Effects of Prompts on the Frequency of App Use: A Stress Management App for Perinatal Mental Health

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Abstract

E-interventions such as smartphone apps may facilitate an alternative treatment for mental health issues. However, often apps are not used after a certain period of time, which limits the potential effectiveness of app intervention programmes. Addition of prompts in app-based programmes may potentially enhance user engagement with apps. 'Positively Pregnant' is a smartphone, self-help, interactive app for pregnant women that aims to reduce anxiety, stress and other related problems during the perinatal period. The primary aim of the current study was to test the effectiveness of prompts to increase the app use and also to determine participants' satisfaction with this stress management app using two groups (guided and non-guided activity). A two-group experimental study design was used on a sample of 88 participants within the New Zealand population. Participants were randomly assigned to one of two groups. The guided activity messages were sent to the participants in guided activity group once every day for 44 days; however, both (experimental and control) groups received 'tip of the day' (a general positive quote) every day. Participants completed a pre-assessment questionnaire at the time of recruitment. Further assessments were completed at 24 weeks gestation, at 36 weeks gestation and at 1-month postnatal period. Data from 'satisfaction and app use' questionnaire for 24-week gestation was analyzed for this study. No significant difference was found in regards to frequency of app use between two groups. On average, participants in the guided activity group did not report using more components of the app than the participants in non-guided group. No significant differences were found on satisfaction with the app, or on willingness to recommend the app to a friend. Results of this study suggest that the

prompts may not be an effective tool to enhance user engagement with this sort of app; however, technical factors may have affected results in this pilot study; therefore, replication is desirable, may be considering the use of direct measures to determine if they correspond with the reported measures used in the study.

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Introduction

The prospect of embracing parenthood marks a significant milestone in anyone's lifetime. The initial stage that leads to parenthood is bearing a pregnancy, which has often been speculated as a joyous experience in any couple's lives (Fallon & Brabender, 2018; ch.1). However, sometimes pregnancy may become both stressful and challenging at times for many women (Sprenger, Mettler & Osma, 2017). Stress in pregnancy increases risk for a number of physical and mental health problems including preterm birth and postnatal depression (Barber et al., 2013; Tragea et al., 2014). Stress/anxiety during pregnancy is associated with poor obstetric outcomes (O'Connor et al., 2003) and behavioural/emotional adjustments in children. Thus, there are likely to be adverse impacts of perinatal mental illness on the mother's health, as well as on the child's development (Dunkel, Schetter & Tanner, 2012; Osma, Barrera & Ramphos, 2016; Woods et al., 2010). Awareness of perinatal mental illnesses is not new; and has been documented since the times of Hippocrates (400 B.C.) and the Vedas (500 B.C.) (Ferreira, 1965). Despite being aware of perinatal mental illness, many women are reluctant to seek treatment for it at the early stages of pregnancy due to various reasons (Goodman, 2009).

Access to a significant body of information related to perinatal health issues is now not limited to books, journals and magazines. The advent of technology, including the internet, provides ease of access to healthcare information, which often serves as the easiest mode of communication in the area of healthcare and can be an effective solution for various, but not all health problems (Roberto et al., 2007). Internet access via smartphones is frequently the most available medium of communication or interaction (Lattie et al., 2016). This may include enabling individuals to have an

accessible communication with their health practitioner as well as the ability to download various healthcare and mental health support applications, many of which are free to download thus cost effective (Lui, Marcus & Barry, 2017).

Users' acceptance of internet-based intervention programmes for health problems (which includes physical and mental health) has also been growing swiftly (Lui, Marcus & Barry, 2017), so as smartphone app-based intervention programmes (Osma, Barrera, & Ramphous, 2016). App interventions may provide more frequent engagement with the treatment than other internet-based interventions because smartphones can be easily accessible anywhere and at any time (Kenney, Dooley & Fitzgerald, 2015). These programmes may be used as a substitute for face-to-face treatment to accommodate individuals facing barriers related to financial issues, travel costs and lack of time to attend therapy sessions or for other miscellaneous reasons (Tate, Wing, & Winett, 2001). However, despite various advantages, there is limited evidence regarding the efficacy and effectiveness of these apps (Zhao, Freeman & Li, 2016) due to considerable attrition rates among app users after a certain period of time (Lui, Marcus, & Barry, 2017; Osma, Barrera, & Ramphous, 2016). Assessing the efficacy of e-health interventions is an imperative concern in healthcare. It would be helpful to determine whether and how users interact with these programmes (or apps), and what factors are associated with their attaining benefit from the interventions. Consequently, more research needs to be conducted on how to enhance the probability of continued use of apps by users; in order to promote better outcomes from smartphone app based interventions.

Antenatal distress is an important mental health problem. E-health interventions might be effective to address it, because they are accessible and may be helpful

for stress management and psychoeducation in mental health (Kenney, Dooley & Fitzgerald, 2015). The problem with e-health interventions such as apps is that they often aren't used. The factors that affect user engagement in mental health apps are not well researched. One promising strategy for engagement is prompts.

The current study uses an app named 'Positively Pregnant', which is a self-help interactive primary and secondary intervention tool for pregnant women that aims to reduce anxiety, stress and their related problems during the perinatal period by using various intervention strategies presented in the app. The primary aim of the present study is to identify whether providing daily notifications/prompts increase the frequency of using the app by the participants.

Chapter 1: Literature Review

Pregnancy and Perinatal Mental Disorders

Pregnancy is a time of transformation for many women and as a result, it becomes difficult for some of them to cope with the emotional changes they experience during that period (Sprenger, Mettler & Osma, 2017). These changes may affect their psychological, physical, social and emotional states. Sometimes, these changes make pregnant women feel vulnerable; however, vulnerability ranges from low intensity to high intensity and varies from person to person (O'Hara & Wisner, 2014). During the perinatal period, some women are likely to develop mental health disorders such as stress, depression and anxiety. These disorders can often be exacerbated when women ignore initial symptoms, and accept them as normal symptoms of pregnancy (O'Hara & Wisner, 2014). When women are unable to cope with these vulnerabilities effectively, they are at increased risk of developing mental illness during their perinatal period; this is known as perinatal mental illness (Paschetta et al., 2014).

It has been identified that a few women carry their pre-existing mental disorders and they may persist or worsen during pregnancy; reoccurrence of these mental disorders during the perinatal period are also considered as being perinatal mental disorders (O'Hara & Wisner, 2014). For instance, a woman might have had a history of depression and anxiety in the past and pregnancy may lead to reoccurrence of these problems because of factors related to the pregnancy. These conditions would also be considered perinatal mental disorders, as their presence during pregnancy may have negative consequences on the mother's, infant's and family's well-being (Meltzer-Broody, 2011).

Nature of Perinatal Disorders

Perinatal Stress and its impacts

Stress during pregnancy and until one year after a child's birth is termed perinatal stress; however, stress during pregnancy is known as prenatal stress and women may experience this for several reasons, for instance worries regarding pregnancy (e.g. previous miscarriage), or personal problems (such as relationship strain, or separation) (Bergman et al. 2008; Glover, 2011).

Stress during pregnancy has a significant influence on baby's overall growth and development (Glover, 2011), which later may be associated with emotional, behavioural and cognitive problems in children (Glover, 2011). Prenatal stress is associated with the elevated levels of glucocorticoid (cortisol) in pregnant women, and this can have a negative influence on the intrauterine milieu during pregnancy, which may have adverse impacts on baby's brain development (Buss et al., 2012). It has been identified that the hippocampus and amygdala of a foetus develop at the early stages of brain development, and elevated levels of cortisol affects the growth of hippocampus and amygdala structures of foetus's brain (Buss et al., 2012).

Evidence shows that maternal stress during pregnancy has negative effects on children's overall growth and as a result, affected children may experience psychological, physical, and biological disorders such as cardiovascular diseases, various other metabolic syndromes (Glover, 2011), neurodevelopmental and neuropsychiatric disorders (Buss et al.; 2012). Hence perinatal stress should be addressed at the early stages of pregnancy in order to minimize its risks to the mother and baby

Perinatal Anxiety and its impacts

A few studies have shown the prevalence of various anxiety disorders during the perinatal period despite lack of research in this area in comparison to perinatal depression (Clavarino et al.; 2010; Ross & McLean, 2006). Anxiety consists of autonomic arousal, feelings of apprehension, fear and irritability. It varies from excessive worry to panic attacks, and may be exacerbated during pregnancy or sometimes remain until the postpartum period, causing a mild to moderate range of impairment and distress to the mother's health and foetus's development (O'Hara & Wisner, 2014; Deklava et al., 2015).

It has been identified that for some women the onset of anxiety occurs at the time of their pregnancy, and may be considered a pregnancy specific anxiety that appears due to negative thoughts regarding the process of pregnancy, such as anxiety about giving birth, worries about having an abnormal child, and also concerns about personal appearance (Deklava et al., 2015).

The effects of maternal anxiety on children are adverse in nature and associated with poor behavioural/emotional regulation among young children (O'Connor et al., 2003), risks of neurodevelopment problems among infants (Clavarino et al., 2010;Talge, Neal & Glover, 2007), and are also considered a factor for the development of further mental illness in children (Kinsella & Monk, 2009). Studies also show that anxiety during pregnancy increases risk for preterm birth and associated risks (Dunkel Schetter & Tanner, 2012). Children of women encountering anxiety prenatally or during the postnatal period are also more likely to develop attention problems at 5 to 14 years of age (Clavarino et al., 2010; Van Den Bergh et al., 2005). A high level of maternal anxiety during the first half

(mainly 6-24 weeks) of pregnancy has also been associated with onset of symptoms of ADHD in childhood (Van Den Bergh et al. 2005).

Consequently, it is evident that perinatal anxiety is associated with cognitive, behavioural and neurodevelopmental problems in infants (Clavarino et al., 2010; Kinsella & Monk, 2009; Van Den Bergh et al. 2005). Therefore, recognition and amelioration of such symptoms is imperative at an early stage of pregnancy.

Perinatal Depression and its impacts

Perinatal depression in pregnant women consists of women experiencing minor or major episodes of depression during perinatal period, and may adversely affect their lives, their children and their families (Alhusen & Alvarez, 2016; O'Hara & Wisner, 2014). A study by O'Hara et al (2014) has indicated that approximately 20 percent of pregnant women experience depression and anxiety during the pregnancy and first 3 months after the baby's born.

There is a lack of research demonstrating particular risk factors of developing prenatal depression in pregnancy (Meltzer-Broody, 2011). However, a considerable amount of research has been undertaken to identify the risk factors for the development of postnatal depression. Research has indicated that many psychological factors can be accountable for this, including a previous history of depression, stress, financial hardships, insufficient social support, being a young or single mother, trauma related to a previous miscarriage, and being a first time mother (Muzik & Borovska, 2010; Sprenger, Mettler & Osma, 2017).

Depression can be detrimental for pregnant women, as well as for their infants, if ignored prenatally (Muzik & Borovska, 2010). In addition, women with perinatal

depression often experience negative cognition and suicidal ideation, which interfere in their lifestyle (Paris, Bolton, & Weinberg, 2009). Some consequences of depression can include for mothers to become isolated from others; experience low self-control and self-esteem; have poor intake of nutritional food leading to gaining or losing weight; experience a decline in their partner relationships; have impaired bonding and relationships with their infants; initiate or continue substance use; or experience other unfavorable impacts on their health and life (Field, Diego, & Hernandez-Reif, 2006; Wisner et al., 2000; Winner et al., 2009).

Not only a mother but also a child can experience a variety of developmental problems under the influence of perinatal depression, such as low birth weight, and being small for his/her gestational age (Kelly et al., 2002; Muzik & Borovska, 2010). In a review, Field, Diego & Hernandez-Reif (2006) concluded the other associated risks of perinatal depression to infants that include being less active, more irritable, less attentive, having scarce facial expressions, and experiencing more delay in development than a typical infant. Hence, it is necessary to implement preventive interventions at the prenatal stage in order to reduce the risks of developing postnatal depression among affected mothers. Studies have shown that depression during prenatal period is considered as a strong predictor of the postnatal depression (Muzik & Borovska, 2010; Suri et al., 2007).

Importance of screening for prenatal mental disorders

A wealth of literature has identified various risk factors increasing the probability of developing perinatal mental illness and its deleterious impacts on a mother's health and her foetus's development (Clavarino et al., 2010; Field, Diego & Hernandez-Reif, 2006; Muzik & Borovska, 2010; O'Conner et al, 2003;).

Therefore, lack of recognition and treatment for stress and distress might lead to further risks that involves, potential to develop postpartum depression or a range of other stress disorders in the postpartum period (Muzik & Borovska, 2010; Dunkel Schetter & Tanner, 2012; Pearlstein, 2008). These conditions may enhance the probability of a mother experiencing depression developing impaired relationship with the infant, and also likelihood of worsening the stress, depression, and anxiety during postpartum period (Dunkel Schetter & Tanner, 2012; Pearlstein, 2008).

Clinical screening has been recommended through using screening tools (assessment questionnaires) to assess the levels of depression, anxiety and stress at different stages (first, second and third trimester) of pregnancy to screen early signs of distress or developing perinatal mental disorders (Munoz et al., 2006; Wisner, Scholle & Stein, 2008). Screening at the early stages of the pregnancy helps in implementing early interventions to prevent postnatal mental health problems (Munoz et al., 2006; Thombs et al., 2014). In short, screening at the initial stages of pregnancy may be helpful in addressing problems as they develop preventing a variety of health and mental health problems in mothers and their children

Traditional strategies addressing prenatal health

A number of research studies has already been conducted in using various preventive treatment strategies such as cognitive behavioural therapy (Appleby et al., 1997), interpersonal therapy (O'Hara et al., 2000), and bright light therapy (Bais et al., 2016) to address postnatal depression and has been found effective. However, the attention of researchers has been drawing towards the area of

prenatal mental health in order to possibly prevent the onset of postnatal depression (Austin, 2004; Barber, 2012). There are various traditional stress-related coping strategies available for addressing prenatal health that vary from psychological, spiritual (meditation, yoga), religious, physical, pharmacological, to culturally practiced strategies (Bennet et al., 2009). Psychotherapy (especially CBT) is the most accepted and effective treatment method to address problems related to depression and anxiety among pregnant women (Arch, 2014; Goodman, 2009; Lavender, Ebert & Jones, 2016; Spinelli & Endicott, 2003). Several studies have indicated that healthcare practitioners recommend various coping strategies that are acknowledged as effective strategies; adopting exercise that includes walking, stretching, and aqua-aerobics that are individually tailored and are pertinent to the client's health, preference and suitability (Curtis, Weinrib & Katz, 2012; Moyer, Reoyo & May, 2016; Parker & Smith, 2003; Woolhouse et al., 2014).

A study by Khalfa et al (2003) has shown that listening to music has been found to be an effective tool in terms of reducing negative emotions caused by a psychologically stressful task by controlling salivary cortisol levels. There is an empirical evidence of the efficacy of music therapy suggesting pregnant women to use music therapy, a cost-effective method in their everyday life to reduce the stress, anxiety and depression among pregnant women (Chang, Chen & Huang, 2008). Another study was conducted to determine the effects of listening to music on pain reaction and anxiety during labour. The study has shown positive effects of listening to music in reducing labour pain and anxiety during the latent phase

of labour (Liu, Chang & Chen, 2010). Thus, listening to music appears to be helpful to pregnant women to reduce levels of stress and anxiety.

Mindfulness approaches including guided imagery, body scan, relaxation, and breathing exercises have shown positive and effective results in addressing psychological stress and anxiety among pregnant women (Arch, 2014; Woolhouse et al., 2014). An empirical study has reported that interventions encompassing mind and body through various pregnancy-related yoga techniques, meditation practices and breathing exercises, were found associated with exhibiting a decrease in psychological stress, pregnancy complications, preterm births and low birth weight when compared with a control group (Narendran et al., 2005).

Individually administered Interpersonal therapy (IPT) as a treatment intervention has been found potentially consistent treatment approach among health practitioners for clients to address antenatal depression. (Choate & Gintner, 2011; Lenze & Potts, 2017; Spinelli & Endicott, 2003). Lenze and Potts (2017) studied a brief IPT programme, tailored according to the individual needs of low-income stressed pregnant women. Participants in the brief IPT programme reported high satisfaction with the programme and also exhibited significant improvements in social support satisfaction. However, the feasibility of the brief IPT was limited due to a high attrition rate despite considering the hard economic conditions among low-income population and providing resources to attend the sessions (Lenze & Potts, 2017).

Self-help intervention programmes may potentially address barriers encountered by individuals in accessing treatment programme for perinatal mental health

concerns (Milgrom et al., 2011). Milgrom et al. (2011) conducted research to determine the effectiveness of a self-help antenatal intervention programme, *Towards Parenthood,* and found a significant effect of the programme in reducing the symptoms of depression, anxiety, and perceived parental stress among pregnant women in an experimental group (Milgrom et al., 2011). However, high attrition rates were also observed despite the provision of high levels of autonomy in using the intervention and also delivery of additional telephone support by the research team. Therefore, it becomes difficult to draw a robust conclusion for whether the intervention was effective for all the participants (Milgrom et al., 2011).

In order to try to address this difficulty in maintaining participation levels in self-help strategies such as mindfulness, yoga and self-help books, researchers have used various prompts such as contacting clients using telephone or sending them emails and text messages (Lenze & Potts, 2017; Narendran et al., 2005). A few studies have shown high levels of follow up by research team for the participants to have better adherence with treatment programmes (Chang, Chen & Huang, 2008; Lenze & Potts, 2017). For instance Chang, Chen & Huang (2008), in their study, asked the participants to maintain a diary to record and to record their use of the music therapy programme. However, it has been observed that despite being paid high levels of attention (follow up), participants in the psychotherapy intervention studies as well as self-help programmes display high attrition rates (Lenze & Potts, 2017; Milgrom et al., 2011). Thus, it is important to discover the potential barriers that hinder individuals continuing treatment programmes and

need to be addressed in order to recommend effective strategies according to individual needs (Alkhaldi et al., 2016; Bakker et al., 2016).

