each day and attributing a cause to each event which is global, permanent and pervasive. Seligman, Steen, Peterson and Park (2005) compared this exercise with four other positive psychology interventions – a gratitude visit, best possible self-imagery, identifying signature strengths, using signature strengths in a new way – and a placebo control exercise. The outcome variables measured were happiness measured by the Steen index (outlined in Seligman et al, 2005) and depressive symptoms measured by the CES-D (Radloff et al, 1977). Initially, the gratitude visit condition showed the greatest increase in happiness and decrease in depressive symptoms up to the one-month post-test measurement. After this, only the three good things exercise and using signature strengths in new ways showed effects at the three and six month follow up. This suggests that these two exercises are the most likely to lead to long term changes in happiness scores and reductions in depressive symptoms.

These results have been replicated in several different settings, providing further support for this conclusion. Mongrain and Anselmo-Matthews (2012) found very similar results to the Seligman et al (2005) study, showing that the Three Good Things exercise led to increased happiness at one week, three months and six months post intervention. However, they found that all conditions showed similar reductions in depressive symptoms. Contrary to this, Littman-Ovadia and Nir (2014) found that the effects shown were not due to increased optimism but from reduced pessimism. The same suggestion was also made for affect, as they showed no difference in positive affect, but a reduction in negative affect and no difference in life satisfaction, but a decrease in emotional exhaustion. They also examined the potential moderating effects of initial baseline optimism and found that higher initial optimism led to a greater decrease in negative affect, a greater decrease in emotional exhaustion and a greater increase in life satisfaction.

Schueller (2012) suggested a further moderating factor of personality, specifically introversion and extraversion. This study replicated the original results from Seligman et al (2005) to show positive effects of the exercise on happiness and a reduction in depression. It was theorised that the effectiveness of different types of interventions would depend on the users' extraversion level, and that the type of intervention should be selected based on this to make it more suitable. Although personality was not found to be a significant factor, it was trending towards significant and Schueller (2012) remains confident that with further research this conclusion will be supported.

Further support for the Three Good Things exercise has been shown both cross-culturally and with different age groups. Gander et al (2013) replicated the effects of the Seligman et al (2005) study in a German population in terms of an increase in happiness but found no effects for a reduction in depression. However, this does show that the exercise can be used in a wider European context and can be translated into different languages and retain the effect. Finally, the Three Good Things exercise is included as a part of the Penn Resiliency Programme, which uses positive psychology interventions in schools. Seligman et al (2009) showed that this programme was effective in a meta-analysis of 17 studies, finding reductions in depression, anxiety and behavioural issues among the students. Although there is clearly some contradiction regarding the specific effects and their mechanisms, it can be concluded that the Three Good Things exercise shows improvements to well-being and is a suitable exercise to be used in positive psychology interventions. In the current intervention being developed, the Three Good Things exercise is included as "*Write down three things that went well toda*y."

Best Possible Self/Positive Future Imagery

The next included exercise is best possible self-imagery and positive event imagery, both of which have been shown to increase optimism. Much of the research on the link between best possible self-imagery and optimism, is the best possible self-imagery exercise as first outlined by King (2001). In this initial exercise, participants were asked to write for 20 minutes per day for four consecutive days about their best possible self. It was shown that as a result of the exercise, there was an increase in positive affect, more optimistic content in the later writing and higher composite well-being scores (a combined measure of life satisfaction using the Satisfaction With Life Scale (Diener et al, 1985) and optimism using the Life Orientation Test Revised (LOT-R; Scheier, Carver and Bridges, 1994). This exercise was replicated and expanded by Peters et al (2010), who used one writing exercise and then 5 minutes per day of mental imagery about the participants' best possible self. This was shown to temporarily increase positive future expectations, independent of positive affect. It was suggested in this study that this could be a suitable manipulation to increase optimism to be used in other studies to establish causality in relationships between optimism and other variables. This exercise is included in intervention described in this chapter by getting participants to picture their best self and to write down one quality that they have.

Goal Setting

Another included exercise was based on goal setting as a method to increase optimism. There are two potential relationships between goal setting, optimism and well-being that have been suggested. Medlin and Green (2008) showed that goal setting was related to optimism with engagement as a mediating factor. Optimism was then shown to result in increased performance. Goal setting has also been linked to increased self-efficacy, with visualisation of mastery as a mediating factor (Luthans et al, 2006).

Visualisation of mastery is related to the best possible self-imagery previously described and suggests that a combination of imagining a best possible self and setting goals to achieve that can positively affect optimism.

The second potential mechanism for the effects of a goal setting intervention on optimism, is the use of planning rewards to reinforce positive expectations for the future. It has been shown that optimism is related to an a priori belief about how likely future rewards are to happen (Stankevicius et al, 2014). The exercise taps into this by getting the participant to plan future rewards. If rewards are planned, this hugely increases the likelihood that they will happen, which can increase optimism. This also uses the concept of pervasiveness and permanence of events; over time, it becomes apparent that rewards and positive events can be possible in different situations and at different time points, which increase optimism and future expectations of positive events. In the intervention developed for this study, participants were asked to plan something nice that they would do for themselves the following day.

Self-Efficacy

Another included question in the daily exercises is "*What did you do well today*?" which is designed to get the participant to think of things they have achieved and been successful at to build self-efficacy and confidence in their abilities. One contributing factor to self-efficacy is previous mastery and achievement (Bandura, 1977). Self-efficacy interventions challenge the personal v. external aspect of attributions and are aimed at getting individuals to explain positive events with a realistic personal attribution. In a meta-analysis of 27 studies, Ashford et al (2010) showed that self-efficacy interventions that include an aspect of feedback are the most effective at increasing self-efficacy.

Interpersonal Relationships

The final two questions included in the daily exercises are: "*Think of someone you enjoyed talking to today. What were you talking about?*" and "*Think about someone you like at work. Write down one reason you like them.*" These questions are designed to increase interpersonal positive affect and to improve relationships - Brissette et al (2002) showed that optimism led to increased perceived social support. Karademas (2006) showed that optimism mediated the effects of self-efficacy and perceived social support on well-being, and Trunzo and Pinto (2003) showed that affective and emotional social support mediated the relationship between optimism and distress. By getting individuals to focus on positive social relationships, not only will this challenge the attributions of negative social events, in the same way as outlined for the other components, but it will also showcase social support. It is expected that this will increase optimism.

This gives a total of seven different exercises. Each of these daily exercises were included in the question list once, except for the Three Good Things exercise which was included twice as it was the main target of the intervention and has already been the most established as an effective intervention to increase optimism. This list was loaded into the app and randomised, so each participant received a different question each day from the list. It was regulated however, to ensure that the questions were more even, so each question can only be included a maximum of once a week. This ensures that although each participant receives a different question each day, and that in just over a week of usage, they should have received all the questions. This increases the variety of the app so that participants do not find the activities repetitive and boring.

Application Flow

Each day, when the users open the app, they are presented with one of the questions and a space to input their response. Depending on the question, either one or three responses are required. When the user taps on the response box, the keyboard is launched for them to type in their response. They are then asked to press a 'submit' button, for the application to save the answer. If the user exits the application before they have completed and submitted an activity, the application is set to return to that activity the next time the app is opened. Some daily activities require more than one response, each of which is submitted and saved individually so if the participant doesn't complete all the answers in one go, the next time they return to the app, they will have to complete any remaining answers. If the participant doesn't use the application on one or more days, once loaded the application will ignore any missed days and present the activity for the current day. There is a calendar function included in the application where users can look back over previous answers. However, they cannot change them, and they cannot go back to complete days they have missed. Where the participant has started the day's activity but not completed it by the end of that day, the system will allow them to complete that activity and then move onto the current day activity. Therefore, a participant can only start one routine activity per day. Once the answer has been submitted, the app loads a completion screen to tell that participants that their response has been saved correctly. Following this, the user can re-enter the app, but they will only be able to use the calendar function to look back over previous answers and won't be able to change their response or complete another activity. The appearance of the application is shown in Figure 15.

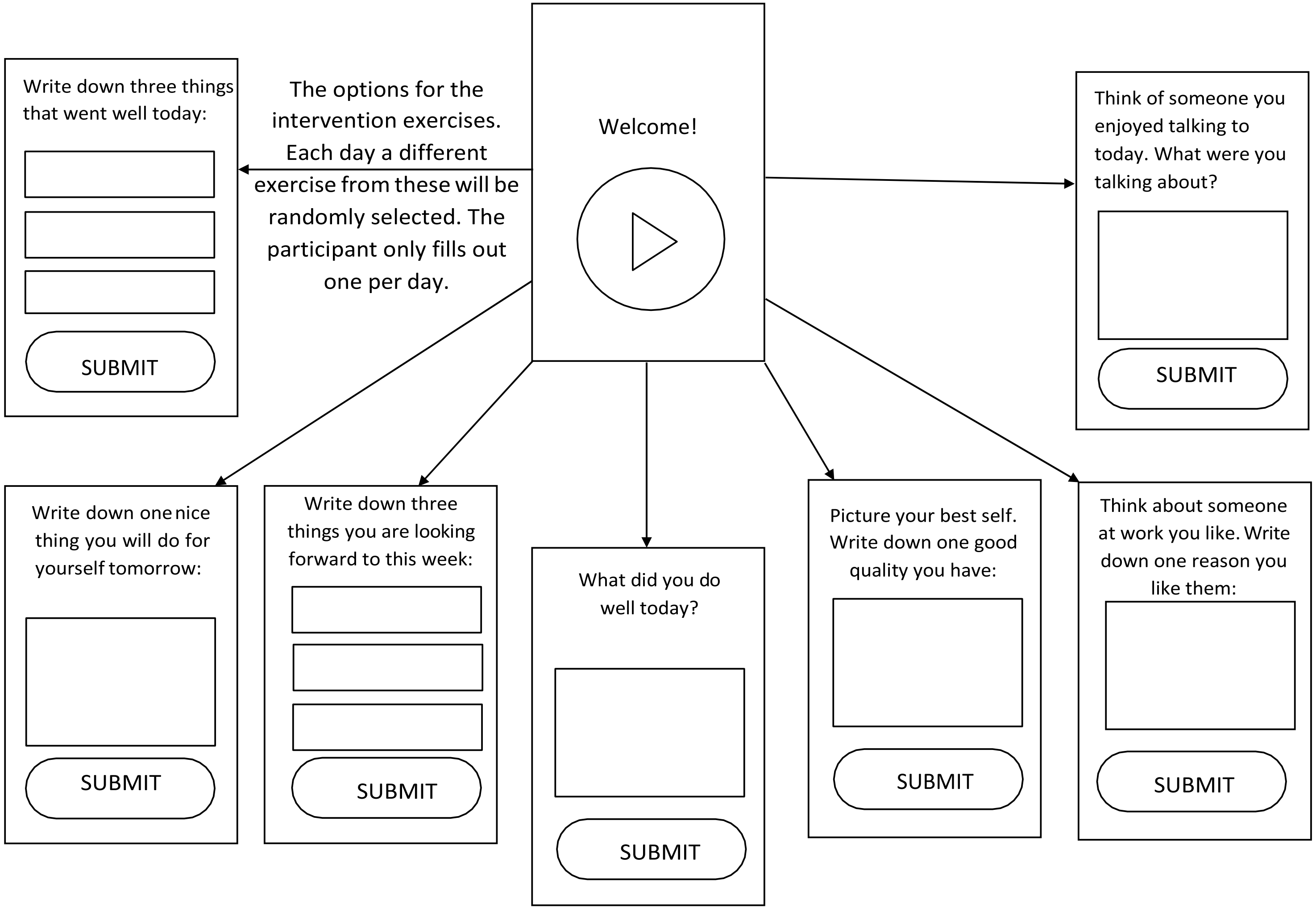

Figure 15: Application Flow

Usability Testing

Method

Procedure

Once the prototype application had been developed and the initial function had been tested, a full usability test was carried out. An opportunity sample of participants were recruited at a summer holiday education event where they were accompanying children attending the activities at the event, hosted at the University of Nottingham. Participants who consented to take part were shown the application on a tablet device provided by the researcher. They were shown the full process of using the application, starting with loading the application from the home screen. The researcher explained that the application contained a daily diary activity and showed the participants the calendar function. After this, the participants were asked to complete the exercise randomly presented by the application, to get a feel for how it worked and whether it was easy or not to use. Participants had five minutes to use the app and were asked to complete the daily exercise as if they had downloaded the app themselves. Once they had completed the activity and had a few minutes to try out the calendar function, they were asked to complete a composite usability questionnaire hosted on an online survey platform, also presented to them on the researchers tablet device, about the usability of the prototype application.

Measures

Mobile Application Rating Scale (uMARS) (Stoyanov et al, 2016)

The composite usability questionnaire was made up using items from 3 questionnaires. The first was the first three sections of the User version of the Mobile Application Rating Scale (uMARS) (Stoyanov et al, 2016), which was designed to be completed by end users of the app. The uMARS is made up of four main subscales measuring Engagement, Functionality, Aesthetics and

Information, as well as some further questions on App Subjective Quality and Perceived Impact. The first three sections (Engagement, Functionality and Aesthetics) were included in this composite questionnaire but the Information section was not included as this study was focused on the usability of the app for the delivery of the intervention, rather than the content of the questions or their specific aims. For each question, the participants were presented with five statements and asked to choose the response which was the closest to their opinion. One example question included on the scale is:

"Q1. Is the app fun/entertaining to use? Does it use any strategies to increase engagement through entertainment (e.g. through adding game features)?

1. *Dull, not fun or entertaining at all*
2. *Mostly boring*
3. *OK, fun enough to entertain user for a brief time (< 5 minutes)*
4. *Moderately fun and entertaining, would entertain user for some time (5-10 minutes total)*
5. *Highly entertaining and fun, would stimulate repeat use"*

The participant would choose the statement that matched the closest with their experience of using the technology. Responses 1 and 2 are generally negative, response 3 is generally neutral or moderate and responses 4 and 5 are generally positive. Therefore, a score of 2 on the scale indicates a negative opinion about the usability of the app, and a score of 5 would represent a highly positive view, indicating that the app was highly user- friendly. The uMARS questionnaire is included in Appendix D. During its development, the uMARS scale was piloted with a sample of 13 people, and then fully validated with a sample of 164 people (Stoyanov et al, 2016). The internal consistency was high, with an alpha of 0.90, and high values for each subscale of above 0.70. The test-retest reliability was measured over one, three and six month follow ups, and was found to be strong. Readability was also examined and found that it required Grade 8 reading skills, which should be very suitable for most adults (Stoyanov et al, 2016).

System Usability Scale (SUS) (Brooke, 1996)

The second scale included was the System Usability Scale (SUS) (Brooke, 1996), which was developed in response to the lack of cost-effective methods for assessing usability. The scale has been shown to have a high internal consistency with an alpha of 0.97 (Finstad, 2010). It has also been shown to be correlated to measures of actual performance when using the system, whereby greater ratings of usability are associated with better performance (Finstad, 2010; Peres et al, 2013). It was concluded, using over 10 years of combined research, that the SUS was a highly robust scale (Bangor et al, 2008). The SUS uses a 5-point scale where participants indicate how strongly they agree with the statement presented, where 1 represents strongly disagree, 2 represents disagree, 3 represents neither agree nor disagree, 4 represents agree and 5 represents strongly agree. An example item included in the scale is: "*I needed to learn a lot of things before I could get going with this system.*" The full SUS is included in Appendix D.

Ease of Use Questions

The final section of the questionnaire contained the same questions on Perceived Ease of Use included in the questionnaire study outlined in Chapter 5. Seven questions were included which were developed from previous questionnaires from Davis (1986) and Hu et al (1999) which measured perceived ease of use as part of the Technology Acceptance Model (Davis, 1986). These questions also use a 5-point scale to indicate agreement with the presented statement where 1 represents strongly disagree, 2 represents disagree, 3 represents neither agree nor disagree, 4 represents agree and 5 represents strongly agree. An example question included is: "*My interaction with this application was clear and easy to understand*." The same questions were used in order to provide a point of comparison between opinions of general well-being apps, and this specific prototype app which uses a daily diary method.

Perceived usefulness was not measured in this study as the focus was to test the usability of the mobile delivery method. Whilst perceived ease of use relates to the delivery of the intervention and is therefore suitable for this study, perceived usefulness relates to the content and whether it is deemed important or not by the target audience. Although the prototype application assessed in this study included an example intervention, it was not the focus of the study and so usefulness questions relating to it were not included in the measures. Firstly, this focuses the participants on the delivery method and ensures that their rating for usability are not affected by their opinions about the content or about mental health interventions. Secondly, focusing on the ease of use only allows the results to be more generalisable. The daily diary method could be used to host a range of other interventions such as goal setting, gratitude journaling or cognitive exercises. If the delivery method is shown to be easy to use, this helps to increase the acceptability of any application hosting a similar intervention. The perceived usefulness of the content can them be manipulated based on the aim and target audience of the intervention. Clear marketing and communication about the specific content chosen could influence the perceived usability of these other apps, which would be future research for each intervention.

In addition, as a cross-sectional design was used and the participants were only briefly exposed to the application, it would have been more difficult for them to form definitive judgements about the usability of the application. As perceived ease of use is more evident during shorter use, it is possible for users to form a judgement on this during the limited timeframe. Asking participants to focus on both topics during the time would increase cognitive load and may lead to less accurate judgements. Finally, the measures used to assess usability thoroughly contains three question sets and a range of open questions. Adding more questions to this which do not support the focused aim of the study could increase participant fatigue and discourage them from participating or completing the open questions at the end of the measure. A full list of the questions used in the measure is included in Appendix D.

In addition to the three sections of questions, participants were asked to fill out the demographic details of age, gender and occupation. They were also asked to give themselves a Confidence Rating out of 5, to indicate how confident they felt using technology in general, with 5 indicating full confidence and 1 indicating not confident at all. Finally, participants were asked several open response questions regarding the usability of the prototype application, to identify any potential changes that could be made in order to increase usability or attraction to the application. These questions were presented on a separate screen to the initial questionnaire and participants were free to add anything if they wanted to. Although the data collected was qualitative in nature as they were open response questions, the responses were very short, often only a couple of words, and it was decided that thematic analysis, as used with other qualitative data sources in this thesis, would not be suitable. Also considering that many of the responses were repeated, showing convergence of opinion, it was decided that a more suitable method would be to analyse the responses byfrequency to demonstrate which responses were most salient, in the form of a content analysis. The most frequently made suggestions could then be investigated to see which would be practical and possible to implement if the application were to be further developed in the future.

Participants

25 participants were involved in the usability test. 24% were male and 76% were female. Ages ranged between 28 and 72 years old, with an average age of 43.13 years. Represented occupations included nursing, teaching and therapists. Most participants rated themselves as quite or fully confident with using technology. Table 10 shows participant characteristics.

Table 10: Table of characteristics of participants in the usability study

Ppt.	Gender	Age	Occupation	Confidence Rating
1	M	44	HR Officer	5
2	F	38	Homemaker	3
3	M	40	Surgeon	5
4	F	47	Parent	5
5	F	34	Fundraiser	5
6	M	47	I.T.	5
7	F	35	Nurse	3
8	F	43	Teacher	3
9	M	72	Retired	4
10	F	29	NHS	3
11	F	37	Childcare Manager	4
12	F	42	Chaplain	3
13	F	52	Transport Planner	3
14	F	52	Language Teacher	4
15	M	44	Accountant	4
16	F	44	Academic	5
17	F	42	Occupational Therapist	5
18	F	42	GP	4
19	F	-	Speech Therapist	-
20	F	45	Account Manager	5
21	F	47	Team Manager	4
22	F	42	Teacher	-
23	F	46	Housewife	-
24	M	-	-	-
25	F	28	Nurse	5

Results

User Mobile Application Rating Scale (uMARS)

The average total score on the uMARS ranged between 2.44 and 4.58, with an overall average score of 3.56. The average score for the Engagement subscale was 3.03, the average score on the Functionality subscale was 4.45 and the average score on the Aesthetics Subscale was 3.41. Given that rating the app a score of 2 or less indicates a negative response, a score of 3 indicates a neutral or moderate response and a score of 4 or more indicates a positive response, this suggests that the app overall was rated as moderately usable, with moderate level of engagement, moderately acceptable aesthetics and presentation, but positive ratings for functionality, indicating that the actual working of the app is smooth and highly usable. Five questions in the measure received average scores above 4 on the scale, which were Questions 6 (4.46), 7 (4.32), 8 (4.63), 9 (4.48), 10 (4.04). The topics of these questions surrounded the function of the application, its overall ease of use and smoothness of function - including every question in the Functionality Subscale. The scores indicate that the application was rated highly on accuracy and speed of the functions, ease of learning, clarity of labels and instructions, smoothness of screen links, clarity of interactions with the application and suitability of the arrangement of content. This suggests that the application functions correctly and is easy to use and understand by users.

Four questions were rated below the middle score of 3 on the scale, which suggested that the application fell short of the criteria on Questions 1 (2.92), 3 (2.65), 4 (2.64) and 12 (2.92). These questions were regarding the appearance of the applications and indicated that the app was rated as not fun or entertaining, and didn't have enough customisable options, interactive features or a very engaging appearance. This suggests that although the application was rated as easy to use, it is not very engaging and in order to improve overall scores on the uMARS, changes need to be made to the overall appearance.

System Usability Scale (SUS)

In the 10-item System Usability Scale (SUS), items 2, 4, 6, 8 and 10 are negatively worded, but the equation to calculate the overall usability score weights these appropriately. When these are recoded to become positive scores, the average scores for each item varied from 3.20 to 4.90, with an overall average score of 4.18, which suggests that the application was given a generally positive rating, with most participants rating the scale as usable. The calculation for the overall score weights each odd numbered item as (score-1) and each even numbered item as (5-score). These coded scores are then summed and multiplied by 2.5 to give an overall usability between 0 and 100. The SUS score for this application was 79.9. This meets the guidelines outlined by Bangor et al (2008) who state that a score of 72.75 is considered a good level of usability and a score of 85.58 is considered excellent. Given the range of scores shown by the uMARS, this result on the SUS was expected as although the application was rated as usable, improvements are still needed to make it excellent for the end users.

Ease of Use Questions

The final section of the questionnaire included the Ease of Use Questions. Average scores ranged from 3.13 to 5.00, which was the maximum score, with an overall average score of 4.36. This indicates that on average the app was rated positively and as generally easy to use, with some participants rating it as very easy to use. This suggest that the daily diary method as presented in this application is easy to use and understand and that it takes little instruction or previous knowledge to become competent using it. Overall, this specific application given as an example was rated as easier to use than general well-being apps as rated in the questionnaire outlined in Chapter 5. This suggests that a daily diary method is easier to use than some existing methods that people have used previously and may simplify some apps. It also suggests that for people who had not encountered well-being apps previously, clear explanation or demonstration may show them how easy they can be to use and encourage them to consider using one.

Open Questions

In order to analyse the comments made in response to the open questions, a manifest content analysis was conducted. Content analysis refers to a group of analysis approaches used to interpret text-based data (Rosengren, 1981). The type of content analysis used will depend on the data available and the aims of the study (Weber, 1990). Although many techniques could fall under the umbrella of content analysis, there are four main approaches: conventional, directed, summative and manifest (Hsieh and Shannon, 2005). A conventional content analysis uses an inductive approach to generate categories from the data without influence from previous literature and is particularly used when previous theories are limited (Kondracki and Wellman, 2002). A directed approach to content analysis uses a deductive method in order to expand on previous theories and key categories are derived from these theories before coding (Potter and Levine-Donnerstein, 1999).
In a manifest content analysis, the frequency of specific words or content is measured, which allows some transformation from qualitative to quantitative data (Kondracki and Wellman, 2002). An example of where quantitative content analysis has been used is to examine the content of corporate email signatures (Rains and Young, 2006).

One of the advantages of a quantitative analysis is that it doesn't rely on subjective perceptions or interpretation and provides a transparent analysis of the data (Krippendorff et al, 2004). A summative content analysis takes the frequencies from a manifest analysis and includes some latent analysis of meaning of the words and content included (e.g. Babbie, 1992). As the responses in this study were mainly comprised of short words or phrases which were not being used to expand or create a theoretical model, a manifest content analysis - or quantitative analysis - was conducted to examine the frequency of each suggestion, in order to demonstrate some consensus on the most popular suggestions as a potential guide for future development of the application. Each response was read, and the suggestions included were categorised using an inductive method where the categories were derived directly from the data as the analysis was ongoing. The frequencies of responses in each category were then calculated and these are summarised and presented in the following sections.

What changes would you make?

When asked about changes, 19 participants responded and many of them indicated that they would like to see changes to the presentation of the applications, which was the most frequently mentioned change, with 13 respondents referring to aspects of the design. 4 people suggested that the colours of the application be changed, both to make it more engaging and to make the font clearer. 3 participants stated that they would like to see more visuals, such as pictures included that were relevant to the content. 7 respondents stated that it needed be generally more visually appealing. Finally, 3 participants mentioned that they would like to see notifications added, in order to remind people to complete the exercises daily.

What customisable options would you want?

15 participants suggested that they would like to be able to customise these features, including colours and notifications, in order to fit in better with their preferences. 2 people suggested they would like to be able to choose the colours, including coloured backgrounds for reading, and calming colours to suit their mood at the time. In order to best accommodate these suggestions, it would be most suitable to make this an option that individuals can customise themselves. 2 people also suggested that they would like to include their names in the application and have it refer to them by name, to give a sense of familiarity. 3 people stated that they would like to see more reminders or notifications, and 3 people were interested in a seeing a well-being summary as part of the application. Finally, 5 participants stated that they would like to be able to choose some other functions to add onto the

existing activities. One participant suggested that there could be a list of extra functions and users could select which ones they would be interested in adding on.

What other features would you like to see?

When asked about other features they would like to see included, 17 participants responded and mentioned links to other applications or information; respondents suggested including health and lifestyle information (1), linking the app to their calendar to sync with others (1), a notes feature (1) and the use of graphs to represent some of the information, such as tracking well-being over time (1). Linking to other useful features was also recommended as it could encourage people to use the app, by drawing them in using a necessary feature and making it easier to remember with a more salient trigger (1). For example, people would remember to load this calendar to see their appointments and be prompted to complete the exercise. 1 respondent also recommended that pictures be included, either as part of the application, or as a feature whereby people can upload their own pictures as positive memories and reminders. Finally, it was suggested by 2 participants that positive quotes could also be included, or a space included for people to include their own quotes, notes or reflections.

How can we make the app more engaging?