Barriers to receiving treatment for prenatal mental illnesses

Focusing on barriers to receiving treatment, a few studies have found in that when women of low economic status do undergo screening, there are several factors that contribute to their being unable to take part in a treatment intervention: limited finances, no partner's support, minimal social support, problems related to transportation, and other issues (Lenze & Potts, 2017; Miller, Shade, & Vasireddy, 2009; Tate, Wing, & Winett, 2001). In contrast, high-income and well-educated women were found to experience different barriers to receiving treatment for prenatal mental illnesses. The most likely potential barriers were lack of time to continue an intervention programme, childcare issues and the perceptions of being stigmatized (Goodman, 2009).

Research has also revealed that there are many women who receive screening and are assessed as moderately or severely depressed on psychological assessments; however, they find it difficult to accept or identify themselves as depressed. Despite receiving the referral to mental health providers, they are reluctant to consult a mental health practitioner (Miller, Shade, & Vasireddy, 2009). The reasons may be that many women have their own perceptions, beliefs and attitudes and may become hesitant or uncomfortable disclosing their moods, stresses and any psychological problem to any unfamiliar mental health provider (Bennett et al., 2009).

In spite of this, some studies also show that a few women who prefer to have treatment consider that the maternity care services are not appropriate settings for

initiating conversations about such sensitive issues as depression; however, they would prefer to use an obstetrics clinic or mental health services in case they feel depressed or for other problems related to mental health (Bennett et al., 2009; Goodman, 2009).

Addressing barriers using Internet based interventions

There are an array of treatment options available to support women and their families in critical times, and in the era of Internet, it has become possible for health practitioners to overcome the barriers experienced by low-income or high-income pregnant women (or women facing other obstacles to accessing treatment) by providing the option to adopt internet based intervention programmes (Goodman, 2009; Miller, Shade & Vasireddy, 2009). There are numerous websites that offer self-help tools to address numerous mental health problems that include depression, anxiety, stress and various other difficulties pregnant women encounter (Bakker et al., 2016; Tripp et al., 2014). These programmes are not limited to pregnant women but are only an arm's length away to be used by anyone in the time of crisis. Internet-based interventions have a great potential to provide psychological, emotional and moral support for problems related to physical or mental health ranging from the mild to moderate levels of severity (The National Institute of Mental Health, 2017).

The following section addresses the positive impacts of technology in the field of healthcare in the terms of providing treatment for various health-related problems by trying various kinds of e-interventions, such as online intervention programmes, web-based programmes, interactive computer-based interventions and smartphone applications as a first stop before consulting any professional.

The section also discusses how technology has been contributing to enhancing the opportunities to access new strategies and information for the individuals who experience difficulty in receiving or opting for professional face-to-face treatment for various reasons. Although e-interventions provide a potential platform for people with various health issues who are unable to afford an expensive treatment programme, usage of such e-interventions and individual engagement with them are still at low levels (Brouwer et al., 2008; Fry & Neff, 2009; Muench & Baumel, 2017).

Internet- based approaches addressing healthcare problems

Technology and Healthcare

Advancement in technology has made the delivery of healthcare easier in that treatment intervention programmes can be facilitated electronically. These are called "e-health" (where 'e' stands for 'electronic') treatment intervention programmes (Brettlecker et al., 2008; Tripp et al., 2014; Wantland et al., 2004). The provision of healthcare has also become relatively accessible these days due to the widespread facility of internet services that cover the majority of habitable geographical areas around the globe (Blaya, Fraser & Holt, 2010). Developed nations around the world are taking advantage of the facilities internet provides in every field: business, education, healthcare and many others.

The emergence of e-health took place approximately at the end of the twentieth century when internet had just started catching consumers' and professionals' attention in the field of healthcare (Boulos et al., 2011). Initially e-health was used to maintain clients' records, personal information, and to obtain health-related information while using Internet websites; however, now it has started showing

benefits for various other purposes such as facilitating internet-based treatment interventions (Patrick, Intille & Zabinski, 2005; Ventola, 2014).

With the passage of time, technology has extended to a level where a broad shift has occurred from using computer-based health-related programmes to contemporary mobile phones and devices. These handheld devices with the latest technology, such as smartphones and tablets, feature better flexibility, functionality and mobility (Patrick, Intille & Zabinski, 2005) so that instantaneous access to internet and acquiring other (general or specific) information on these devices has become relatively accessible (Boulos et al., 2011; Ventola, 2014).

The latest smartphones models not only facilitate health-related information through using search engines but also incorporate other functions such as sensing, tracking, providing location based knowledge and other information processes (Norman et al., 2007; Patrick, Intille & Zabinski, 2005). There are many apps (charged for and free of charge) related to healthcare available in the market. Consumers download these apps based on their healthcare requirements and personal preferences, and use them for receiving help in times of crisis, supplementing their knowledge regarding health and well-being, and also monitoring progress using self-management features (The National Institute of Mental Health, 2017). The primary objective of e-health programmes is to use the latest information and communication technologies to address various issues experienced by clients, patients, health care professionals, and health care providers by using a cost effective and widely accessible electronic devices (The National Institute of Mental Health, 2017). Various research studies have already suggested that e-health programmes have robust prospects to improve health

behaviours and health outcomes among users (Alkhaldi et al., 2016; Blaya, Fraser & Holt, 2010; Donker et al., 2013).

Delivering Healthcare using Technology

Contemporary e-health devices such as smartphones and tablets are faster, more responsive, less expensive and are capable of reducing several barriers (such as time, professional distance) encounter by individuals, in a relatively cost-effective manner. (Patrick, Intille & Zabinski, 2005). Not only clients are taking its advantages but the mental health professionals have also upgraded paper-pencil assessments to electronically based assessments, which is often convenient for both the client and the practitioner (Wantland et al., 2004)

There are many health related websites and enormous amount of information available on websites that people prefer to use as self-help tools before seeking a professional consultation to address mild level problems related to general health as well as mental health (Donker et al., 2013). However, many people prefer smartphone or tablets to obtain an access to computer or web-based treatment programmes because they offer more flexibility in terms of using it at any time, any day or anywhere, even when most required (Patrick, Intille & Zabinski, 2005; Wantland et al., 2004).

Often individuals prefer to adopt self-help programmes to address their mental health problems at initial stages for various reasons, such as being hesitant in disclosing their mental health issues; fear of being labeled; too long wait for appointments with professionals; financial challenges such as paying expensive costs for a face-to-face treatment; issues related to travelling (for people residing in rural areas); fear of being judged; and others (Tate, Wing, & Winett, 2001).

Studies have shown that pregnant women encounter various barriers to seeking treatment for perinatal depression too. A few barriers are: transportation, money, childcare, bad experiences with previous mental health provider and lack of information about treatment related agencies/organizations (Alvidrez & Azocar, 1999; Byatt et al., 2012; Kim et al., 2014; Kopelman et al., 2008). These barriers may potentially contribute to hindering them from seeking a professional treatment related to their mental health problems during pregnancy (Byatt et al., 2012; Kim et al., 2014).

Some studies have shown that smartphone mental health applications have a great deal of potential to address various difficulties people experience participating in an intervention programme (Alkhaldi et al., 2016; Thomas & Lupton, 2016). Smartphone app based treatment interventions provide a high level of autonomy for individuals that may enhance the trust, independence and motivation levels of individuals who opt for app-based treatment interventions; therefore, these e-based programmes can be considered as a crucial tool for present and future use (Alkhaldi et al., 2016; Bakker et al., 2016; Zhao, Freeman & Li, 2016).

To address barriers in receiving treatments, smartphone healthcare related app interventions can act as a potent toolkit in serving as an alternate mode of treating general or mental health issues among individuals who avoid engaging either in a face-to-face treatment or any traditional treatment intervention due to certain challenges as well as prefer to opt a cost effective treatment (Morrison et al., 2017). However, it has been argued that dissemination, exposure and use of the apps seem to lag behind the actual expectations, therefore it has been suggested that active participation of health practitioners in terms of recommending

smartphone apps to clients may increase their acceptability and adoption rates among individuals, because involvement of a professional in recommending apps to clients may serve as reinforcer for them, which further may lead to increase the use and engage with the app treatment among clients (Brouwer et al., 2008, 2011).

Accessibility of Smartphones

Accessibility and affordability of Internet or a smartphone is relatively easy, which is a significant factor to consider when it comes to the adoption and the use of smartphone app interventions for individuals' well-being (Brouwer et al., 2008; Morrison et al., 2017). Penetration rates of Internet and smartphone use have become relatively high. Research New Zealand conducted a survey to determine the use of smartphone and communication devices by the New Zealand population. They found that in year 2015, 70 percent of all the adults in New Zealand had an access to a smartphone and 72 percent had an access to a laptop or a notebook (Research New Zealand, 2015). The current statistics on the ownership of smartphones was not available; however can be estimated from the penetration figures from year 2013-2015 (which was 46 percent increase in the ownership of smartphones by adults in New Zealand from year 2013-2015) that ownership of smartphones must have been raised since year 2015's survey report (Research New Zealand, 2015).

On the other hand, people from the underdeveloped and developing countries may struggle to gain access to these services and devices for various reasons, which can act as a barrier for their taking part in an e-health intervention (Bailey et al., 2010). Research has been showing that better affordability of the devices and

services in developed countries offers more ease in adopting and using the smartphone app interventions (Boulos et al., 2011). Smartphones offer better mobility that facilitates the treatment interventions reaching a great number of people (Brouwer et al., 2008).

Smartphone Apps addressing General/Mental Health

Researchers have shown that individuals' interest has been drawing towards operating smartphone apps for self-healthcare, because it enables them to gain control of their healthcare. Control of self-healthcare leads the individuals to gain a sense of empowerment, autonomy and privacy that may aid in enriching their knowledge of self-health literacy and self-care (Calvillo, Roman & Roa, 2015; Thomas & Lupton, 2016). In general, smartphone apps help patients in monitoring and tracking their health on regular basis (Bakker et al., 2016). Generally, patients with chronic illnesses such as diabetes and obesity can make a use of inbuilt self-monitoring or self-tracking tools; keep a record to observe regular improvements or deteriorations in their physical health (Bakker et al., 2016).

There are numerous smartphones apps related to health care that focus on promoting different aspects of the health such as promoting physical activity (Middelweerd et al., 2014), weight management (Bardus et al., 2016), smoking cessation (Strecher et al., 2008), and oral contraception (OC) reminders (Gal, Zite & Wallace, 2015). Likewise, there are a number of apps and internet-based programmes available in the market addressing issues such as depression, anxiety and stress, related to mental health (Bakker, Kazantzis & Rickard, 2016; Carbring et al., 2013; Powell et al., 2013).

It has been found that pregnant women express high levels of interest in adopting and operating smartphones during their pregnancy period (Thomas & Lupton, 2015). A report from UK's famous brand "Baby Centre" (online destination for pregnant women and new parents) revealed that pregnant women are frequent users of smartphones during pregnancy and childbearing period (Rise of Mobile Mum, 2012). It has been observed that the use of pregnancy related apps by pregnant women has been increasing, because use of apps in pregnancy enables them to have an easy access to pregnancy related imperative information. It also enables them to obtain an active track on their own health as well as building a bond with their babies (Thomas & Lupton, 2015). Apps have also made social interactions relatively affordable and accessible in terms of interacting with family and friends at any time of the day or to seek support from them in the times of crisis. Similarly, apps with informative and interactive features are the apps most accepted by pregnant women because these apps can be tailored according to their needs in required times (Lupton, 2017; Thomas & Lupton, 2015).

Encouragement for using smartphones during pregnancy

Studies have shown that pregnant women emphasize that their smartphones their great companions during pregnancy (Lupton, 2017; Thomas & Lupton, 2015). Using apps related to pregnancy on smartphones provides psychological and emotional support to expectant mothers in the time of need, either in supporting to calm their heightened emotions or to track the pregnancy progress (Alkhaldi et al., 2016; Thomas & Lupton, 2015; Tripp et al., 2014). Pregnant women also acknowledge that they are more reliant on smartphone apps in receiving instant,

and significant information related to pregnancy at the first instance without visiting doctors, midwives (Lupton, 2017).

Smartphone apps often provide tailored suggestions and guidance. A few of the USA based pregnancy related smartphone apps provide direct links to the crisis centre/help centre, adding another relevant feature which strengthens their relationship with the selected apps because it facilitates instant connectivity with professional consultants (The National Institute of Mental Health, 2017).

A few apps related to pregnancy enable pregnant women to obtain timely updates on gestation, images of developing the foetus, and various other important milestones associated with the baby that helps them in developing a special bond with their babies at early phases of pregnancy (Thomas & Lupton, 2015; Tripp et al., 2014). Smartphone apps facilitate support to pregnant women, ranging from the information about physical aspects of their body during pregnancy to every milestone their babies pass. However, pregnant women do not always have a positive relationship with these apps. A few studies have shown that occasionally these apps arouse feelings of apprehension by providing an overload of information while offering suggestions and guidance (Thomas & Lupton, 2016; Lupton, 2017; Tripp et al., 2014).

Engagement levels of pregnant women with Smartphone app

A few studies have recognized that pregnant women prefer to be more vigilant about their health and well-being during the pregnancy period in order to provide additional protection for their babies (Lupton, 2017; Thomas & Lupton, 2015). Emergence of online self-help programs or apps adds an extra support for pregnant women in terms of providing emotional and psychological support

during the pregnancy period. A study by Carissoli et al (2016), was conducted on pregnant women using an Italian smartphone app to improve their well-being and to learn coping strategies to deal with the anxious and stressful situations during pregnancy by using a pregnancy app called “BenEssere”. Participants were asked their experiences with the app and it was found that participants had positive experiences with the app. They reported that the app was easy to use and had high levels of engagement with the app. Activities provided in the app appeared effective during stressful times in terms of bringing oneself in a relaxed state.

Another study was conducted to determine the interest of pregnant and postpartum women in using health-related apps. Participants showed their interest to use those apps during perinatal periods which could be downloaded free of charge (Osma, Barrrera & Ramphos, 2016). Thus, it can be predicted that the acceptance, experience, and feasibility rates of using the apps are great at certain levels among them (Carissoli et al., 2016 Osma, Barrrera & Ramphos, 2016). However, the engagement and usage levels with apps are significant factors, which are yet to be uncovered (Carissoli et al., 2016; Lupton, 2017; Thomas & Lupton, 2015).

A body of research has suggested that computer-based e-interventions have positive effects on the modification of behaviour; however, they are identified to have a small effect size because of low levels of user engagement (Brouwer et al., 2011; Norman et al., 2007). This may be because users’ lack of interest with the passage of time creates difficulty maintaining the engagement levels over an extended period of time and eventually affects user engagement levels of with e-interventions (Brouwer et al., 2008; Hutton et al., 2011; Kohl, Crutzen & de

Vries, 2013; Morrison et al., 2014). Minimal or no usage and engagement with the e-interventions may affect the efficacy of treatment programmes, as efficacy can only be determined if the user intends to initiate an ideal level of engagement with the e- interventions (Norman et al., 2007).

Determining the engagement levels of users with the apps is a growing area of interest for research (Muench & Baumel, 2017). Apps have been found to be more accessible than computers. Various researchers have suggested that an optimal level of app usage and engagement must be observed in order to maintain the efficacy of the apps (Fry & Neff, 2009; Muench & Baumel, 2017; Morrison et al., 2014; Norman et al., 2007). Various behaviour change models can enhance understanding about working of these interventions so as to design the app interventions to be more effective.

Behaviour Change Models and Strategies

E-intervention programmes in the field of healthcare are relatively newer than the traditional interventions (Patrick, Intille & Zabinski, 2005). E-interventions such as apps or web-based programs attract users and are recommended by health practitioners because these programmes are both cost and time effective (Mauriello et al., 2011). A considerable amount of literature has demonstrated the feasibility and acceptability of various e-interventions in addressing general and mental health disorders (Kim et al., 2014; Lattie et al., 2016; Mohr et al., 2017; Mauriello et al., 2011). It has also been identified that users discontinue or minimize using and engaging with the intervention programmes, which can have a considerable impact on treatment outcomes (Kelders et al., 2012). Therefore, it becomes imperative to determine the factors that contribute to enhancing users'

engagement levels with e-interventions in order to obtain optimal benefits of these apps or online intervention programmes. There are various behaviour-based theories and models that have been applied to health behaviours. Some behaviour related models/theories may contribute in understanding the individual behaviour in terms of adhering, engaging and optimal use of e-interventions for the required period of time. These behaviour related models and strategies may offer significant ideas in improving the design of the apps in future research in order to obtain essential results from individuals, hence are discussed below.

Fogg's Behaviour Change Model (FBC)

Fogg (2003) presented "the concept of persuasive technology" and discussed designing an effective technology system that makes a positive impact on individual's behaviour. Persuasive technology is designed to persuade people to change their attitudes or behaviors. Fogg purposed that people respond to computer-based devices because they support them making their tasks easier. The devices are interactive, which enhance the probability of individual's interactions with the devices, and the devices can sometimes be effective in changing behavior for the better. However, a key limitation of persuasive technology, such as apps or web-based interventions, is that it is difficult to predict users' interaction levels (low or high) with them (Muntean, 2011). Fogg (2009) proposed a behavioural model, which highlights the combination of 3 key factors: motivation, ability and triggers, in order to determine target behaviour. He further argued that these three factors work simultaneously and should be present at the same time to generate target behaviour. He claimed that his model could be used to predict the user behaviour in relation to technology, because it is likely to be applicable to human-computer interactions.

The three elements--motivation, ability, and triggers--are briefly explained below.

Motivation is the key factor to be considered in bringing change or modifying target behaviour. Fogg suggested that motivation can be intrinsic or extrinsic in nature, and motivation contributes to influencing the occurrence of target behaviour. Positive and negative consequences can affect the individual's motivation, and that motivation determines target behaviour. For instance, a friend of a pregnant woman suggests that she download a pregnancy related mental health app and she downloads it; however she will not use that app if she is not sufficiently motivated. According to Fogg's model, the distress she is experiencing will lead her to download the app and the fear that her stress will continue may act as a motivator that will determine her app use behaviour.

Ability is the second important factor that may lead to the user's behaviour change. Fogg argued that the presence of motivation alone would not help target behaviour occurring unless the person is capable of performing that behaviour. For instance, if that pregnant woman was highly motivated to use the app but due to some external factors (phone crash, unavailability of internet services, unable to operate the app) was not able to use the relevant device, this would make her unable to interact with the app. However, presence of high motivation here can play a role to make the user (pregnant woman) determined to explore the ways to accomplish a task.

Trigger *is* the final element of the Fogg's Behaviour Model (FBM), in which Fogg (2009) identified that the motivation and ability alone would not be enough to determine the target behaviour. An individual may have both elements (motivation and ability) present but there are certain behaviours that require

triggers to be delivered for the desired behaviours to occur. For example, the pregnant woman in previous examples has motivation and ability to use the app intervention; however, forgets or her busy working schedule may hinder her interaction with the app intervention. In this situation, triggers can work to remind her to use her app in order to determine target behaviour. Therefore, involving strategies and components based on a suitable behaviour model(s) at the time of designing the app or in research design may show a great potential in terms of making an e-intervention treatment successful.

Prompts in relation to app use from behavioural perspective

From a behavioural psychology perspective, notifications/prompts may act as a discriminative stimuli and elicit a desired behavior. It happens because a notification signals a new information (new guided message of the day) that may reinforce an individual's interaction with the app at that time (when individual receives a notification). However, it is important to determine what can affect the function of discriminative stimuli.

The app itself may or may not function as a reinforcer, which potentially can affect the function of discriminative stimuli (notifications).The app can act as a reinforcer if its characteristics such as effective design, relevant content and other features are relevant to user's needs and then discriminative stimuli may elicit a desired behavior. On the other side, if app will not function as a reinforcer, then there are chances that discriminative stimuli will not function as a reinforcer and will be unable to elicit a desired behavior (interacting with the app). Therefore, the characteristics of the app such as personal relevance of the app intervention, design of the app, and relevant content of notifications can act as potential and

significant factors in terms of an app's ability to act as a reinforcer (Brouwer et al., 2008, 2011).

Notifications/prompts may potentially act as motivating operations, which enhance the reinforcing effectiveness of the stimulus (app). Similar to Fogg's model, this could be creating a temporary unpleasant state associated with the "expectation to engage" which is relieved as soon as the user engages with the activity suggested through guided prompt. Hence, the delivery of prompts may increase the probability of engaging in the target behaviour, which may improve the effectiveness of the app or the other technology-based interventions (Brouwer et al., 2008)

Interactions with the app are potentially (but not certainly) reinforcing. Interaction with the app may act as a reinforcer for an individual on the basis of a few factors such as usability of app, easiness in navigation, usefulness of content and obtained desired/positive outcomes from the use of app. Also, temporary factors such as temporary distressing events (e.g. arguing with the partner) or biological changes may affect the function of interacting with the app. For example, if a pregnant woman is feeling anxious, and her being interacting with the app reduces the woman's anxiety at that time, the behaviour of that woman is negatively reinforced, which increases the probability of app use behaviour to occur again. Thus that woman will use the app again if encounter the similar situation in future (Ringdahl & Falcomata, 2009).

Various strategies based on behavioural principles can be adopted while designing apps to obtain optimal outcomes from an intervention. Prompting (a behavioural technique) in terms of texting, emailing, push-notifications and inbuilt

notifications can play a substantial role. These can either be used as a stand-alone intervention or selected as a component of the intervention to increase the levels of user engagement (Fry & Neff, 2009).

Prompting and its impacts on treatment adherence

Prompting is a behavioural principle that increases the probability of eliciting a desired behaviour by adding stimuli to an individual's environment. Basically, a prompt acts as a cue or extra support that can help an individual to elicit a desired behaviour that otherwise might not occur in the absence of that cue. Likewise, prompts can be integrated with behavioural intervention strategies in order to persuade individuals to maintain or enhance the engagement levels with the treatment intervention such as internet and app interventions (Morrison et al., 2017 Muench & Baumel, 2017). For example, when a user adopts an app for monitoring or tracking any self-activity but shows minimal levels of engagement with the app after a certain period of time. Prompting (in the form of notifications, text messages) may encourage the user to increase engagement levels with the intervention.

Health practitioners used to send the reminders (a prompting strategy) to clients by post; these then were replaced with phone calls and these are now being sent in the form of text alerts because traditional electronic communication devices (telephones) have now been replaced with contemporary devices such as smartphones and tablets (Norman et al., 2007; Ventola, 2014). E-health interventions (smartphone apps) incorporate prompt strategies, such as alerts, push-notifications, general notifications, texts, emails and any cue that acts as stimuli to elicit the desired behaviours (Morrison et al., 2017). Some studies have

found that providing prompts in association with interactive behaviour change components (such as providing individualized computer-tailored feedback, goal settings) may enhance participants' engagement levels with the apps content. Enhanced engagement levels further may lead to the completion of an intervention program (Brouwer et al., 2011). Behaviour related components such as peer and professional support in an intervention plan have a potential in terms of motivating clients to enroll in an intervention and extent their visits to the app interventions. Fry and Neff (2009) found in their systematic review that delivery of periodic prompts generally report positive outcomes of an intervention programme, especially when periodic prompts were combined with counselor's support. Delivery of periodic prompts potentially increase the frequency of using e-intervention programmes among users, and more interaction with the e-intervention was found associated with increased effectiveness of intervention treatment.

Prompts can be annoying and intrusive at times; however, they contain useful information, therefore, identification and delivery of prompts at an optimal time may promote effective user engagements with app interventions (Muench & Baumel, 2017). Various studies have been showing the positive effects of receiving and using notifications in different areas of behaviour change interventions. A systematic review was conducted by Krishna, Boren and Balas (2009) in which they included a number of studies addressing areas related to healthcare to examine the significance of mobile phones and text-based interventions in improving health and well-being. Studies included in this systematic review used phone call and message prompts to enhance the improvements in health outcomes among participants. It was found that

interventions including reminders, disease monitoring and management, and short text messages have a great potential to bring significant improvements in health outcomes and processes of care.

Clarke et al. (2005) conducted a follow up second three-arm randomized controlled trial using ODIN (2) intervention program, containing two interventions and one control group. Reminders using postcards were delivered to one intervention group and brief telephone calls to another intervention group in order to remind participants to return to the website so as to increase the participants' usage of the intervention program. This trial yielded positive results in terms of participants' usage of intervention program and greater reductions in depressive symptoms were reported among participants in both intervention groups as compared to a control group (Clarke et al., 2005). Hence, the study suggests that providing prompts with mail and phone prompts increases the adherence, use and engagement of participants to internet-based self-help programs.

It has been argued that the most effective prompts are those that are relevant to users' subject matter, recur at a suitable time; display variability in subject matter on a regular basis (Brouwer et al., 2011). In a systematic review, De Leon, Fuentes and Cohen (2014) found that use of periodic prompts in behaviour change interventions elicit positive results; however the studies included in this review used a combination of various components (such as prompts, feedback, goal-setting and others) in the study designs, which makes it difficult to draw conclusions regarding the most effective combination of components to use in behaviour interventions. Fry and Neff (2009) also confirmed similar findings in

their systematic review and suggested that the only way to determine the most effective behaviour component is to comparing the prompt alone with other prompt types.

Ross and Wing (2016) conducted a phone-based randomized pilot study to determine the efficacy of self-monitoring technology with and without providing a scheduled phone call support (prompt) in a 6-month weight loss intervention programme. Participants were randomly allocated to three conditions: self-monitoring tools (ST), technology-based tools (TECH), and technology-based tools combined with phone call (TECH+PHONE). Participants in the ST group were given traditional self-monitoring tools such as a reference book to keep a written record of calorie intake, weight-loss and physical activity each day and no further contact was made with participants after the initial session. Participants in the TECH group were provided a smartphone app and asked to track their calorie intake and physical activity every day, no further contact was made with the participants in this group either. Participants in TECH+PHONE group were provided the app for self-monitoring along with phone calls. Number of the calls was scheduled to decrease gradually (8 weekly, 4 bi-weekly and 2 monthly). Phone calls were scheduled to provide extra support, and also to focus on other behavioural weight loss techniques. Participants in the TECH+PHONE group lost significantly more weight than the participants in two other groups from baseline to 6 months. Participants in TECH+PHONE group were found higher on adherence to their self-monitoring calorie intake than other groups. Therefore, results of this pilot study suggested that newer technology in addition with the provision of phone calls enhances the adherence and weight loss in comparison to use traditional self-monitoring tools. Combining prompts with these phone calls

go beyond being just prompts to use the app, but provide additional support and information to users. Therefore, prompts can be effective and beneficial in behaviour modification if used along with e-interventions.

E-intervention is relatively a young area of research, and little is known about the optimal number, type, and duration of prompts (Morrison et al., 2017). The following sections summarize the finding on factors that may increase user engagement with e-health interventions. (Brouwer et al., 2011; Morrison et al., 2017).

Prompting components affecting user engagement with apps

Sometimes an optimal level of use and engagement with app interventions becomes a struggle for users. For users with full and busy lives, their engagement with apps tends to compete with other demands. Researchers have reported several factors in terms of delivering prompts that affect the user engagement with the app interventions (Muench & Baumel, 2017). The characteristics of prompts that influence the frequency and duration of user engagement with app interventions are discussed below.

Timing of delivering prompts

Timing refers to a specific point of time for receiving prompts when a user is more likely to attempt to open and operate the app (Morrison et al., 2017; Muench & Baumel, 2017). The “just-in-time” is a recent mobile phone intervention design that caters to the constant changing needs of individuals by delivering them right type of support at the time of need considering their altered internal and contextual state (Nahum-Shani et al., 2016). This intervention design has a strong potential for successful uptake by recipients and has also been found as being

effective in terms of promoting healthy behaviours among users (Nahum-Shani et al., 2014). Therefore, “just-in-time” intervention design can be adopted in designing prompts in app interventions. For instance, Free and colleagues (Free et al., 2011) conducted a study to determine the efficacy of “txt2stop”, an automated text-based smoke cessation programme. Participants received five messages a day for first five weeks of intervention and the frequency of messages were reduced to three a week for next 26 weeks. The content of the message was based on motivational messages and behaviour change techniques. The txt2stop intervention was found significantly effective in improving smoke cessation among participants. During this intervention, if any participant experienced a relapse or craving while using intervention, he or she was able to receive support by using the app components at these times by sending a message “lapse” or “crave” to the help centre. The participant would receive a number of supportive and encouraging texts to distract and address the episode of “lapses” or “cravings” in order to maintain healthy behaviours and this concept in the study can be associated with the “just-in-time” design, meaning that along with the prompts, participants had an access to the other supportive messages at much required time, in right amount.

User perception is a vital factor to consider in terms of accepting or rejecting notifications at certain times (Mehrotra et al., 2016). Mehrotra et al. (2016) evaluated the influence of notification timing on user’s reports of disruptiveness of the notifications. Mobile notifications were perceived as being more disruptive when sent to the users when they are in the middle of performing a task than when beginning or finishing a task, probably because the user perceives the disruption as increasing with the increase in the complexity of on-going task (Mehrotra et al.,

2016 in Muench & Baumel, 2017). During travelling time after work and during leisure time, notifications are perceived to be most disruptive and are more likely to be avoided by users (Mehrotra et al., 2016). Research conducted on adolescents to determine the feasibility of an app called "CopeSmart" by Kenney, Dooley and Fitzgerald (2015) found that participants in this study considered notifications as an encouraging factor to use the app; however, evening time (8pm) was found the most popular and acceptable time for app engagements (notification time was set by default for 8pm on daily basis). Early mornings and late nights were the least popular times for accepting and checking on notification. In a small study of the preferences of women with perinatal mood disorders, these women indicated a preference for online peer support after six in the evening (Baumel & Schueller, 2016). Therefore, it is difficult to set a single "one solution for all" conclusion allotting a timeframe for delivering notifications, as various populations prefer various time frames.

Frequency of prompts

Frequency, in the context of sending notifications, refers to the "number of prompts" that may be appropriate in sending to a user (Muench & Baumel, 2017). Frequency of delivering prompts/notifications is an imperative factor to consider when it comes to determining the impact of delivering prompts on individual's app usage. Frequency of app use can be determined by assessing total number of visits (in the form of logging) to the app intervention by users. (Fry & Neff, 2009). Some studies confirm that various types of prompts/notifications enhance user engagement with app content as well as engagement with the app (Brouwer et al., 2008; Ferney et al., 2009; Severson et al., 2008); however, the frequency of prompts to achieve optimal levels of results is yet to be identified (Fry & Neff,

2009; Muench & Baumel, 2017). A study by Lombart and colleagues (1995) examined the effects of providing more frequent (weekly) versus less frequent (3 weekly) prompts in order to obtain a desired behaviour among participants in walking group programme. Results indicated that participants who were delivered prompts more frequently (weekly) were found to have adhered to the walking programme (exercise) for a longer period of time.

In another study, Morrison et al. (2017) reported the positive effects of delivering frequent reminders to two intervention groups in a randomized trial of a smartphone-based stress management app named "Healthy Mind". The study contained three groups: two intervention groups (intelligent and daily notification) and one control group (occasional notification). Participants in both intervention groups received frequent notification every day and occasional notifications were sent to participants in the control group. Three different types of notifications: tool announcement (new tool to be unlocked); tool suggestion (encouraging re-use the app tools that had previously found helpful); and general reminders (reminders to re-use the app) were delivered every day to participants in both intervention groups. Results indicated that participants in both intervention groups logged in and used the app more than the participants in control group. Findings of this research suggested that the provision of frequent notifications with variability in the content of the notification may enhance the usage and participants' exposure to the content of the app intervention (Morrison et al., 2017).

On the other hand, some studies have found that delivery of repeated and uncontrolled frequency of prompts decreases the effectiveness of prompts (Morrison et al., 2017; Muench & Baumel, 2017). Also delivering a similar

prompt repetitively, using different formats (such as texts, emails and notifications) may have adverse effects on users' engagement behaviour and their use of app interventions (Muench & Baumel, 2017). Intrusive delivery of constant prompts using different formats may result in high levels of frustration among users, which may lead to users deleting or ceasing to use the app interventions (Morrison et al., 2017; Muench & Baumel, 2017).

Mode of delivery

The term *mode of delivery* refers to the "stimulus type" delivered to the individual in order to elicit the desired behaviour (Muench & Baumel, 2017). There are various types of stimulus used as prompts such as email, push notifications (notifications that display on the phone's screen despite the screen's being locked), text messages, phone calls, alerts and also in built features in app interventions for delivering prompts. Research studies have found that the mode of delivering prompts may affect the outcome of behaviour in behaviour change interventions (Fry & Neff, 2009). In a long-term (12 months) weight loss study, three groups (telephone, mail and treatment-as-usual) were selected for a weight loss intervention in order to find the effect of using different prompt strategies on participants' weight loss. Results showed that participants in telephone group (phone counselor scheduled frequent phone calls to provide guidance to the participants for each lesson) lost significantly more weight treatment-as-usual group, and mail group also lost more weight on average than participants in the treatment as usual group at six months of intervention assessment. No significant difference in weight loss was found between the telephone and mail groups of intervention at 12-month assessment, but participants in both intervention groups lost more weight than participants in treatment-as-usual group (Jeffery et al.,

2003). Therefore, this study concludes that mode of delivering prompts has an impact on the effectiveness of an intervention programme. Study showed that telephone prompts were more effective than email prompts at six months, but not at 12-month assessment. Generally, prompts delivered using telephone mode offer more support and information; thus are likely to be more effective mode of delivering the prompts but as no difference was found at 12-months assessment, thus it cannot be concluded whether telephone prompts would be more effective than email prompts for long term intervention programmes.

Brouwer and colleagues (Brouwer et al., 2011) conducted a systematic review of the characteristics of the internet-delivered interventions associated with better exposure to the intervention and its content. This review supported the idea that the prompt type affects the app use and engagement levels. It was found that that approximately 50 percent of the studies in this systematic review included peer/counselor and email/phone contact as prompts. Results concluded that peer/counselor support was associated with the longer time spent on intervention website and emails/phone contact were found to be associated with the frequent visits to the interventions website. Therefore, it is suggested that self-help programmes can be more effective along with the delivery of prompts with it. However, it is not clear what mode of delivery (emails, phone calls, counseling) is more effective in terms of obtaining better outcome.

Characteristics of app interventions affecting user engagement

Structure of app

The structure of the app holds an important place in determining individual's visits to e-interventions (apps). Studies have demonstrated that more structured

apps and website appear to be associate with more revisits (Brouwer et al.; 2008; Danaher, McKay, & Seeley, 2005; Danaher et al., 2006). Various important characteristics of apps such as simple and guided structure of the intervention, minimal or no levels of complexity to unlock next levels, and provision of comprehensible (using clear language) information foster revisits the app from users (Brouwer et al. 2008; Morrison et al., 2017). In a systematic review, Brouwer et al., (2008) concluded that provision of clear, easy and structured information contributes to extended visits from the app users.

App content

Smartphone app users are more likely to open and make repeated visits to the apps if the notifications are based on theoretically informed content and on behaviour strategies (Fogg, 2009; Fry & Neff, 2009; Leon, Fuentes & Cohen, 2014). Morrison and colleagues (2017) conducted a mixed method study to examine the impact of timing and frequency on notification response and usage of an app called “Healthy Mind”. In the qualitative section of their research, participants reflected on the content of the notifications. They criticized the repetitiveness of content used in notifications and appeared frustrated and demotivated to encounter recurring content of notifications. They expected new information in every notification sent in order to revisit the app. It may be suggested that providing different and exciting information may improve the chances of users experiencing a more stimulating and rewarding experience with the app (Morrison et al., 2017). Brouwer et al. (2008) also supported that provision of new content in notifications reinforced the user behaviour to revisit to the app intervention. App interventions that are less static create eagerness and keenness among users to obtain the next level of feedback or information that

enhances the user engagement with the app intervention (Brouwer et al., 2008; Napolitano et al.; 2003).