Participants were also asked how the app could be made more engaging. 18 people responded and again recommended pictures and colours (5 participants each) as well as fonts (2 participants) and overall visual appeal. They also suggested elements of gamification be used; 1 respondent suggested the use of in-apps rewards like badges to collect to keep people using the app over time and 1 suggested a link to a social element or the opportunity to connect with others.

How can we encourage people to use this app?

Finally, respondents were asked how people could be encouraged to use the application, and 15 people responded with most frequent answer being to introduce and publicise it using social media in order to introduce it to a wider range of people (3 participants). It was also stated that the application should either be made available for free, or be sponsored by their employer, so that it was free for users. Finally, 2 participants suggested that any advertisement should take into account the likely target audience and be tailored towards them in order to maximise usage.

<u>Discussion</u>

A mixed-methods study was conducted to assess the usability of a prototype well-being application which uses a daily diary methodology in order to increase optimism. 25 participants were given a demonstration of the application, given chance to use it and then asked to complete a questionnaire containing a composite measure of the uMARS, the SUS and perceived ease of use questions, as well as five open-response qualitative questions. The results of the quantitative questions suggest that the app scored highly on the function-related questions on the uMARS and highly overall on both the SUS and on the ease of use questions, which shows that it is usable and easy to understand. The app scored lower on the questions related to the appearance and engagement which suggests that improvements are needed in this area. This was supported by the qualitative questions, in which respondents made suggestions for improvements to the prototype such as adding colours and pictures to make it more visually appealing as well as more customisation and advertisement on social media.

Links to Previous Literature

The results of this study support the previous literature demonstrated by the review in Chapter 3, which showed that mobile applications for the delivery of well-being interventions are considered easy to use by the target audience. McKay et al (2019) conducted a usability study of 27 behaviour change applications targeted to mental health and well-being that they had sourced from app stores, and showed that on average, the apps were rated 3.26 out of 5 overall on the uMARS, which was the highest score out of all types of behaviour change apps tested. The prototype app outlined in this study received an overall average score of 3.56 out of 5, which is a slightly higher score than these applications. This shows that the application is at the same standard as others available for download and suggests that this app would be competitive with others in terms of usability and ease of use, which would help to attract people to it.

Similar conclusions were shown by the SUS results. Bangor et al (2008) suggested that an overall score of 72.75 on the SUS is considered as a good level of usability, and 85.58 is considered an excellent level of usability. The prototype application in this study received an overall score of 79.9 on the SUS, which meets the threshold for a good standard of usability. The studies identified in the literature review (Chapter 4) showed slightly higher scores on the SUS overall with Krafft et al (2019) showing a score on the SUS of 82.92 for the application used in their study, and Kizakevich et al (2018) showing a score of 85 for the PHIT for duty application. Although these scores are slightly higher and closer to the threshold for excellence, both these and the prototype application in this study all met the acceptable level of usability, which again indicated that the prototype application is to the same standard as other apps available.

Links to the Technology Acceptance Model

Perceived Ease of Use

The results from this mixed-methods usability study can be linked to the Technology Acceptance Model. The focus of this study was the usability and perceived ease of use of an example mobile application for well-being. Therefore, the three quantitative measures used link to the perceived ease of use facet of the TAM. From the uMARS, the subscales of Functionality and Aesthetics were used which assess the ease of use and appearance of the application, reflected in questions about how easy it would be to learn how to use the app and how easy it is to navigate through. The SUS and Ease of Use questions also all related to this factor. The results from the three measures combined indicate that the application was rated as easy to use by the participants. This would suggest that the daily diary method is easy to use and understand as a platform. Although the prototype app included positive reframing exercises as the content, this could easily be swapped for alternatives such as goal setting or performance monitoring, or other mental health purposes such as CBT or symptom management.

Perceived Usefulness

Whereas perceived ease of use relates very strongly to the delivery method and the practicality of the app, perceived usefulness is related to the content of the intervention and application. As the current usability study focuses on the method rather than the content, there is not a current link to perceived usefulness. This factor is very important in the implementation of the application, and clear communication about the purpose of the application and its benefits would contribute to increasing the perceptions of usefulness in the eyes of potential users. The uMARS subscales of Information and Perceived Impact would relate to the perceived usefulness of an application and reflect the quality and usefulness of its content.

Design Features

The qualitative aspect of the study was mostly related to the successful design features and where improvements are needed. Included in the uMARS was a rating of how clear the instructions and labels were in the application, and the prototype application was rated highly on this scale and so this is one positive design feature that should be kept even if the content is changed.
The open questions indicated that changes needed to be made to the design of the application's appearance in order to make it more engaging and visually appealing. Additionally, the Aesthetics subscale of the uMARS also reflects the design features of the application by assessing the layout, graphics and visual appeal. The TAM states that the design features affect the perceived ease of use and perceived usefulness and suggests that changing these features could lead to increase in these perceptions. For example, easy to understand graphics and signposting could make the application easier to use or may make the content more accessible and easier to process, thereby increasing its usefulness to the target audience.

Engagement

The results from this study also support the role of engagement, which is included in the model of determinants of perceived ease of use (Venkatesh, 2000) and TAM 3 (Venkatesh and Bala, 2008). The Engagement and Aesthetics subscales of the uMARS measure how engaging and visually appealing and application is and are equally weighted with the functionality in the overall score. The prototype application received average scores for both engagement and aesthetics which suggest that these areas would be the focus of any future improvements in order to raise the overall score on the uMARS. This conclusion is further supported by the open questions, the results of which suggest that participants would like to see a more visually appealing application with more colours and images. As this was the focus of the comments made by participants, this demonstrates the importance of engagement and visual appeal to users and suggests that once an application is easy to use, users' focus turn to engagement and the intrinsic motivation to use the system. This aligns with research by Hsu and Lu (2004) which suggests that perceived usefulness and perceived ease of use cannot be the only contributing factors to usage of a technology, as they don't explain why people use technologies which are not directly useful to them such as video games. This type of technology provides entertainment rather than a function and so they suggest that engagement is also a highly motivating factor.

Links to the CFIR

The results of the usability study can also be connected to the CFIR, through the intervention characteristics factor. Specifically, the usability of an application is related to the facets of complexity, design quality and packing and adaptability. A system that is overly complex is not adaptable enough to suit a range of users and a system with poor design and packaging quality would not be rated as highly usable. That the prototype application has been rated as usable in this study, suggests that it demonstrates suitable level of complexity, adaptability and design quality, which contribute to a more effective implementation process. However, improvements have been suggested to improve the quality of the packaging and presentation. With this application, the CFIR indicates that the low visual appeal and lack of engaging features would act as a barrier to successful implementation. Usability testing can be used in the development stages of creating an application to assess whether an application meets these criteria, and if not, changes can be made to create the right level of complexity, adaptability and a user-friendly design with high quality packaging. Meeting these criteria will contribute to more effective and efficient implementation, as suggested by the CFIR.

Limitations

There are several limitations with the study design which need to be considered when interpreting or generalising the results of this study. Firstly, a convenience sampling strategy was used which may limit the representativeness of the eventual sample and limit the generalisability (Emerson, 2015; Erickson, 1979). A cross-sectional design was also used, as the respondents only filled out the survey once, at the given time point. Therefore, it is not possible to claim causation of relationships (Carlson and Morrison, 2009). However, longitudinal studies are resource intensive and can be affected by participants dropping out of the study between measurements (Levin, 2006). A cross-sectional design was therefore more practical for this study, but the results cannot be used to confirm any directional relationships. As a result of these design features, it can be concluded that it is possible that the results would have been slightly different if the study had taken place at a different time or place. However, the results found in this study concur with previous research into the usability of well-being applications, which helps to support the conclusions. One further limitation resulting from the use of a cross-sectional design is that the participants were asked to form judgements about the usability of the application after a short exposure, rather than after prolonged use in their own time. Due to practical constraints, including the inability to publish an application on a trusted store before testing, it was not possible to get participants to use the application for longer, and so their impression of usefulness would have to be formed quickly and may not be as accurate as a result. If the application was to be introduced for usage, a longitudinal pilot study carried out with actual users from the target audience who had longer exposure to the app would be beneficial.

Conclusion

A prototype application was developed to host a well-being intervention which used a daily diary activity method in order to increase optimism. A usability test was conducted with 25 potential users, who completed the uMARS, the SUS, ease of use questions and open questions relating to their experiences with a short taster of using the application. Overall, the usability of the application was rated positively across three measures and was shown to meet the standards previously demonstrated in the literature for similar applications in this area. Improvements were suggested relating to the appearance and engagement of the application, with participants stated that the visual appeal needed increasing in order to attract users. These results were presented in relation to the TAM and the CFIR. In addition, these results also show support for a role of engagement in the TAM, as suggested by the model of determinants of perceived ease and TAM3. Usability testing can contribute towards successful implementation on an application by providing an indication of the satisfaction with the intervention characteristics. The next stage of the research was to further investigate the implementation of such an application, and to further assess some of the factors presented in the CFIR, using a series of focus groups.

Chapter 7: Study 3: A focus group investigation into potential barriers or facilitators to the implementation of well-being applications in the workplace

Aims

This chapter outlines Study 3 which uses a qualitative approach to investigate implementation as the third aspect of user experience, and addresses the third aim of this thesis which is:

- To investigate the barriers and facilitators of implementing a well-being application in a workplace context.

In this study, a series of focus groups were conducted in which working adults were asked about potential barriers towards the implementation of mobile applications for well-being in the workplace, and any facilitating factors that could encourage usage of such applications.

The results of the previous chapters show that mobile applications for the delivery of well-being interventions offer several advantages such as ease of access and flexibility. Chapter 3 showed that in previous studies, applications of this type have been rated as user friendly, and Chapter 6 demonstrated that the prototype application created in this thesis met these standards for usability and was generally rated as positive and easy to use and understand. However, there are indications, such as in the qualitative section of Chapter 5, that perceived usefulness and ease of use might not be enough to encourage regular and repeated use of the applications. This suggests that there are other factors relating to the implementation of the application that contribute to its success or failure. In order to establish what these factors are in a well-being context, and which are most relevant, a qualitative study containing a series of four focus groups was conducted. 25 working adults took part in these groups and were asked about possible barriers or facilitators to successful implementation of a well-being application in a workplace setting. Five factors were identified using thematic analysis; *Outcomes, Previous Use of Technology, Flexibility, Time Pressure and Engagement*. Although an inductive analysis approach was initially taken, these results can be linked to the Technology Acceptance Model and the CFIR.

In order to assess the factors related to implementation and the barriers to usage, it was important to consider the context of the implementation. For this study, the workplace was chosen as the context for implementation.
Poor mental health of employees can be very expensive for employers and business owners, especially through absenteeism and reduced productivity (Aikens et al, 2014). Therefore, investment in the mental health and well-being on employees can lead to benefits for the employers such as increased worker engagement (Malinowski and Lin, 2015), better team working (Papenhausen, 2010) and increased job satisfaction of employees (Jung and Yoon, 2015). In order to attract employees, businesses now need to offer opportunities for fulfilment and support for their employees' well-being (Barlow, 1999) and offering cost-effective and easy to access interventions through mobile technology can be one method of achieving this. Additionally, the CFIR (described in Chapter 2) is relevant to the workplace and several of the facets depend on an organisational context such as external policies and incentives, peer pressure, networks and communication and a culture of implementation of new processes. Many of these factors which are proposed to contribute to more effective implementation are only present in the workplace, suggesting that the workplace might be a suitable context for implementation of a new intervention. Therefore, this study used a sample of working adults and asked them about barriers and facilitators to implementation in a work context. Participants were asked about the current usage of technology in the workplace, how a new intervention could be implemented and any issues that might affect to successful usage and implementation that they could foresee.

Method

Participants

The sample of participants used in the study was an opportunity sample, using employees from local businesses. The advantages and disadvantages of this method are discussed in Chapter 4, but it was decided that this would be the most suitable method of sampling for this study as a result of practical constraints. Four focus groups were conducted using the following groups:

Group 1: Participants for the first focus group were approached via a gatekeeper within their organisation who had shown interest in the research area and was contacted to identify any employees who might be interested in taking part. This focus group involved 7 employees of a local housing association. The participants ranged from around 25 to around 45 years old, with three females and four males who had several roles in the organisation, including administration-based roles, service-based roles and support based roles. This gave a perspective from both halves of the organisation – the office-based roles and the field-based roles.

Group 2: The second focus group was a convenience sample of was made up of a group of 5 postgraduate researchers working in the Division of Psychiatry and Applied Psychology at the University of Nottingham, who were developing a technology-based intervention or using technology in their own research. They were taking part in a group discussion about using mobile technology in research and were all asked if they would be willing to have the discussion recorded for the purposes of this research, to which all agreed. Participants in this group were all females in their 20s who all had postgraduate degrees. Their areas of research included adults with dementia and children with ADHD, and all were using mobile technology.

Group 3: The third focus group was made up of 8 members of a professional services department within an academic institution, with 4 males and 4 females, who all had office-based roles. Although the participants in this group had some familiarity with mental health research, they were asked about mobile technology in relation to their own workplace and their own usage, rather than in a theoretical way. Many had a medical background and had previously worked in the NHS in areas such as working with nursing staff and brought this perspective into their discussion.

Group 4: The final sample was made up of 6 NHS administrative staff, with 5 females and 1 male participant, with ages ranging from 20s to 50s, which a variety of experiences. In this group there were two people who openly discussed their own experiences with mental health issues and used this perspective when talking about usage of mobile technology in this context.

Table 11 below shows the demographic details and participant codes of those who took part in the focus groups.

Table 11: Demographics of Focus Group Participants

Group	Participant	Gender	Age Range	Occupation
1	1	M	35-45	Housing Association (Office)
1	2	M	35-45	Housing Association (Craft)
1	3	M	35-45	Housing Association (Craft)
1	4	F	18-25	Housing Association (Office)
1	5	F	45-55	Housing Association (Office)
1	6	F	45-55	Housing Association (Office)
1	7	M	18-25	Housing Association (Office)
2	1	F	18-25	Researcher
2	2	F	18-25	Researcher
2	3	F	18-25	Researcher
2	4	F	18-25	Researcher
2	5	F	18-25	Researcher
3	1	M	25-35	Professional Services
3	2	M	35-44	Professional Services
3	3	M	45-55	Professional Services
3	4	M	35-45	Professional Services
3	5	F	35-45	Professional Services
3	6	F	35-45	Professional Services
3	7	F	25-35	Professional Services
3	8	F	18-25	Professional Services
4	1	F	35-45	NHS Administration
4	2	F	25-35	NHS Administration
4	3	F	18-25	NHS Administration
4	4	F	45-55	NHS Administration
4	5	F	25-35	NHS Administration
4	6	M	35-45	NHS Administration

Procedure

Participants were invited via a gatekeeper to attend a one-hour focus group to investigate opinions on the use of mobile technology in the workplace, and for mental health and wellbeing interventions. Participants were told that the focus groups would be audio recorded but in the resulting transcription they would be anonymous. Although there were several set questions, and the participants were clearly told the overall aim of the focus group, the discussion was kept purposely informal to allow the participants to feel comfortable sharing their experiences and to encourage a discussion between participants with little direction from the researcher. Puchta and Potter (2004) state that this is an advantageous approach as "*informality encourages interaction to happen [and] facilitates styles of response that are especially useful in focus group research*" (p25.) This approach also allows new ideas to be generated and shared and for participants to construct new ideas collaboratively, which as previously stated is one advantage of the method. The participants were given some initial questions (included below) and prompts when necessary and were asked about their current use of mobile technology both in the workplace and in their personal lives, ways in which they could see technology becoming beneficial, their opinions on the use of mobile technology for mental health initiatives, any barriers or issues they could see with implementing technology-based interventions, and possible suggestions of ways to overcome these. At the end of each focus group, they were also given the opportunity to comment on anything else they thought would be relevant. Once these had been recorded, the transcripts were ready for analysis.

List of questions

1. What mobile technology do you currently use and what purpose do you use it for?
2. How can we encourage people to use mobile technology for well-being?
3. Are there any barriers that would prevent people from using a well-being application at work and how can we overcome them?
4. Do you have any further comments you would like to make?

In addition to these main questions, probing and follow up questions were also used to add further details to the points made and to clarify when needed. As previously stated, these questions were left purposefully general in order to elicit a range of response and to encourage people to feel comfortable to share their opinion.

Ethical Considerations

Participants were reminded that it was their choice to take part in the study and any comments they chose to make should be entirely voluntary and that they were under no obligation to take part, even if they had previously agreed. One disadvantage of focus groups is that the group setting could discourage people from making comments they feel are important, but wouldn't want to make in front of others, particularly colleagues as with the participants in this study. In case this situation arose, participants were reminded that they could contact the researcher at any time if they have something else they wanted to discuss that was relevant to the study. Participants were also reminded that they would be kept anonymous throughout the research process – consent forms were stored separately to any data and any identifiable information in the audio recordings was removed during transcription. Once transcribed the audio recordings and transcriptions were stored in accordance with data protection protocols, as outlined in Chapter 3.

One potential ethical issue with focus groups is the revelation of sensitive or personal information, such as mental health issues. During the focus groups, several participants made reference to their own experiences with mental health issues, and mental health conditions that they were seeking help for. After ensuring that these individuals were fully anonymous, no further action was taken by the researcher as all participants who had mentioned mental issues also noted that they were receiving help and no concerns were raised about mental or physical safety.

Data Analysis

Thematic Analysis

Using the audio recording of the focus groups, thematic analysis was conducted which has been described as the process of identifying patterns or themes within a qualitative data set (Braun and Clarke, 2006). The process of this thematic analysis followed the six-phase process presented by Braun and Clarke (2006), which are:

Phase 1 – Familiarising yourself with the data

Phase 2 – Generating initial codes

Phase 3 – Searching for themes

Phase 4 – Reviewing themes

Phase 5 – Defining and naming themes

Phase 6 – Producing the report

These phases outline the initial process of thematic analysis to provide structure and clarity, but it is an iterative process where researchers may need to move between the phases in a different order and repeat them at different times. Data collection, analysis and report writing may happen concurrently and be interlinked in a non-linear fashion in order to generate the most accurate analysis (Creswell et al, 2007).

Once the data recordings had been transcribed, they were listened to again to note any initial emerging ideas and relevant points, which is considered an important stage in analysis (Riessman, 1993). The transcriptions were read through several times in order to gain familiarity with the data. The codes were then generated in a two-step process; firstly through an inductive process with minimum influence from previous theory (Boyatzis, 1998) followed by a deductive stage where previous literature was used to corroborate the themes and ideas generated by the analysis. This is shown in the combination approach taken by Fereday and Muir-Cochrane (2006) who suggest that using dual approaches represents rigor in analysis and ensures that the analysis is robust and includes an appropriate level of detail. In several cases, the themes generated could be linked together under over-arching themes following the literature and therefore, subthemes have been used where necessary. A detailed discussion of thematic analysis, including its advantages and limitations is outlined in the Methodology (Chapter 4).

Coding Manual Development

For qualitative studies, the main quality criteria used are trustworthiness and rigour (Houghton et al, 2013; Golafshani, 2003). In quantitative data collection, trustworthiness is demonstrated using statistical methods such as reliability and validity and there is a great focus on ensuring that the research process and analysis methods are replicable by maintaining transparency in the reporting. Methods sections should include sufficient detail to allow other researchers to conduct exactly the same study to confirm the results. Statistical methods of validation are not possible with qualitative data, so other methods are needed to confirm trustworthiness and rigour. Lincoln and Guba (1985) suggest several criteria for trustworthiness in qualitative analysis, which are credibility, transferability, dependability, confirmability and audit trails. Credibility refers to the matching between the views the respondents intends to put across and the views the researcher interprets (Tobin and Begley, 2004). One way to increase this is to check the conclusions with a member of the focus group to confirm that their responses have been correctly transposed and interpreted (Lincoln and Guba, 1985). However, this reduces the anonymity of the respondents by directly linking them with the data after analysis.

Transferability is the ability to generalise the conclusions. This requires rich explanations of the themes with suitable examples so that those who are interested in generalising the findings to their own context would be able to assess whether it was suitable to do so (Lincoln and Guba, 1985). Dependability can be achieved by ensuring that the research and analysis processes are clearly outlined and could be audited or replicated to confirm then results if needed. This clear record also ensures confirmability by demonstrating that the results are data-driven. Lincoln and Guba (1985) suggest that confirmability is achieved when there is a transparent process and credibility, transferability and dependability are all evident. As stated, one method of ensuring transparency is to include an audit trail which Koch (1994) demonstrates dependability and shows the rationale for decisions made in the analysis. Another researcher should be able to follow this trail and come to similar conclusions. It is argued that in many qualitative studies, replication of the thematic analysis methods used is difficult as they do not report enough detail about the process to allow this (Roberts et al, 2019).

One method which can be used to increase the transparency of the process to allow for replicability is the use of a codebook (Roberts et al, 2019). This involves including definitions of the codes used to identify the themes in the analysis so that the process can be followed in detail and would be developed during Phase 2 of Braun and Clarke’s (2006) method of thematic analysis - generating initial codes. Fereday and Muir-Cochrane (2006) outline the steps needed to develop a codebook, based on a framework by Crabtree and Miller (1999):

Stage 1 - Developing the code manual

Stage 2 - Testing the reliability of the code

Stage 3 - Summarising data and identifying initial themes

Stage 4 - Applying the template of codes and additional coding

Stage 5 - Connecting the codes and identifying themes

Stage 6 - Corroborating and legitimising coded themes

Depending on the research design, the codebook can be developed from previous literature or from an initial scan of the collected data. In the focus group study presented in this chapter, the codebook was developed from an initial scan of the data, in order to keep the analysis data-driven. Boyatzis (1998) states that the codes included in the manual should include the code label or name, a definition of the theme, and examples. The codes used in the focus group study are included in Appendix E, which was then used the complete the rest of the thematic analysis following the processes outlined by Fereday and Muir-Cochrane (2006) and Braun and Clarke (2006).

The inclusion of the codebook aims to increase the transparency of the data analysis process and allow enough detail for the analysis to be replicated. The nature of the questions and the themes identified suggest that it would be possible for these conclusions to be generalised to other workplaces, which increases the transferability. As suggested by Lincoln and Guba (1985) the analysis process has been clearly outlined, including a description of the codes used for analysis to provide an audit trail, which increases the dependability and confirmability of the analysis.

Triangulation

Triangulation is a process which involves combining data from multiple sources to converge on a conclusion and has been used as a qualitative strategy to confirm validity (Carter et al, 2014). Four methods of triangulation were proposed by Denzin (1978) and Patton (1999); (1) method triangulation where multiple methods are used to investigate the same aim, (2) investigator triangulation where multiple researchers provide observations or analysis, (3) theory triangulation where theory is sued to confirm or refute a conclusion and (4) data source triangulation where data is collected from different types of people to include alternate perspectives. In the analysis of the focus groups, two methods of triangulation have been used. Firstly, there was some data source triangulation as different groups were used from different organisations in order to confirm the common themes across contexts. However, the main method of triangulation used was theory triangulation. The data analysis was conducted independently of the previous research and models outlined in this thesis to ensure a data-driven process. The conclusions were linked to the TAM and the CFIR to confirm the results after the themes had been developed to provide triangulation for the findings, which also acts as confirmability. The data-driven analysis and the theoretical models came to the same conclusions independently before being linked which suggests that they support and confirm one another.

Results

Once conducted, the thematic analysis gave the following structure of themes and subthemes (Figure 16, below). Each theme and subtheme will be described in full, using quotes from the participants to provide detail as suggested by King (2004).

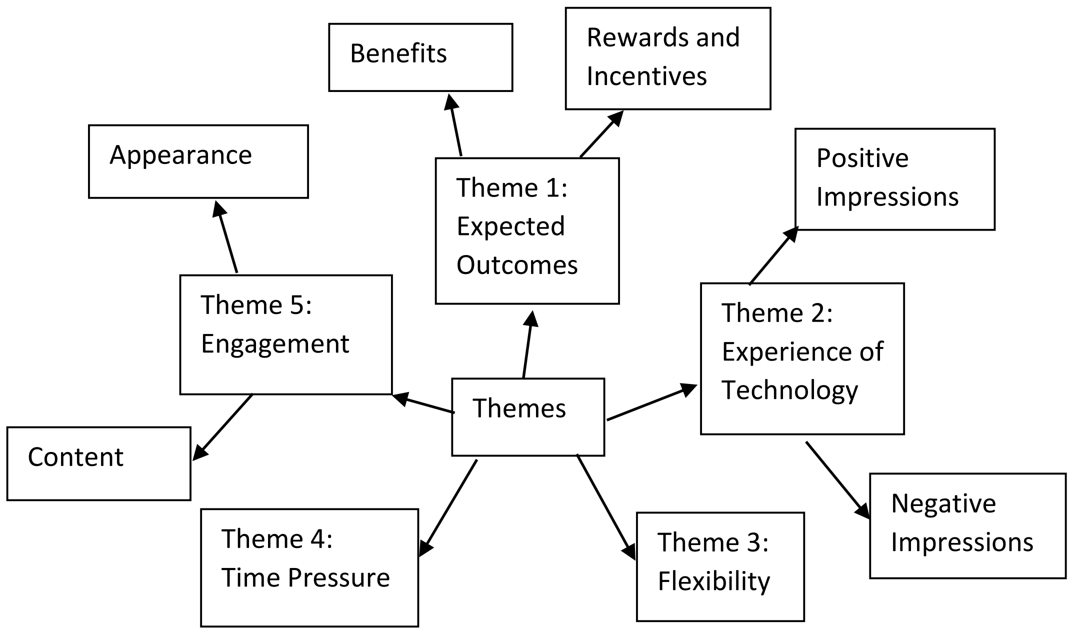

Figure 16: Themes identified in the thematic analysis of focus group results

Theme 1: Outcomes

Benefits

The first theme identified was the idea that the interviewees wanted evidence that the proposed technology would give them a benefit of some description. This theme encompassed two codes, which were the proof that the technology would achieve its aims and help with workplace well-being, and the idea of a reward or external encouragement for completing the app, regardless of the actual effects on mental health. This theme was very prominent in the discussion, with several participants commenting on this concept several different times and coming back to it at different points in the discussion. All participants commented in this area at least once throughout the discussion, suggesting that this is an important topic. The first mention was explicitly stated with one participant asking: *"What do I get out of it?"* [F1, P2], and suggesting that others would ask the same when presented with the application. They wanted to know whether there would be *"something to give back to those who want to engage"* [F1, P1]. There were several variations of this question expressed throughout. One participant summarised this point by stating:

"The ultimate thing is I would want to know what's going to be different at the end of it. If I'm going to invest all of this energy and time, what's in it for me? Secondly, what's in it for everybody else but, everybody's always thinking, normal human behaviour is, what's in it for me? What am I going to get?" [F1, P5]

Their main concern was that a proposed app would live up to expectations and change whatever it was promising to change, in this case workplace well-being. It was suggested by the participants that focusing on this aspect and showing evidence that well-being would be improved by the app would increase usage and adherence. This suggests that well-being in an important priority for the employees and would be an attractive factor. As one participant stated:

"I think initially you'd find resistance to it but actually if they started doing the stuff correctly then they will actually see that it does benefit them to take that time out." [F3, P4]

They stated that one way to demonstrate the benefits to participants was to have an ongoing report:

"A weekly report…a bit like my Fitbit" [F3, P6]

They suggested that this would allow participants to see what was changing for themselves and allow them to feel more involved. This need for the benefits of the application were summarised by stating that in essence:

"You've got a sales job to do" [F3, P4]

"If you know what you're doing it for… you're much more likely to give it a go" [F1, P1]

Rewards and Incentives

The other aspect of the expected outcomes covered the use of rewards and incentives to externally motivate people to use the app. One participant stated that they *"definitely think"* [F1, P3] that a reward would be needed to encourage interest. It was suggested that usage of the app or any other technology could be included in any existing reward structure. They gave the example that in their organisation, there is a reward system that uses shopping vouchers. However, one participant stated:

"I don't know if that's something that might drive somebody but then, is that the right attitude to have?" [F1, P5]

This suggests that they felt extrinsic rewards were not the correct method to increase adherence to a well-being intervention. Although it was clear that gaining something in return was important for the interviewees, there were some difference in opinion of what this should entail.

All agreed that it should be clear what the aim of the intervention is (ideally something of interest to the target audience), and there should be evidence for its success. Some participants would like to see a reward, and it may be that even though it might not be the 'right attitude' to have, it is necessary to start the change in culture towards using this intervention regularly.

Theme 2: Experience of Technology

The second theme is previous experience with technology which can be divided into positive and negative impressions of technology. Some participants suggested that the widespread usage of technology demonstrated that it would be suitable for delivering interventions while others stated that negative experiences of using technology in the past could be off-putting.

Positive impressions of technology

One participant stated that the current use of mobile technology indicated that it was a good avenue for the development and delivery of well-being interventions and that it has potential to be used in a positive capacity. They said:

"Everybody's using technology so much… gives us even more reason to look into apps that could help people… why wouldn't we do that because people use it anyway" [F2, P1]

It was also suggested that this current interest could be utilised to increase participation or usage of the new technology. Technology is already part of many people's lives and it is something they have become accustomed to using, so participants thought that this could encourage people to use the intervention. They said:

"[You could] piggyback it onto an existing outlet for something everybody wants" [F3, P1]

"Make it part of an existing process and build things into your routine" [F3, P4]

Negative impressions of technology

However, some of the participants reported that they already felt that they spent too much time of their mobile devices, with one participant stating that they had realised how much time they were spending on technology such as social media sites, without seeing any benefits. Participants suggested that although there were advantages to using technology, there was a fine balance before they were using them too much and they noted that much advice for well-being is to stop spending so much time on technology and social media, especially before sleeping.

"how many hours I would waste scrolling and not getting anything out of it" [F4, P2] and that it *"really became a bit of a problem… there's nothing for me"* [F4, P2]

"[Mobile devices are] a double-edged sword [and] also part of the problem" [F3, P3]

"I live on my phone I'm guilty of it – it's quite sad that we have to agree to no phones" [F3, P6]

"Spending a long time just on your phone or your computer has a negative impact… technology has an addictive side" [F2, P3]

Some participants stated that they felt apps were not the best option for themselves personally and that they would prefer having the option to use a different method. One participant, who had attended a mindfulness-based workshop which was supported by follow-up sessions using an application, said:

"I found myself not needing to use [apps] because the theory [from the course] all went in my head…the app got in the way a bit...telling me to do things" [F4, P1]

Another suggested that using technology to take the place of a system that already worked well, such as writing in a journal or making physical notes, but not actually be advantageous or suits everyone's preferences:

"not everyone likes to use apps do they, some people like to write things down. [using an app] is just another thing to do" [F4, P4]

Some participants expressed concern that not everyone would have the same level of technological literacy to be able to benefit if an app-based intervention was introduced. They suggested that:

"a big amount of people just don't access any technology at all" [F1, P2] or *"aren't actually on email"* [F1, P2]

This suggests that the current technology structure would influence the use of new technology. People who hardly use email may be unlikely to use a mobile app, either by choice or due a lack of knowledge. There was also suggestion about how much people personally used mobile technology, their own attitudes to it and their own level of technological literacy. One participant stated:

"My mum had to learn how to use a phone in the past 5 years… for certain people it's just more difficult to engage with technology, it just takes up so much effort to learn how to use it" [F2, P5]

This suggests that the current usage of technology and the openness to the use of technology should be assessed before implementing a new technology. It may be that some training before implementation is required to teach people the necessary skills and ensure that everyone meets the minimum required level of technological literacy. Assessing the level of technological literacy in all target areas of the organisation is clearly important. It was also suggested that the previous attempts to introduce technology in one of the organisations (FG1) had impacted on the opinions about any future implementation of technology interventions. The participants stated that they didn't use technology *"as much as we want to"* [F1, P5] and that this was related to having *"continuous IT fails"* [F1, P5] previously. One participant stated:

"don't have many apps on [their] work phone – its antiquated" [F4, P1] They

also said that:

"[The] existing devices don't work as well as they could" [F1, P5]

"Technology that we've attempted to roll out… has continuous fails… to have something added onto that when the existing devices aren't working as well as they could… it might be seen negatively" [F1, P5]

They stated that this could cause any new technology to be viewed badly before it had even been tried. This suggests that examining the current IT support and making sure that the basic technology such as mobile devices and computer software is working correctly before trying to implement a new technology on top. It also suggests that support throughout the use of mobile technology is important to prevent the fails and to make sure that any technological issues don't overshadow the benefits of the technology. As one participant stated:

"with technology, you just never know [what will happen]" [F4, P5]

Theme 3: Flexibility

The next theme identified was the concept of making the app as flexible as possible to make it suitable for everyone in the organisation, which would involve having different options for personalisation where possible, either in the delivery, content or presentation of the app. One participant stated that:

"a one size fits all approach doesn't work" [F1, P5]

They state that allowing customisation for as many aspects as possible would encourage people to use the app, and reduce the feelings previously mentioned of adding too much to the workload, by allowing people to use the application at more suitable times or locations. It was also stated that:

"everyone is different so what works for one person and what one person likes, another person won't so it is good that it can be a bit adjustable…you can pick and choose what works for you" [F4, P5]

A variety of different customisation options were suggested, including offering the app in *"various formats… that's more suited to their role"* [F1, P2] such as on desktop as well as on a mobile device and that it could perhaps be linked to a screensaver so that it was very visually salient and easy to remember. This was linked to the previous points about technology usage, as they suggested that not everyone had or used a work mobile device, but that equally field-based colleagues who work away from the office environment may not have easy access to a laptop or desktop computer to use. One participant stated that they:

"use the computer at work for everything" [F4, P1] , that sometimes apps are *"more time consuming than helpful [if you are already using a computer]"* [F4, P1] and that *"it would be good if people could use it on a computer so you can give people more options"* [F2, P1]

Having a choice in how they use the intervention, including the option not to use technology at all, could also increase autonomy, interest in the intervention, and overall usage. It was also suggested that different methods of interacting with app could be utilised such as visual media, such as uploading or taking photos, which one participant said was:

"much better I think, like having images to represent your feelings" [F4, P4]

Several participants also suggested that a voice recognition method could be useful as people might not like to use technology for entering data, as some people find the format on mobile devices difficult to navigate and struggle to use the keyboard functions in comparison to using a voice recording function:

"It's talking to me and I'm talking back to it… I'm not having to write anything… I'd probably use it. If there is anything remotely like form filling, I will not do it. I do not have the patience" [F4, P5]

"my attention span is really short, I can't write especially on a phone, I just cannot write paragraphs" [F4, P3]

"voice overs are a very big thing" [F2, P1]

They also suggested that the actual app itself be customisable to the individual and that people should be allowed to complete the exercises at a time that would suit them and their routine. It may be that this time needs to be flexible not just to the person, but to the day as schedules differ from week to week. It was stated that it:

"needs to be relevant to the day" [F1, P3] and *"fitted to the person"* [F1, P2].

One person stated that the reason they didn't use an app was because:

"It didn't fit into my life…. I forced myself to use it rather than it being a natural thing" [F3, P7]

To make an app or technology-based intervention fit the person, they suggested that the intervention should be flexible as to when it needed to be completed to make it fit around work schedules and workloads but that a notification might be helpful to keep track. The interviewees suggested that they *"don't mind a pop up"* [F1, P5] as long as they could snooze it until it was more convenient for them. They also pointed out that the timing of any notifications or reminders was important, as there was no point reminding them to fill out a diary of their day if their day had only just started. They therefore suggested that they could set their own notification time, or that it was somehow linked to their log off procedure at the end of the day. This was contradicted by another focus group, where participants suggested that reminders may add an unwanted pressure, which could cause stress - the exact opposite of what a well-being application aims to do.

"that negative self-thought of 'Oh I need to do this', and 'I haven't done it' and 'I'm awful for not doing it'" [F4, P5]

"those reminders when you haven't done something just aren't helpful and they make you more want to ignore it and not want to do it" [F4, P5]

"I know I need to do it, stop reminding me!" [F4, P3] However, they did state that it was:

"good to have positive stuff like yay, you did it!" [F4, P5]

Giving people a choice of method and time seemed to go some way to reducing concerns about it getting in the way of their jobs or being too much of an inconvenience. This links to the previous theme of rewards, as the motivation or positive reinforcement and praise could act as a reward and have the same encouraging effect.

However, they did say that:

"You're not going to be able to please everyone… you just have to make it the best you can" [F4, P3] and *"any kind of treatment or help isn't going to work for everyone. People have to find out what works best for them."* [F4, P5]

They also added that there needs to a balance between flexibility and adding on too many options which become overwhelming and off-putting. This echoes the balance needed between reminders and pressurising notification.

"You want to give people choice…. [without] adding more complexity" [F2, P1]

The need for choice in customising the app, but also in whether to use it at all was emphasised by further comments which suggested that making employees feel like they are being forced into using it would be disincentivising:

"People are doing it because they've been told they've got to do it" [F3, P4]

"If you mandate it, it loses its power" [F3, P1]

This suggests that an element of control is necessary to encourage people to use a well-being app, which links to the previous theme of personalisation. Employees want to feel in control of when and how they use this type of technology and to take ownership for it themselves. This can be facilitated through clear communication when it is introduced, and by involving users in the development, such as conducting focus groups or user acceptance testing.

Theme 4: Time Pressure

One theme that recurred in several of the focus groups was the pressure associated with finding time to complete anything extra, and the organisational culture that they felt pressured them into being seen to be constantly working. One participant stated that they had previously felt:

"glued to that desk then, Monday to Friday, 9 to 5" [F3, P6] and made to *"feel guilty"* [F3, P5] for taking any time to themselves in the day. This was associated with a lack of making mental health a priority and always leaving it to the end of the list of things to do. One participant stated that:

"We all know we should invest time and effort to do things for our health but until there's a problem, we tend not to carve it out" [F3, P4]

This was echoed by another participant who felt that there were always more things to do and that when there are so many things competing for attention and so many tasks to be completing in their working day, it was difficult to make a compromise between the demands. They stated that:

"Taking that time out is also a challenge. Where do I find the 10 minutes a day to go on the app? What would I stop doing that I'm doing now in favour of whatever [the app] has got to offer?" [F3, P3]

Participants stated that they already felt under pressure to complete their everyday tasks at work in time and claimed that they *"haven't got time to do the existing jobs"* [F1,P5] to deadlines and to the expected standard, and felt that if this type of application was offered by their employer, that they may feel like they were being asked to do even more by completing it.

They thought this would be asking them to do extra during work time without making any extra time provision for this. They asked if they would *"get time off"* [F1, P5] their roles to complete this extra task. This suggests that they are completing the task because they have been asked to, rather than from any personal motivation to improve their wellbeing, which again calls into questions whether this is the 'right' attitude. This point also suggests that it is important to look at their existing workload, whether using the app would be something that could help with that, and whether allowances can be made to schedules to allow for this. This aspect was mainly identified in the first focus groups and may reflect the culture of that organisation and indicate underlying problems that would need to be addressed before any new technology was introduced.

This suggests that one way of increasing participation is to ensure that participants are given enough time to complete the exercises. One way of ensuring that this happens is to make sure that there is full management support for the use of well-being apps, which is clearly communicated and demonstrated to staff. Participants stated that it would be helpful if an app was implemented:

"in partnership with HR to promote that amongst staff as something [they – HR and management] recognise as good" [F3, P4]

"It has to be bought into from the top down and that space [time to use it] must be honoured" [F3, P3]

<u>*Theme 5: Engagement*</u>

<u>Content</u>

The final theme identified was the contribution of the content to the engagement with the app. Several participants mentioned apps that they have previously used but had disengaged with and stopped using – one said that they *"let it go, I don't know why"* [F3, P5]. Another said:

"I didn't stick with it for very long and I didn't keep the app very long and I think that it was because I couldn't see how it fit in with my life and I had to force myself to use it and it was not a natural thing to use" [F3, P7]

One participant suggested that this was due to the freshness and novelty of the content and stated that:

"It's got to be interesting enough for the user as the majority of apps are used for 6 weeks and then no one uses them anymore… it's really hard to have the content that keeps it fresh enough to keep them coming back… you've got to have a constant stream of stuff coming at people that interests them to keep them engaged with it because otherwise you use it a couple of times and then drift off" [F3, P3]

Another participant mentioned that they were *"very utility driven"* [F3, P4] and that most of the apps that they did engage with were *"replacements for things [such as calendar, torch etc]"* [F3, P4]. They also stated that:

"if there was an app that I found was helpful then I would use it otherwise it wouldn't get touched…. If it adds value, people will use it. I have a need – it offers benefits for me" [F3, P4]

Some participants also mentioned making the app fun and enjoyable as well as helpful, and ensuring that the content drew people back in to keep them using the app for leisure purposes, as well as for increasing well-being:

"You need to increase the engagement to increase the amount of time people spend… to make it enjoyable also" [F2, P5]

There is also a suggestion that the content must be pitched at the correct level for the audience and while it should be fun, there needs to be:

"[a] balance between making something that's too childish and making something that's too difficult… it still needs to be fun and enjoyable" [F2, P1]

This links to the literature on gamification which shows that adding in interactive game elements to an app can lead to increased engagement and adherence as well as better outcomes. These comments suggest that it is important to establish what the target population's current attitudes towards technology are, and to establish ways of demonstrating that the content is worth the taking the time out. The content needs to be engaging to encourage people to choose this app over the vast array of others that are available, and it must compete with the huge focus on social media, but offering something different, something engaging, and something useful to people. It may be that the best way to achieve this is to combine several different functions, including gamification, a social element, engaging content and a useful function that would encourage users to open the app in the first place.

Appearance

There were also some references to the appearance of the app and how to increase engagement through the visuals as well as the content. One participant stated that:

"I think that it's really important to make it colourful and exciting to look at, it needs to be engaging" [F4, P3]

Participants suggested that what would count as engaging and the type of appearance people would want to see might vary depending on their characteristics and so the target audience should be considered during development. They said:

"You need to consider the population you're making it for while developing the app [to increase user friendliness]" [F2, P1]

It was stated that there should be collaboration between psychologists creating the content and the designers creating the look of the technology, but that: *"this link is missing"* [F2, P5]

This also links to gamification, which helps to add visual appeal by introducing more interactive displays, higher level graphics and more engaging features. One way in which the suitability of the appearance can be examined is by conducted user acceptance tests or further focus groups with a finished product in order to examine how the target audience responds,

and whether the level of visual appeal is suitable for both the target audience and suitable for the content being displayed.

Discussion

Four focus groups were conducted with working adults from a range of backgrounds, which resulted in five factors relating to the implementation of mobile technology interventions. The first theme indicated that it was important to consider what the end users were getting out of the usage, and to consider whether rewards would be suitable. It was also suggested that it is important to maintain clarity when discussing the intervention with users – being clear about what the benefits are and why they should use this. Secondly, it was suggested that it was important to look at the existing use of technology, to ensure that the levels of technological literacy and technical support were high enough to support a mobile-based intervention to allow it to run smoothly. In this case, if participants have a negative view of technology initially, the first theme of emphasising the benefits may be even more crucial.

The third theme focused on the flexibility of the app, and suggested that several different versions should be offered, potentially even including non-technology-based methods in order to cater for all members of the target audience. This is important for both the presentation and the usage of the app, including format and reminders. Another theme concerned time pressure and finding time to use more mobile apps. Many participants felt that they didn't have enough time to spare on extra tasks, or that they felt they already used more technology than they liked without gaining any benefits from it. This suggests that the workplace needs to take into consideration existing demands on its employees when introducing new initiatives, and it may be that allowing ten extra minutes of free time in order to complete this will help encourage participation. There was also a sense of poor organisational culture identified in the groups, with the suggestion that participants feel they are under too much pressure and that mental health is not given a high enough priority.

Finally, the last theme identified was the need to keep the content relevant, fresh and engaging to keep people using the app beyond the initial interest. It may be that once people have established a habit and are automatically seeing their lives in a more positive light, that they no longer need the prompts from the app, but it is important to keep people engaged until that habit is formed. Although these themes provide an overview of what to consider and will be applicable in some way to every workplace, the details will be specific to each individual organisation. It is recommended that these points should be considered when designing a new technology to be used in the workplace, but it is best practice to run a focus group in the intended context to gain perspectives of the target audience. The points will vary depending on the organisational context – what constitutes an appropriate reward, the culture of accepting a new intervention, the current use of technology, the level of technological literacy, the infrastructure, the workplace demands and schedules will all be different in every organisation. The only way to ensure that the intervention is best suited to the employees is to "*ask them directly*" – a final quote from a participant in the focus groups.

Including participants not only helps to identify the contextual factors mentioned but gives them autonomy and a sense of involvement and pride in the project, which will also help to increase participation and interest in seeing the intervention through.

Links to Previous Literature

The results from this study support the findings from previous studies into implementation. Fullerton and McWatters (2002) also found that the incentives used affected the implementation of a new organisational system and stated that these rewards could be both financial in the form of compensation or through other methods such as employee empowerment. The effect of reward was also shown by Gregory and Lodge (2015) who demonstrated that academic workload was a barrier to the implementation of new technology for learning and stated that a lack of incentives to offset this addition to the workload was a further issue. This link to high workloads was shown in this focus group study with the subtheme of time pressure at work, where participants stated that they already felt under pressure to complete more work in less time and they felt that they couldn't add anything more on top of this. Gregory and Lodge (2015) stated that time was needed for academics to learn how to use the new technology and how best to implement it in their work, but that time for professional development and new training was often not considered as part of the expected workload but was an additional pressure on top of this. They recommended that workplaces take account of this when considering a new system or technology and allow time for the training as part of the workload, rather than adding additional pressure with no assistance.

The need to allow for training was also reflected by Martin-Baranera et al (1999) who stated that a lack of computer skills would act as a barrier to usage. They suggested that people with a high level of technological literacy would view the new system as highly useful, but that those with low technological literacy would view it as an extra burden and an increase on their workload, due to the lack of confidence in using it making it take longer to learn and use. Even those with high technological literacy cannot use a system if there are repeated technological failures, which are also considered a barrier to implementation (Jousimaa et al, 1998; Hobbs et al, 1999). This was noted in one of the focus groups, where participants reported that the current technology they had was unreliable and often failed. This led them to view new technology negatively, as they expected failures and were discouraged from using the technology available. This relates to the theme of Experience of Technology.

Another theme identified in the study presented in this chapter, was the time pressure that employees felt under. This was also shown by Cabana et al (1999) who found that both external factors such as time, and environmental factors such as resources, could act as barriers to implementation if they were not present. They also suggested that a lack of outcome expectancy could act as a barrier, which reflects the Outcomes theme in this study. If users do not feel like they will gain anything from using the new system, then they feel no motivation to do so. Support has also been shown for the theme of Flexibility, which represented being able to adapt the technology to suit different roles and preferences, by Ash et al (1999) who stated that the new system needed to be tailored to suit the work environment for it to be used. Finally, Williams, Perillo and Brown (2015) conducted a scoping literature review of implementation of evidence-based practice in healthcare organisations and found five barriers to implementation; the workload, a lack of staff support, a lack of resources, a lack of authority to implement change and an organisational culture that was resistant to change. Two of these, the workload and the lack of resources were also identified in the focus groups, as well as links to the effects of staff support on the success of a system.

Links to the TAM

The results from the focus groups can also be linked to the TAM variables. Firstly, the theme of Expected Outcomes and the subtheme of Benefits are related to Perceived Usefulness. The benefits that the users expect to see after completing the exercises lead to it being perceived as useful or not. Clear communication of these expected benefits can also increase perceived usefulness and attract participants towards using it. The theme of Flexibility relates to the Perceived Ease of Use element of the TAM. Participants in the focus groups stated that they expected mobile technology to be easy to use as it offered a more flexible delivery method. They also stated that providing more options to tailor the intervention to the individual and make it fit better into their lives could also increase perceptions of ease. The theme of Experience of Technology can also be linked to perceived ease of use, as participants stated that their previous experiences with technology and their technological literacy would affect their perceptions of any new technology introduced, especially if the previous experience was negative.

Additionally, previous experiences with technology also link to one of the TAM extensions outlined in Chapter 2. Venkatesh (2000) included computer self-efficacy and computer anxiety as a determinant of perceived ease of use. The themes identified in this study show further support for a role of engagement, which was also included in this model (Venkatesh, 2000) and in TAM3 (Venkatesh and Bala, 2008). The theme of engagement was identified in the analysis, without using the literature to guide the interpretation. This shows the importance of engagement in the motivation to use mobile apps, as it came from data-driven analysis, without guidance from the researcher during the focus group itself. The fact that it was then supported by the theoretical model of the determinants of perceived ease of use and TAM3 shows reciprocal support for engagement as a factor and confirms that the original TAM does not include all relevant factors as it was originally developed. This shows support for making extensions to the model, such as TAM3 (Venkatesh and Bala, 2008).

Links to the CFIR

There are also several links between the focus group results and the CFIR. Firstly, the subtheme of Rewards can be linked to the Outer Setting factor of the CFIR and the facet of external rewards and policies. Participants in the focus groups stated that they felt an external reward from their employer would increase attraction to the application and ensure usage over time. This is also related to the culture of the organisation, which would need to value well-being enough to put investment into the rewards, making sure the activities are being completed and arranging rewards as a result. As stated, the subtheme of Benefits can be related to the Inner Setting and communication facet of the CFIR, as clear communication regarding the expected benefits of the intervention could attract people by increasing perceived usefulness. This subtheme is also related to the Intervention Characteristics factor of the CFIR and both the evidence strength and quality of source facets. Employees are more likely to understand and trust in the benefits of the intervention when there is clear evidence to support the claims, delivered by a credible and trustworthy source.

The next identified theme of Experience of Technology can also be linked to the CFIR, through the Inner Setting and the culture of the organisation, including the implementation culture, the Outer Setting through external policies and needs and resources of the organisation, and to the Process, through the planning of the implementation. This theme relates to the need to consider the current organisational context for implementation, especially regarding the usage of technology by employees. Participants stated that their opinions on technology would be coloured by their previous experiences with technology implementation, especially negative experiences, and this would affect the perceived ease of use of the application. Previous experiences with implementation of any intervention, both technology-based and otherwise is linked to the implementation culture in the organisation and whether the changes are viewed as positive or negative by the employees. It is also related to the external policies of the organisation, and looking at the current use of technology, the current policies regarding well-being and any current or previous implementation projects. The difficulties with using previous technology reported by some of the participants can be linked to the resources of the organisation, or lack of up to date and functioning technology as a resource deficit. Difficulties and expectations of technology can also be linked to Individual Characteristics, regarding the individual state of change and their personal technological literacy. Crucially, all these elements can be incorporated into the Process factor of the CFIR, under the facet of planning – clear planning and inclusion of these issues when planning for the implementation could help to reduce these barriers and encourage usage. The weight of these concerns is dependent on the context of the organisation, and this can be evaluated during the planning stage.

The next theme was Flexibility, which relates to the Intervention Characteristics, particularly the facet of adaptability. Participants stated that allowing choice with regards to the delivery and frequency of the intervention, as well as some customisable options would increase their attraction to the application and possible resulting usage. The fourth theme of Time Pressure is again related to both the Inner and Outer organisational setting, through both the culture of the organisation and the current policies. Organisations may need to make changes here in order to encourage employees to feel comfortable taking the time to use the application and now feel so under pressure to complete tasks they are already struggling with. The final theme of Engagement related to both the Intervention Characteristics, and making the application attractive and entertaining, and the Process factor, where engagement is specifically mentioned as a facet in the CFIR.

Limitations

There are several limitations with the study design which may impact the interpretation or generalisability of the results. Firstly, an opportunity sampling strategy was used, where participants were recruited if they were easily available to the researcher – in this case, participants who worked at interested organisations nearby. In addition, a cross-sectional design was used, where participants attended one focus group and were asked about their opinions at the specific time. These facts allow the argument that different results would have been found if different participants had been used by chance, or if the research had taken place at a different time. Although this could be the case, the findings of the study aligned with previous studies and suggestions from the literature and so while the results may have been slightly different under different circumstances, it is possible to be confident in the results found.

A further limitation is that participants in the focus groups were asked about potential barriers and facilitators they could see affecting the implementation of a well-being application in the workplace, without having used the application previously. The aim was to get a general feeling from participants without focusing on a specific application, in order to allow some generalisability, but their answers may have been different if they had used the application or been through the implementation of something similar in their own workplace. Verkasolo et al (2010) suggest that the TAM is most effective when used in relation to a specific technology system, and so it is reasonable to suggest that the same would be true for focus groups on the topic of accepting a new application. As this research was conducted in a general sense, it would be advisable to conduct more specific focus groups before the actual introduction of a well-being application to the workplace. Related to this, focus groups are heavily context dependent, and the work environment contributes strongly to the eventual outcomes. In this study, different focus groups had different topics that were the most salient and while there were common threads, evidenced in the thematic analysis conducted, the importance of these factors were weighted differently for each group and workplace. Although one of the advantages of focus groups are the contextual details they include which enrich the research picture, this can also limit the generalisability. Again, it would be appropriate to conduct more focus groups with the specific target audience of any future workplace implementation to assess the salience of each factor and to help guide where efforts to facilitate implementation might be the most effective.