Interactive behaviour change strategies

Several research studies have found that smartphone apps or web interventions based on behaviour change theories/strategies comprising interactive components such as goal setting (Brouwer et al., 2008, 2011), individualized tailored content (Danaher et al., 2006) , periodic lessons and feedback (Tate, Wing & Winett, 2001), self-monitoring (Brouwer et al., 2008; Ferney et al., 2009), self-managed education, and involvement of counselors (Fry & Neff, 2009) demonstrate enhanced use and user engagement with the app-based or web-based interventions. It has been addressed in a systematic review that e-interventions containing reminders, suggestions, counselor support, social facilitation, frequent updates, and/or tailored feedback on completing goals influence user behaviour positively, and tend to extend the user interaction and adherence with e-interventions (Kelders et al., 2012). Furthermore, this systematic review suggested that persuasive technology and intervention characteristics predict the levels of user adherence with the web/internet interventions. In another study that Brouwer et al. (2008) conducted to determine the potentially important factors affecting user visits to a, internet-delivered behavioural intervention, it was found that tailored feedback, relevant and reliable information, and easy navigation structure promotes extended users visits by users, whereas monitoring personal progress is associated with revisiting the internet interventions. Therefore, users can consider the role of app characteristics as extremely significant in terms of obtaining better adherence and usage of e-interventions.

Tailored prompts

Tailored prompts are prompts, which are relevant to the user's own situation, needs, preferences and interests. Studies have found that tailored prompts are more effective in terms of enhancing the user levels of engagement with app interventions and in bringing behaviour change among users (Fry & Neff, 2009; Kreuter & Wray, 2003). Svetkey and colleagues (Svetkey et al., 2008) conducted research with overweight adults as participants. Three intervention groups: telephone, online intervention, and control were selected for the research to determine the effects of intervention on preventing weight regain among participants. At 24 months, both treatment intervention (telephone, online intervention) groups had regained significantly less weight than the control group; however, at 30 months, participants in telephonic intervention had regained significantly less weight than the other treatment groups. This may be because the telephone group contained a few extra prompting components, which included a 5-15 minute telephone contact with participants each month, and face-to-face guidance and support after every four months. Hence, this suggests that personalized feedback may be important in maintaining behaviour change.

Tate, Jackvony and Wing (2006) conducted a weight-loss study and compared three groups: human email counseling (periodic personalized feedback from human counselor along with an access to a comprehensive website); computer-automated counseling (computer-automated periodic prompts and access to a comprehensive website); and no counseling (no feedback was facilitated, only access to a basic website). At three months, participants in both treatment intervention groups showed a significant loss in weight when compared to no counseling group. However, at six months, the human email counseling feedback

group had lost significantly more weight than the automated feedback and no counseling groups. Therefore, these two studies support the idea that personalized feedback and additional support such as counseling, phone calls and others are helpful to intervention outcomes, and this may be because of increased engagement with treatment programs. High levels of engagement with the interventions are revealed as related to the positive change in health behaviour (Alkhaldi et al., 2016).

Gamification

Gamification means using game-related elements in the non-game contexts (Lupton & Thomas, 2015). Usually, healthcare app interventions are non-game applications. However, a few studies have introduced gaming mechanisms into health apps and found that this raised engagement levels of users. Gamification features may include scoreboard, personalized feedback, goal setting and competition based games (Muntean, 2011). Gamification is a simple feature, yet makes the app content more attractive to users and may lead to high levels of adherence to the app interventions, as games are associated with fun time (Muntean, 2011). There is no research into the effect of this in healthcare arena, but app designers may consider gamification an important component to introduce in app interventions so as to improve user engagement levels

In light of existing literature on the factors affecting the user engagement with apps and app use, there are various factors that need to be considered prior to the design of the app or designing a study in order to achieve better outcomes of an intervention treatment programme. Perinatal stress and distress is an important problem for mental and physical health (Meltzer-Broody, 2011). Mobile apps are

a mechanism for delivery of preventative interventions that may be effective for improving distress levels. Effectiveness of interventions depends on the reciprocity of app use. There are some characteristics of apps that may facilitate increased app use. One of these is delivery of prompts that helps reminding the user to access the app.

The current study's aim was to test the effectiveness of prompts to increase the use and satisfaction with a stress management app for pregnant women. It was hypothesized that providing a series of prompts guiding the user to explore a variety of elements in this complex, multi-part app would increase the frequency and breadth of app use, and would increase overall satisfaction with the app.

The research questions for the present study are as follows:

I. Would providing notifications/prompts to the participants in the guided activity group lead them to use the app more than the participants in the control group? Would they also explore the more of the app's components than participants in the control group?
II. Would participants in the guided activity be more satisfied with the app and recommend the app to their friends?

Chapter 2: Methods

This chapter details the smartphone software application (app) used in this project and its components. A brief introduction to the research team of this project, which was part of a larger pilot of the app, is included. This chapter outlines the app intervention, design of the study, recruitment methods and process, ethical considerations, background demographics, and measures used in the study.

Positively Pregnant App Pilot (PPAP)

The current study is part of a broader pilot research project, which aimed to develop/refine and evaluates the effectiveness of a newly designed smartphone app called 'Positively Pregnant'. A team at University of Waikato lead by Carol Cornsweet Barber developed this app. This app is a self-help informative and interactive tool designed specifically for pregnant women to use during the perinatal period in order to manage pregnancy related challenges and transformations. This smartphone app provides various tools for pregnant women that enable them to reflect on their strengths, stressors, supports and positive coping strategies to maintain their physical and psychological wellbeing during pregnancy. This smartphone app provides positive coping strategies to alleviate the effects of stressors, offers a selection of strategies, provides information about pregnancy and related issues and also recommends online links to contact appropriate organizations in order to seek desired help. This smartphone app is composed of four key modules: Know Yourself, Do Something, Find Out and

Conversations. A brief description of each given module is discussed below along with figures.

Know Yourself

This section of the app is a self-assessment tool, in which participants complete inventories for self-assessment and receive feedback and suggestions based on those inventories. It consists of seven components, five of which comprise inventories that help in assessing participants' potential strengths, stressors, health behaviours, cognitive styles and coping strategies.

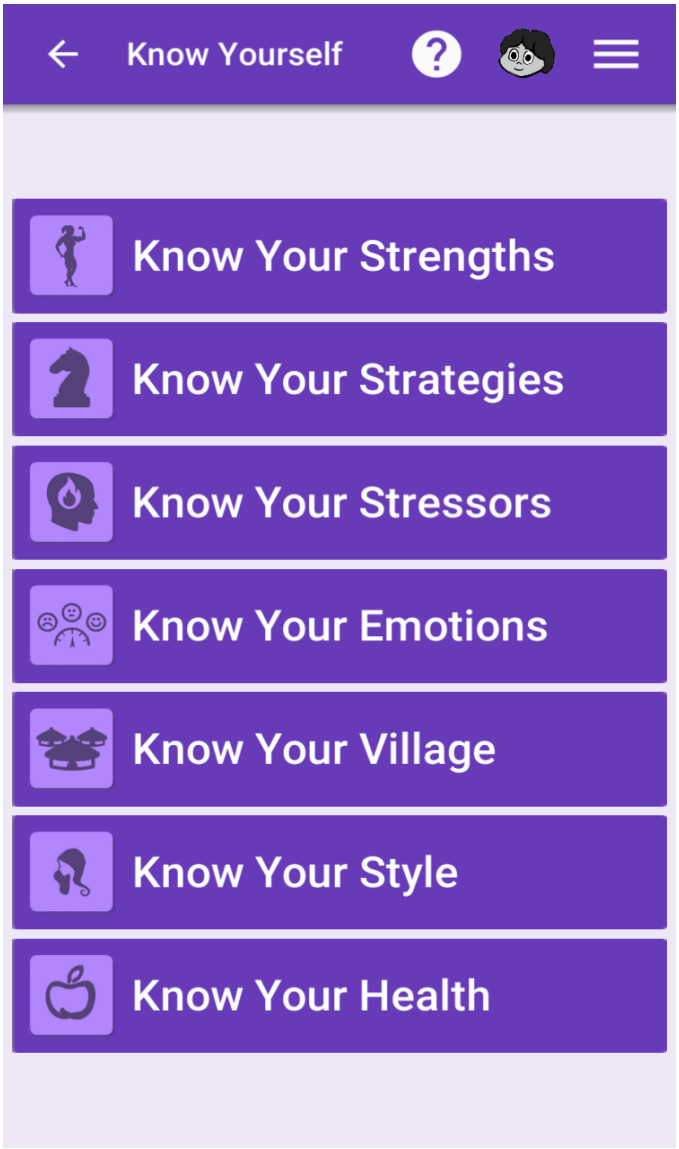


Figure 1. Screenshot: outline of the section "Know Yourself"

One component keeps track of emotions; with notifications that can be turned on to receive reminders on a daily or weekly basis to record emotions. Emotions can be personalized and customized if one decides to track any specific emotion oneself. This section of the app has another component ‘Know your village’, which enables participants to add the people they trust in terms of receiving any support, in terms of sharing pregnancy related talks, in terms of obtaining good advice, in terms of contacting them in an emergency, in terms of having fun, in terms of being, comfortable leaving the baby. Once people are added under the ‘know your village’ component, one can see at a glance who should be contacted in a critical situation.

Do Something

The second section of the app is ‘do something’. This consists of various activities one can select to manage stress and improve physical, emotional and psychological well-being. This section of the app contains nine components as displayed in *Figure 2*. Within audio activities, there are six different types of audio activities including body scan, relaxation breathing, stretching, and guided imagery of a beach, a garden and a tree house. Hence, there are a total of 14 activities in the “Do Something” section of the app. The facility to play a game named ‘Hatch3’ is also provided. In the activity ‘Have a laugh’, touching the screen directly links the user to ‘YouTube’ to watch funny videos of babies for fun and entertainment. These activities can be chosen to perform according to one’s preference.

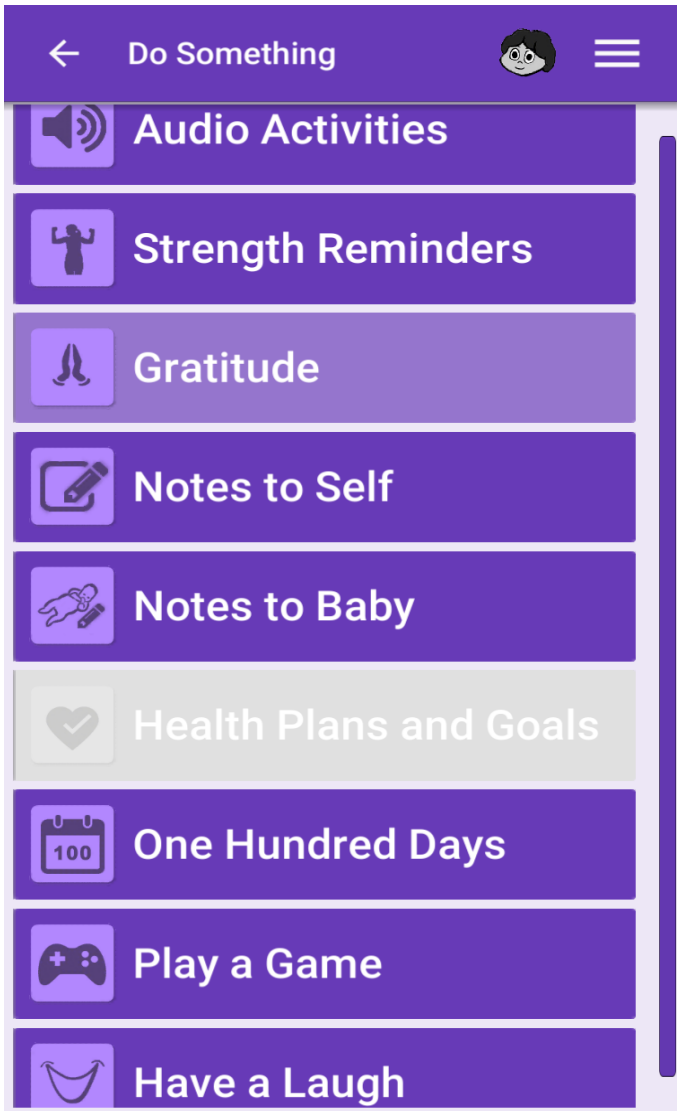


Figure 2. Screenshot: outline of the section "Do Something"

Find Out

The third section of the app, 'Find Out', helps pregnant women to reflect on the social and emotional aspects of entering motherhood. There are 30 brief informational topics, organized into six sections shown in *Figure 3.* To view a full list of 'Find Out topics' refer to Appendix A. These components have further links providing information on being pregnant. Online links to appropriate pregnancy-related resources in New Zealand are provided.

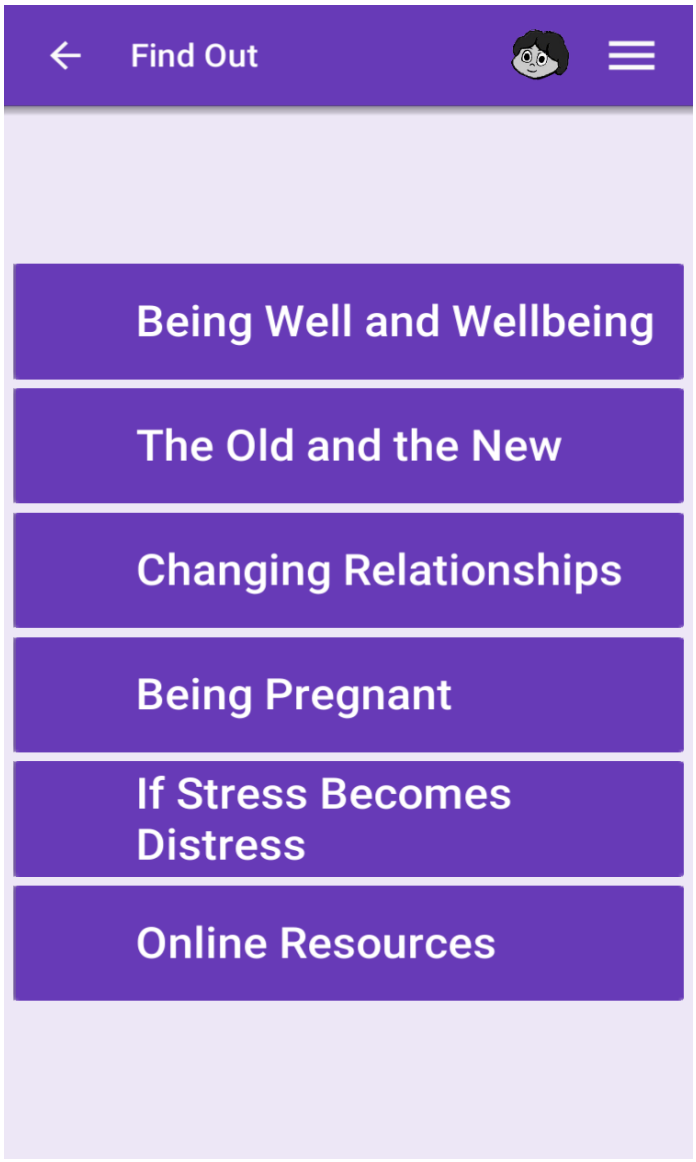


Figure 3. Screenshot: the outline of the section “Find Out”

Conversations

The fourth section of the app is named ‘Conversations’ which provided suggestions for topics of conversation about preparing for parenting, in terms of organizing important ceremonies (traditional or contemporary based on choices), in terms of having discussions about financial matters and making plans for the baby’s birth in order prevent challenges that they could face at or after the child’s birth. Basically, this section is about encouraging discussion between the woman and her partner or support person about some important topics around pregnancy

and parenting and this may contribute in preparing new parents for the upcoming transitional phase of their lives before the arrival of their child.

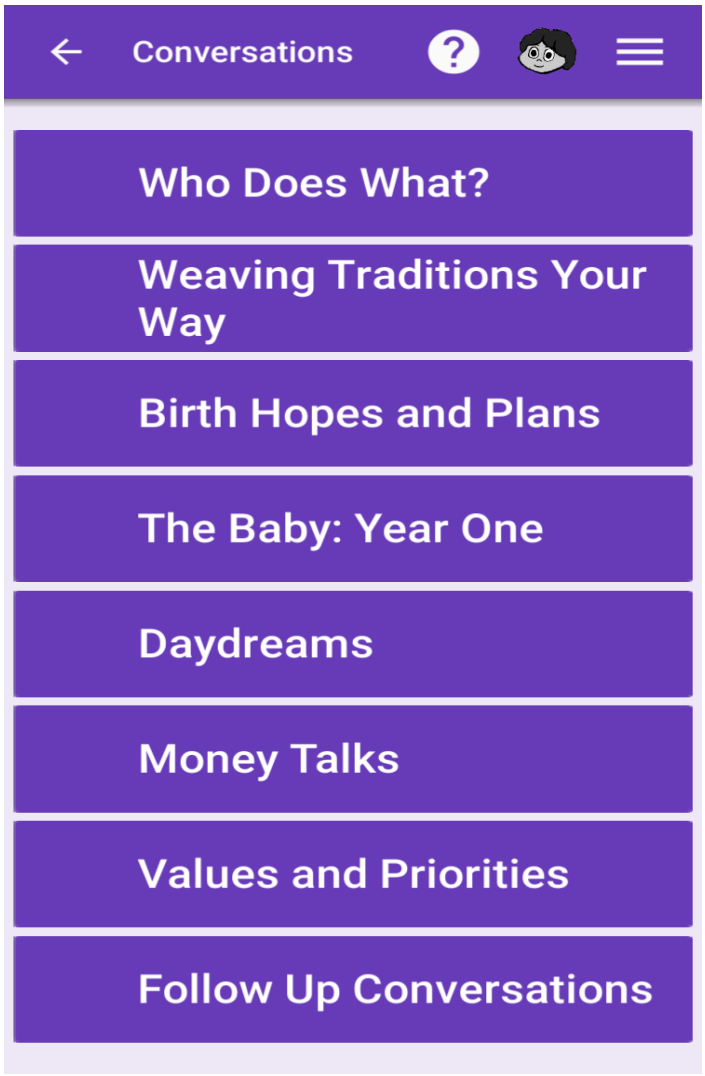


Figure 4. Screenshot: outline of the section "Conversations"

App intervention

Another element 'Tip of the Day' was scheduled to deliver every day to both groups. 'Tip of the Day' contained positive quotes about life, pregnancy and some general tips about day-to-day life. Other features such as mood tracking and reminders were open to use for participants in both groups.

For the purpose of this study, a series of guided prompts were developed to take the user through all the components of the app. If "guided" was turned on, the user received one notification each day for the first 44 days of use, briefly describing and directing them to an element of the app. To view a full list of guided messages, please refer to Appendix B.

Experimental and Control Groups

This study is a two-group experimental design study, in which participants were randomly assigned to one of two groups, a Guided Activity Group (the experimental) and a Non-guided Activity Group (the control group). The key purpose of this study was to determine the effect of delivering prompts on the frequency of app use by participants in the guided activity group in comparison to the participants in the non-guided activity group.

Guided activity

The guided activity group is the experimental group. The term, guided activity has been used to refer to notifications, therefore, these notifications were sent to participants with messages guiding them to engage with the app components of the application following a structured pattern. The guided activity (notification) of the day, along with the date, would display on the main screen for a designated period (44 days) and touching to that notification would take the participant to the suggested activity page shown in the figure 5. For example, in figure 5, the guided activity message appeared on the phone's screen and when the participant would touch the 'hello baby' (green colour icon) that would take her to the page linked to that icon; however, there was no obligation for the participants to interact with the provided notifications, and they could ignore the notifications and use the app as they desired. The guided prompts suggested that they explore an element of the

app, and went through all the components in a sequence varying the type of activity every day.

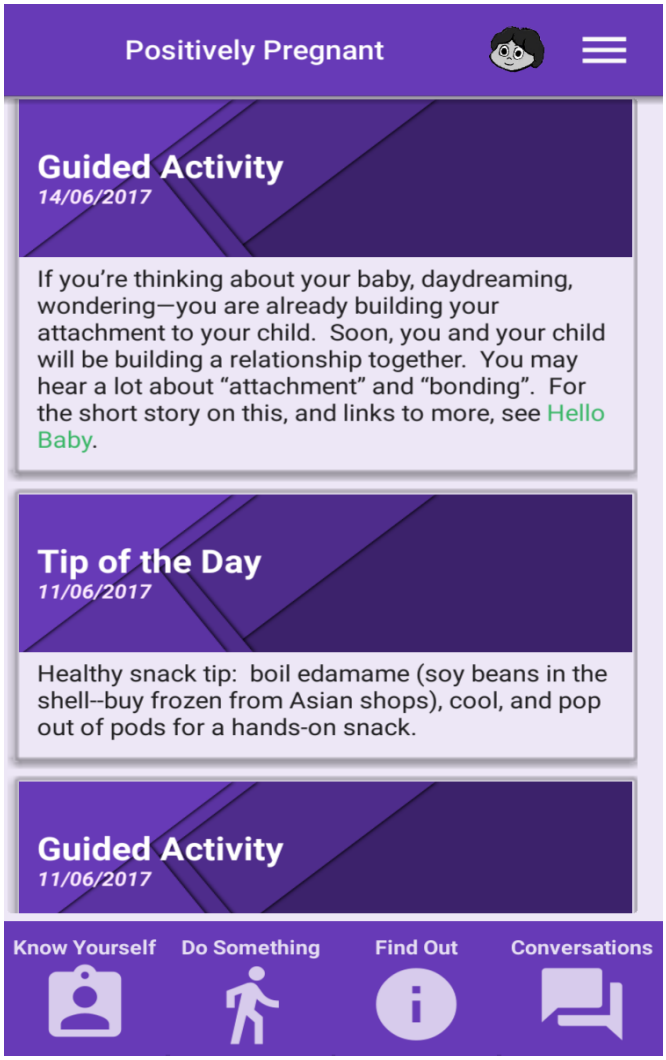


Figure 5. Screenshot: example of the "guided" version of the app.

Non-guided activity

The Non-guided activity group is considered the control group. Participants had no access to the notifications other than receiving the 'tip of the day'.

PPAP Research Team

In total, seven people were involved in this broad research project, including one head/supervisor (primary researcher), five student researchers were working on different aspects of the app and a Research Assistant (RA), who was the primary contact for participants in the study. The RA was responsible for communicating with all of the student researchers regarding the recruitment process and the distribution of participants to each student researcher.

Recruitment

As a part of a broad pilot project, I worked in collaboration with the other team members of 'Positively Pregnant App' in order to recruit participants for this research project. The participants were invited to participate in the research through business cards (Appendix C), research posters (Appendix D), press releases (Appendix E), newspapers, and emails.

Firstly, printed posters were displayed at the University of Waikato at different locations (including the notice board in department of psychology, Faculty of Arts and Social Sciences, student learning Centre). The research posters were also posted in various medical centers and other locations, including medical clinics, childcare centers, library, birthing centers' and similar family oriented services and businesses. The head of the project also sent emails to the midwives, childbirth educators, General Practitioners (GP's), and counseling and mental health professionals.

Secondly, printed cards were distributed to midwives at a function held to celebrate International Midwives Day at a local venue. The head of the research also took an opportunity to promote the research project through giving speeches at Regional College of midwives meeting, North Island GP CME conference and Regional perinatal mental health services meeting.

Thirdly, the research coordinator and the head of project contacted the administrators of community pages on Facebook and asked them to share the study posters on their pages such as using Perinatal Anxiety and Depression Aotearoa Page. A Facebook page named "Positively Pregnant" was created to promote this research project. Also, student researchers involved in the project posted the study on their personal social media accounts such as on their Facebook walls. Initially recruitment was local to the Waikato region, but later expanded to national. Most of the national recruitment was conducted through Facebook, including the Facebook page (Positively Pregnant) and e-mail list of Perinatal Anxiety and Depression Aotearoa.

Fourthly, the head of this project sent emails to Parents place, Antenatal educators, Pregnancy Yoga teacher, Migrant/ethnic services provider, Waikato Interfaith Council, Fertility Associates counselor, NZCOM Waikato and Auckland regions, Middlemore and Auckland DHB midwives and Perinatal Anxiety and Depression Aotearoa list.

Also, three press releases were organized in collaboration with the Marketing and Communication Coordinator for the Faculty of Arts and Social Sciences at the

University of Waikato. These press releases were subsequently published on the university's website.

Finally, the head of the project organized to report about the research study and its purposes in local newspapers called *Hamilton News* and *Matamata Chronicle.*

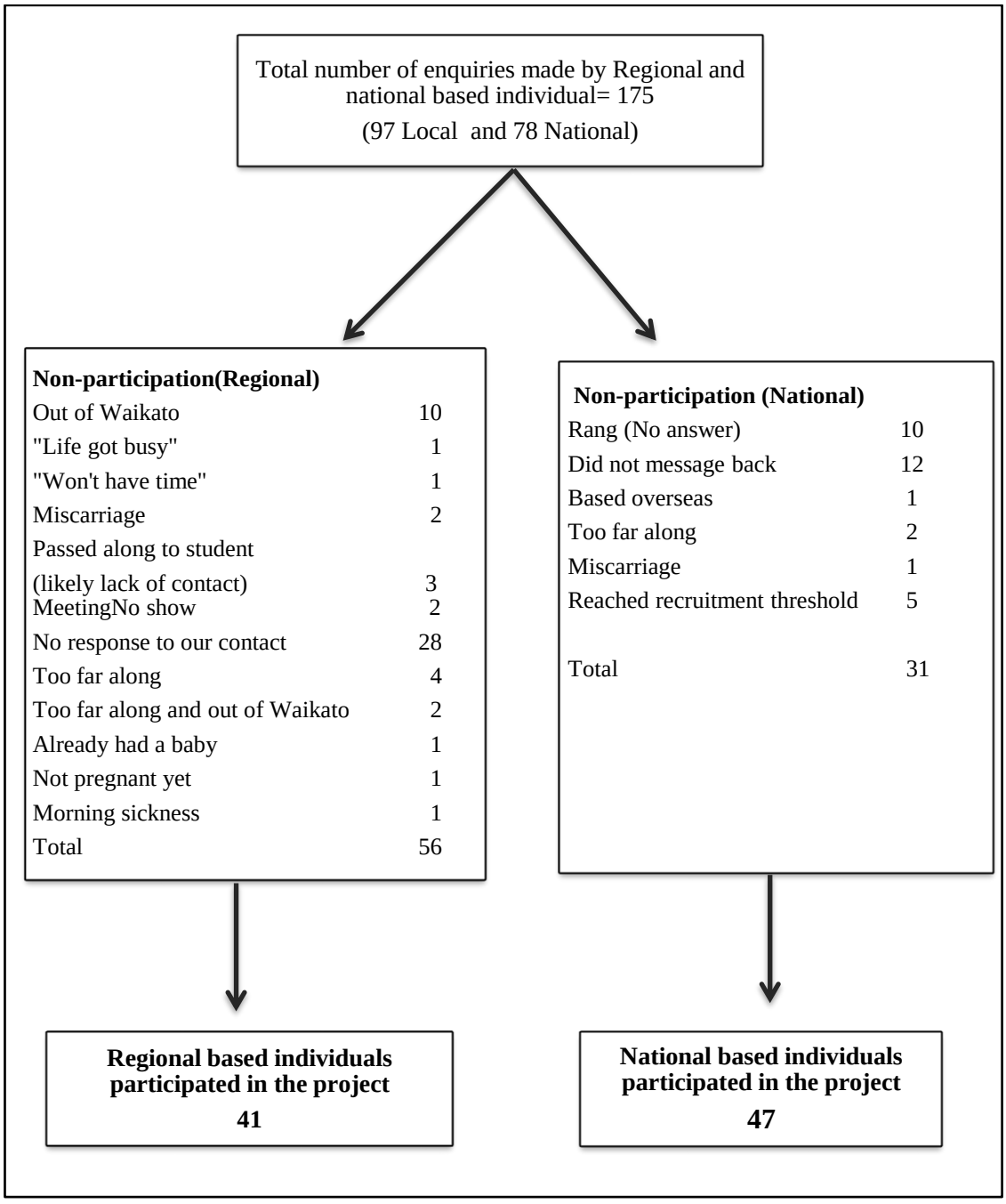
Inclusion Criteria

The inclusion criteria for participating in the research were that: (1) the pregnant woman must be able to understand and speak English, (2) she should be pregnant at less than 20 weeks' gestation, and (3) she must be a smartphone user. Although the app was promoted as a helpful tool for stress and distress, there was no inclusion or exclusion based on these conditions. Thus, any pregnant woman who was interested to take part in the project was welcomed.

Details of participants' recruitment

This research project was open for participation of pregnant women all around New Zealand. As a result, 175 women contacted the research coordinator (RA) to enquire about research project. There were two stages of recruitment, regional and national. Face-to-face meetings were held to recruit regional (Waikato region) participants, while national participants were recruited by contacting them on phone. Out of 175 pregnant women, 97 were located in Waikato region and 78 were located nationwide and eventually 88 pregnant women were recruited, 41 of whom were regional based and 47 were national based. Detailed information about recruitment of participants and the reasons for non-participation by some of the participants who responded initially has been displayed in the table.

Table 1. *Detailed information about overall recruitment/participation numbers*



Demographic characteristics of participants

Demographic characteristics were obtained; however, due to an error in the main project, two demographic variables (a) age (b) ethnicity were deleted, and only collected at a later assessment point (postnatal); therefore, age and ethnicity were

not available for the data analysis of the current study. Recorded information about participants' demographic features is displayed in the table 2.

Table 2 *Demographic characteristics of all participants*

Demographic characteristics	N= 88	(%)
Education		
No formal qualifications/diplomas	3	(3.4)
High school/secondary diploma	10	(11.4)
Some tertiary/university	8	(9.1)
Tertiary undergraduate level	36	(40.9)
Tertiary graduate level	31	(35.2)
Working status		
Working full time	41	(46.6)
Part time/casual	27	(30.7)
Volunteer/unpaid work	5	(5.7)
Not working outside home	18	(20.5)
Occupation		
Unemployed	6	(6.8)
Studying	12	(13.6)
Caring for children	52	(59.1)
Caring for other family members	4	(4.5)
Disabled or unable work due to illness	0	(0)

Enrolment Methods

Two methods were used to enroll participants for this research project: a) face-to-face meetings b) telephonic conversational meetings to recruit the participants. Processes of downloading the app and pre-assessment were conducted online in

both methods. The participants residing in the Waikato region, within the reach of contacting them personally, were enrolled via organizing face-to-face meetings and participants residing in the other parts of the country, where a personal meeting was difficult to arrange, were enrolled online.

Face-to-Face Enrolment

Once the participants made contact with the RA or the head of the project via the phone call or email to express interest in taking part in the study, the RA then rang them to determine their eligibility (gestation, language, and use of smartphone) and willingness to take part in the research. Then, upon ascertaining participants' eligibility and willingness, the RA arranged a time to meet the participants according to their preferred time and location (their preferred place), so as to explain the research in detail and to acquire the signatures of participants on a typed (written) informed consent.

Enrolment process

During the enrolment process, an information sheet (Appendix F) and two consent forms (Appendix G) were given to the participants. Participants were asked to read the information about the research printed on the information sheet. Participants were also free to withdraw from the project at any time. Participants were given an opportunity to ask questions and, if they agreed to proceed, were invited to sign both of the consent forms. Out of two consent forms, one was given to the participant and the other one was given back to the RA to maintain research records. A link to a survey questionnaire for pre-assessment was sent to participants' email addresses along with unique identifiers (linking codes), in order to avoid collecting their names online or in the app. The RA recorded these unique identifiers on a separate list, along with other details of participants,

including their email addresses, contact details and their physical addresses. The student researchers were given unique identifiers at the time of allocating participants to the researchers. The unique identifier was required to be entered at four points of assessment, which was: pre-assessment (baseline), at 24 weeks and 36 weeks gestations, and also after one month after the baby's birth. Participants were encouraged to complete an initial baseline survey questionnaire immediately while in the meeting in order to address any queries they might have regarding the app or any other questions related to the survey questionnaire to which the researcher could respond immediately. Once the participants completed the survey questionnaire, a link to download the app was sent to them via email. Participants were allocated randomly either to the guided or non-guided version of the app. Later, the RA sent emails to the participants to ask them to complete questionnaires at 24 weeks and 36 weeks of gestation and at one-month postnatal assessment point.

Online Enrolment Process

The online enrolment procedure was used to enroll participants who were out of our geographical reach to conduct face-to-face meetings. For online enrolment, the RA allocated participants to each student researcher along with the unique identifier number (linking code) along with participants' names. Initially, student researchers contacted allocated participants via making a phone call to check their eligibility to take part in the research. Upon checking the inclusion criteria, they were asked to provide a preferred time to phone them back to provide support in installing the app on their phones. The information sheet about the research project and consent form was sent to their email addresses before the student

researcher made the next phone call. Participants were advised to read the information sheet prior to the next phone call so as to gain a detailed insight into the research. Those who chose to participate were asked to sign the consent form and send that back to the provided email address prior to the next call. Participants were contacted a second time via phone calls at their preferred times. A survey questionnaire along with a unique identifier code was sent to the participants on their email addresses with instructions about how and when to use that unique identifier code before attempting pre-assessment. Participants were advised to complete the questionnaire before the next phone call. They would be asked to install the app at that time. Participants were given approximately 20-25 minutes to complete the baseline survey questionnaire then another call was made to support them installing the app. Then the student researcher would add participants on the administrator's page and after adding all the participants, the researchers reported enrolment outcomes to the RA.

Ethical considerations

The materials and procedure used in this research project gained ethical approval from the School of Psychology Human Research Ethics Committee at the University of Waikato (#17:01). A number of considerations are described below.

Informed consent of participants

Informed consent was obtained from the participants at the time of recruitment. They were given two consent forms (one copy for the participant and other signed copy for research record) to be signed. The similar process was adopted for the nationally located participants; however, the consent form was sent by email.

Privacy, Anonymity and confidentiality of participants

Considering privacy, anonymity and confidentiality clause in the project, participants were informed what would happen with the data. Researchers notified participants that their names would not be displayed on the app and would only be recorded separately by the RA, for the purposes of correspondence.

Consideration of social, cultural and Māori responsiveness

Social and cultural responsiveness was a significant area to be considered with sensitivity as participants in this project belonged to diverse cultures, ethnicities and social groups. Therefore, no social and culture based exclusions were considered in this research project. Also, our research team was composed of various social communities and ethnicities that included pakeha, Māori and migrants thus student researchers recognized each of above mentioned communities and ensured the processes and information had to be respectful and acceptable towards all the diverse communities.

Ensured minimal risk

The key researchers were well aware of the possibility of some participants to be feeling stressed or distressed while using the app or completing self-report questionnaires. However, the app had a facility that contained links to specific resources as well as tools for handling stress and distress to address particular problems to alleviate the stress levels of participants in the time of crisis (being stressed or distressed).

Participants' access to the findings

As it was mentioned in the informed consent form that participants could attain access to the findings of the project. Therefore, participants who indicated (✓) on consent form across the statement 'I wish to receive a copy of findings' were sent

the findings of the study so as to acknowledge and respect their valuable contribution in the project.

Measures

A subset of measures from the larger research project was used for this study project; all study measures outlined in Table 3. Background and demographic history, as well as the measure called ‘Satisfaction, app use, and feedback’ were the measures used in study. A survey was developed for this study collecting demographic variables and some variables related to childbearing; this was collected at the enrolment data point. Childbearing history included number of times women being pregnant before, experienced any miscarriage/stillbirth, and had any pregnancy termination and number of children living with you. To view the demographic questionnaire, please refer to Appendix H.

Satisfaction, app use, and feedback

This measure was developed for this pilot research project in order to identify the participants’ level of use and satisfaction with this app. It was used at the 24-week gestation and 36-week gestation assessment points. Participants were asked how often they used the app over the prior two weeks, what parts of the app they had used, how satisfied they were with the app, and whether they would refer it to a pregnant friend. Participants were also encouraged to provide feedback/recommendations and also suggestions for additions and changes. Participants were asked to provide feedback about all four sections of the app. All of the items under three sections named ‘Know Yourself’, ‘Do Something’ and ‘Conversations’ were on a three-point scale ranging from ‘helpful’, ‘not helpful’ and ‘haven’t tried’. The question regarding the fourth section, ‘Find Out’,

was asked in the form of open-ended questions about how many of the 'Find Out' sections they had read. A 5-point likert-type rank order scale ranging from 'no' to 'all of them' was selected to obtain the answer for this question. To review a copy of the full survey questionnaire, please refer to Appendix I.