Finally, there are some limitations to the focus group method which are relevant to this study. As participants are together in a group with their colleagues, their anonymity is reduced and so there may be comments they do not feel comfortable sharing. There may also be incidences of social desirability bias (where participants give answers they feel are the most socially acceptable (Maccoby and Maccoby, 1954)), in order to present themselves in the best light possible in front of their colleagues. Participants were offered the chance to contact the researcher privately if there was anything else they wanted to add, in an effort to mitigate this effect, but this does not mean that it was removed completely. A full discussion on the advantages and disadvantages of the use of focus groups was included in Chapter 4.

Conclusion

In conclusion, the themes identified in the focus groups can be linked to factors in the CFIR and can be used to make recommendations for implementation and for increased usage through the TAM variables. Clear communication regarding the aims of the intervention and the possible benefits from a trustworthy source could lead to increased perceived usefulness and flexibility and adaptability of the application, possibly incorporating other delivery methods too, could increase perceived ease of use. Clear planning, considering the organisational context factors such as previous use of technology and current workplace culture could lead to a more effective implementation which leads to increased usage. Overall, this suggests that while mobile technology is an attractive option to deliver a wellbeing intervention in the workplace, detailed planning is required during the implementation phase in order to maximise the possible benefits.

Chapter 8: Discussion

Aims of the Thesis

The overall objective of this thesis was to investigate the usage of mobile technology as a delivery method for well-being interventions. A mixed-methods approach was used in order to examine this from several angles and to provide a detailed picture on the user experience of mobile applications for well-being. The thesis therefore had three aims:

1. To validate pathways from the Technology Acceptance Model (Davis, 1986) in a well- being context, and to investigate the acceptability of mobile applications for well-being.

2. To evaluate the usability of prototype well-being application.

3. To investigate the barriers and facilitators of implementing a well- being application in a workplace context.

Three studies were conducted in order to address these aims, and each looked at a different aspect of the user experience: Acceptability, Usability and Implementation:

Study 1 - *Acceptability*: The first study is a quantitative study which used an online questionnaire to validate pathways from the Technology Acceptance Model in a well-being context and examines several factors which influence the acceptability of well-being applications. This study is outlined in Chapter 5 and was mainly quantitative in nature, but a small qualitative section is included.

Study 2 - Usability: The second study is a mixed-method study which investigates the usability of a prototype application that delivers an example well-being intervention, the development and testing of which is reported in Chapter 6. This involved a questionnaire which participants completed after using the prototype application, and several qualitative questions about how the application could be improved.

Study 3 - Implementation: The final study examines the implementation of a well-being application in a workplace context. A series of four focus groups were conducted with working adults from a range of organisations to gain feedback on the implementation in this context and how it could be facilitated. This study is outlined in Chapter 7.

All three studies also aimed to present the findings in relation to the Technology Acceptance Model (Davis, 1986) and the Consolidated Framework for Implementation Research (Damschroder et al, 2009) which were presented in Chapter 2, in order to provide recommendations for future research and practice.

Summary of Results

Mobile technology can offer a delivery method for well-being and mental health interventions with a range of benefits including cost effectiveness, ease of access and equality of access. These benefits can only be maximised if the technology is accepted by the target audience, if the application is usable and engaging and if it is implemented correctly with consideration of the context and clear communication. This thesis included three studies which aimed to assess the acceptability, usability and implementation of mobile technology in a well-being context, combining theoretical, quantitative and qualitative analysis to give an overall picture of current research in this area and guidelines and directions for future research.

Firstly, in Chapter 1, the advantages and disadvantages of using mobile technology as a delivery method for well-being interventions were examined and it was concluded that there were several clear benefits to using mobile technology. Mobile technology has already been used for a wide range of uses, including the delivery of interventions in other contexts, such as health information, smoking cessation and weight loss programmes. It was expected that the benefits shown such as cost effectiveness and ease of access would also apply to hosting well-being interventions.

In Chapter 2, one widely-used theory which aims to explain the acceptability of new technologies was presented; the Technology Acceptance Model (Davis, 1986) which states that the design features of a technology affect two variables; the perceived usefulness of the technology and the perceived ease of use. These variables are proposed to predict attitude towards using the technology which in turn predicts actual usage of the technology. This model has been empirically validated in a range of contexts including telemedicine and health information applications but had not yet been validated in a mental health or well-being context. Research support for the model was outlined, as well as several extensions that have been made in order to include more precedent factors. This support is contrasted with several criticisms of the model, including the complexity of the relationships involved and the lack of a factor related to the entertainment value of the technology. The Consolidated Framework for Implementation Research (CFIR) (Damschroder et al, 2009) was also outlined, and a combined model was suggested to include factors from both models, which contribute to a successful implementation of a technology-based intervention.

A literature review was conducted in Chapter 3 to establish the methods used for investigating the acceptability and usability of mobile applications for mental health and well-being, using behavioural change techniques. Out of 456 studies identified by the review, 21 of these were studies that examined a mobile application which aimed to increase a facet of well-being in a healthy adult population. 7 of these studies included a measure of acceptability or usability, mainly as a secondary outcome measure behind the effectiveness of the intervention included in the application. 2 of the studies used the System Usability Scale in order to assess the usability of the application, 2 used the Mobile Application Rating Scale and 2 used the Client Satisfaction Questionnaire. Most of these studies also included a qualitative analysis of interviews or open questions included in a post-intervention questionnaire.

Overall, the applications were rated positively as usable, but this review highlighted the lack of connection to theory or implementation that research into the usability and acceptability of mobile technology as an intervention delivery method currently demonstrates.

To address this, three studies were conducted which would examine three aspects of user experience (acceptability, usability and implementation) which would focus on the experience of using technology as connect the results to the theoretical models of the TAM and CFIR, in order to provide evidence-based recommendations on the future use of technology as a delivery method for well-being interventions. Chapter 4 outlined the methodology for these studies, and containing an explanation of the mixed-methods design, the data sources gathered, the analysis methods used, and the ethical considerations needed.

The first study, presented in Chapter 5, aimed to validate relationships from the Technology Acceptance Model in a well-being context, following the method used by Hu et al (1999) to validate the model for telemedicine. 170 people responded to a questionnaire measuring their perceived ease of use, perceived usefulness and intention to use well-being applications on their mobile device. Initial regression analysis of these results suggested that perceived ease of use and perceived usefulness both predicted intention to use. It was also shown that perceived ease of use predicted perceived usefulness. These relationships supported those shown by Davis (1986) and subsequent research into the TAM. Further mediation analysis showed that perceived usefulness fully mediated the effect of perceived ease of use on intention to use, which further confirms the original evidence from Davis (1986). This study supports the relationships shown in the TAM and shows that perceived usefulness and perceived ease of use affect the usage of technology.

This study also included a qualitative element which analysed the results of an open-answer question which was included at the end of the questionnaire. 75 of the 170 respondents left a response to this question which asked if they had anything to add following completion of the questionnaire. These results were analysed using thematic analysis and five themes were identified which were Routine, Practicalities, Social Element, Design Features and Clarity. These themes involved difficulty with getting into the habit of using apps, the practical benefits or difficulties of using apps as a delivery method, the need to maintain a social element and the potential isolation of technology, making the app engaging and customisable, and the need for clarity around what a well-being is for, what it involves and the benefits.

Once the relationships from the theoretical model had been quantitatively supported, and the acceptability of mobile technology as a delivery method for well-being interventions demonstrated, the next stage was to examine the usability of such application in Chapter 6. A usability test was conducted using a prototype application, in a mixed-methods study. The app was developed using a daily diary design where users complete one entry per day designed to reframe daily expectations and recollections in a positive manner. The study included the results of a combined questionnaire of the User Mobile Application Rating Scale (uMARS), the System Usability Scale (SUS) and Ease of Use questions, and five qualitative questions with open response answers. The results suggested that the prototype application was considered easy to use but that it can be improved by making the appearance more engaging and more visually appealing.

The final study reported in Chapter 7, aimed to investigate the acceptability and implementation of mobile technology-based interventions in a workplace context, using a qualitative methodology. A series of four focus groups conducted with 23 employees from different organisations who were asked about the acceptability of technology as a delivery method and any potential barriers to implementation that could affect the acceptability. Thematic analysis was conducted and five themes were identified; Expected Outcomes, Experience of Technology, Flexibility, Time Pressure and Engagement which covered the need to consider the context of implementation, the clarity of communications of what the app involves and its potential benefits, the need for flexibility and customisation options to make it suited to different individuals and the need to make the app engaging both in terms of content and appearance. The implications for implementation were discussed.

<u>Quality Criteria</u>

In Chapter 4, a range of quality criteria for a mixed-methods design were presented. For the quantitative studies, these quality criteria were the traditional statistical methods of reliability and validity (Neuman, 2016; Lacity and Janson, 1994).

For qualitative studies, Tracy (2010) outlined eight steps to ensure quality, several of which have clearly been included in this research project. The first was that the research should focus on a worthy topic. The rationale for this topic was outlined in Chapter 1, and with the increase in interest in both building mental health, and in the use of technology as a delivery method, the combination of these two areas is relevant and demonstrates timely significance. A second criteria was the inclusion of detail descriptions from appropriate samples. In these studies, potential end users of a technology-based intervention were included, with a range of ages and occupations represented. A further criterion was that the findings should be transferable. In this project, due to the population distribution, the findings can be transferred to other technology-based interventions. For example, many of the implementation barriers and facilitators identified in Chapter 7 are applicable to the implementation of technology-based interventions that might use a different content or have a different intervention target.

The next criterion was that the research project should contribute to theory and in practice. In these studies, the Technology Acceptance Model has been validated in a new context (Chapter 5) which shows new applicability to the theory, and also provides some support for several extensions to the TAM, such as the inclusion of technological literacy in TAM3 (Venkatesh et al, 2000). There are also implications for practice as the implementation barriers and facilitators included in Chapter 7 which can shape future implementation projects using technology as a delivery method. The implications of the thesis are discussed in more detail later in this chapter. The next criterion was 'meaningful coherence' which represents the use of appropriate methods and analysis to achieve its aims. The rationale for the mixed-methods design and data analysis techniques was presented in Chapter 3 and showed that the most suitable methods were used. Finally, the last criterion was ethical considerations, which were also presented in Chapter 3. Considerations for the confidentiality, anonymity and self-determination of the participants were taken into account at all stages of data collection.

In addition, Creswell and Tashakkori (2007) stated that the results of a mixed-methods study should also be integrated to include both aspects in the final conclusions. Fetters et al (2013) state three methods of data integration in a mixed-methods study which are integration through the narrative, integration through transformation of the data and integration using joint displays. The most suitable method for integration in this study is through a narrative integration, which involves combining the results of each study to form an overall conclusion, which is presented in the following sections concerning the implications of the thesis. Fetters et al (2013) also stated that these techniques can lead to three results; confirmation where the two types of data show similar conclusions, discordance where the show opposing findings and expansion, where one method shows a different perspective to the other. In this study, the findings showed similar conclusions and so confirmation was shown, which strengthens the conclusions made.

Guidelines for Future Research Using Mobile Applications

The results of this thesis strongly suggest that mobile applications are a suitable delivery method for well-being interventions and have shown that they are easy to use. Future research into well-being and interventions to increase it should consider mobile applications as the delivery method due to the advantages they can offer. Although there are many mobile applications already available to download, a large proportion of these have not been researched and are not scientifically supported and so there is a clear need for more research to focus in this area. This thesis can help to contribute to this by providing theoretical and empirical evidence, both quantitative and qualitative, to support the usage of mobile applications as a delivery method. As well as forming part of the research picture, there are also implications for practice. The support demonstrated in this thesis provides confidence for practitioners to use mobile applications, knowing that the assumption that they are effective and accepted by users has been supported by these studies. The theoretical evidence presented and the results from the focus groups help to guide future practice and introduces a scientific lens to an already widely used method.

This section aims to combine the previous literature and the research presented in this thesis to provide guidance for future development and use of mobile applications to facilitate the benefits of using them as a delivery method that have been clearly outlined, both here and in previous literature. This guidance will cover the three main parts of the process; the development of a new application (based on how to increase its eventual acceptance), the implementation of the new application and the reporting of the results to inform future research and practice, with the aim of increasing the efficiency of the process by sharing knowledge, both here and in the future.

Firstly, the research on the Technology Acceptance Model suggests three main considerations during the design and development of the application, which will increase its eventual acceptance. These factors are important to consider at this stage, as they are easier to manipulate and change during the design phase, rather than once the app is complete.

1. Perceived Usefulness: The app should be useful to its intended target audience, so it is important to consider exactly who this is and why they would want to use the application being developed. Focus groups or a survey of attitudes could be useful at this stage to understand what is salient to the target audience and what they find to be useful for them.

2. Perceived Ease of Use: The app should be easy to use with clear and understandable text, easy to find buttons and clear instructions. There shouldn't be too much information presented on each screen of the application and it should be easy to read, as well as suitable and relevant for the target audience. The application should also work well, with no crashing and smooth transitions between screens or functions. Usability tests should be conducted as part of the app development to ensure that it works as intended and to resolve any issues which cause any unnecessary interruptions to use.

3. Enjoyment: It is also suggested the enjoyment may contribute to the acceptance of the application and so it is important to provide some form of engagement for the target audience, such as gamification. This should not obscure the overall aim of the application but should help to keep the users' attention and give them an incentive to continue using the application beyond initial contact.

Once the application has been developed and tests have been carried out to confirm its usability, the next stage is to introduce the application to the target context. The CFIR (Damschroder et al, 2009) provides a clear framework which outlines factors which can facilitate or obstruct implementation and should therefore be taken into consideration when planning implementation. Focus groups such as those reported in Chapter 7 can be used to identify the most salient of these factors depending on the context. The most significant barriers and facilitators will be specific to each context and so it is important to do some form of investigation before implementation in each new context. The results reported in Chapter 7 can act as a starting point for a discussion guide for similar focus groups with the same aims. Focus group participants could be asked about the expected outcomes of using the application, the existing use of technology in the organisation and any accommodations that would need to be made in order to facilitate use of the app, in order to gather contextual information which can be used to shape the implementation. The results of the focus groups conducted in this research suggest several considerations for implementation, which could be combined with the results of context-specific focus groups to facilitate implementation.

1. Users want to know what the benefits of using the application will be, both in terms of the aim of the application and any incentives or rewards offered for using it. The benefits of the application should be clearly communicated to users during the implementation, which will help to increase perceived usefulness. If any incentives can be offered, these should also be made clear.

2. The existing structure of the organisation needs to be considered, including the previous usage of technology within the organisation. If users have had poor experiences, they made be apprehensive about using new technology and work may need to be done before the introduction of the application if technological literacy is low.

3. Flexibility is also important to users – some people want to use different devices at different times and if allowances can be made to accommodate this need for flexibility and autonomy it may increase perceptions that the app is easy to use, not just in terms of being simple to use, but also easy to fit into existing patterns of behaviour.

4. Time pressure can also act as a barrier to using a new application and users will need to be allowed time to use the app and complete any tasks required, especially if mandated or compulsory.

5. The focus groups, combined with other research, suggest that engagement is important in encouraging use of an application and any engaging or entertaining features should also be clearly communicated to potential users to stimulate their interest.

Once focus groups have identified the most salient contributing factors from the CFIR, the implementation can be planned to cater to them. It is important to emphasise the facilitating factors such as perceived usefulness, the ease of use and any entertainment functions and to minimise the barriers by making accommodations where possible. The aim of this is to encourage as many people as possible to use the application in order to demonstrate the greatest benefit.

Once the benefits have been demonstrated, the final step is to report on not just the findings, but the full process including app development and implementation. One possible contributing factor to the limited research in the area of acceptance of well-being applications and limited information for practice is the quality of the existing reporting. It has been shown during this thesis, such as in the literature review in Chapter 4 and in the review by Donker et al (2013), that the current reporting of research into technology is often lacking in enough detail for it to be considered high quality. The following guidelines are offered, to ensure that future research reporting on the use of mobile technology as a delivery method for an intervention is clear, replicable, high quality, and can be used by practitioners and researchers when they are selecting an intervention to implement in order to increase well-being.

- Firstly, the report should contain both an analysis of the effectiveness of the intervention and the usability of the technology. Both aspects are important when comparing interventions. This provides an indication of which interventions may be most suitable for a chosen population, and of what might need to be improved with future research.

- This analysis should be conducted first-hand by the developers of the app, at the time of its development. This allows for better reporting of the details, a more in-depth knowledge of the app development and a suitable contact for more information or clarity if required. Independent reviewing is very useful to gain a non-biased view, and this can be done alongside the researchers own evaluation and presented either together or separately.

- The content of the intervention should have a clear, scientific evidence base and be tied to an underlying theory that should be outlined and adequately described. This allows professionals and specialists to choose the app they want to implement with their clients more easily, as they can identify which theoretical base is most suitable for their aims. For example, someone looking for an app to help with depressive symptoms could choose an intervention based on Cognitive Behavioural Therapy principles and be confident that the app will meet the requirements of the population and include robust, reliable techniques.

- The development of both the theory-based content and the delivery method should be outlined clearly. This should include details on any user involvement in the development process, such as focus groups or user testing programs. Detailing these steps shows the consideration of the context during the development. Giving an overview of the content development or selection also provides another comparison point for contrasting different interventions, and a consideration point for selection.

- The target audience of the intervention should be clearly stated, as well as the actual demographics of the final sample the intervention was tested on and of any participants involved in the development process. This allows users to match an intervention to the required audience and allows for future researchers to see which groups it needs testing on in the future. For example, a CBT based intervention for anxiety that has only been tested on people taking anti-anxiety medication cannot be generalised to a population not taking medications, until it has been tested in that sample. Reporting on a detailed range of demographics makes this clearer, and any demographics that are relevant to the effectiveness of the intervention should be included.

- The methodology of testing the app, both in terms of effectiveness and usability, should be reported to a replicable standard. It is important that the method is clear for both future research and replication studies, but also so that if the intervention is freely available to use, it is being implemented properly and accurately. This methodology should clearly state the frequency of the intervention sessions, the duration of each session, whether booster sessions are offered or required, how many sessions are expected as a minimum threshold to see an effect and the adherence at each stage. This allows contextual factors such as frequency of intervention to be compared across studies to identify which context is most effective.

- The methodology reported should also include the use of any comparison groups in the assessment of the effectiveness. Where possible, a control group should be used to measure any placebo effect. The intervention may also be compared against other groups e.g., using different frequencies, different platforms or different demographic groups. This not only strengthens any conclusions made about the effectiveness of the app, but also allows for comparison of different interventions, different contexts and different combinations to find the most effective for the target audience.

- The methodology should also report details of the technology, including which devices the technology is compatible with, whether it is available or has been tested on different platforms, the level of customisability in the intervention such as notifications, font sizes etc., and the level of ongoing technical support available in case of any technological issues during the intervention.

• Finally, if possible, some comment should be made about the cost effectiveness of the app, including its development and testing. As previously mentioned, the cost effectiveness of mobile technology is one of its strongest benefits, as usually once a technology is set up, it is relatively easy and cheap to maintain. However, this may vary if devices need to be provided to participants or if there is ongoing technical support needed. Including some estimates of these costs, or of the expected cost reduction as a result of using technology, can also help with comparison.

Strengths

The strengths of this research project lie in its integration of methods, findings and perspectives in order to create a more complete picture of the user experience of mobile technology as a delivery method for well-being interventions. This was examined from three different perspectives regarding the acceptability, the usability and the implementation which in previous studies have either been looked at in isolation or overlooked in favour of focus on the effectiveness of the intervention content. All three stages should be of equal importance as they are all connected – the usability of an application and the way it is implemented could alter perceptions of mobile technology and its acceptability regardless of how effective the content of the hosted intervention is. A further strength of this research is that is utilised a mixed-methods approach and combined both quantitative and qualitative research in order to assess these factors of user experience. Using both types of analysis gave a combination of the benefits of both; the statistical strength of the quantitative findings collected, analysed and presented in an objective and reliable format, and the contextually rich detail from the qualitative study which allowed user involvement in the process and gave insights into the experiences employees have with technology, and how the workplace context can affect their perceptions of technology, which were not picked up on using the statistical analysis of the TAM alone.

The user involvement itself was also a strength. Killikelly et al (2017) suggested that user involvement in the development and testing of a new technology could increase adherence once it was implemented. By involving potential users, it was possible to investigate potential barriers to use and to anticipate ways to overcome them if it were to be implemented in the future, by making recommendations linked to the CFIR. A further strength was the integration of the two research models; the TAM and the CFIR. Although the CFIR provides a clear framework for the implementation of workplace initiatives, it does not include any specific detail for when those initiatives might be delivered using mobile technology. The TAM does offer factors which can explain the uptake and adherence of technology but is seldom used to make recommendations around how to facilitate usage (Bashange, 2015). It can be linked to the CFIR to create a combined model which explains the implementation of this type of intervention, taking into account the full range of factors and intervention characteristics. Using the CFIR also provided a clear structure in which to analyse and synthesis the findings from both the quantitative and qualitative aspects, in line with the quality criteria expressed in Chapter 4. Overall, the integration of aspects that are usually considered separately has allowed for more detailed conclusions to be made surrounding the usage of mobile technology for the delivery of well-being interventions.

Finally, the most prominent strength of this research was the application of scientific methods to provide clear evidence and theory to support the usage of mobile technology as a delivery method going forward. Mobile technology is already widely used, often without regulation or evidentiary support as noted in Chapter 1. However, the research presented in this thesis helps to move towards the reduction of this problem by integrating empirical studies and relevant theories in order to provide an informed judgement that mobile applications are an accepted and effective delivery method for well-being interventions. The conclusions and recommendations made in this thesis as a result do not introduce mobile apps as a delivery method but provide justification for their use and scientifically confirm the assumptions that they would be suitable. This allows future researchers or application developers to have increased confidence in this delivery method and informed guidelines on how mobile apps can be best designed and implemented to create a more user acceptable intervention.

Limitations

There are several limitations with the current research which are important to consider when interpreting the findings. The three main limitations with the design of the studies is the reliance on self-selecting samples, the use of cross-sectional data only and the use of behavioural intention as the outcome measure. The use of a self-selecting sample can allow for self- selecting bias which can lead to issues with representativeness and generalisability of the study results (Braver and Bay, 1992). In the current project, participants volunteered to complete the questionnaires or take part in a focus group. It is possible that the people who were willing to take part and subsequently volunteered were already interested in well-being or mental technology, or could already have a favourable opinion that made them want to take part. It is not possible to know if there is any difference between the people who chose to respond and people who saw the advert but chose not to take part (Costigan and Cox, 2001). This issue was raised in one of the focus groups, where there was a discussion about the need to get the opinion of those in the organisation who never used technology, not even email, and what they would think about the introduction of new technology. However, in ethical research it is not possible to ask people their opinions if they are unwilling to do so. In the open questions at the end of the TAM validations questionnaire, there were a range of responses, including several negative responses about the use of technology or well-being applications, as well as positive or constructive points. This suggests that a range of responses were recorded and that some people who were not inclined to use mobile technology or to improve their well-being took part in at least that section of the study.

The next limitation with the design was the use of a cross-sectional design in all three studies presented here, and in many of the studies reported in the literature review. This design means that no causal inferences can be made (Levin, 2006; Setia, 2016), although the findings in relation to the TAM support previous causal studies which showed the same relationships.

In addition, a cross-sectional study provides only a snapshot of the current opinions. If this study had been conducted at another time point or with other participants, the responses and results might have been different (Levin, 2006). Based on the previous literature reported in the review, this is not just a limitation of this current study, but of the research area. This limits the generalisability of the results and it is an important consideration during their interpretation. Future research should focus on including follow-up measures of both the effectiveness and acceptability of the application. This links again to the CFIR, which includes in the Process factor an evaluation facet related to evaluating all aspects of the implementation process, which would include acceptability of the technology.

The final limitation is the use of behavioural intention as a proxy measure for actual usage. In this study, it was not possible to measure actual usage in the TAM study (Chapter 5) as it did not involve a specific application. Even in the usability study, participants briefly used the prototype application and so a measure of actual usage couldn’t be taken. Many studies have shown that behavioural intention and actual usage are consistently and reliably correlated, and many studies use behavioural intention as a proxy measure for actual usage based on this repeated finding (Shih and Huang, 2009; Venkatesh et al, 2003; Alleyne and Lavine, 2013). However, behavioural intention is a subjective measure whereas actual usage is an objective and more reliable measure. The relationship between behavioural intention and actual usage has not been shown to be a perfect positive correlation, suggesting that behavioural intention is not the only predictor for usage. This was shown to in the open questions are the end of the TAM questionnaire as participants stated that even though they believed the application to be useful and downloaded it, actual usage over time did not occur.

Addressing the Criticisms of the TAM

This thesis has also not been able to address some of the criticisms levelled at the TAM, outlined in Chapter 2. Firstly, it was stated that research into the TAM variables and relationships generally relies on self-report measures which are not a truly objective measurement (Legris, Ingham and Collerette, 2003; Yousafzai, Foxall and Pallister, 2007). This study chose to continue using the self-report measures used in previous studies, as they have been previously validated. As this aim of the quantitative study was to validate relationships from the TAM in a new context, it was important to mirror previous validation study as closely as possible to ensure that there were no interfering effects from any changes made. It can also be argued that as the TAM involves measures of perceptions and intentions, that self-report is the only true way to measure people's own thoughts, without having to make assumptions. Although this was identified as a weakness of the original model, this was outweighed by the necessity to use self-report measures in this study.

The argument was also made that the relationships shown in different validation studies of the TAM could be contradicting such as in Davis (1986) where perceived ease of use was shown to directly affect attitude towards using, but in subsequent studies, the effect of perceived ease of use has been indirect, through perceived usefulness (Venkatesh and Davis, 2000). This study supports the findings by Venkatesh and Davis (2000) and helps to add weight to this version of the model but does not resolve the contradiction between these studies. More research is still needed to fully examine this difference and under what circumstances each might be true.

However, it has been possible to address other concerns with the TAM. Firstly Lee, Kozar and Larsen (2003) suggested that a reliance on student-only samples limited the generalisability of results. In this research, two general population samples were used, and one sample of employees. The studies in this thesis move away from the usage of students as the main source of data.

In the final study, the findings are viewed from a workplace perspective, with suggestions for implementing mobile technology-based interventions in the workplace made. Additionally, this research takes into account the criticism made by Bashange (2015) who stated that measuring acceptability of technology using the TAM was previously limited to description with no inferences made, and that this was not enough. This thesis has aimed to link the acceptability and usability found to recommendations for implementation and has linked the TAM to the CFIR in order to use the findings from the TAM to increase future uptake, adherence and acceptance of mobile technology in a well-being context.