Assessment Points

In total, eight measures of satisfaction and wellbeing along with a brief demographic history assessment were collected for the study as a whole.

Table 3. *Name of the measures used and assessment points*

Measure	**Pre**	**24 weeks**	**36 weeks**	**1 Mo P/N**
Background Demographics/maternity history	✓			
Depression, Anxiety and Stress (DASS)	✓	✓	✓	✓
Edinburgh Postnatal Depression Scale (EPDS)	✓	✓	✓	✓
Perceived Stress Scale (PSS)	✓	✓	✓	✓
Prenatal Health Behaviour Scale (PHBS)	✓	✓	✓	✓
Global Health Rating	✓	✓	✓	✓
Satisfaction and app use		✓	✓	
Parenting Sense of Competence Scale (PSCS)				✓
Obstetric outcome and childbirth experiences (CEQ)				✓

Qualtrics survey software was used to collect the data online. Baseline assessment was completed at the time of enrolment. Further assessments were completed at 24 weeks gestation, and at 36 weeks gestation and at 1-month postnatal period. However, only the 24-week gestation assessment was used in this study. A list of measures is provided in table 3 along with the different points of assessments.

Data Analysis

Data from two assessments points (a) Pre-assessment and (b) 24-week assessment were used to conduct the analysis for the current study. Data from Qualtrics were downloaded into SPSS version 24, checked and recoded where it was necessary to do so. Descriptive statistics was used to evaluate normality before running statistical tests. Baseline demographics were reported as frequency and percent for categorical variables. Non-parametric tests were used for running most of the analysis because some data were ordinal and some data were not normally distributed. Spearman's rank-order correlation was used to examine the relationship between various key variables. Mann Whitney U Test was used to compare the differences between two independent groups because of ordinal levels of measurements used. Independent T-Test was used to compare the means of two groups (guided and non-guided group) when data were at interval levels of measurements.

Chapter 3: Results

The maternity history of all the participants is displayed in Table 4. The sample was a mixture of new mothers-to-be and those who already had experienced pregnancy. More than half of the total sample experienced pregnancy before, whereas; less than half women were first time mothers. About one third women in the sample experienced miscarriage/stillbirth at least once in their maternity histories. Also, a small number of women in the sample underwent fertility evaluation/treatment and a few pregnancies were an outcome of the fertility treatment.

Table 4. *Maternity histories of all participants*

Maternity History (n=88)	**n (%)**
Have you ever been pregnant before	
Yes	54(61.4)
No	34(38.6)
Miscarriage/Stillbirth	
No, never	32(59.3)
Yes, once	18(33.3)
Yes, More than once	4(7.4)
Pregnancy termination	
No, Never	49 (90.7)
Yes, once	3(5.6)
Yes, more than once	2(3.7)
Number of children	
0	38(43.2)
1	36 (40.9)
2	9 (10.2)
3 or more	5 (5.7)
Any fertility evaluation /treatment	
Yes	16(18.2)
No	72(81.8)
Is this pregnancy the result of fertility treatment	
Yes	8 (9.1)
No	80 (90.9)

Table 5 presents descriptive statistics for app use, satisfaction, recommendations to a friend, and reading 'Find Out' topics. Frequency of the app use in last two weeks in table 5 shows that almost half of the total participants used the app once or twice in last two weeks. About forty percent

of the participants were somewhat satisfied with the app. A few participants were found extremely satisfied with the app too. About one third participants were intent to recommend the app to a pregnant friend and less than half participants in the sample read a couple of 'Find Out' topics and the number of participants who did not read any 'Find Out' topic was almost similar.

Table 5 *Frequencies of variables used*

Assessment Questions	**n**	**%**
App use in last two weeks	**(n=62)**	
Haven't used it	23	36.5
Once or Twice	30	47.6
A few times a week	8	12.7
Most days at least once	2	3.2
Satisfaction	**(n=62)**	
Somewhat dissatisfied	9	14.5
Neither satisfied nor dissatisfied	25	40.3
Somewhat satisfied	25	40.3
Extremely satisfied	3	4.8
Recommendations	**(n=62)**	
Probably not	16	25.8
May be	19	30.6
Probably yes	20	32.3
Definitely yes	7	11.3
Read any of "Find Out" topics	**(n=57)**	
No	25	43.9
Couple	24	42.1
Several	6	10.5
Quite a few	2	3.5

Table 6 presents the descriptive statistics of user reports of the helpfulness of different app components. In section, “Know Yourself “more than half (58.9 percent) participants found component “Know Your Health” followed by the component “Know Your Strengths”.

Table 6 *App use experience of participants at 24-week assessment*

Module	Helpful N (%)	Not helpful N (%)	Not tried N (%)
Know Yourself			
Strengths	31 (55.4)	18 (32.1)	7 (12.5)
Strategies	27 (48.2)	15 (26.8)	14 (25.0)
Stressors	30 (53.6)	14 (25.0)	12 (21.4)
Emotions	25 (44.6)	15 (26.8)	16 (28.6)
Village	22 (39.3)	16 (28.6)	18 (32.1)
Style	20 (35.7)	14 (25.0)	22 (39.3)
Health	33 (58.9)	10 (17.9)	13 (23.2)
Do Something			
Strength reminders	14 (25.5)	12 (21.8)	29 (52.7)
Notes to self	11 (19.6)	9 (16.1)	36 (64.3)
Gratitude	13 (24.1)	9 (16.7)	32 (59.3)
Relaxation breathing	19 (33.9)	4 (7.1)	33 (58.9)
Stretching	14 (25.0)	7 (12.5)	35 (62.5)
Body scan	9 (16.1)	9 (14.3)	39 (69.6)
Guided imagery	3 (5.6)	7 (13.0)	44 (81.5)
100 things	5 (9.4)	9 (17.0)	39 (73.6)
Notes to baby	9 (16.1)	9 (16.1)	38 (67.9)
Health goals and plans	11 (20.0)	6 (10.9)	38 (69.1)
Have a laugh	17 (30.4)	8 (14.3)	31(55.4)
Play a game	15 (26.3)	8 (14.0)	34(59.6)
Know your emotions	13 (23.2)	7 (12.5)	36 (64.3)
Conversations			
Who does what	18 (31.6)	7 (12.3)	32 (56.1)
Weaving traditions	14 (24.6)	6 (10.5)	37 (64.9)
Birth hopes plans	14 (24.6)	5 (8.8)	38 (66.7)
The baby: year one	9 (15.8)	6 (10.5)	42 (73.7)
Day dreams	7 (12.3)	5 (8.8)	45 (78.9)
Money talks	13 (22.8)	3 (5.3)	41 (71.9)
Values and priorities	14 (24.6)	4 (7.0)	39 (68.4)

In the section “Do Something”, a very small number of women found guided imagery useful; however many participants did not try this activity. About one third of the participants in the sample found components Relaxation Breathing and Have a Laugh useful. Nearly one-third participants reported Who Does What component useful in section Conversations. The total number of app components rated as either helpful or not helpful was added together to form a variable, ‘total number of app components tried’, which indicated the total number of app components tried by each participant.

Correlations among app use and satisfaction variables

Spearman’s rank-order test was used to investigate the relationship between app use and satisfaction variables. Table 7 presents the relationship between variables: frequency of app use, total number of app components tried, satisfaction and recommendation to a friend.

Table 7 *Correlations between app use and satisfaction variable*

Variables	App use (last two weeks)	App Components Tried	Satisfaction
App use (last two weeks)			
Total app components tried	-.049		
Satisfaction	.275*	.205	
Recommendation	.293*	.247	.807**

Note: *p<0.05. **p<0.01

Frequency of app use was not significantly correlated with total number of app components used, but was modestly correlated with satisfaction with the app and recommendation of the app to a friend. Number of app components tried was not significantly correlated with other use or satisfaction variables. Satisfaction with the app and likelihood of recommending the app to a friend were strongly positively correlated.

Correlation between duration of access and components used

Because participants could enroll at any time before 20 weeks' gestation, and the timing of assessessments were determined by gestation, participants varied in amount of time they had access to the app before the app use survey. Spearman's rank-order test was used to examine the relationship between total number of days between study enrollment and the 24-week assessment point.

The frequency of app use in last two weeks was not significantly related to the number of app components tried, correlation coefficient (r) =-.113, p= .408. The total number of the days participants had access to the app was not significantly related to the number of app components tried by participants', correlation coefficient (r) = .132, p= .331.

Spearman's rank-order test was also used to examine the correlation between variable total number of days the app was used and the app use in last two weeks. It was determined that these two variables were not significantly related to each other, correlation coefficient (r) = -.139, p= .277: hence duration of app access was not found associated with the app use in last two weeks.

Correlation between maternity history and use of app components

There are two separate but related variables having to do with maternity history—how many child/children the person is caring for, (is referred to the variable -- number of children), and whether they have had previous pregnancies (is referred to variable-- previously pregnant).

The variable number of children (a participant already have) was not significantly related to the number of the app component tried and frequency of the app use, correlation coefficient (r) = .093, *p*= .494 and correlation coefficient (r) = .019, *p*= .881 respectively

Pearson correlation was used to examine the correlation between variable 'previously pregnant' and total number of app components tried. It was determined that these two variables were not significantly correlated with each other, correlation coefficient (r) = -.143, *p*= .294.

Whether or not the woman had previous experience of miscarriage or stillbirth, was not significantly related to the number of app components tried, correlation coefficient (r) = .230, *p*= .206. No relation was found between two selected variables because variable miscarriage did not contribute participants in more or less use of the number of app components tried.

Intervention comparisons

Two groups: guided activity and non-guided activity groups were used in this study; therefore we compared these two groups on frequency of app use and the number of app components tried. The total sample consisted 88 participants, and

the sample was evenly distributed (50% participants in guided and 50% participants in non-guided activity group) to each group. Out of whole sample, 71.6% participants completed 24-week gestation assessment and 28.4% did not complete 24-week gestation assessment. The sample at 24-week gestation assessment contained 52.38% participants in guided and 47.61% in non-guided group.

The Mann-Whitney U test was used to test for a significant difference in frequency of using the 'Positively Pregnant' app between two groups; U=537.500, standardized test statistics (Z) = .136, p= .816, effect size estimate(r) = 0.017. The Mann-Whitney U test is non-significant for the scores in regards to using the app between two groups because *p*-value of .816 is greater than the critical value of 0.05.

In order to test whether there is effect of the intervention on total number of app components used, the independent t-test was used to determine the differences between the overall means of two selected samples (Field, 2013).

On average participants in the guided activity group did not use significantly more app components (*M*=12.03, *SE*=1.21) than the participants in the non-guided activity group (*M*=11.88, *SE*= 1.63). The difference, -.149, was not significant; t (22) = -.074, *p*= .94. The effect size observed was small (d=0.018).

Satisfaction with the app between two groups

The satisfaction levels of using the 'Positively Pregnant' app among participants in the guided activity group (mean = 3.48, SD= .834) did not differ significantly from the non-guided activity group (Mean= 3.21, SD= .726). The Mann-Whitney

U test was used to test the difference in the satisfaction levels; U=564.000, standardized test statistics (Z) = 1.296, *p*= .195, effect size estimate(r) = 0.164

Recommending 'Positively Pregnant' to a friend

The frequency of the response scores for recommending the 'Positively Pregnant' app to a pregnant friend among participants in guided activity group (Mean= 3.36, SD= .929) did not differ significantly from non-guided activity group (Mean= 3.21, SD= 1.048). Mann-Whitney U test was used to find the difference between two groups in terms of recommending the 'positively pregnant' app to a pregnant friend, where U=527.000, standardized test statistics (Z) = .714, *p*= .475, effect size estimate (r) =0.090.

Frequency of reading 'Find Out' topics between two groups

The frequency of exploring and reading the "Find Out" topics in the Positively Pregnant by participants in guided activity group (Mean= 1.90, SD= .870) did not differ significantly from the participants in non-guided activity group (Mean= 1.54, SD= .647). The Mann-Whitney U test was used to find the difference between two groups in terms of reading the topics in 'Find Out' component, where U=495.000, standardized test statistics (Z) = 1.608, *p*= .108, effect size estimate(r) = 0.213, where p value is greater than critical value 0.05 (.108>0.05)

Participants' reasons for not using the app

Participants were asked to provide the reasons for not using the app in the form of a question such as "How often have you been using 'Positively Pregnant' over the last two weeks? Haven't used it (why not)." Participants provided their answers,

which are summarized in table 8. Full list of participants' responses is provided in Appendix J

Table 8 *Summary of the Reasons for no app use by participants in both groups*

Guided activity group	Non-guided activity groups
A few participants replied that they were busy with life, kids, study, and sick child.	Few answers were similar such as being busy with the life, work, and children.
The app was not relevant to their condition and they preferred to use the other relevant apps	App was too generic to use
Not sure what the benefits of using this app would be.	One of the participants had lost her friend in a car crash and she had been dealing with the situation
A few women said that the app was not appealing so they lost their interest in it.	A participant said that she needed to reinstall the app as she bought a new one
Three participants reasoned that app was boring which lead her to discontinuing her use of the app after a short period of time.	One participant said that she did not receive any feedback after supplying all the information, so she stopped using it
One participant mentioned that she had forgotten to use the app.	

Participants' feedback (app use)

Overall, the feedback received from participants in the experimental and control group was a mixture of positive and negative. Summarized comments are provided in table 9. To view full listing of comments provided by participants, please refer to Appendix K.

Table 9 *Summary of feedback on app use experience by participants*

Guided activity group	**Non-guided activity group**
The app was easy to use, navigate, enjoyable and provided valuable content.	A couple of participants in this group mentioned that they liked the app and it was easy to navigate.
One participant said that she enjoyed the 'know your stressors' component as it gave her deep insight and reassurance when needed	A few participants were busy (work and home) and could not make the most of using the app.
A few participants said that app was irrelevant for their situation as it seemed to them for women with unhappy pregnancies	This app might have been extremely useful for a first pregnancy because of its valuable content
A few participants noted that the content of this app would better be suitable for first time mums	Participant did not like the app because of no inclusion of the daily diary in order to track the appointment schedules and times
Two participants mentioned that the mediation activities were good and useful	Two participants commented that the a few activities under the 'do something' component are great to perform.
Two participants found that daily notifications were helpful in terms of reminding them of using the app.	Activities were helpful, however a lot of information in one app is bit overwhelming.
One participant complained of not receiving the notifications despite being in guided activity group	One participant said she would have used the app more, if not working full time.
One participant found note to self and baby were useful.	One participant said that she really liked the quotes 'tip of the day'

Summary of the results

To summarize the results, Variable app use in last two weeks and satisfaction, and satisfaction and recommendations were found associated to each other, whereas none of the other variables (such as variables related to maternity history) were found to be related to the frequency of app use. No significant difference was found among variables, frequency of app use, satisfaction and recommendations between two groups. Frequency of app use among participants in the guided activity group was not significantly increased despite delivery of daily notifications. No significant difference was found among frequency of app use and use of the number of app components tried between two groups. However, summary of suggestions and feedback from participants were received and are displayed in the tables 8 and 9 and appendices related to participants' feedback is also provided.

Chapter 4: Discussion

The current study has examined the effectiveness of delivering prompts to participants in the guided activity group in terms of increasing the frequency and scope of app use and satisfaction during the intervention period. This chapter will discuss the research findings, their implications for development of this app and similar apps, some strengths and limitations of this study, and directions for the future research.

Positively Pregnant App use and Satisfaction

Discussing overall findings in terms of app use, nearly half of the pregnant women in the sample used the app once or twice a week in the two weeks prior to the 24-week assessment point, and only 3.2 percent of women used it once in most days. It is possible that other variables such as lack of time to use the app; being busy with family, children and work (Kim et al., 2014); and internal variables such as lack of motivation; and unfavorable physical health might have contributed to using the app less frequently (Brouwer et al., 2008; Muench & Baumel, 2017). Some women mentioned these factors in their comments on their app use.

Most women were either neutral (about 40%) or somewhat satisfied (about 40%) with the app and slightly less than half said they would probably or definitely recommend the app to a friend. Frequency of app use in the last two weeks was significantly but modestly positively correlated with satisfaction; in other words, women who were more satisfied with the app were somewhat more likely to have used it recently.

A qualitative study based on various theories concluded that user satisfaction with the mobile is determined by the perceived ease of using the app, usefulness of the app, and expectations from the app. These factors would enhance the app use among users and that would lead to user satisfaction with the mobile applications (Olubusola, 2014).

Factors associated with use or not use of app

No relationship was found between the total number of components used in the app and satisfaction levels of participants, suggesting that using more components of the app did not lead to more satisfaction. As expected, satisfaction with the app was found to be related to the recommendation of the app to friends. Similarly, in a study by Kenny, Dooley and Fitzgerald (2015), participants showed high levels of satisfaction with the app and reported that they would recommend it to a friend.

Associations were explored between app use and a number of variables that might, based on theory and/or literature, have been predictive of app use and might have contributed in app use behaviour of participants. The number of children in the home was not associated with frequency of app use, in spite of comments from participants that they thought they might have used it more before they had children. A few participants also commented that the app would have more benefit for the first time mothers, but no association was found with whether or not women had been pregnant before.

Other variables, previous experience of pregnancy, miscarriage and termination of pregnancy, were also not associated with frequency of app use. Prior pregnancy loss might be expected to be associated with stress and anxiety during pregnancy,

and possibly increase motivation to engage with the app, but this was not found in the present study. Variables miscarriage and termination of pregnancy did not lead the participants to use the app more. It might have happened because they might have been using other apps alongside or taking an extra care from the available resources (social and family support and others) around them, it might have made them not to be worried during pregnancy (Orr, 2004), which could have lead them not to use the app more frequently.

Effects of guided prompts

It was hypothesized that participants in the guided activity group would use the app and its components more upon the delivery of prompts. However, the current study found that delivery of prompts did not make a difference to the frequency of app use at 24 weeks' gestation, to breadth of use of various app components, or to satisfaction or to willingness to recommend the app to a pregnant friend among participants in the guided activity (experimental) group.