Engagement

The combined research presented in this thesis also agrees with one further criticism suggested by Hsu and Lu (2004), who state that in some contexts, perceived usefulness does not explain actual usage, such as with the use of technology for entertainment. The engagement with the technology, and its ability to entertain and provide something beyond usefulness has been demonstrated throughout this thesis. In the open questions as part of Study 1, participants stated that even though they thought a well-being application was useful, they still failed to make a habit of using it, because it wasn't entertaining or engaging. In Study 2, participants rated the prototype application as highly easy to use but stated that the appearance needed to be more engaging and made suggestions for how the application could be made more appealing an entertaining. In Study 3, one of the themes identified in the analysis of the focus group responses was engagement, and the need to create dynamic content that kept people engaged and entertained. Participants also wanted to know what the benefits were, and if an app could be made entertaining, this could act as one benefit that would draw people in and ensure usage. This links to research presented in the first chapter which states that gamification can be used to positively change health behaviours (Johnson et al, 2016). This also links to the criticism regarding the usage of behavioural intention rather than actual usage as an outcome measure. In the open question study even though participants had downloaded the app, representing an intention to use it, they didn't maintain usage which they attributed to a lack of engagement. This could explain the gap between intention to use and actual usage in some cases.

The studies presented in this thesis demonstrate support for the influence of perceived ease of use and perceived usefulness on behavioural intention to use a technology, and clearly shows that engagement also plays a role. This suggests that the TAM needs to be extended to include this. There are two ways in which engagement could be incorporated. Firstly, it is included in the models of determinants of perceived ease of use (Venkatesh, 2000) and in TAM3 (Venkatesh and Bala, 2008). These models suggest that engagement perceived enjoyment acts as an adjustment factor onto the anchor of computer playfulness in order to predict perceived ease of use. This model does not suggest any direct relationship between perceived enjoyment and behavioural intention. The studies presented in this thesis were conducted to focus on the relationships of the original TAM model and were therefore conducted without influence from the model extensions. Independently, it has been concluded that engagement is an important factor in technology use - with as much frequency and importance as perceived usefulness. This indicates that engagement or entertainment may have a role to play in the TAM equal to or exceeding perceived usefulness in some situations and suggests that the role of engagement may have been underestimated as a determinant of perceived ease of use. The results of this thesis demonstrate the possibility of including engagement as a determinant of behavioural intention, alongside perceived usefulness and perceived ease of use. The evidence in the model of determinants of perceived ease of use (Venkatesh, 2000) and TAM3 (Venkatesh and Bala, 2008) shows that there is also a relationship between engagement and perceived ease of use. Therefore, taking into account all evidence presented so far, a proposed extension to the TAM is shown below in Figure 17.

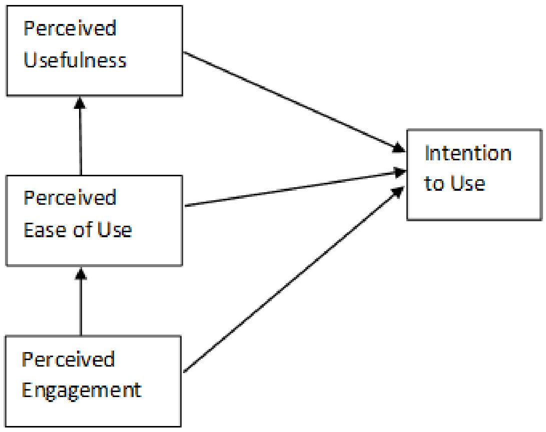

Figure 17: Proposed Extension to the Technology Acceptance Model

This model has previously been developed by van der Heijden (2004) as the hedonic system adoption model, although it was suggested that perceived ease of use would predict “joy” (as perceived enjoyment is termed) rather than enjoyment predicting perceived ease of use. Van der Heijden’s model was used as the basis for the Hedonic-Motivation System Adoption Model (HMSAM) (Lowry et al, 2013) which used cognitive absorption instead of perceived enjoyment. Cognitive absorption is a second-order construct made up of five first-order construct; joy, control, immersion, temporal dissociation and curiosity. The original TAM variables of perceived ease of use, perceived usefulness and behavioural intention are included still included in the model with the same proposed relationships. Figure X below shows the HMSAM model including the facets of cognitive absorption.

It was shown that perceived ease of use was positively associated with perceived usefulness, curiosity, joy and control, that control, joy and curiosity were positively related to immersion, and that perceived usefulness, joy, curiosity and control were positively associated with intention to use. Finally, they found that any effect of perceived ease of use was fully mediated by joy, control and perceived usefulness. Kurkinen (2014) also suggested that the enjoyment was a significant antecedent of behavioural intention in hedonic technology usage, but also in mandatory usage.

The result found in the study presented in Chapter 5 shows a similar mediation effect of perceived usefulness on the perceived ease of use to intention to use relationship, which suggests further support for the HMSAM as well as the TAM. Each of the three studies presented in this thesis independently suggested an influential role of engagement, without prior influence from these theories. This suggests a more significant role for enjoyment than as purely a determinant of perceived ease of use. This lends support for the HMSAM and for the direct relationship between enjoyment and behavioural intention which Lowry et al (2013) showed.

Implications of the Thesis

Acceptability

The research presented in this thesis shows that mobile technology is viewed as an acceptable delivery method for well-being interventions. Although participants in the qualitative studies stated that they would like flexibility to choose the delivery method they use and to customise the technology they are given, they acknowledge the range of benefits to using technology, including cost-effectiveness and ease of access. Generally, technology was viewed as positive, with a few important considerations such as privacy and the lack of social connection that can result from being reliant on technology. Relationships from the Technology Acceptance Model (Davis, 1986) was validated in a well-being context (Chapter 5), showing that perceived usefulness and perceived ease of use still predict intention to use the technology, and this is the first study known which has shown the validity of these relationships in this context. This has advanced the theory firstly by showing support for the relationships in the model, and secondly by demonstrating their validity in relation for technology for mental health. Given the benefits of using technology in this area presented in Chapter 1, this provides a model which can be used to increase acceptability so these benefits can be accessed. This implies that to increase usage of a new technology, the perceived ease of use and perceived usefulness need to be increased as much as possible in order to result in increased intention to use.

Usability

Mobile technology applications designed to deliver well-being interventions have been shown to be generally rated as usable. This was shown in the literature review (Chapter 3) where every included study showed positive reviews over a range of measures. This was further supported by the usability study conducted (Chapter 6), which indicated that the prototype application which used a daily diary methodology to deliver positive reframing exercises was rated as easy to use. Although future applications using a different method may not generate the same results, the combined results of the literature and the study indicate that overall, these types of applications are easy to use. Participants found them easy to understand and learned how to operate them with very little input or training. Going forward, applications, particularly using the daily diary method, can be expected to be easy to use and the focus should then be on creating useful and engaging content to be hosted on them.

Implementation

The results of the studies included this thesis have been presented in relation to the CFIR model for implementation, described in Chapter 2. The findings from the qualitative studies indicate that the context of implementation is very important to the acceptability of the new technology, and there are several things to take into consideration during the planning phase of the implementation process which include the previous usage of technology, the levels of technological literacy, the lifestyle or working style of the individual and where technology would fit into their lives. The combined model incorporated the TAM with the CFIR and showed that these can be used together in order to explain or contribute towards the successful implementation of interventions which are specifically technology-based.

The studies presented in this thesis have implications for theory and future research by demonstrating that the core relationships of the TAM are valid in a well-being context. Future research needs to examine the relationships suggested in the TAM extensions, outlined in Chapter 2, to identify whether these are valid in a well-being context, and whether there are any additional relationships that explain acceptability in a well-being context that are unique to that type of application. The usability study (Chapter 6) demonstrates that mobile technology is viewed as generally easy to use and it is concluded that apps would be a suitable delivery method for any future interventions and should be considered in future research as a cost-effective method that can reach a wide range of people. Finally, there are implications for practice through the connections made to implementation, which apply to both the usage of mobile technology for well-being, and for other purposes. It is suggested that contextual analysis is carried out during the planning of the implementation process but identifies some factors that may affect implementation.

Technology Acceptance Model

The final implication of this study is the need for an extension to the TAM to include engagement or enjoyment. Results from all three studies presented here demonstrated that engagement played a role in increasing intention to use a technology and to maintain usage over time. Two possible mechanisms have been suggested in extended models of the TAM. The first proposes that perceived enjoyment acts as a determinant to perceived ease of use, with no direct relationships to behavioural intention (Venkatesh, 2000). However, in the usability study outlined in Chapter 6, even when the prototype was rated as easy to use, participants felt that it was lacking in engaging features and would need improvements to its appearance in order to increase engagement. Qualitative responses in Study 1 and Study 3 both demonstrated that even though participants knew well-being apps were useful and that maintaining well-being is important to do, it still wasn't enough to motivate them to use it long-term. The qualitative data shows the need for an entertainment feature to sustain usage for long enough to see actual benefits. This suggests a larger role of engagement than as a determinant of perceived ease of use. This conclusion supports second mechanism which is proposed by the HMSAM (Lowry et al, 2013) which shows that perceived enjoyment (known as cognitive absorption) has a direct effect on behavioural intention, and that perceived ease of use affects perceived enjoyment. The main theoretical outcome of this thesis is that it supports an extension to the original TAM by including engagement or perceived enjoyment and suggests that it would have a more dominant role as shown in the HMSAM.

Final Conclusion

Mobile technology can offer a wide range of benefits for the delivery of interventions such as ease of access and cost-effectiveness and can be suitable for the delivery of well-being interventions designed to increase well-being in healthy adults in order to promote flourishing and fulfilment. However, such technology-based interventions can only be effective if the target audience engages with the applications. This thesis aimed to use a mixed-methods approach to investigate user experience with mobile applications designed to deliver well-being interventions. Three empirical studies were presented which investigated the acceptability, usability and implementation of well-being applications. The TAM and CFIR models were presented in order to provide structure to the results. Firstly, the TAM was validated in a well-being context and it was shown that perceived ease of use predicted perceived usefulness, which predicted attitude and intention to use well-being applications, which suggested that usability affected intention to use. Following this finding, a prototype application was developed, and a usability test conducted, which showed that the application was highly usable but that it needed to be more entertaining to attract users. Finally, a series of focus groups were conducted to assess the barriers and facilitators for the implementation of well-being applications and recommendations for future usage of well-being applications was discussed. Overall it was found that mobile technology is a highly suitable delivery method for well-being interventions and should be considered in both future research and practice. This thesis adds the current body of knowledge by demonstrating the validity of the TAM in a well-being context, by using the model to interpret the results of usability testing, by examining the barriers and facilitators of implementation of well-being applications and by demonstrating a prominent role for engagement in the motivation to use well-being applications.

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Appendices

Appendix A: Chapter 3: Literature Review

A1 : Quality Assessment (Evans et al, 2015)

Table 12: Quality Assessment of the studies found in a systematic review of well-being applications

Study	A		B	C		D		E		F		G			H			
	Q1	Q2	Design	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2	Q3	Q1	Q2	Q3	Q4
Krafft et al (2019)	2	5	CCT	1	1	3	3	1	1	3	3	2	1	2	Ind	Ind	1	2
	Moderate		Strong	Strong		Weak		Strong		Weak		Overall = Weak						
Bakker and Rickard (2018)	1	3	Cohort	2	1	1	2	1	1	4	4	1	3	3	Ind	Ind	1	3
	Weak		Moderate	Strong		Moderate		Strong		N/A		Overall = Moderate						
Kizakevich et al (2018)	2	5	Cohort	2	N/A	N/A		1	1	4	4	1	3	2	Ind	Ind	1	2
	Moderate		Moderate	Strong				Strong		N/A		Overall = Strong						
Mak et al (2018)	1	5	RCT	2	4	1	1	1	1	1	1	1	1	2	Ind	Ind	1	2
	Moderate		Strong	Strong		Weak		Strong		Strong		Overall = Moderate						

Heber et al (2016)	1	2	RCT	2	4	1	1	1	1	1	2	1	1	1	Ind	Ind	1	2
	Moderate		Strong	Strong		Weak		Strong		Moderate		Overall = Moderate						
Van Emmerick et al (2018)	1	5	RCT	2	4	1	1	1	1	2	3	1	2	3	Ind	Ind	1	2
	Moderate		Strong	Strong		Weak		Strong		Weak		Overall = Weak						

Appendix B: Chapter 4: Methodology

B.1: Ethical Approval Letters

DPAP Committee

03/05/2019

Supervisor: Louise Thomson

Applicant : Catherine Smith

Project: Project Id PhD Project - Technology Acceptance Model in a Workplace Well-being Context

A favourable opinion is given to the above named study on the understanding that the applicants conduct their research as described in the above numbered application. Applicants need to adhere to all conditions under which the ethical approval has been granted and use only materials and documentation that have been approved. If any amendments to the study are required, an amendment should be submitted to the committee for approval. An end of study form will be required once the study is complete.

yours

David Daley

Professor David Daley

Co-Chair of DPAP Ethics Subcommittee

Amanda Griffiths

Professor Amanda Griffiths

Co-Chair of DPAP Ethics Subcommittee

The University of Nottingham

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Investigators: Catherine Smith and Louise Thomson

Title of study: An investigation into the use of mobile applications for increasing optimism in the workplace

Duration of study: Until September 2019

Ethics reference number: 235

Wednesday 7th June 2017

A favourable opinion is given to the above named study on the understanding that the applicants conduct their research as described in the above numbered application, and adhere to all conditions under which the ethical approval has been granted and use only materials and documentation that have been approved. If any amendments to the study are required, an amendment should be submitted to the committee for approval.

David Daley

David Daley (Professor)

Co-Chair of DPAP Ethics Subcommittee

Amanda Griffiths

Amanda Griffiths (Professor)

Co-Chair of DPAP Ethics Subcommittee

Appendix C: Chapter 5: Empirical Validation of the Model

C.1: Participant Information Sheet

PARTICIPANT INFORMATION

STUDENT RESEARCH PROJECT ETHICS REVIEW
Division of Psychiatry & Applied Psychology

Project Title: *Technology Acceptance Model in a Workplace Well-Being Context*

Researcher/Student: *Catherine Smith (Catherine.smith@nottingham.ac.uk)*

Supervisor/Chief Investigator: *Dr Louise Thomson (louise.thomson@nottingham.ac.uk)*

Ethics Reference Number: 0282

We would like to invite you to take part in a research study about the use of mobile technology to improve well-being. Before you begin, we would like you to understand why the research is being done and what it involves for you.

What is the purpose of this study?

This study is part of a PhD thesis which overall aims to investigate the use of mobile applications for improving mental health and well-being. As technology is becoming more advanced, more prevalent and more relied upon in society, it is important to investigate its effects on mental health and well-being. Mobile applications have been developed to improve well-being and this thesis aims to investigate how these apps are used, how people can be encouraged to use them and to invest in making time for their mental health, and whether mobile technology is the right method to help with this. This study aims to investigate some of the factors which affect people's attitudes towards well-being applications and their interest in using them. Some examples of well-being or mental health applications include Headspace, Happify, stress management apps, anxiety management app and apps that use Cognitive Behavioural Therapy techniques.

Why have I been invited?

Participants are needed who have experience with using mobile technology such as smartphones or tablets, who are familiar with using mobile applications on these devices and who have some knowledge or awareness of using mobile apps in a mental health context and it is expected that students are likely to have this awareness.

Do I have to take part?

It is up to you to decide whether or not to take part. If you do decide to take part, you will be asked to read this information sheet and then continue to the next page which asks for your consent to participate. You may change your mind about being involved at any time or decline to answer a particular question. You are free to withdraw at any point before or during the study without giving a reason.

What will I be asked to do?

If you choose to take part, you will be asked to complete a questionnaire which will ask you to rate how strongly you agree with the statement provided, in reference to well-being applications. The questionnaire takes around 10-15 minutes to complete. There is also a section for you to add notes, if there is anything else you feel you'd like to add. You will not be asked about your own mental health or asked to disclose your own experiences with using mental health services or support.

Will the research be of any personal benefit to me?

We cannot promise the study will help you but the information we get from this study may help to inform the design and development of future mobile applications to improve well-being to make them more effective and more engaging to use. To thank you for participating, you will be entered into a prize draw with a chance to win one prize of a £20 Amazon voucher or one prize of a £10 Amazon voucher.

Are there any possible disadvantages or risks in taking part?

There should be no disadvantages at all to taking part. If you change your mind at any time, you can stop answering the questions without giving a reason and your previous answers can be removed.

What will happen to the information I provide?

Your responses will be completely anonymous, no identifying details will be collected, and your consent form will be stored separately from your responses. There will be no way to identify you from your responses. This means that it will not be possible to remove your responses after they have been collected, but you are free to withdraw at any time whilst completing the questions, and your responses up to that point will be destroyed. Your responses will be held on a secure, password protected server and can only be accessed by the researcher, supervisors and examiners. This data will only be at risk in the very unlikely event on a security breach on the university servers. We believe there are no known risks associated with this research study; however, as with any online activity the risk of a breach is always possible. We will do everything possible to ensure your answers in this study will remain anonymous. This study is being conducted as part of a PhD thesis and the responses you give will be included in the final thesis. The results from this thesis may also be written up to publish as a journal article or used as part of a research presentation. If you would like to receive a copy of the overall results from this study, please email the researcher and a summary can be sent to you.

We will follow ethical and legal practice and all information will be handled in confidence. Under UK Data Protection laws the University is the Data Controller (legally responsible for the data security) and the Chief Investigator of this study (named above) is the Data Custodian (manages access to the data). This means we are responsible for looking after your information and using it properly. Your rights to access, change or move your information are limited as we need to manage your information in specific ways to comply with certain laws and for the research to be reliable and accurate. To safeguard your rights we will use the minimum personally – identifiable information possible. You can find out more about how we use your information and to read our privacy notice at:

https://www.nottingham.ac.uk/utilities/privacy.aspx.

The data collected for the study will be looked at and stored by authorised persons from the University of Nottingham who are organising the research. They may also be looked at by authorised people from regulatory organisations to check that the study is being carried out correctly. All will have a duty of confidentiality to you as a research participant and we will do our best to meet this duty.At the end of the project, all raw data will be kept securely by the University under the terms of its data protection policy after which it will be disposed of securely. The data will not be kept elsewhere.If you have any questions or concerns, please don't hesitate to ask. We can be contacted before and after your participation at the email addresses above.

What if there is a problem?

If you have any queries or complaints, please contact the student's supervisor/chief investigator in the first instance. If this does not resolve your query, please write to the Administrator to the Division of Psychiatry & Applied Psychology's Research Ethics Sub-Committee adrian.pantry1@nottingam.ac.uk who will pass your query to the Chair of the Committee.

Many thanks for your participation.

C.2: Technology Acceptance Questionnaire

Please answer the following questions by rating how strongly you agree with the statements:
(Strongly Disagree, Disagree, Neither agree nor disagree, Agree, Strongly Agree)

1. Using well-being applications can have a positive impact on my life
2. Learning to operate well-being applications would NOT be easy for me.
3. I intend to download a well-being application.
4. It is NOT easy for me to become skillful in using well-being applications.
5. Using well-being applications can improve my mood.
6. Using well-being applications is a good idea.
7. I intend to use well-being applications even if I am feeling well currently.
8. I find well-being applications INFLEXIBLE to interact with.
9. I intend NOT to use well-being applications routinely.
10. Using applications can make maintaining my well-being easier.
11. Using well-being applications is UNPLEASANT.
12. I intend NOT to use well-being applications at all.
13. I would find it easy to get well-being applications to do what I need.
14. Using applications CANNOT improve my well-being.
15. I would use well-being applications as often as needed.
16. Using well-being applications is beneficial to my health and well-being.
17. I would find well-being applications easy to use.
18. I would find well-being applications NOT useful.
19. I would use well-being applications as often as possible.
20. My interaction with well-being applications would be clear and understandable.
21. Using well-being applications CANNOT enhance my daily life.

Please write in the space below anything else you wish to note about your experiences with using well-being or mental health applications:

C.3: Table of participant demographics – Technology Acceptance Online Survey

Table 13: Demographics of participants from the Technology Acceptance Online Survey (Study 1)

Ppt No.	*Age*	*Gender*	*Occupation*	*Have you used well-being or mental health applications on your phone or mobile device before?*	*If you have, which have you used?*
1	31	Male	Lecturer	Never	
2	21	Male	Student	Sometimes	Headspace
3	24	Male	Banking specialist	Never	N/a
4	22	Female	Student	Never	
5	30	Female	Sales Assistant	Never	
6	27	Female	Solicitor	Never	
7	24	Female	Sales Assistant	Sometimes	Calm, Calm Harm, others a long time ago
8	23	Female	Receptionist	Very occasionally	Head space and calm
9	19	Female	Retail	Sometimes	Sayana
10	26	Male	Senior Digital Marketer	Sometimes	Calm
11	55	Male	Occupational Psychologist	Never	
12	30	Female	Occupational Psychologist	Very occasionally	Headspace
13	28	Female	Service Manager	Very regularly	Calm and head space
14	26	Male	HR professional	Very occasionally	Calm, Headspace
15	23	Male	Student	Sometimes	Binaural Beats
16	31	Female	Student	Never	
17	39	Female	Self-employed	Very occasionally	Relaxation apps
18	25	Male	Project Manager		
19	29	Male	Consultant	Frequently	Headspace
20	34	Male	Business Travel Consultant	Very occasionally	Rain Rain
21	44	Male	Accountant	Very occasionally	Youper
22	62	Male	Director	Never	
23	27	Female	Researcher	Very occasionally	Head space
24	25	Female	Phd Student	Sometimes	Headspace, fitness apps
25	24	Male	Unemployed	Never	
26	26	Male	Researcher	Never	

Ppt No.	*Age*	*Gender*	*Occupation*	*Have you used well-being or mental health applications on your phone or mobile device before?*	*If you have, which have you used?*
27	42	Female	Company Director	Sometimes	Fitness pal, VGB hypnosis,
28	24	Male	Consultant	Never	
29	25	Female	Assistant Language Teacher	Very occasionally	Headspace
30	22	Male	Student (health psychology and clinical skills MSc)	Very occasionally	headspace
31	31	Male	Teacher	Never	
32	39	Male	Teacher	Never	
33	34	Male	Teacher	Sometimes	A “nature sounds” mixer, for sleep.
34	51	Female	Office Manager	Never	
35	41	Male	Accountant	Sometimes	Samsung Health
36	58	Male	Accountant	Never	
37	48	Male	Accountant	Never	
38	38	Male	Accountant	Never	
39	57	Male	Commercial IT Consultant	Very occasionally	relaxation
40	48	Male	IT Consultant	Never	
41	64	Male	Programme/project Manager	Never	N/A
42	47	Male	Risk Manager	Never	
43	50	Male	Accountant	Very occasionally	Calm music
44	39	Male	Commercial Director, pharma company	Very occasionally	Headspace
45	51	Male	IT Manager	Very occasionally	Big White Wall
46	67	Male	Retired accountant	Never	
47	43	Female	IT Architect	Sometimes	Yoga and meditation apps
48	50	Male	Corporate Banker	Very occasionally	Insight timer (meditation)
49	44	Male	Business Analyst	Never	
50	47	Female	Accountant	Very occasionally	Calm, guided meditation
51	44	Male	Accountant	Frequently	fitbit
52	50	Male	Management Consultant	Never	
53	45	Female	Accountant	Never	

Ppt No.	*Age*	*Gender*	*Occupation*	*Have you used well-being or mental health applications on your phone or mobile device before?*	*If you have, which have you used?*
54	48	Female	Project Manager	Never	
55	61	Male	Management Consultant	Never	
56	47	Female	Chartered Accountant	Very occasionally	Meditation apps
57	58	Male	Retired	Sometimes	Simple habit, big white wall
58	52	Male	Company Director	Never	
59	66	Male	Chartered Accountant	Never	
60	58	Male		Never	
61	43	Male	University Academic	Sometimes	Happify, headspace and few others
62	45	Female	Accountant	Never	
63	33	Female	Resourcing	Sometimes	Calm, work based apps
64	39	Male	Sales Manager	Never	
65	55	Male	Company Director	Never	
66	53	Male	Television Producer	Never	
67	47	Prefer not to say	Manager	Frequently	Calm
68	61	Female	Management Consultant	Very occasionally	Meditation app
69	56	Male	Accountant	Never	
70	41	Female	Head of IT business Operations	Never	
71	43	Female	Recruiter	Sometimes	Mediation Apps
72	54	Male	Accountant	Very occasionally	Can’t recall the name, it was offered through work, was questionnaire based and led you to other resources.
73	50	Male	Accountant	Never	
74	50	Male	Finance	Never	
75	46	Female	Accountant	Sometimes	Headspace
76	34	Male	Business consultant	Never	

Ppt No.	*Age*	*Gender*	*Occupation*	*Have you used well-being or mental health applications on your phone or mobile device before?*	*If you have, which have you used?*
77	57	Male	Retired	Sometimes	Apple Health & Snorelab
78	54	Male	Management Consultant	Never	
79	47	Female	Solicitor	Never	
80	51	Male	Programme Manager	Never	
81	62	Male	Retired	Never	
82	40	Female	Solutions Architect	Never	
83	55	Male	Retired	Never	
84	18	Female	Student	Very occasionally	Headspace, #Mindful
85	52	Male	Accountant	Very occasionally	Apple breathe on Apple watch
86	73	Male	Retired	Never	
87	49	Male	Telecoms Engineer	Never	
88	18	Female	Student	Very occasionally	Headspace
89	18	Female	Student	Very occasionally	Calm
90	57	Male	Management Consultant	Very occasionally	Inner health
91	18	Female	None	Never	
92	38	Male	IT Technician	Never	
93	53	Male	Management Consulting Director	Never	
94	43	Male	Recruitment Business Owner	Very occasionally	Headspace
95	49		Team Manager in Financial Services	Never	
96	36	Female	Lecturer	Never	
97	48	Male	Finance director	Sometimes	Headspace
98	54	Male	IT Manager	Never	
99	58	Male	Project Manager	Never	
100	18	Female	Student	Very occasionally	Calm
101	48	Female	Accountant	Sometimes	Bellabeat Leaf
102	62	Male	Retired Project Manager	Never	
103	18	Female	Student	Sometimes	MyFitnessPal, Headspace, Clue