The variable, total number of app components tried was the most expected variable to be affected by the guided prompts, because the guided prompts suggested trying each of the components in turn. However, even this variable was found not significantly associated with prompt use. There was no significant difference; in spite of this being the variable number of app components tried was most strongly expected to be affected by the guided use. This may suggest that people did not follow the prompts or that people in the control group did explore the app. Part of the underlying assumption of the app, in providing a wide variety of assessments and activities, is that different things would be useful to different people, and it was not expected that all people would like or use all components.

There are various underlying factors, which might have affected the frequency of app use among participants in the intervention group. Frequency of app use might have had affected because participants were free to control the app; turning the notifications off might have impacted on this variable. Participants would have had the app for varying times, and app use is known to be affected/reduced over time **(**Hutton et al., 2011; Kohl, Crutzen & de Vries, 2013; Morrison et al., 2014**);** however, when examined the correlation between duration of app access and frequency of app used was not correlated, hence the varying time did not affect the frequency of use of app in this study.

The notifications may have been ignored for various reasons such as not being at a right place or time to attend the prompts when delivered, which might have impacted the frequency of app use. This argument is consistent with a study by Muench and Baumel (2017), which asserts participants' tendency to ignore automatic triggers (prompts) that affect the frequency of app use which usually happens in long term interventions, so may well have happened in the current study.

Out of 88 participants 62 carried on until the 24 week assessment point; therefore, 26 women who started the study but did not complete the 24 week assessment, and it is not known whether or not they used the app; it seems likely they did not, but this is not clear. However, it was noticed that data retrieved at 24-point assessment was evenly distributed, despite a number of missing cases between experimental and control group. Hence, differential attrition did not seem to be an issue.

Satisfaction and Recommendations

The variable, satisfaction with the app, was not significantly different between two groups and also, variable willingness of recommending the app to a pregnant friend was found non-significant between the two groups. As was discovered earlier while running correlations, satisfaction is associated with recommendation; hence, it becomes evident that participants in the guided activity group were no more or less likely to recommend it to a friend than those in the control group.

Strengths of the study

The app was designed in New Zealand, therefore the direct links to numerous local online resources related to appropriate organizations were available in the app. Participants could access and explore the required information by going to the related links. Contact with the pregnancy related organizations could also be made via direct links, which provides easy access to required benefits at the right time. Also, a few participants were appreciative about 'Positively Pregnant' as a culturally (Maori) oriented app.

Another strength of the study was that the delivery of prompts designed to be consistent with the recommendations of previous research (Morrison et al., 2017; Muench & Baumel, 2017), being delivered daily and provided unique information each time. Research has shown that uncontrolled frequency of prompts affects the effectiveness of the prompts, which may result in ignoring or stopping the use of the app (Fry & Neff, 2009; Morrison et al., 2017; Muench & Baumel, 2017).

The app intervention provided was a sole self-help program without using any element of human-support such as contacting participants via phone or email for

prompting them to use the app more frequently. If the self-help program had been combined with a human-support element for this pilot project, it would have been difficult to assess the separate contribution of prompting versus human support in terms of frequency of app use and firm conclusions would be difficult to make about the effectiveness of the prompts. Entirely technologically-determined prompts and user support is the most realistic model for self-help programmes in normal use, and so makes the most sense to test in this research. Hence, delivery of prompts provided a great deal of insight as to future app design.

Another point to be considered is that the study was able to use a true experimental design, with random assignment to an experimental and control groups, and attrition from both the groups was comparable.

The sample was diverse in terms of region, education, and occupation, and included women who were first time mothers as well as experienced mothers; however, we were unable to access data about age and ethnicity.

While acknowledging the strengths of this study, it contains limitations too, which are discussed below.

Limitations of the study

A point that should be considered is to the mode of collecting data. Data was collected using self-report questionnaires. It has been claimed that self-reported assessments pose threats to validity and it becomes difficult to draw firm conclusions from such data, specifically when there is frequency to be measured in a study and one can confront recall errors at the time of assessments (Chan, 2009 in Lance & Vandenberg, 2009; p.313). It would be optimal to collect data on

actual use of the app, but this was not available because of technical limitations in the pilot project.

For the purpose of this study, it would have been better to have the first follow-up assessment collected four weeks after the person installed the app, rather than dating it by gestation. This is because some participants had enrolled in the study at very early stages of pregnancies (less than 12 weeks gestation). Therefore, if the most intense period of app usage is the first month or so of access, some of these women might have been responding to the questionnaire two or three months after their most active use. It may be possible that this might have had impacted on their responses to open-ended questions. For example, when participants were asked to mention useful components of the app, 4 of 10 participants who responded to this question in the guided activity group said they could not remember what was useful for them despite using the components of the app.

Another point to consider is lack of demographic factors ‘age’ and ‘ethnicity’, which were missing at the time of data retrieval. Age and ethnicity are imperative variables to analyze in relation to frequency of app use. Andone et al. (2016) found that younger participants use smartphones for longer than adults and older participants. Therefore, access to an age variable would have allowed for examining the correlation between age and frequency app use. Ethnicity may also be an important variable to test the frequency of app use. For instance, a study conducted in United States has reported that African Americans and Latinos rely more on their smartphones than white people regarding heath information, education-related content and job seeking (Anderson, 2015). Hence, availability

of this variable could have provided an insight on whether or not ethnicity was associated with frequency of app use.

A limitation is that this study was being conducted during a pilot study of an app that was still in the process of active development, so some software and usability problems were discovered during the course of the study. A few participants reported from the experimental group that they did not receive notifications when they were meant to be receiving them as a part of the experimental group. Such technical issues may have raised discrepancies in the remaining data set (Kenny, Dooley & Fitzgerald, 2015).

A few participants commented on not receiving feedback through app after putting all the required information in the app. However, the app did provide the feedback, but apparently participants might not have been able to find it because feedback feature was not clearly visible on the app; thus future design of the app needs attention to be paid in terms of making the feedback clearly available.

Implications

The guided activity prompts were not found to be effective in terms of increasing the frequency of app use or satisfaction with the app among participants in the intervention group. Despite these prompts being timed optimally (once a day) and having unique content relevant to the state of the users (related to pregnancy, and changing every day), they did not seem to make a difference to frequency, scope, or satisfaction with the app. It may be that further studies with different timing of assessments, and ideally with direct user data collection, would shed more light on this.

Regardless of these positive points of the app, there were various findings that suggested that 'Positively Pregnant' could be improved for future use. A number of participants in the both groups expressed their concerns about the length of reading material in the app that contributed to their discontinuing their use of the app. As both groups raised the similar concerns, it is important to address this concern in developing the next version of the app in order to increase the engagement and usage levels of participants. Muench and Baumel (2017) mentioned in their study that content framing is a significant part of designing an app. While framing app's content, designers should consider a careful construction of app's look, length, variation or other components of the app in order to obtain frequent use of app by participants. It has been suggested that extensively text based app may affect the frequency of app use and engagement with the device among participants (Muench and Baumel, 2017), because unstructured app might not function as a reinforcer for users, hence may affect the frequency of app use.

The 'Positively Pregnant' app has been developed to help pregnant women to reflect on how they manage stress and distress. However, participants in this study were not using the app very frequently by the time the 24-week assessment was made.

One reason could be that after downloading the app participants gained the entire control of using it in their own way and participants might have had gone through the numerous components of the app in the initial days of the intervention, and as intervention period was long and this might had caused them stop using the app at early stages of intervention (Lattie et al., 2016).

To increase the frequency of app use, developers or designers should consider introducing a lock-incentive feature for components; meaning that participants could only move to the next level once the previous level was finished in order to unlock the next level. This feature can easily be incorporated in the app design and an effective design aids better engagement with an app (Brouwer et al., 2008, 2011). In a study conducted by Mohr et al. (2017), involving of lock-incentive feature in the intervention programme yielded positive outcomes in terms of maintain curiosity among participants reaching to further level, which enhanced the engagement level of participants with the intervention programme.

Research has shown positive outcomes of behaviour interventions when behaviour techniques (prompts) are combined with occasional additional support such as emails, phone calls (Fry & Neff, 2009; Ross & Wing, 2016). Technical help with the app installation and replacement after phone changes is an important concern and does need to be attended to. For example, a few participants raised the concern of reinstalling the app in their responses and mentioned in the comments that they were seeking help; therefore a lack of contact can be predicted from both sides. Including scheduled phone calls or sending timely emails in terms of determining any concerns related to research or device used, may address this concern effectively (Dinger, Heesch & McClay, 2005).

A number of participants expressed their views for introducing some elements related to the baby in the app such as growth of baby every week, rather than an app with intense levels of text addressing mother's present state only (Lupton, 2017).

In a qualitative study by Lupton (2017), participants commented that elements related to baby in an app provided them a sense of visualization, elements such as comparing baby's growth with the size of a fruit or vegetable helped them to visualize the size of their babies and they used to check the app more often in terms of checking the development of the foetus. A few participants suggested the addition of a blog or forum in order to facilitate a platform for all the mothers using the 'Positively Pregnant' app to build connections with other women in a similar situation. Research shows that blog/forum related elements provide psychological relief (positive outcome) to pregnant women in terms of feeling a connectedness with other women in similar situations and these forums (reinforcers) provide them a sense of privacy in which to discuss private concerns which they might be unable to share with their friends and health practitioners during a face-to-face encounter (Lupton, 2017).

Facilitation of tailored prompts in the improved version of 'Positively Pregnant' is an essential point to be considered. Tailored prompts refer to the prompts related to women's maternity history so the content of prompt messages displayed on the screen should vary depending on whether the woman is a first, second or third time mother. In this way, the user will feel the relevance of prompts to her situation and may be more likely to respond by visiting the app

Participants suggested adding better personalization features in the 'Positively Pregnant' such as provision of displaying mothers' name, facilitating (bump) photo diary in the app, and other features, which can make app look personalized. Customization refers to a feature which helps the user to customize app according to one's requirements, such as selecting the time of prompts to their preferred

times. Studies have also claimed that personalization and customization is an imperative feature to be present in an app in order to begin initial interaction with an app device so that participants tend to relate to the app more positively (Fry & Neff, 2009; Muench & Baumel, 2017). Personalization and customization features can be easily incorporated modifications and should be considered to add in the next version of 'Positively Pregnant'.

Recommendations for future apps

It was found that prompts did not make any difference modifying user's behaviour in order to use the app more frequently. Therefore, to make the prompts effective, theory based behavioural models should be incorporated while designing the structure of the prompts that would help attracting the users.

Addressing study design, intervention should be implemented for a relatively shorter period of time in order to have a closer look at the patterns of use across time, and across the course of pregnancy. Interventions for longer periods lead participants to stop using the app at the early stages of the intervention because they potentially take benefit from the app in early days of intervention and no longer feel the need of using the app (Lattie et al., 2016).

The findings generated from the current study could be applied to the next version of 'Positively Pregnant' in terms of enhancing the use of the app. Originally, the app's design is based on the 'resilience model' of psychology, in which various activities are facilitated for pregnant women to benefit. The strategies involved would also help pregnant women reflecting, planning and practicing helpful strategies. The app had been designed by using the psychological knowledge addressing anxiety, depression and stress among the targeted population.

However, the findings are not favorable in terms of effectiveness of delivering prompts. It is evident that numerous participants discontinued the study and several stopped using the app for their own reasons and interests such as being busy looking after children and family, full time work (Kim et al., 2014); (as it was mentioned in the comments by participants that they would have used the app more if not working full time). However, e-intervention is relatively a new area for research, therefore, it is important consider that addition of behaviour principles/ techniques such as monitoring, incentive, tailored feedback and prompting should be considered for any future version of 'Positively Pregnant' in order to obtain better participant app usage levels.

Conclusion

Pregnancy can be a joyous experience, however may become stressful for many women. A plethora of literature has shown the barriers pregnant women encounter to have an access to intervention treatments for stress and distress during pregnancy. However, the emergence of smartphones has been addressing these barriers in an effective way in terms of facilitating individuals in accessing information and interventions for psychological health. The current study is a part of a broader project. In this pilot project, the app 'Positively Pregnant' has been designed for pregnant women to use in stressful times or to enhance their well-being throughout the perinatal period. The current study was designed to observe the frequency of app use among participants in the experimental group after delivering the prompts on daily basis for a certain period of time.

Findings of this study show that participants in the intervention group did not use the app more than the participants in the control group. Results were not found

significant for the variables chosen for analysis. Findings gathered by subjective questions provide suggestions and recommendations from participants in order to improve the app design, content and structure. Guidelines from related literature were followed to deliver the prompts, but failed to attain significant difference for frequency of app use between two groups. To improve 'Positively Pregnant,' the developers should consider reducing the length of the text portions of the app. Features like personalization and customization should be looked at. Self-report measures can be used to measure the levels of anxiety, depression and stress but inclusion of programming to monitor app use in the app would be helpful to access the accurate frequency of the app use in order to avoid participants' over-or under-estimation of frequency related data. Behaviour change theories should be included while designing the app, because behavioural models have a potential to provide an insight in terms of designing an effective structure of the app, designing content of the app, designing features of the app in relation to understand the user characteristics so as to enhance the, engagement and frequency of app use.

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Appendix A- List of 'Find Out' Topics

Category	Topic
Being well and well being	
	Taking care of your self
	Information without overload
	Mind and body as one
	What is stress?
	Stress and the body
	Coping with stress
The old and the new	
	Who am I now?
	Culture, tradition, and finding your way
	Maori tikanga for pregnancy and birth (Bridgette)
	Spirituality, faith, and mindfulness
	Control, choice, and responsibility
	Money woes
Changing relationships	
	Partner to co-parent
	Single parent not solo parent
	Mothers and grandmothers
	Siblings: the privilege and price of sharing
	When conflict gets out of hand: violence in relationships
	Hello baby: Attachment and bonding
Being pregnant	
	Pregnancy after infertility
	Pregnancy after loss
	When something goes wrong: Medical Complications
	Your pregnant body

	Birth plans and fears
If stress becomes distress	
	Managing worries
	Managing moods
	Your own worst enemy?
	If your childhood was not so rosy
	Perinatal mental health—maintaining your balance through change and challenge
	What if? getting help

Appendix B: List of guided prompt messages

General welcome message:

For unguided version:

- Welcome to Positively Pregnant! You'll see there are lots of parts to the app, so take your time exploring to find out what works for you. Some options will open up to you when you've done a particular "Know Yourself" bit, and some are available from the start. If you're feeling a bit stressed or looking for ideas for building your resilience, look at "Ideas".

For guided version:

Bold bits should link to the activity indicated

Day	**type**	**Module**	**prompt**
1	General	any	Welcome to Positively Pregnant! You'll see there are lots of different parts, so I'll have some suggestions for things to try each day, but you can also explore yourself. You don't have to do things in any particular order, though there are some options that will open up once you've done a particular "Know Yourself" bit. For today, just take a few minutes to check out the different parts of the app.
2	KY	Strategies	A good thing to start with is **Know your Strategies**. You'll read descriptions of things that might help you relax, stay healthy, and manage stress, you'll rate each one, and then they'll be sorted into your Toolkit, and you'll have the Suggestions tool available to you.
3	DS	Breathing	Find a quiet and comfy place, and try out **Relaxation Breathing** (from Audio

			Activities)—it takes about 8 or 9 minutes.
4	FO	Taking care of yourself	In "Find out" you'll find short bits you can read about the social, emotional, and psychological parts of pregnancy and becoming a parent. You can read them in any order, but you might want to start today with the very first one, **Taking Care of Yourself**
5	CO	Who does what?	"Conversations" are guides for you and your partner or support person to talk about your wishes, decisions, fantasies, and practical planning for the baby. You can also use them by yourself to think or write your thoughts. A good one to start with might be **Who does wha**t? It's about chores...you get to rate what you think your partner really does, and your partner does the same, and you see how you match.
6	IDEAS	Toolkit/suggestions	Once you've done "Know your Strategies", your **Toolkit** will appear in the "Ideas" area. Take a look at it—you'll see which were your favourite strategies. You can rearrange them if you think they're in the wrong boxes. Then if you're wanting a suggestion of something to do to de-stress, hit **Suggestions** for some ideas, based on your own Toolkit.
7	KY	Strengths	Try **Know Your Strengths** next—you'll think about and rate your own

			qualities and the people and resources around you.
8	DS	Strength Reminders	If you've completed "Know Your Strengths," look at **Strength Reminders**—you can find it either in the "Ideas" page, or in "Do Something." It will give you some ideas about how to build and act on your strengths.
9	FO	Information without overload	Are you finding yourself suddenly flooded with advice and information? Take a look at **Information without Overload.**
10	CO	Daydreams	Do you find yourself thinking about your child starting school, or as a teenager? In the conversation **Daydreams**, you talk about the hopes you have and challenges you might run into as your child grows up.
11	KY	Know your health	Now is a good time to review your health habits and get some ideas about how to keep yourself and your baby as healthy as you can. **Know your health** will help you do this.
12	DS	Health goals and plans	Once you've finished "Know Your Health," you can review your feedback and decide if there are some things you'd like to set as goals—look at **Health Goals and Plans**
13	FO	Your pregnant body	Your body is busy doing mysterious and important work...but this can sometimes be just plain weird. Some thoughts on this, in **Your Pregnant Body**

14	CO	Weaving traditions	People have all different customs and ideas about having babies...are yours and your partner or support person's the same? What traditions do you want to keep, alter, set aside? Talk about this with **Weaving Traditions**
15	KY	Know your village	It takes a village to raise a child (they say, and they are right). Have a think about who you have in your personal village, using **Know your Village**
16	DS	Notes to baby	You can use **Notes to Baby** to keep a journal of or for your baby—could be photos of your belly, thoughts, poems, whatever you want.
17	FO	Mind and body as one	What's in your head? What's in your body? How are they linked? Some thoughts on this in **Mind and Body as One**
18	CO	Values and priorities	What is important to you as a parent, and for your child? Take some time to think about this, using the **Values and Priorities** conversation
19	KY	Stressors	Things happen...sometimes good things, sometimes bad things. **Know your stressors** will give you some feedback on changes and challenges in your life over the last year.
20	DS	Guided Imagery: Beach	Take a ten-minute trip to the virtual beach, in **Guided Imagery: Beach.**
21	FO	What is Stress?	What is the difference between having stress (stuff happens!) and being stressed out? Take a look at **What is Stress?**

22	CO	Money Talks	Babies change your budget as well as your life. For some ideas for talking and planning, try **Money Talks**.
23	KY	Emotions	It's common to have strong feelings during pregnancy, and sometimes it's hard to see the wood for the trees. You can use **Know your Emotions** to track your feelings and see if there's a pattern.
24	DS	Gratitude	It can be helpful to pay attention to the good things in your life, big and small. Try out **Gratitude** to remind you to do this, and to keep a record of those nice things, which you can review any time in "Ideas"
25	FO	Coping with Stress	It isn't just what happens, but what you think about it, who you've got on your side, and how you manage it—some thoughts about this in **Coping with Stress**
26	CO	Year One	As the bump grows, you might be thinking about some of the practical aspects what it's going to be like to have a baby in your home—you and your partner or support person can talk about this using **Year One**
27	KY	Style	We all have different beliefs and styles of thinking and making decisions. You and your partner or support person can take some short quizzes and then compare styles in **Know Your Style**.
28	FO	Your Own Worst Enemy	Do you have a devil on one shoulder, saying you'll be a bad mother? Most of us do, some bigger than others...read

			some ideas about handling those negative thoughts in **Your Own Worst Enemy**.
29	DS	Notes to Self	If you've got some nagging thoughts or self-doubts bugging you, try **Notes to Self** to remind yourself of what your kinder and more sensible self would like to say to you.
30	FO	Birth Plans and Fears	Starting to think about the birth? **Birth Plans and Fears** has some ideas and information about preparing for the birth and handling worries.
31	CO	Birth hopes and plans	Take some time to talk with your partner or support person about your **Birth Hopes and Plans**
32	DS	Stretching	One way to relax and care for your pregnant self is to take a gentle **Stretching** break. It takes about ten minutes, and will not make you sweat. Unless you are sweating already.
33	FO	Managing moods	We've all got moods...but sometimes moods have us, and we need to coax or wrestle them back into a proper relationship. Some ideas on this in **Managing Moods**.
34	DS	100 Things	**100 Things** is a creative form of repetition...you do one thing (sketch, write, make, photograph, sing, remember...) for 100 days, and see all the variations you can make. You can record this with the **100 things** tool—or just do it!