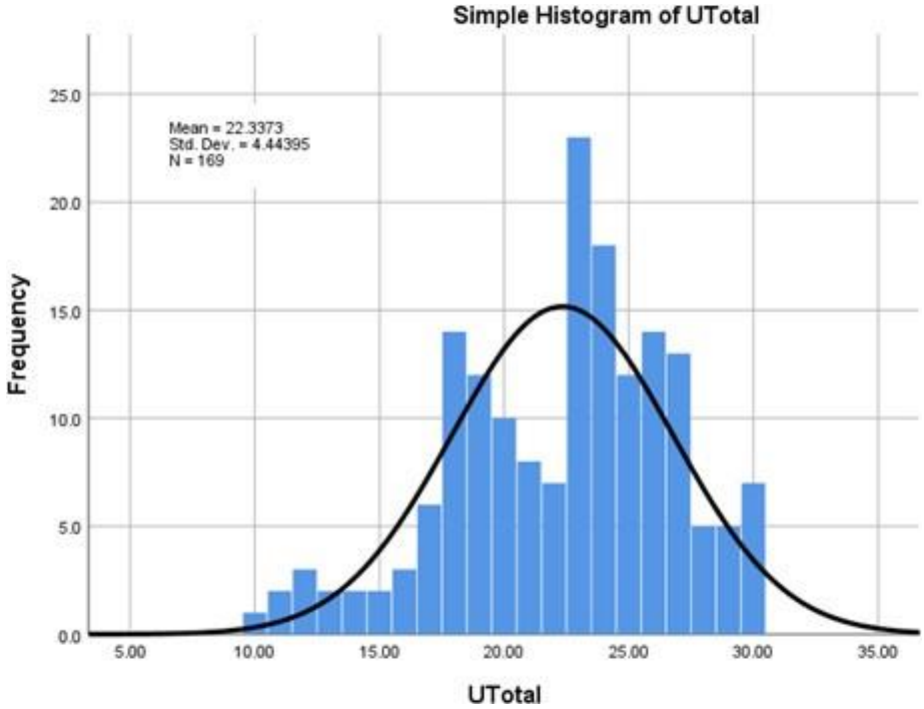
Ppt No.	*Age*	*Gender*	*Occupation*	*Have you used well-being or mental health applications on your phone or mobile device before?*	*If you have, which have you used?*
104		Male	CEO	Frequently	Beat panic
105	60	Male	CIO	Very occasionally	Can't remember
106	54	Female	IT consultant	Sometimes	Headspace
107	63	Male	Technology Consultant	Never	
108	49	Male	Senior Project Manager	Never	
109	50	Female	Accountant	Sometimes	Calm Headspace Well-being portal
110	50	Female	Senior Management Emergency Planning	Sometimes	Head Space
111	54	Male	Accountant	Very occasionally	Headspace
112	45	Male	Accountant	Never	
113	56	Male	Digital Leadership Consultant	Frequently	VeryFitPro
114	42	Female	Finance	Never	
115	51	Male	CTO	Never	
116	60	Female	Personal & Business Coach	Very occasionally	Headspace, CBT diary, Mywellness, fitbit,
117	50	Male	IT Project Manager	Sometimes	Forgot
118	46	Female	Accountant	Never	
119	58	Male	Accountant	Never	
120	41	Male	Management Consultant	Never	
121	50	Female	Project Manager	Very occasionally	Calm
122		Male	Mgmt Consultant	Never	
123	55	Female	Business Analyst	Never	
124	54	Female	Semi-retired	Sometimes	Headspace for meditation, apps for walking and running
125	51	Male	Consultant	Never	
126	49	Male	Sales	Sometimes	can't remember
127	29	Male	Finance	Very regularly	Strava, Garmin connect
128	58	Male	Management Consultant	Never	

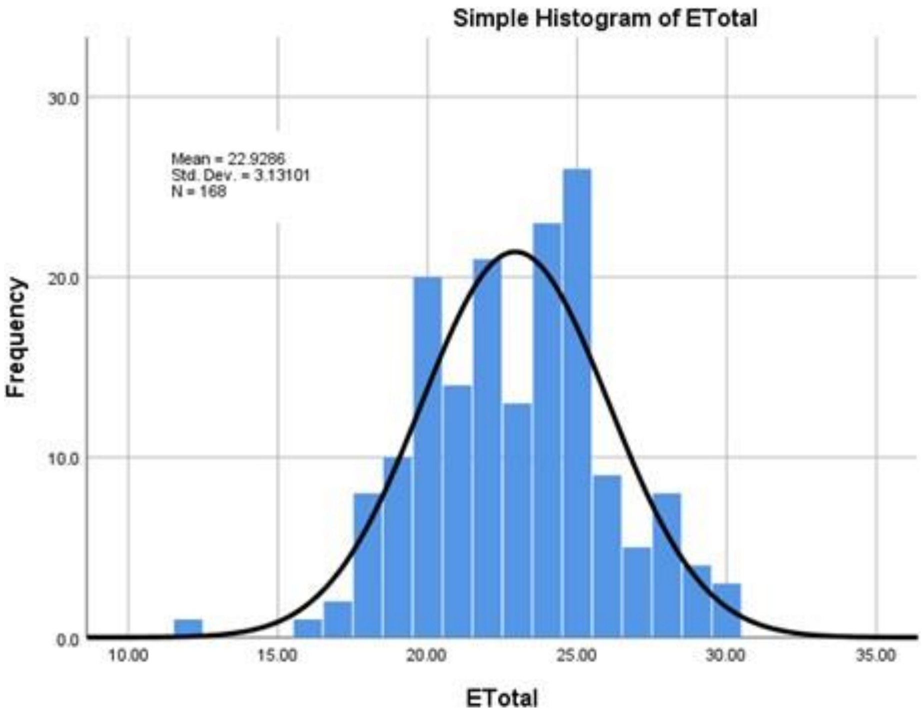
Ppt No.	Age	Gender	Occupation	Have you used well-being or mental health applications on your phone or mobile device before?	If you have, which have you used?
129	57	Female	PA	Never	
130	43	Female	People Business Partner	Very occasionally	Headspace
131	53	Male	Senior Management NHS - Primary Care Lead	Sometimes	mindfulness, relaxation, meditation
132	37	Male	Recruitment Consultant	Very occasionally	Health applications - activity monitoring
133	44	Male	Recruiter	Frequently	Insight Timer
134	21	Female	Student	Very occasionally	Moody month
135	51	Male	Finance Director	Sometimes	Headspace, Calm
136		Male		Never	
137	45	Male	Engineer	Very occasionally	Insight timer
138	50	Male	Accountant	Frequently	Headspace
139	38	Female	Alumni Development Officer	Never	
140	44	Female	Consultant	Very occasionally	Headspace
141	43	Male	Risk Manager	Never	
142	35	Female	University Lecturer	Very occasionally	Headspace
143	55	Male	Banker	Sometimes	Bhuddify
144	40	Male	License Manager	Never	
145	49	Female	Company director	Never	N/A
146	38	Male	Recruiter	Never	
147	49	Female	Indirect Tax Adviser	Never	I don't think I have ever needed them
148	50	Male	Risk Director	Never	
149	49	Female	Management Consultant	Sometimes	Breathe
150	42	Male	Accountant	Never	
151	42	Male	IT Manager	Never	
152	65	Male	Retired	Never	
153	61	Male	IT Consultant	Very occasionally	Breathing/ Mindfullness App
154	39	Female	Pensions Officer	Sometimes	Headspace and What's Good
155		Female	Accountant	Never	
Ppt No.	*Age*	*Gender*	*Occupation*	*Have you used well-being or*	*If you have, which have you used?*

				mental health applications on your phone or mobile device before?	
156	39	Male	Account Manager	Very regularly	Headspace, calm, 10 percent happier, care and perform, breathe
157	54	Male	Tax Adviser	Never	
158	46	Male	Director	Never	
159	60	Male	Management Consultant	Very occasionally	HeadSpace
160	44	Male	Commissioned Officer Royal Navy	Never	
161	55	Male	Educator	Frequently	Calm
162	44	Female	Physiotherapist	Frequently	Strava, Insight Timer, Headspace, Plum Village app, C25k
163	29	Male	Management Consultant	Very regularly	Headspace
164	39	Male	British Army Combat Medic	Never	
165	57	Female	Adjunct professor	Never	
166	50	Male	Project Manager	Never	
167	61	Male	Executive Director	Never	
168	62	Male	Retired Chartered Accountant	Sometimes	headsted
169	22	Male	Nights Manager	Never	
170	58	Male	Accountant	Never	n/a

C.4: Quantitative Analysis

Histograms





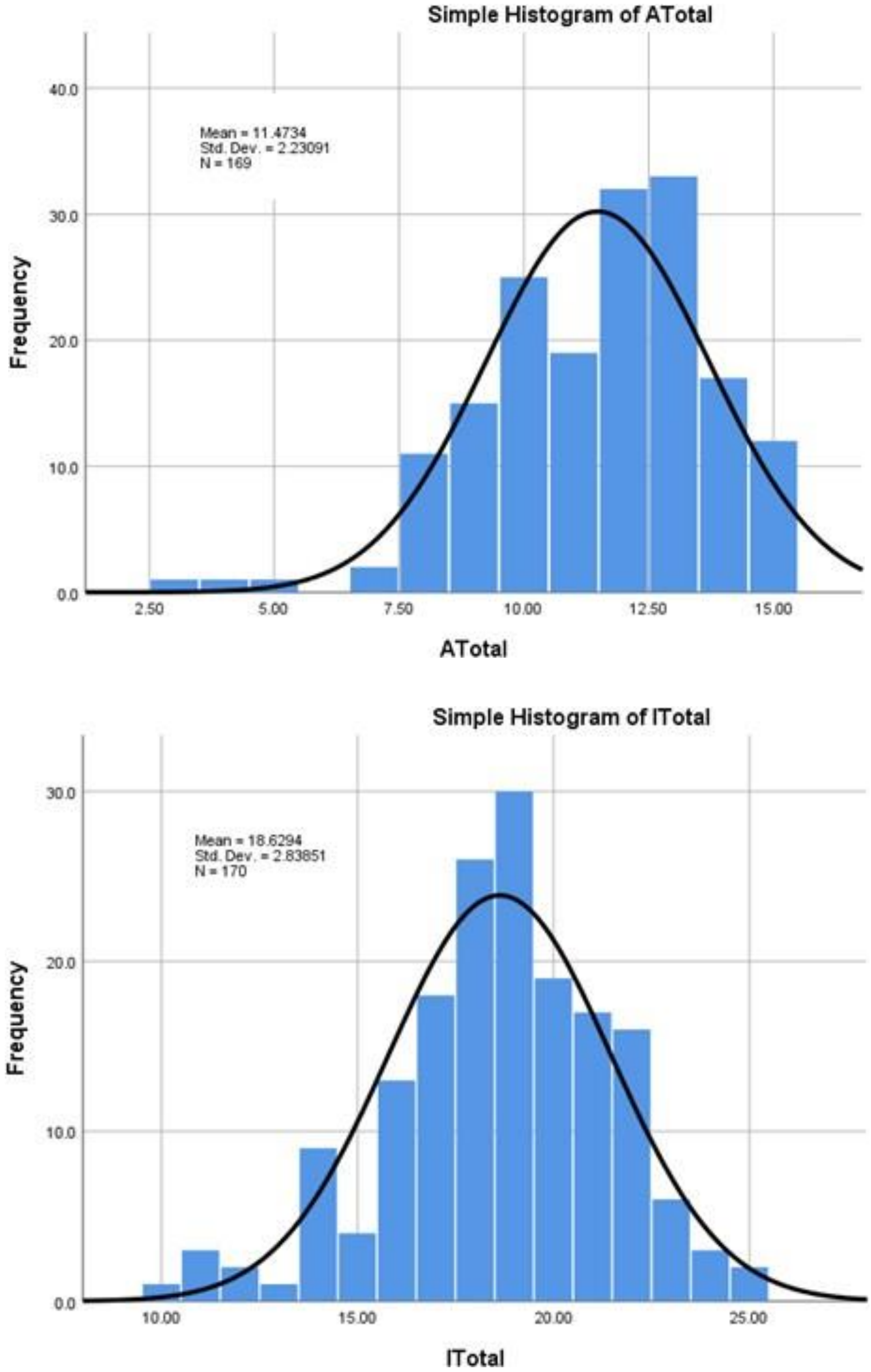
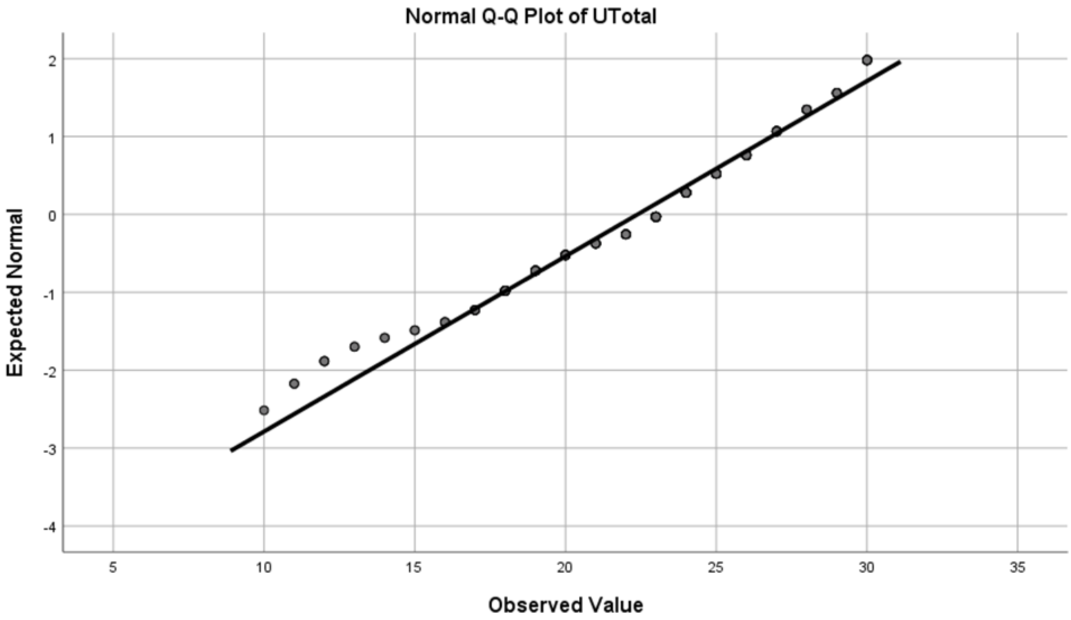
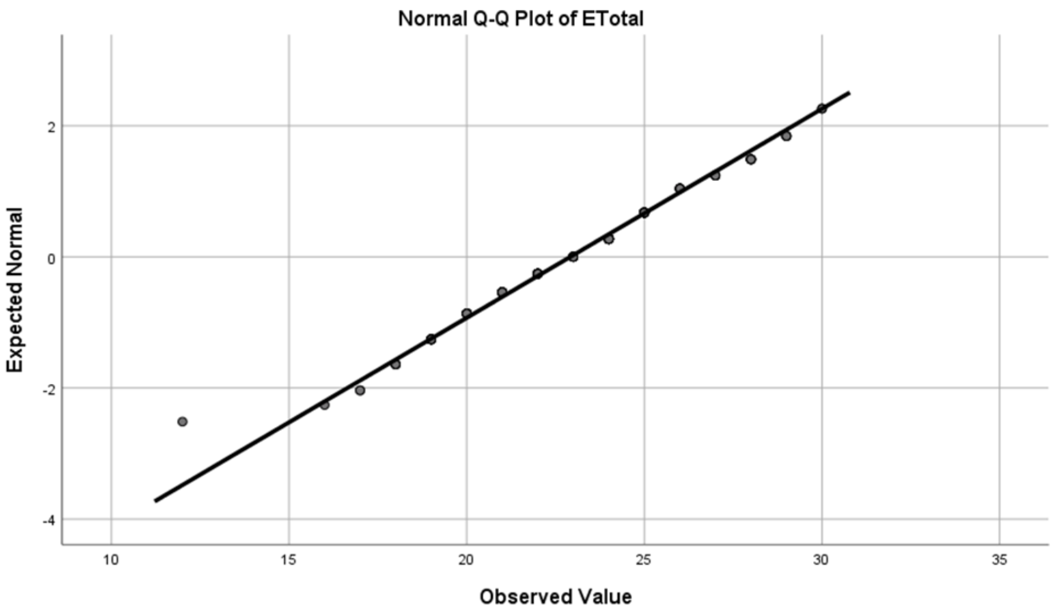


Figure 18: Simple Histograms for the normality of the TAM variables

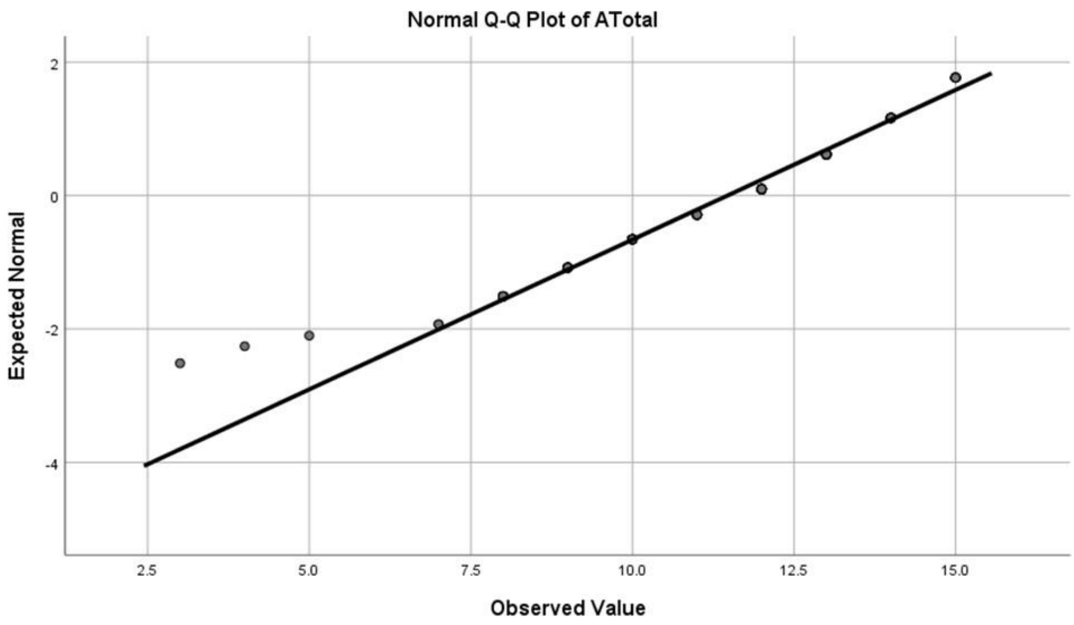
Q-Q Plots



Normal Q-Q Plot of UTotal
Expected Normal
Observed Value
2
1
0
-1
-2
-3
-4
5
10
15
20
25
30
35



Normal Q-Q Plot of ETotal
Expected Normal
Observed Value
2
0
-2
-4
10
15
20
25
30
35



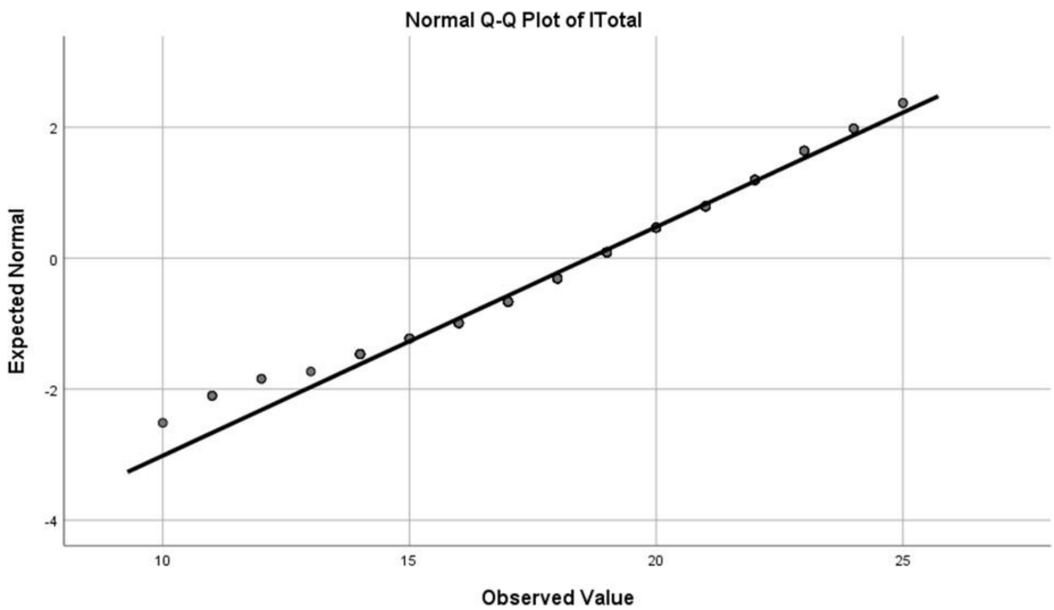
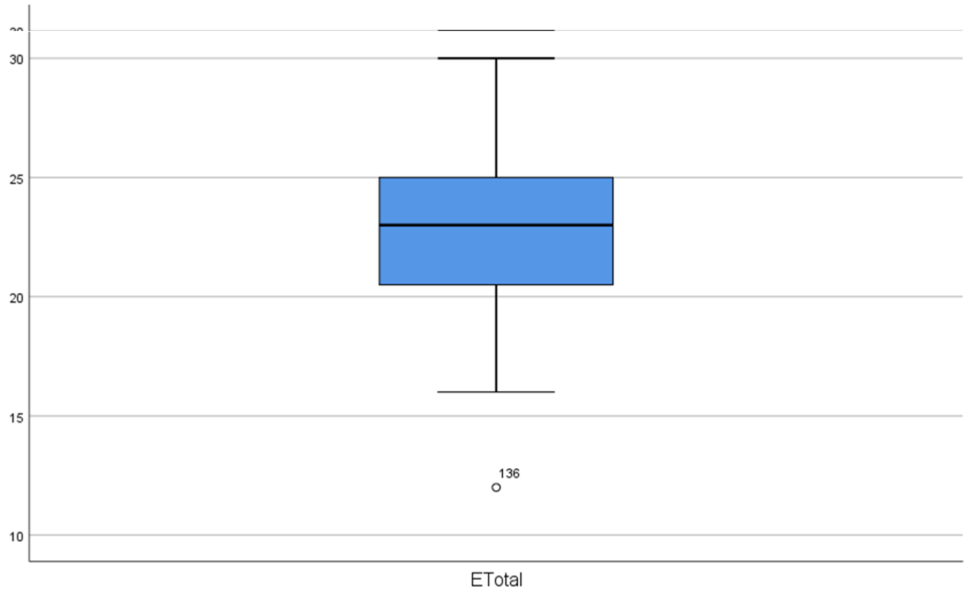
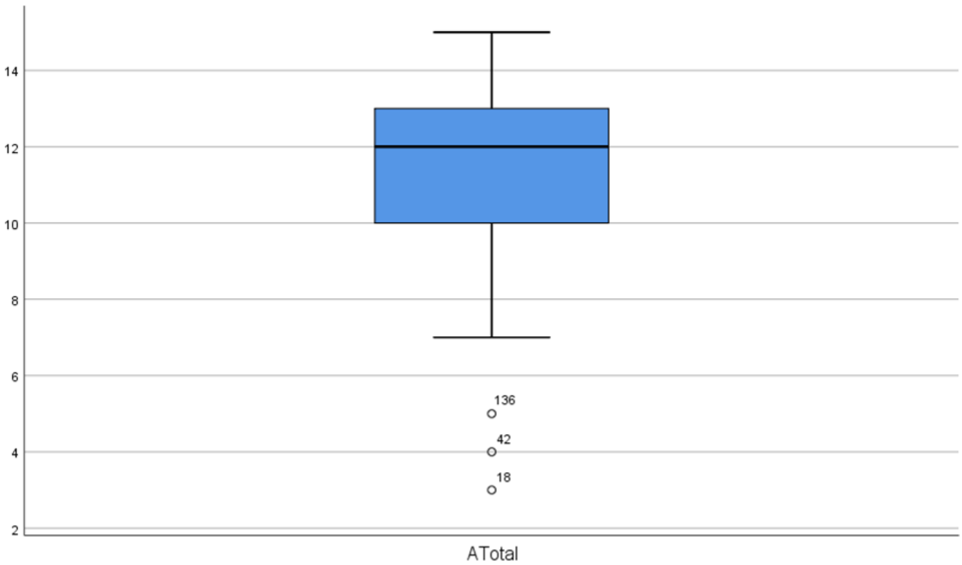


Figure 19: Q-Q Plots for the TAM variables

Box Plots





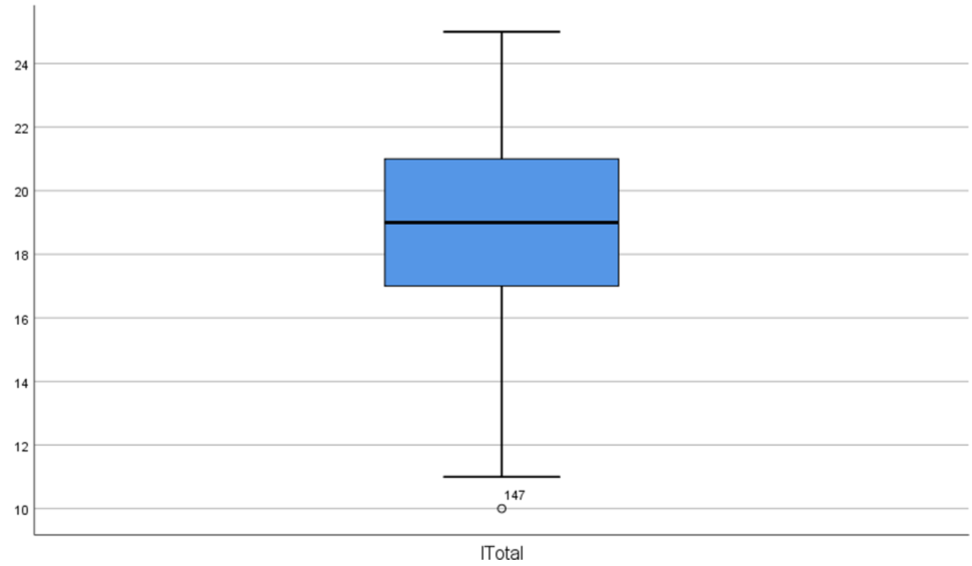
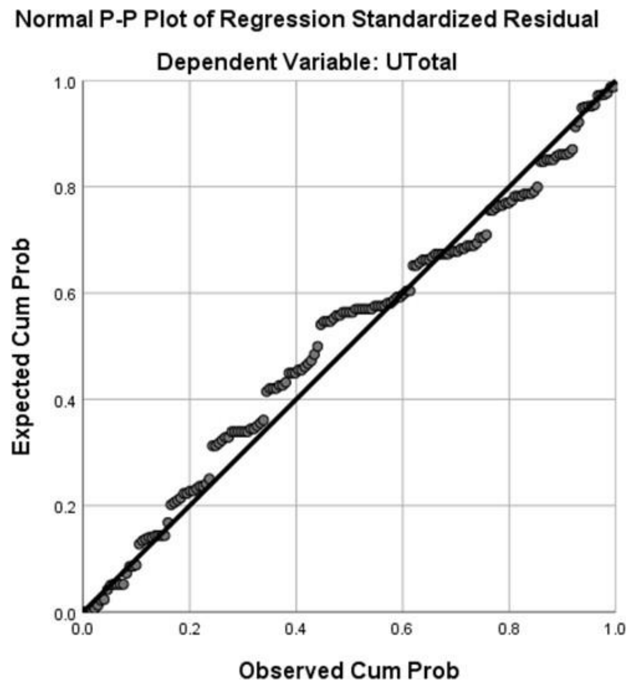
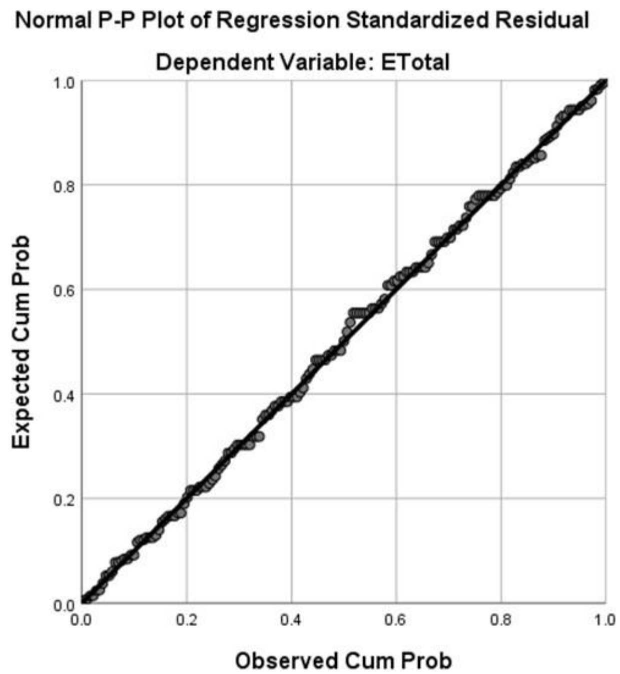
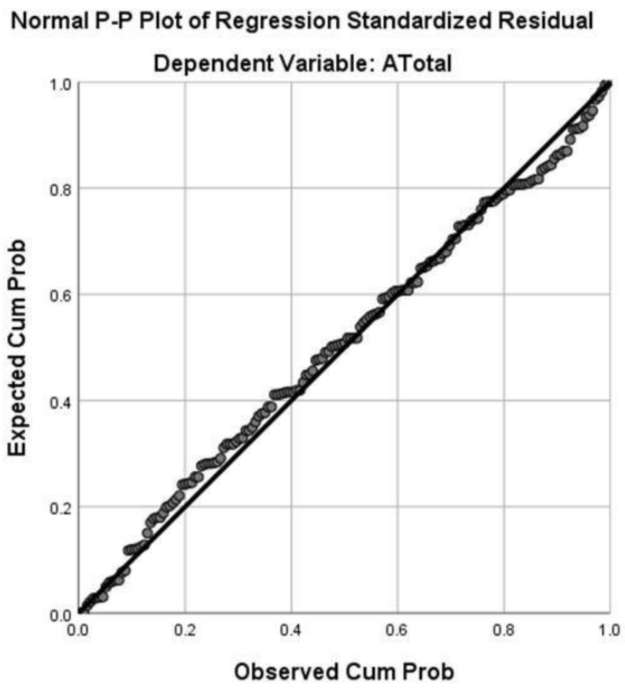


Figure 20: Box Plots for the TAM variables

P-P Plots (Residuals)







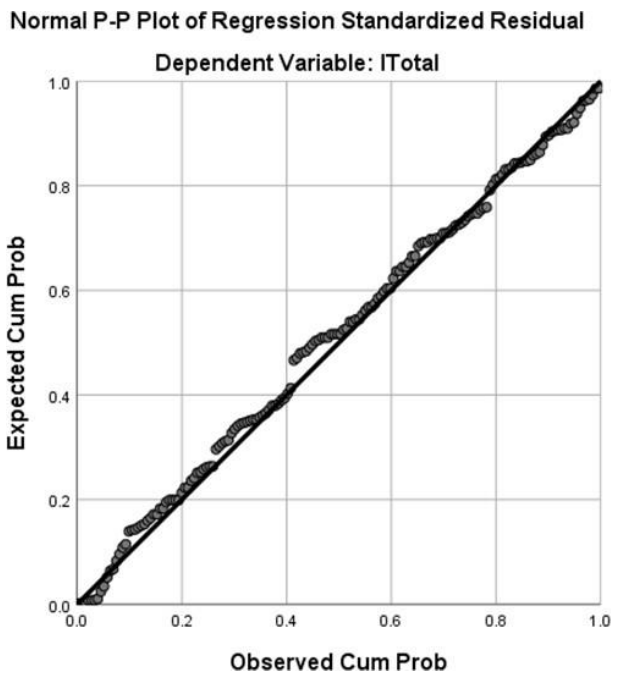
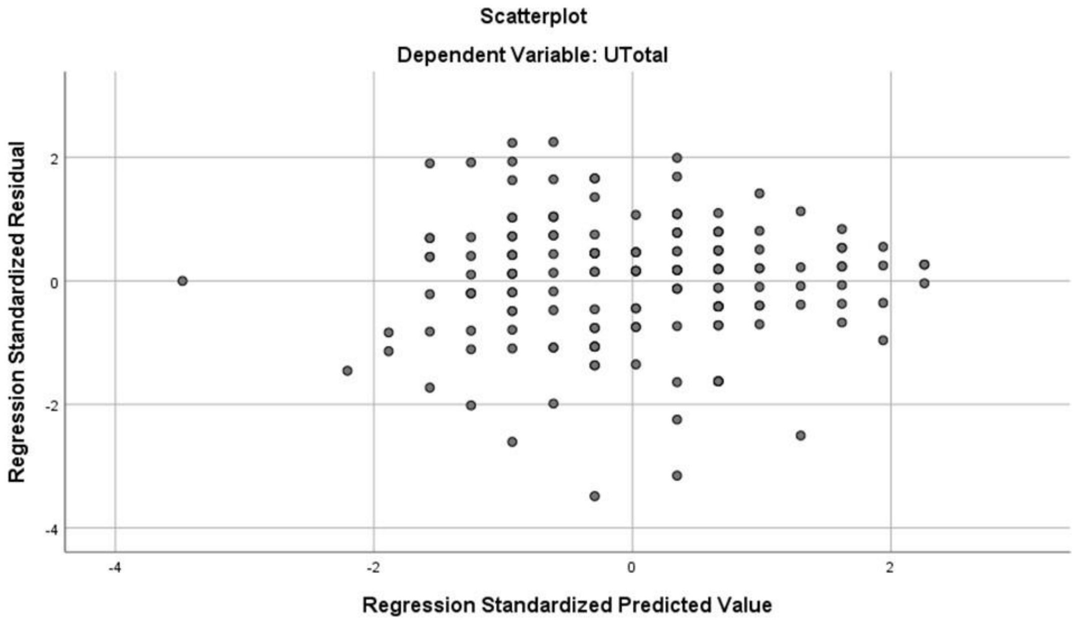
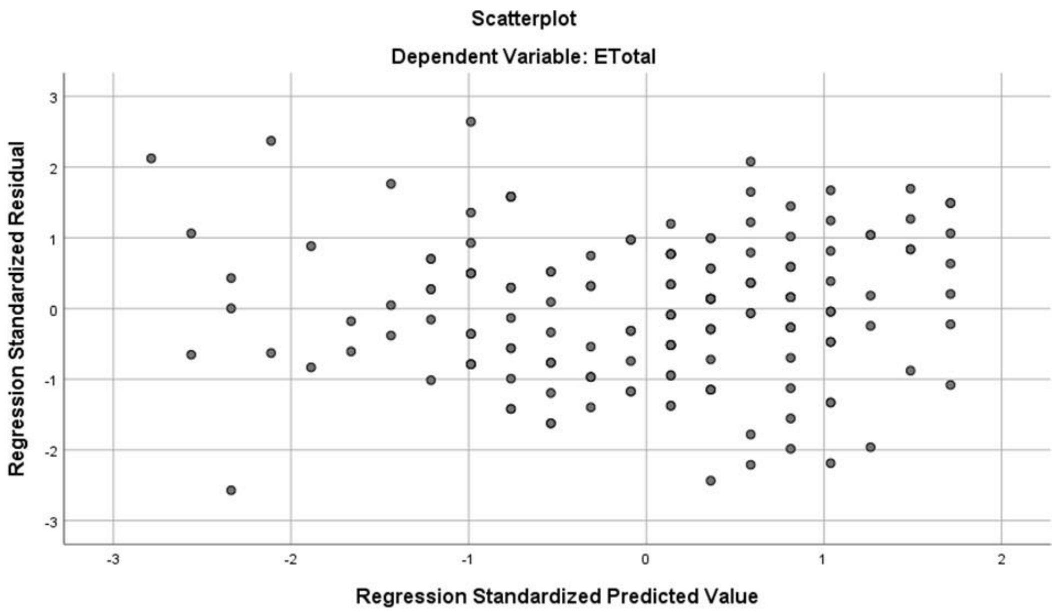


Figure 21: P-P plots for the TAM variables

Scatterplots (Residuals)





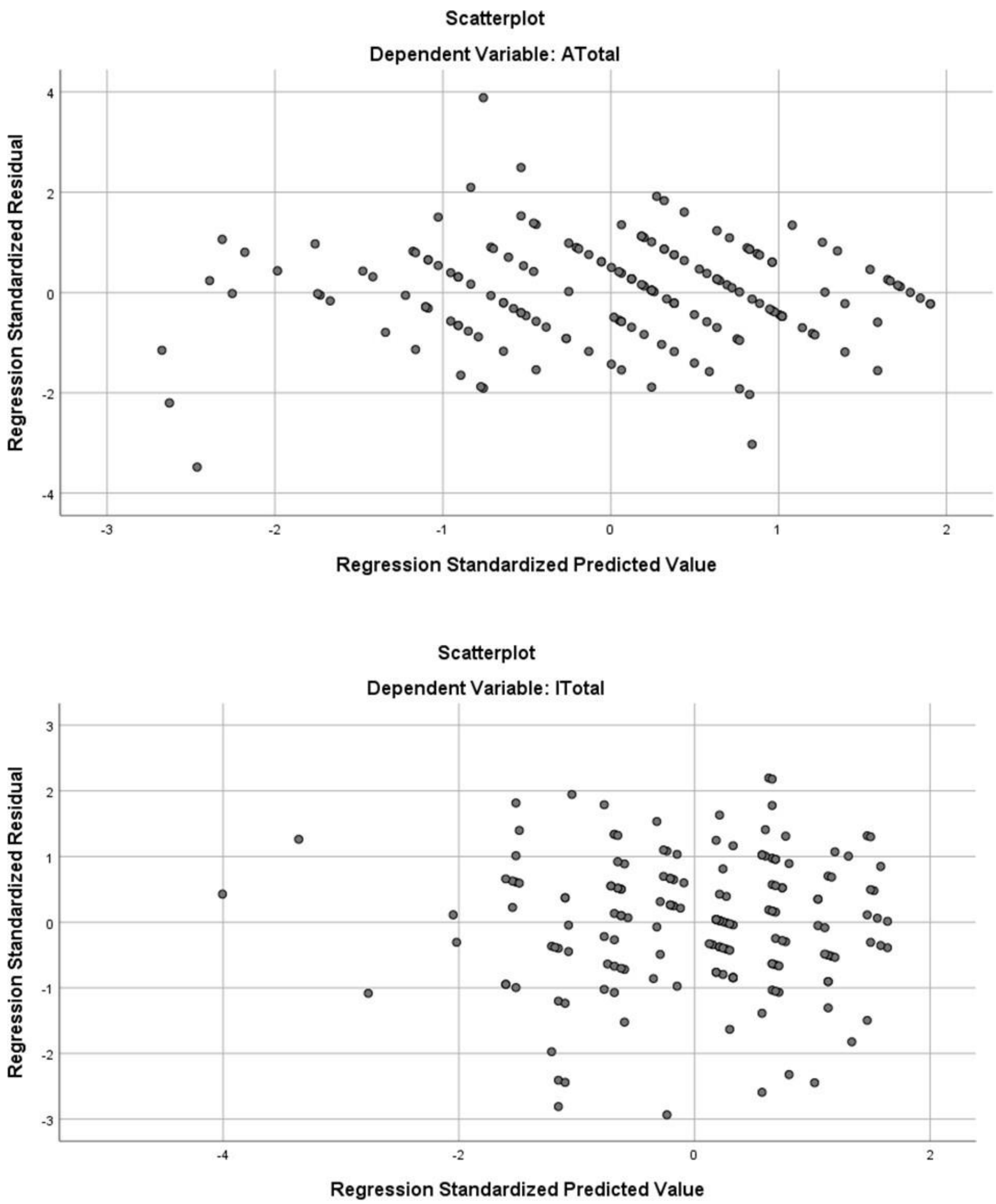


Figure 22: Scatterplots for the TAM variables

C5: Open Question Responses

Table 14: Demographics and verbatims responses from the open question in the TAM survey

Ppt. No.	Age	Gender	Occupation	Have you used well-being apps before?	Comment
1	21	M	Student	Sometimes	I personally found that I wouldn't keep using them routinely - even when I might have needed them. The mindset I was in found it more of a chore than beneficial.
2	24	F	Sales Assistant	Sometimes	Don't use them very routinely, have never managed to stick to the habit of using them, but I like to keep a few on my phone as a "backup" or safety net for when I'm feeling low. During worse phases of depression I struggle to do any activities at all and often my phone is the only thing I have energy to look at, and sometimes the apps can be a helpful /comforting distraction to help pass some time.
3	26	M	Digital marketer	Sometimes	I think that I have slightly more awareness over mental health applications than the average person thanks to working with a mental health startup and also the experiences of losing a friend to suicide. While there is much talk in the media over mental health awareness, I feel like that is starting to stagnate because the next step is being overlooked: how to actually help those with mental health issues (by the use of things like apps etc).
4	28	F	Service Manager	V. Regularly	The success and impact of well being apps are very much dependent on the application software, useability and costs. Therefore the questionnaire findings may be inaccurate due to people's personal interpretation of what 'use' would be.
5	23	M	Student	Sometimes	They are helpful in learning techniques like mindfulness but one cannot use them to share feelings.

Ppt. No.	Age	Gender	Occupation	Have you used well-being apps before?	Comment
6	31	F	Student	Never	Nil
7	39	F	Self-employed	V. occasionally	I have used apps for relaxation and they are OK. I think there would be occasions in which to have some extra help through apps will be good. However, I have reservations about their use as I believe that many people (particularly young people) could end up relying on apps to feel better, which could be isolating and isolation is one of the main enemies of well-being. People should be encourage to have real contact with others leaving their phones beside, to share their worries with their friends and to ask for help when they need. I agree on that apps can be a good supplement, but I don't know whether people are starting to believe that all solutions may come through their mobile phones.
8	34	M	Travel Consultant	V. occasionally	I generally find them very relaxing if you pay for additional features. The free versions severely limit their effectiveness
9	44	M	Accountant	V. occasionally	Good when can't get to see counsellor or friends
10	62	M	Director	Never	More suited to regular use than dipping in and out
11	24	M	Unemployed	Never	I have not come across a well-being application per se. I have been directed to websites which explore feelings towards issues such as Depression or Anxiety. This may not answer the question above, in fact it will not at all. However, I feel that a MH app should target the underlying thinking patterns behind issues such as depression and Anxiety, in order to undermine the prevalance of such issues. It is my view that being able to target problems such as negative or dysfunctional thought patterns would be beneficial. It is often these which provide the seeds for issues which naturally follow them. For instance, a person may have a thought such as "I feel worthless after doing this questionaire". It would be useful for an app to be able to address this thought pattern, for instance, have some way of challenging this thought pattern. For instance, a pop up might appear stating "are you sure?". Hope this helps, keep making the world better :)
12	25	F	Language Teacher	V. occasionally	I find that I only actively seek out well-being apps when I'm feeling particularly stressed or anxious, so often it can feel unpleasant to use them because of that connection. I am aware that such apps

Ppt. No.	Age	Gender	Occupation	Have you used well-being apps before?	Comment
					should be used routinely, but I lack motivation so maybe if there was some incentive to use it regularly that would be beneficial.
13	34	M	Teacher	Sometimes	My experience with well-being applications is limited but has been mostly positive.
14	51	F	Office Manager	Never	Not clear what constitutes a well being application
15	58	M	Accountant	Never	Can't comment as I haven't used them or even know what they are
16	64	M	Project Manager	Never	na
17	39	M	Director	V. occasionally	Poor science behind wellbeing apps. CBT apps seem better evidenced. Overall I think they're a poor substitute for getting proper face-to-face help
18	43	F	IT Architect	Sometimes	A mobile application is just a tool to provide a service or content - it's not in itself as important as the actual content or service, nor the motivation to want the content/service. My opinion obvs!
19	47	F	Accountant	V. occasionally	Experiences to date have been in relation to guided mediation to help sleep. Have found them to be effective when used but do not use routinely
20	44	M	Accountant	Frequently	Used in conjunction with fitbit watch (with heart monitor)
21	50	M	Mmgt. Consultant	Never	None
22	48	F	Project Manager	Never	They're helpful as long as you can tap in and out of them at your own leisure. Regular notifications can create greater anxiety
23	58	M	-	Never	I am quite IT literate, but i dont know what a Well being application is. I will look into it, but if you gave some examples of packages.
24	43	M	Academic	Sometimes	They are great when you get the chance to use them, but if you forget then you won't be able to sustain the positive effects that you had initially. Good luck with your research!

Ppt. No.	Age	Gender	Occupation	Have you used well-being apps before?	Comment
25	39	M	Sales Manager	Never	Cost of such applications may prove to be prohibitive. Would need to be low cost or free for me to consider using one.
26	55	M	Director	Never	I think for people exp mental health issues they need someone at the very point they are 'reacting' - and not hospital opening hours. I do think people to people is best because it is more flexible (reacting to what is being heard). AI may be helpful but it still can’t 'sense' things in people. BUT I think a tech app may help in very specific situations especially in maintaining mental health rather than at point of (what appears to be for the individual) a crisis.
27	53	M	TV Producer	Never	Will probably use them soon, but fingers crossed I haven’t had the need so far
28	56	M	Accountant	Never	Never used these applications but curious.Best wishes in your research . Mental health is undervalued and not for most people an issue until people have awful breakdowns
29	43	F	Recruiter	Sometimes	find them useful & calming
30	54	M	Accountant	V. occasionally	It was useful.
31	34	M	Business Consultant	Never	I never used one of these applications, but I don’t mind having a look on one for future updates
32	57	M	Retired	Sometimes	Using apps can help you monitor your own wellbeing e.g. how many steps taken in a day and allow a profile to be built which factually states your profile and identify what to do to improve health
33	47	F	Solicitor	Never	I work in a large global manufacturing organisation which has a focus on mental health to be honest until recently I Would have been really negative about apps and mental health generally - however listening to comments of colleagues about apps that help them has opened my eyes and would embrace any app that helps peoples mental health - lets get rid of the stigma and lets talk about are feelings it okay not to be okay!
34	51	M	Programme Manager	Never	An example of likely well being apps would help people that have never used one before or isn’t aware they have used one.

Ppt. No.	Age	Gender	Occupation	Have you used well-being apps before?	Comment
35	40	F	Solutions Architect	Never	I have never used any well being applications and probably never will, although I understand how they could be useful.
36	52	M	Accountant	V. occasionally	I think they are useful tools. The automated rhythm of an app or other software can start the habit of small changes to routine which contribute to an overall improvement in wellbeing and mental health.
37	73	M	Retired	Never	I see no relation between 'well-being; and 'mental health' issues, other than a vague commonality of little value on a research exercise. Neither term is defined in a meaningful, crisp and unambiguous fashion, and as I am geriatric, I have a view on 'mental health' and what that means, but 'well-being' is such a modern, nebulous and ill-defined term as to be meaningless in a scientific study. My daughter has a PhD and several years research experience in a related field. If this could be of value, I'd be happy to enquire if she'd be willing to assist in this research.
38	49	M	Telecoms Engineer	Never	I don't know what you are going on about. I have never heard of the applications, and the contradictory questions on the previous page are a waste of everyone's time.
39	57	M	Mmgt. Consultant	V. occasionally	As with all apps finding time to use them is the challenge
40	38	M	IT Technician	Never	Although I don't normally use them - I would think they could be helpful. I have myself been severely depressed and have gotten myself out of it.
41	53	M	Mmgt. Consultant	Never	I mainly use fitness apps rather than strict well being apps e.g. Garmin, Zwift, Trainer Road and the native app on my indoor bike trainer.
42	43	M	Recruitment Director	V. occasionally	Pretty indifferent. Basic concept but did not do much over a short period so stopped using.
43	54	M	IT Manager	Never	Mental Health is important, my employee utilises an open space called safe space to discuss mental health issues, ideas and where appropriate guidance
44	58	M	Project Manager	Never	Never used a WBA so tried to respond as best I could under those circumstances.

Ppt. No.	Age	Gender	Occupation	Have you used well-being apps before?	Comment
45	48	F	Accountant	Sometimes	Simplicity and minimum effort is key. Devices which capture and upload data regarding movement, heart rate, exercise, sleep patterns etc and combine this as a measure against other subjective data manually input like emotional state and feelings to support understanding of mental health and calm down confusion and anxiety help massively. Links to further information, tips and support channels all in one place would also help. Too much time spent staring at digital interfaces can have adverse impacts on mental well being so interactions need to be efficient.
46	49	M	Project Manager	Never	I have never used these applications but might consider using them in the future
47	50	F	Accountant	Sometimes	I think well being applications have a big role to play in helping people sleep or deal with stress. Good luck with the PhD
48	45	M	Accountant	Never	.
49	56	M	Digital Consultant	Frequently	None
50	51	M	CTO	Never	I've never used any of these apps, so I don't feel qualified to comment on their usability or effectiveness. I wouldn't turn to an app for emotional wellbeing / mental health support. I do use apps for physical well-being / exercise
51	60	F	Business Coach	V. occasionally	I think it is too tempting to immediately start using other apps that are less helpful and instead waste time.
52	-	M	Mmgt. Consultant	Never	Never tried them but fairly cynical about the concept of them but depends on personality. If you found things like "little book of calm" useful then I'm sure there would be some benefit - But i didn't !

Ppt. No.	Age	Gender	Occupation	Have you used well-being apps before?	Comment
53	55	F	Business Analyst	Never	As I have not had any mental health issues or used an app, I've answered the questioned based on my capability with using apps and my experience of using motivational books
54	54	F	Semi-retired	Sometimes	I would use a well-being app that fits what I'm trying to achieve (e.g. meditation); at the end of the day, it's like everything else, you only get out what you put in - whether it's using an app or following an exercise plan
55	58	M	Mmgt. Consultant	Never	I have no direct experience of all's supporting mental health more aware of physical health monitors. I do find tech is a double-edged sword as the overuse of tech such as Facebook Instagram etc can I feel be risky with the potential to be bullied harassed and judged
56	57	F	PA	Never	Really sorry but I've never used one. I would be open to try one though!
57	53	M	NHS Management	Sometimes	As an advocate for Mental Well-being - thank you for the opportunity to participate.
58	37	M	Recruitment Consultant	V. occasionally	I believe apps are useful for many people, however I don't currently feel I need one. I think I would be more likely to use if I had a need
59	51	M	Finance Director	Never	Headspace uses regular notifications to just remind us how important it is to not ignore our mental health. My favourite? "Your phone can do many amazing things, now put it down!"
60	-	M	-	Never	I would not use well-being apps as I fear google would use any information against me and would not treat it properly - talking to people close to me and professionals would be my preferred route to assisting my mental well being
61	50	M	Accountant	Frequently	I try wherever possible to allocate myself time without distractions so I can use my Headspace app. I have also found it beneficial I try to use the same time of day more often, so the routine becomes second nature rather than chore like
62	44	F	Consultant	V. occasionally	Just because it's a well-being app with good intentions doesn't mean it was well designed
63	35	F	Lecturer	V. occasionally	The questions were not particularly clear and many of them depends on the person, the problem and nature of support

Ppt. No.	Age	Gender	Occupation	Have you used well-being apps before?	Comment
64	55	M	Banker	Sometimes	Weird questions
65	49	F	Tax Advisor	Never	I have never used apps of this kind
66	50	M	Risk Director	Never	I think apps can be useful but can’t replace human interaction
67	61	M	IT Consultant	V. occasionally	Ability to use and helpfulness depends on the application - some user interfaces are horrible, some very nice - hence the wall sitting in some of my responses
68	39	F	Pensions Office	Sometimes	I’ve found guided meditation very useful. I also used an app designed to record gratitude- I think this was very useful but I didn’t keep in the habit of using it. If I was feeling unwell, I would probably start using it again.
69	46	M	Director	Never	I use my phone to de-stress but just by playing the odd game when I’m travelling, not by using any specific well-being apps.
70	60	M	Mmgt. Consultant	V. occasionally	Still early days so no empirical evidence but I believe there are benefits to be obtained
71	44	M	Royal Navy Officer	Never	Attitudes of this type of app are becoming more common place within the armed forces. I personally haven't used them, but am interested in them to support others as and when required
72	39	M	British Army Medic	Never	I believe these applications will have some use, however it shouldn’t replace appointments with a professional mental health worker.
73	61	M	Executive Director	Never	No still a novice
74	62	M	Retired Accountant	Sometimes	used headsted on a tablet as part of a self referral. had biweekly 20 mins with person skilled in the app. have reservations about unsupported apps not from technical stance but from health stance. early days with effect but will continue.
75	58	M	Accountant	Never	I have not used the well-being applications but may have tried one before completing the questionnaire if asked.

Appendix D: Chapter 6: Usability Testing

D1: Participant Information Sheet

PARTICIPANT INFORMATION

STUDENT RESEARCH PROJECT ETHICS REVIEW
Division of Psychiatry & Applied Psychology

Project Title: *Technology Acceptance Model in a Workplace Well-Being Context* Researcher/Student: *Catherine Smith (Catherine.smith@nottingham.ac.uk)* Supervisor/Chief Investigator: *Dr Louise Thomson (louise.thomson@nottingham.ac.uk)* Ethics Reference Number:

We would like to invite you to take part in a research study about the use of mobile technology to improve well-being. Before you begin, we would like you to understand why the research is being done and what it involves for you.

What is the purpose of this study?

This study is part of a PhD thesis which overall aims to investigate the use of mobile applications for improving mental health and well-being. As technology is becoming more advanced, more prevalent and more relied upon in society, it is important to investigate its effects on mental health and well-being. Mobile applications have been developed to improve well-being and this thesis aims to investigate how these apps are used, how people can be encouraged to use them and to invest in making time for their mental health, and whether mobile technology is the right method to help with this. This study aims to investigate the usability of a mobile application and how well it functions.

Why have I been invited?

You have been invited because participants are needed who have experience with using mobile technology such as smartphones or tablets, who are familiar with using mobile applications on these devices and who have some knowledge or awareness of using mobile apps in a mental health context. You indicated your interest in this study as a result of previously participating.

Do I have to take part?

It is up to you to decide whether or not to take part. If you do decide to take part, you will be given this information sheet to keep and be asked to sign a consent form. You may change your mind about being involved at any time or decline to answer a particular question. You are free to withdraw at any point before or during the study without giving a reason.

What will I be asked to do?

If you choose to take part, you will be asked to examine an example mobile application which delivers a well-being intervention in the form of a daily diary entry. You will be asked to complete several short tasks on the application, whilst talking through your thought processes. These tasks will be timed in order to assess how easy the application is to navigate. Following this exercise you will be asked to fill out a questionnaire about your experience with the application, and your thoughts on well-being applications in general. Finally, there will be some short interview questions, also about your experience of using the application and your thoughts on it. The whole session is expected to take around 30 minutes. You will not be asked about your own mental health or asked to disclose anything about your personal experiences or whether you have needed to use mental health support.

Will the research be of any personal benefit to me?

We cannot promise the study will help you but the information we get from this study may help to inform the design and development of future mobile applications to improve well- being to make them more effective and more engaging to use. To thank you for participating in the second phase of this study, you will receive a second entry into the prize draw (one prize of a £20 Amazon voucher and one prize of a £10 Amazon voucher).

Are there any possible disadvantages or risks in taking part?

There should be no disadvantages at all to taking part. If you change your mind at any time, you can stop answering the questions without giving a reason and your previous answers can be removed.

What will happen to the information I provide?

Your responses will be completely anonymous, no identifying details will be collected, and your consent form will be stored separately from your responses. There will be no way to identify you from your responses. This means that it will not be possible to remove your responses after they have been collected, but you are free to withdraw at any time whilst completing the questions, and your responses up to that point will be destroyed. Your responses will be held on a secure, password protected server and can only be accessed by the researcher, supervisors and examiners. This study is being conducted as part of a PhD thesis and the responses you give will be included in the final thesis. The results from this thesis may also be written up to publish as a journal article or used as part of a research presentation. If you would like to receive a copy of the overall results from this study, please email the researcher and a summary can be sent to you.

We will follow ethical and legal practice and all information will be handled in confidence. Under UK Data Protection laws the University is the Data Controller (legally responsible for the data security) and the Chief Investigator of this study (named above) is the Data Custodian (manages access to the data). This means we are responsible for looking after your information and using it properly. Your rights to access, change or move your information are limited as we need to manage your information in specific ways to comply with certain laws and for the research to be reliable and accurate. To safeguard your rights we will use the minimum personally – identifiable information possible. You can find out more about how we use your information and to read our privacy notice at: https://www.nottingham.ac.uk/utilities/privacy.aspx.

The data collected for the study will be looked at and stored by authorised persons from the University of Nottingham who are organising the research. They may also be looked at by authorised people from regulatory organisations to check that the study is being carried out correctly. All will have a duty of confidentiality to you as a research participant and we will do our best to meet this duty.At the end of the project, all raw data will be kept securely by the University under the terms of its data protection policy after which it will be disposed of securely. The data will not be kept elsewhere.If you have any questions or concerns, please don't hesitate to ask. We can be contacted before and after your participation at the email addresses above.

What if there is a problem?

If you have any queries or complaints, please contact the student's supervisor/chief investigator in the first instance. If this does not resolve your query, please write to the Administrator to the Division of Psychiatry & Applied Psychology's Research Ethics Sub-
Committee adrian.pantry1@nottingam.ac.uk who will pass your query to the Chair of the Committee.

Many thanks for your participation.

D2: Usability Questionnaire

Mobile Application Rating Scale (MARS) (Stoyanov, 2016)

Q1. Is the app fun/entertaining to use? Does it use any strategies to increase engagement through entertainment (e.g. through adding game features)?

1. Dull, not fun or entertaining at all [3]
2. Mostly boring [2]
3. OK, fun enough to entertain user for a brief time (< 5 minutes) [15]
4. Moderately fun and entertaining, would entertain user for some time (5-10 minutes total) [4]
5. Highly entertaining and fun, would stimulate repeat use [1]

Q2. Is the app interesting to use? Does it use any strategies to increase engagement by presenting its content in an interesting way?

1. Not interesting at all [1]
2. Mostly uninteresting [4]
3. OK, neither interesting nor uninteresting; would engage user for a brief time (< 5 minutes) [14]
4. Moderately interesting; would engage user for some time (5-10 minutes total) [3]
5. Very interesting, would engage user in repeat use [3]

Q3. Does it provide/retain all necessary settings/preferences for apps features (e.g. sound, content, notifications, etc.)?

1. Does not allow any customisation or requires setting to be input every time [4]
2. Allows insufficient customisation limiting functions [5]
3. Allows basic customisation to function adequately [10]
4. Allows numerous options for customisation [3]
5. Allows complete tailoring to the individual's characteristics/preferences, retains all settings [1]

Q4. Does it allow user input, provide feedback, contain prompts (reminders, sharing options, notifications, etc.)?

1. No interactive features and/or no response to user interaction [5]
2. Insufficient interactivity, or feedback, or user input options, limiting functions [3]
3. Basic interactive features to function adequately [13]
4. Offers a variety of interactive features/feedback/user input options [4]
5. Very high level of responsiveness through interactive features/feedback/user input options [0]

Q5. Is the app content (visual information, language, design) appropriate for its target audience (working adults who regularly use a mobile device)?

1. Completely inappropriate/unclear/confusing [1]
2. Mostly inappropriate/unclear/confusing [0]
3. Acceptable but not targeted. May be inappropriate/unclear/confusing [9]
4. Well-targeted, with negligible issues [10]
5. Perfectly targeted, no issues found [5]

Q6. How accurately/fast do the app features (functions) and components (buttons/menus) work?

1. App is broken; no/insufficient/inaccurate response (e.g. crashes/bugs/broken features, etc.) [0]
2. Some functions work, but lagging or contains major technical problems [0]
3. App works overall. Some technical problems need fixing/Slow at times [5]
4. Mostly functional with minor/negligible problems [3]
5. Perfect/timely response; no technical bugs found/contains a 'loading time left' indicator [16]

Q7. How easy is it to learn how to use the app; how clear are the menu labels/icons and instructions?

1. No/limited instructions; menu labels/icons are confusing; complicated [1]
2. Useable after a lot of time/effort [1]
3. Useable after some time/effort [0]
4. Easy to learn how to use the app (or has clear instructions) [10]
5. Able to use app immediately; intuitive; simple [13]

Q8. Is moving between screens logical/accurate/appropriate/ uninterrupted; are all necessary screen links present?

1. Different sections within the app seem logically disconnected and random/confusing/navigation is difficult [0]
2. Usable after a lot of time/effort [0]
3. Usable after some time/effort [1]
4. Easy to use or missing a negligible link [7]
5. Perfectly logical, easy, clear and intuitive screen flow throughout, or offers shortcuts [16]

Q9. Are interactions (taps/swipes/pinches/scrolls) consistent and intuitive across all components/screens?

1. Completely inconsistent/confusing [0]
2. Often inconsistent/confusing [0]
3. OK with some inconsistencies/confusing elements [2]
4. Mostly consistent/intuitive with negligible problems [8]
5. Perfectly consistent and intuitive [13]

Q10. Is arrangement and size of buttons/icons/menus/content on the screen appropriate or zoomable if needed?

1. Very bad design, cluttered, some options impossible to select/locate/see/read device display not optimised [0]
2. Bad design, random, unclear, some options difficult to select/locate/see/read [0]
3. Satisfactory, few problems with selecting/locating/seeing/reading items or with minor screensize problems [5]
4. Mostly clear, able to select/locate/see/read items [6]
5. Professional, simple, clear, orderly, logically organised, device display optimised. Every design component has a purpose [13]

Q11. How high is the quality/resolution of graphics used for buttons/icons/menus/content?

1. Graphics appear amateur, very poor visual design - disproportionate, completely stylistically inconsistent [0]
2. Low quality/low resolution graphics; low quality visual design – disproportionate, stylistically inconsistent [5]
3. Moderate quality graphics and visual design (generally consistent in style) [10]
4. High quality/resolution graphics and visual design – mostly proportionate, stylistically consistent [7]
5. Very high quality/resolution graphics and visual design - proportionate, stylistically consistent throughout [3]

Q12. How good does the app look?

1. No visual appeal, unpleasant to look at, poorly designed, clashing/mismatched colours [1]
2. Little visual appeal – poorly designed, bad use of colour, visually boring [4]
3. Some visual appeal – average, neither pleasant, nor unpleasant [16]
4. High level of visual appeal – seamless graphics – consistent and professionally designed [4]
5. As above + very attractive, memorable, stands out; use of colour enhances app features/menus [0]

System Usability Scale (SUS) (Brooke, 1996)

Please rate how strongly you agree with each of the following statements: (1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, 5 = strongly agree)

Q1. I think that I would like to use this system frequently.

Q2. I found the system unnecessarily complex.

Q3. I thought the system was easy to use

Q4. I think that I would need the support of a technical person to be able to use this system.

Q5. I found the various functions in this system were well integrated.

Q6. I thought there was too much inconsistency in this system.

Q7. I would imagine that most people would learn to use this system very quickly.

Q8. I found the system very cumbersome to use.

Q9. I felt very confident using the system.

Q10. I needed to learn a lot of things before I could get going with this system.

Ease of Use Questions

Please rate how strongly you agree with each of the following statements: (1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, 5 = strongly agree)

Q1. Learning to operate this system was easy for me

Q2. It would be easy for me to become skillful in using this application

Q3. I found this application INFLEXIBLE to interact with

Q4. Using this application was UNPLEASANT

Q5. I would find it easy to get this application to do what I need

Q6. I found this application easy to use

Q7. My interaction with this application was clear and easy to understand

D3: Results from the Usability Measures

Table 15: Results of the User Mobile Application Rating Scale (uMARS)

Ppt.	Q1	Q2	Q3	Q4	Q5	Engagement Avg.	Q6	Q7	Q8	Q9	Functionality Avg.	Q10	Q11	Q12	Aesthetics Avg.	Total	Average
1	3	3	3	3	4	3.2	3	5	5	5	4.50	4	5	4	4.33	47	3.92
2	1	4	2	2	3	2.4	5	5	5	5	5.00	3	2	2	2.33	39	3.25
3	4	4	4	3	4	3.8	5	5	5	4	4.75	4	4	4	4.00	50	4.17
4	3	2	3	3	1	2.4	3	4	5	5	4.25	4	2	2	2.67	37	3.08
5	1	3	2	3	3	2.4	5	5	4	4	4.50	3	3	3	3.00	39	3.25
6	3	3	3	2	4	3.0	3	4	5	5	4.25	4	2	3	3.00	41	3.42
7	3	3	3	3	4	3.2	3	4	5	5	4.25	4	4	3	3.67	44	3.67
8	3	2	1	1	3	2.0	5	4	5	4	4.50	4	4	2	3.33	38	3.16
9	4	5	2	2	3	3.2	5	5	5	4	4.75	5	5	3	4.33	48	4.00
10	3	3	4	4	4	3.6	5	4	4	3	4.00	3	3	3	3.00	43	3.58
11	3	3	3	3	4	3.2	5	5	5	5	5.00	4	4	3	3.67	47	3.92
12	3	3	1	1	5	2.6	4	1	4	3	3.00	4	4	4	4.00	37	3.08

Ppt.	Q1	Q2	Q3	Q4	Q5	Engagement Avg.	Q6	Q7	Q8	Q9	Functionality Avg.	Q10	Q11	Q12	Aesthetics Avg.	Total	Average
13	3	3	2	3	3	2.8	5	5	5	5	5.00	4	2	3	3.00	43	3.58
14	4	4	1	1	5	3.0	5	5	5	5	5.00	5	4	3	4.00	47	3.92
15	4	3	3	4	4	3.6	5	4	4	4	4.25	4	3	3	3.33	45	3.75
16	2	2	3	3	3	2.6	5	5	5	5	5.00	5	3	3	3.67	44	3.67
17	3	3	4	4	4	3.6	5	5	5	5	5.00	5	5	4	4.67	52	4.33
18	2	1	3	3	3	2.4	3	4	4	4	3.75	4	3	2	3.00	36	3.00
19	3	5	3	3	5	3.8	-	4	4	-	4.00	3	3	3	3.00	36*	3.60
20	3	3	2	1	3	2.4	4	2	3	4	3.25	3	3	3	3.00	34	2.83
21	1	2	1	1	3	1.6	4	4	-	-	4.00	-	3	3	3.00	22*	2.44
22	5	5	5	3	5	4.6	5	5	5	5	5.00	5	4	3	4.00	55	4.58
23	3	3	3	3	4	3.2	5	5	5	5	5.00	4	3	3	3.33	46	3.83
24	3	3	-	4	5	3.75	5	5	4	5	4.75	5	3	3	3.67	45*	3.75
25	3	3	-	3	4	3.25	5	4	5	4	4.50	4	2	1	2.33	38*	3.17
Avg.	2.92	3.00	2.65	2.64	3.72	3.03	4.46	4.32	4.63	4.48	4.45	4.04	3.32	2.92	3.41		3.56

* = Totals are incomplete due to missing value

Table 16: System Usability Scale (SUS) Results

Ppt.	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
1	2	1	4	1	4	1	5	2	5	2
2	4	1	4	3	4	2	4	2	4	4
3	4	1	5	1	5	1	5	1	5	1
4	3	2	4	2	4	2	4	2	4	2
5	3	3	4	2	4	2	4	2	3	2
6	3	1	1	1	1	1	5	1	1	5
7	4	2	5	2	4	2	5	2	5	2
8	4	1	4	1	3	2	4	1	4	1
9	4	2	4	1	4	1	4	1	5	2
10	2	1	4	1	3	2	4	2	4	1
11	2	1	5	1	4	1	5	2	4	1
12	5	5	5	1	3	3	5	3	5	1
13	4	1	5	1	3	3	5	1	5	1
14	4	1	5	1	3	1	5	1	5	1

Ppt.	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	
15	4	2	4	2	4	3	4	2	4	2	
16	2	1	4	1	3	1	5	1	5	1	
17	4	1	5	1	4	2	5	1	5	1	
18	2	2	2	2	3	3	4	2	2	2	
19	5	2	4	2	3	3	4	2	4	2	
20	3	2	4	1	4	1	3	3	3	3	
21	3	2	5	1	4	3	4	2	4	2	
22	5	1	5	1	4	1	5	1	5	1	
23	3	1	5	1	4	1	5	1	5	1	
24	4	1	4	2	4	2	5	1	4	2	
25	3	2	4	1	4	1	5	2	5	1	
Avg.	3.44	1.60	4.20	1.36	3.76	1.80	4.52	1.64	4.20	1.76	
Weight Avg.	2.44	3.40	3.20	3.64	2.76	3.20	3.52	3.36	3.20	3.24	31.96

31.96* 2.5 = 79.9

Table 17: Ease of Use Questionnaire Results

Ppt.	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Total	Average
1	4	5	4	5	5	5	5	33	4.71
2	4	4	4	4	4	4	4	28	4.00
3	5	4	5	5	4	5	5	33	4.71
4	4	4	4	4	4	4	4	28	4.00
5	4	4	4	4	4	4	4	28	4.00
6	5	5	5	5	5	5	5	35	5.00
7	5	5	5	5	4	5	5	34	4.86
8	4	4	5	5	5	5	5	33	4.71
9	4	4	4	4	2	5	5	28	4.00
10	4	5	4	4	4	5	5	31	4.43
11	5	5	2	4	4	4	5	29	4.14
12	5	5	5	5	4	5	5	34	4.86
13	5	5	4	4	3	5	5	31	4.43

Ppt.	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Total	Average
14	5	5	3	5	5	5	5	33	4.71
15	4	4	3	5	4	4	4	28	4.00
16	5	5	2	5	3	5	5	30	4.29
17	5	5	5	5	5	5	5	35	5.00
18	4	4	2	4	2	4	4	24	3.43
19	4	4	3	5	4	5	4	29	4.14
20	2	5	3	3	3	3	3	22	3.13
21	4	4	4	4	3	4	4	27	3.86
22	5	5	5	5	5	5	5	35	5.00
23	5	5	5	5	4	5	5	29	4.14
24	5	4	4	5	5	5	5	33	4.71
25	5	5	4	5	5	5	5	34	4.86
Avg.	4.48	4.56	3.92	4.56	4.00	4.64	4.64		4.36

Appendix E: Chapter 7: Focus Groups

E1: Participant Information

PARTICIPANT INFORMATION

Division of Psychiatry & Applied Psychology School of Medicine,
Faculty of Medicine & Health Sciences

Project Title: An investigation into the use of mobile diary applications in the workplace

Researcher: Catherine Smith Catherine.smith@nottingham.ac.uk

Supervisor: Louise Thomson louise.thomson@nottingham.ac.uk

Ethics Reference Number: 235

This is an invitation to take part in a research study investigating the use of mobile diary applications in the workplace. This information is designed to tell you what it will involve.

Your participation is voluntary, and you may change your mind about being involved, or decline to answer a particular question. You are free to withdraw at any point before or during the study. Withdrawal does not require a reason. Once you have completed and submitted the questionnaire it is not possible to withdraw the data because we won't know who you are.

What is the project about?

The aims of the research are to investigate the usage of mobile diary applications in the workplace, to identify the practicalities and feasibility of using this method within the workplace, and to investigate the effects of keeping a log of experiences.

Who is being asked to take part, and why?

Employees from a range of different business have been asked to take part to show the potential for the use of these apps in different sectors. You are being asked to take part because your employer is happy for you to do so, but there is no obligation from the researcher or from your employer for you to take part.

What will I be asked to do?

You will be asked to look at a prototype version of a mobile application on a demonstration device, and then you will be asked some questions regarding your opinion about the application, including the layout, the customizable options, and any improvements you would suggest. You will also be asked about how the app could be implemented in workplaces similar to yours, how much you think people will engage with it and about your opinions on how it should be tested in the future.

Will the research be of any personal benefit to me?

As this is one of the first pieces of research in this area, it is not possible to say that there will be immediate direct benefit to yourself. This research will inform development of future apps and may have an effect on workplaces in the future as a result.

What will happen to the information I provide?

The information you provide during the interviews will be stored securely in a database and transcribed by the researcher. The data will remain completely anonymous and no identifying details will be attached to any of the quotes provided. Some of the quotes may be used in publication, but if you would prefer for your quotes not to be used, please let the researcher know during the interview.

What will you do with the data?

The findings from this stage will go on to inform the next stage of testing the application. The data gathered during this project will be analysed and used as part of a doctoral thesis by the researcher. It may also be included in published journal articles or conference papers. An executive summary of the findings will be sent to each of the participating organisations. If you would like to find out about the results, there will be an opportunity for you to leave your email address to be sent a copy of the summary.

At the end of the project, all raw data will be kept securely by the University under the terms of the Data Protection Act. The data will not be kept elsewhere. We believe there are no known risks associated with this research study; however, as with any online related activity the risk of a breach is always possible. We will do everything possible to ensure your answers in this study will remain anonymous. You will not be asked to submit any personal information that may identify you into the app, and the actual answers you give to the exercises will not be recorded. The app will not need permission to access any areas of your phone so will not breach your privacy and should not put your identity or privacy at risk of being breached by others.

If you have any questions or concerns, please don't hesitate to ask. We can be contacted before and after your participation at the above address.

THANK YOU FOR YOUR PARTICIPATION

If you have any queries or complaints about this study, please contact the student's supervisor in the first instance. If this does not resolve the query to your satisfaction, please write to the Administrator to the Division of Psychiatry & Applied Psychology's Research Ethics Sub-Committee (MS-DPAPEthics@nottingham.ac.uk, +44 (0)115 8232214) who will pass your query to the Chair of the Committee.

<u>E2: Code Manual for Thematic Analysis</u>

Table 18: Coding Manual for Thematic Analysis

Theme	Code Label	Definition	Description	Examples
1: Outcomes	Actual benefits	The advantages or expected positive outcomes of using the technology	Mentions of needing evidence or communication around the expected outcomes of the technology as an intrinsic motivation to use it	*"If you know what you're doing it for… you're much more likely to give it a go"* [F1, P1]
1: Outcomes	Ways to demonstrate benefits	Methods for the dissemination of the proposed benefits	Suggestions of how the benefits can be communicated to potential users	*"I think initially you'd find resistance to it but actually if they started doing the stuff correctly then they will actually see that it does benefit them to take that time out."* [F3, P4]
1: Outcomes	Rewards	External rewards in exchange for usage of the technology	The use of rewards such as vouchers or money as an incentive for people to use the technology	*"definitely think [a reward is needed]"* [F1, P3]

Theme	Code Label	Definition	Description	Examples
1: Outcomes	Correct mind-set	A difference in opinion around the motivational approach to encourage technology use	Suggestions that an intrinsic motivation would be a more appropriate approach for well-being interventions	*"I don't know if that's something that might drive somebody but then, is that the right attitude to have?"* [F1, P5]
2: Experience of Technology	Can't use technology	People who do not have the skills or opportunity to use technology	Individuals with a low level of technology literacy who don't engage with technology and wouldn't have experience using it	*"My mum had to learn how to use a phone in the past 5 years… for certain people it's just more difficult to engage with technology, it just takes up so much effort to learn how to use it"* [F2, P5]
2: Experience of Technology	Don't want technology	People who would prefer not to use technology for certain tasks	Those with suitable technological literacy but prefer not to use these methods and would like to use more familiar methods such as writing things down by hand	*"not everyone likes to use apps do they, some people like to write things down. [using an app] is just another thing to do"* [F4, P4]
2: Experience of Technology	Technology fails	Previous experience of issues with technology	Experiences of using technology in the past where there has been failures or issues that might put people off future use	*"Technology that we've attempted to roll out… has continuous fails… to have something added onto that when the existing devices aren't working as well*

Theme	Code Label	Definition	Description	Examples
				as they could… it might be seen negatively" [F1, P5]
2: Experience of Technology	Existing use of technology	Existing technology systems that are already in place and used regularly	Many people already use technology in many aspects of their lives including at work - new apps could fit in with this to make use of existing habits	*"Everybody's using technology so much… gives us even more reason to look into apps that could help people… why wouldn't we do that because people use it anyway"* [F2, P1]
2: Experience of Technology	Too much use of technology	Feelings that too much use of technology could be damaging to mental health	Suggestions that people already feel that they use too much technology and it has had a detrimental effect so they are looking to decrease usage and move away from technology	*"Spending a long time just on your phone or your computer has a negative impact… technology has an addictive side"* [F2, P3]
3: Flexibility	Customisation of format	The ability to choose which method of technology to use	Different people prefer to use different technology platforms such as computer or tablets instead of phones and the app should be made available on these devices as well	*"various formats… that's more suited to their role"* [F1, P2]
3: Flexibility	Different features	The option to include different features in	Suggestions that different features could be incorporated into the application,	*"It's talking to me and I'm talking back to it… I'm not having to write anything… I'd probably use it. If there is anything*

Theme	Code Label	Definition	Description	Examples
		additional to the content included in the app	also to make use of existing habits or increase usefulness	*remotely like form filling, I will not do it. I do not have the patience”* [F4, P5]
3: Flexibility	Notifications	The use of notifications to remind people to use the application	Differing preferences for the use of notifications - can be seen as helpful to remind people or stressful if they are seen as pressurising	*“those reminders when you haven’t done something just aren’t helpful and they make you more want to ignore it and not want to do it”* [F4, P5]
3: Flexibility	Need for choice	The need for technology usage to be voluntary	While support is needed to encourage use, there may be resistance if people feel forced to use it	*“If you mandate it, it loses its power”* [F3, P1]
4: Time Pressure	Not enough time	A lack of free time to invest in mental health	People feel that they do not have any time to spare in their schedules, especially for mental health	*“We all know we should invest time and effort to do things for our health but until there’s a problem, we tend not to carve it out”* [F3, P4]
4: Time Pressure	Too many jobs	An overload of too many tasks to complete in a working day	A feeling that people cannot cope with their current demands, without adding on more tasks to complete	*“glued to that desk then, Monday to Friday, 9 to 5”* [F3, P6]

Theme	Code Label	Definition	Description	Examples
4: Time Pressure	Choice of app over something else	The feeling that if they were to use a new app, it would have to replace something they already used	Suggestions that due to a lack of time, using this app would replace another task, so it has to be useful enough to warrant this	*What would I stop doing that I'm doing now in favour of whatever [the app] has got to offer?"* [F3, P3]
4: Time Pressure	Management support	The need for support from management to allow time to use the app	In order to reduce the time pressure, management support is needed to guarantee that time would be allowed to use the app	*"It has to be bought into from the top down and that space [time to use it] must be honoured"* [F3, P3]
5: Engagement	No motivation to continue using	Even when they use the application initially, usage is not maintained	Reports of people downloading an application and using it initially with intention to keep using it, but didn't stay engaged	*"I let it go, I don't know why"* [F3, P5].
5: Engagement	Enjoyment	A sense of enjoyment gained from using the app	In order to make the time spent on the app worthwhile, it needs to be entertaining and the content needs to be refreshed to keep it interesting	*"You need to increase the engagement to increase the amount of time people spend… to make it enjoyable also"* [F2, P5]

Theme	Code Label	Definition	Description	Examples
5: Engagement	Appearance	The visual appeal of the application	The app needs to be well presented with an engaging and exciting visual appearance	*"I think that it's really important to make it colourful and exciting to look at, it needs to be engaging"* [F4, P3]