35	FO	Managing worries	We all get worries, too...especially with such a big thing as a birth and new baby on the horizon. Reading some ideas about **Managing Worries** may help.
36	DS	Body scan	**Body Scan** is a kind of guided meditation, focusing on different parts of your body, one by one. It's a way of getting out of your busy mind, and noticing what is happening now, in your own body. It takes 20 minutes in a quiet space—you might try it before bed.
37	FO	Control, Choice, and Responsibility	Pregnancy and parenthood can bring up all sorts of thoughts and feelings about who is, or should be, in charge of this life...some thoughts about this on **Control, Choice, and Responsibilty.**
38	DS	Have a Laugh	Sometimes what you need is just something silly...Have a Laugh goes straight to Youtube for some funny videos—look at the funny baby ones, or search your own favourites.
39	FO	Who am I, now?	You've probably spent the last few years settling in to who you are—daughter, partner, friend, worker—but now you're adding a huge role to that, and it can be a reshuffle of feelings about yourself. More thoughts on this in **Who am I, now?**
40	DS	Guided Imagery: garden	Take a short trip to a quiet garden in **Guided Imagery: Garden**
41	FO	Partner to Co-parent OR	Adding a baby to a relationship will naturally shift how you and your partner connect, share, and negotiate things.

		Single parent, not alone parent	Some ideas about this are in **Partner to Co-parent.** **OR** Just because you don't have a partner doesn't mean you will be doing this (mothering) by yourself. Take a look at **Single Parent, not Alone Parent**.
42	DS	Guided Imagery: Treehouse	Take a short walk in the woods, and a look at what's behind and what's ahead in **Guided Imagery: Treehouse**.
43	FO	Hello, Baby	If you're thinking about your baby, daydreaming, wondering—you are already building your attachment to your child. Soon, you and your child will be building a relationship together. You may hear a lot about "attachment" and "bonding". For the short story on this, and links to more, see **Hello Baby**.
44			You've explored most of the parts of this app over the last few weeks; there are more topics in "Find Out" that you can browse whenever you want to, and keep using whatever you've found helpful. Remember, if you're not sure what to do, you can always look in **Ideas**, use your **Suggestions** button, or browse the **Do Something** section.

Appendix C: Business card

Positively Pregnant

A new app for budding mums

Interested in helping test the app?
Less than 20 weeks pregnant?

021728796

positivelypregnant@waikato.ac.nz

Appendix D Posters

Pregnancy...

Awe-inspiring and terrifying. Full of changes and challenges

there's an app for that!

We are looking for women in the first half of pregnancy who are willing to try out the app and give us their feedback, both on the app and how they are feeling and coping.

For more information, take a card, or e-mail

Positivelypregnant@waikato.ac.nz

This research is being conducted by a team led by Carrie Cornsweet Barber and Bridgette Masters-Awatere

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

Appendix E: Draft press release

Draft press release

Pregnancy is a time of continuous change—not just physical, but social and emotional. It's also a time for daydreaming, reflection, planning…and sometimes, worrying, doubting, wondering. There is so much going on, and there is no lack of information, advice, and strong opinions whirling around the mother-to-be.

All this is exciting—but also can be stressful. There are dozens of books, websites, and apps out there that will tell you how big your baby is (a grape? Apricot? Banana?), what to eat, and all the possible complications that might occur, but there is much less about the thoughts and feelings that bubble up, how to handle the worries, shifts in relationships, and hassles of pregnancy, and how to use the time during pregnancy to build resilience and plan a healthy future for the whole family.

Well, now there is an app for that. A team at the University of Waikato's School of Psychology, headed by Carrie Cornsweet Barber, has been working for the last three years to develop Positively Pregnant—an app for pregnant women. Positively Pregnant includes tools for self-assessment—taking inventory of strengths, stressors, support, and strategies for coping, health behaviours, and more. From each of these, the woman receives feedback with links to New Zealand resources and information. Other modules are guides for talking or thinking about plans for things like baby care, the birth, finances, and family traditions. There are activities for relaxation, affirmation, journaling, and just taking a break, and information on all sorts of topics related to the social and emotional side of pregnancy.

Many of the activities and principles underlying the app come from the growing field positive psychology—how we can use what we know about behaviour, emotions, and people's habits of thought to enhance emotional and physical

wellbeing and provide people the tools and ideas they need to find their own path to thrive.

Development of Positively Pregnant has been financially supported by the University of Waikato, the TalkingTech Foundation, and by Waikato DHB's perinatal mental health service—but it has also benefited from collaboration and input from many local midwives, antenatal educators, psychologists, and other professionals who support families. The app will ultimately be freely available in New Zealand, and the team plans to develop extensions and versions for postnatal mums, for partners, and possibly for fertility patients.

Positively Pregnant is being pilot tested now in the Waikato. The goal of the pilot is to see how women use the app, to get feedback and suggestions from them, and to see if there are changes in their stress, distress, and health behaviours while using Positively Pregnant. Information from the study will be used to improve the app.

One of the advantages of an app over something like a book is that the app can be tailored to the particular needs of the mother—there can easily be different versions, individualised for the user. In this pilot, the team is especially interested in including women under 20 and Maori and migrant women, in order to get their input and ideas about tailoring the app to their interests.

Any woman who lives in or near Hamilton, is at least 16 years old, in the first half of pregnancy (before 22 weeks, so she has plenty of time to use the app before the baby is born), and who uses a smart phone (either Android or iphone) is eligible to participate. The team is looking to recruit up to 60 women and will follow them through to a month after the baby is born. For more information or to volunteer, e-mail Positivelypregnant@waikato.ac.nz. For more information about what is involved in participating in the study, those interested can look at http://psychology.waikato.ac.nz/positivelypregnant, or find us on Facebook@positivelypregnantapp.

Appendix F: Information sheet

Positively Pregnant: Evaluation and Refinement of a mobile phone app

Pregnancy is a time of change—physical, social, financial, psychological. Many important parts of life are changing, all at the same time. These changes can be exciting and joyful, but also challenging and stressful.

We have been working to develop a mobile phone app called "Positively Pregnant" to help pregnant women to manage the challenges and changes of pregnancy and use this time to reflect on strengths, supports, stresses, and strategies—what works for *you* to thrive and cope with whatever life brings? If you participate in this research, you will receive a copy of the mobile phone app that you can try out for the rest of your pregnancy (and beyond, if you want), and we will ask you to give us feedback about the app, and about your health behaviours and levels of stress and distress over the next few months, until your baby is one month old.

The purpose of this project is to try out and evaluate Positively Pregnant, to see how helpful it is, and what suggestions people have to make it better. Positively Pregnant has four different types of modules in it; there are some (called "Know Yourself") that help you to take inventory and assess yourself, some (called "Conversations") that provide suggestions for things you and your partner or support person could talk and think about in preparation for parenting, activities (called "Do Something") that are things you can to relax and to manage stress and improve wellbeing, and some information (called "Find Out") about the social and emotional side of becoming a mother. If you're in the study, you can look through the app and use anything you think you would find helpful. You aren't required to do any particular part. We are trying out two slightly different versions; which one you get is randomly chosen.

We will ask for your input in three ways.

- First, the app will collect information on what modules you use and what you enter into the app. This information will be linked to a unique ID the app creates; you won't put your name into the app. You will be asked to

send this information to us three times during the study by pushing a button in the app while you have access to internet/wifi.

- Second, we will ask you to fill out some questionnaires online (you can do it on your phone or a computer) before you start using the app, and at three points after that (when you are about 24 weeks pregnant, 36 weeks pregnant, and a month after the baby is born). They will ask about how you are feeling, your health behaviours, your feedback on the app, and (in the last one) you experience of birth and early parenting. Each survey takes about 10-15 minutes to complete.
- Third, after you've been using the app at least a month or so, we may invite you to a focus group to give us feedback and suggestions on the app. A focus group is a small group discussion with several other women who are also pregnant and using the app. We will take notes and use the ideas to help improve the app. If we are organizing a focus group in your area, we will contact you and invite you to attend.

Your feedbacks will all be anonymous, you don't need to answer any question you prefer not to, and you can withdraw at any time.

This study has been reviewed and approved by the University of Waikato School of Psychology Research Ethics Committee. If you have any questions or concerns about your rights as a participant in this research study, you can contact the chair of that committee, Rebecca Sargisson (rebeccas@waikato.ac.nz).

If you have any questions, please feel free to ask! The leader of this project is Carrie Barber, phone number 07 837 9221; e-mail address ccbarber@waikato.ac.nz.

Thank you for your interest in finding out about this project!

Appendix G: Consent form

CONSENT FORM

A completed copy of this form should be retained by both the researcher and the participant.

Research Project: Positively Pregnant App Pilot

Please complete the following checklist. Tick (✓) the appropriate box for each point.	**YES**	**NO**
1. I have read the Participant Information Sheet (or it has been read to me) and I understand it.		
2. I have been given sufficient time to consider whether or not to participate in this study		
3. I am satisfied with the answers I have been given regarding the study and I have a copy of this consent form and information sheet		
4. I understand that taking part in this study is voluntary (my choice) and that I may withdraw from the study at any time without penalty		
5. I have the right to decline to participate in any part of the research activity		
6. I know who to contact if I have any questions about the study in general.		
7. I understand that my participation in this study is confidential and that no material, which could identify me personally, will be used in any reports on this study.		
8. I wish to receive a copy of the findings		

Declaration by participant:

I agree to participate in this research project and I understand that I may withdraw at any time. If I have any concerns about this project, I may contact the convenor of the Psychology Research and Ethics Committee (Dr Rebecca Sargisson, phone 07 557 8673, email: rebeccas@waikato.ac.nz)

Participant's name (Please print):

Signature: Date:

Declaration by member of research team:

I have given a verbal explanation of the research project to the participant, and have answered the participant's questions about it. I believe that the participant understands the study and has given informed consent to participate.

Researcher's name (Please print):

Signature: Date:

Appendix H: Demographics/maternity history

Background Demographics/maternity history (Pre-assessment)

Are you currently working?

- Yes, full time (1)
- Yes, part time or casual (2)
- Yes, volunteer/unpaid work (3)
- No, not working outside home (4)

Are you (choose all that apply)

- Caring for children (1)
- Caring for other family members (2)
- Unemployed (3)
- Studying (4)
- Disabled or unable to work because of illness (5)

What is the highest level of education you have completed?

- No formal educational qualifications or diplomas (1)
- High school/secondary diploma (what type?) (2)
- _____
- Some tertiary/university/undergraduate classes. (3)
- Tertiary/university/undergraduate degree (please specify) (4)
  _____
- Tertiary/university graduate-level degree (please specify) (5)
  _____

Are you currently studying?

- Yes (1)

- No (2)

Have you ever been pregnant before?

- Yes (1)
- No (2)If No Is Selected, Then Skip To Do you have any children living with ...

How many times have you been pregnant before this time?

- 1 (1)
- 2 (2)
- 3 (3)
- 4 (4)
- 5 or more (5)

Have you ever lost a baby to miscarriage or stillbirth?

- No, never (1)
- Yes, once (2)
- Yes, more than once (3)

Have you ever had a pregnancy termination?

- No, never (1)
- Yes, once (2)
- Yes, more than once (3)

Do you have any children living with you now?

- No, none (1)
- Yes, one (2)yes,
- Two (3)
- Yes, three or more (4)

Have you (and/or your partner) had fertility evaluation or treatment?

- Yes (1)
- No (2)

Is this pregnancy the result of fertility treatment?

- Yes (1)
- No (2)

Appendix I: Questionnaire-Satisfaction and app use

Satisfaction, app use and feedback (24 and 36 assessment points only)

How often have you been using Positively Pregnant over the last two weeks?

Haven't used it (why not?) _____

- Once or twice
- A few times a week
- Most days at least once
- More than once a day

Overall, how satisfied have you been with Positively Pregnant?

- Extremely satisfied
- Somewhat satisfied
- Neither satisfied nor dissatisfied
- Somewhat dissatisfied Extremely dissatisfied

Would you recommend Positively Pregnant to a friend who was pregnant?

- Definitely not
- Probably not
- Maybe
- Probably yes
- Definitely yes

How have you found these Know Yourself items?

	Helpful	Not helpful	Haven't tried
Know Your Strengths Know Your Strategies Know Your Stressors Know Your Emotions Know Your Village Know Your Style Know Your Health			

How have you found these Do Something items?

	Helpful	Not helpful	Haven't tried
Strength Reminders Notes to Self Gratitude Relaxation Breathing Stretching Body Scan Guided Imagery (favourite?) 100 Things Notes to Baby Health Goals and Plans Have a Laugh Play a game Know Your Emotions			

How have you found these Conversations?

	Helpful	Not helpful	Haven't tried
Who Does What? Weaving Traditions Birth Hopes and Plans The Baby: Year One Daydreams Money Talks Values and Priorities			

Have you read any of the "Find Out" topics?

- No
- A couple
- Several
- Quite a few
- All of them

Which of the topics do you remember being helpful?

Were there any topics you found unhelpful, confusing or misleading? If so, which ones?

Any suggestions for us to add, remove, or change things?

Other comments about the Positively Pregnant app?

Appendix J: Reasons of not using the app

T2Q2.1 Reasons of not using the app

- Have been meaning to but a friend died in a car crash and I'm just dealing with that now. Nothing against the app.
- Upgraded phone and needed to get app reinstalled
- Have been really busy/tired lately
- Found it is far too generic and things in it do not apply directly to my pregnancy
- Too busy
- I forget, life has been pretty hectic
- I used it initially, but found it wasn't really relevant to me. I don't get stressed or depressed easily so didn't continue.
- Too busy
- Struggling to find what's in it for me. Feel like I'm just supplying info without getting anything back
- Just not user friendly for me so lost interest
- Kind of forgot about it
- I find it boring
- Have been busy studying
- Haven't thought about it
- I'm not really sure what to do with it since I answered all the questions
- Been busy! Tendency at present if i have a question specific to pregnancy I google that and also check the babys progress on app e.g. what looks like at 25weeks
- Have been very busy with work and a sick child
- I just got out of the habit, and haven't thought as much about this second pregnancy as I did the first!
- Forgot
- I've only really opened and had a look a few times forget that i have it / feel doesn't really relate to me
- Haven't wanted to
- I have another app I find more beneficial

Appendix K: Feedback from the participants

T2Q2.11.0 Feedback/Comments

- I think this app would be extremely helpful for a first pregnancy. As this is my 3rd pregnancy I don't feel that much of the information is new to me. For my first pregnancy I would have read/done everything available.
- Add photos. Have it more like a blog
- It has a lot of helpful information, it is just sometimes hard to take in because it is mostly just paragraphs of words to read - no pictures or anything to break up the words as such
- I really enjoyed the stressors section. This pregnancy has been very difficult juggling fulltime study, 2 young children, managing a household and the normal everyday hormones that come with pregnancy. After reading some of the articles about mental health etc I found them helpful and reassuring
- Easy to use
- When I remember, the activities on the app have been helpful
- I feel like I am not really sure what to do with the app once i answered the questions. Am I doing something wrong? Is this because the app is not intuitive to use?
- Takes a bit of time to navigate yourself around the site to identify what is there and helpful to use, do not tend to just glance at it daily at the moment and do the daily tasks which I am sure would make this easier.
- I think it’s great, I'd love to recommend it to friends, can you be in touch when you are ready to launch it =)
- Really enjoying it so far
- I have kind of forgotten about it, but looking at again today it looks like there would be lots of useful things for me, so I will look more into it in the following weeks.

- No good app and would prob use it more if I had more down time at the moment but I am going straight to my usual down time things because I don't have much time at all with work and selling a house.
- Was pushing notifications which were handy to remind me to look, but since last update it's stopped.
- I need to re-download it on my new phone can someone help
- I particularly find the notes to self & baby helpful. I would definitely use the stretching and breathing exercises more if I did not do yoga myself.
- Not really. I think I would use it more if I wasn't working all the time.
- I really like the quotes that come up when the app is first opened. I find the app pretty easy to navigate
- I've found i haven't really used it as feel like it is aimed towards people that may be feeling unhappy in pregnancy or more towards post pregnancy
- I found the daily notifications really good. They came at a good time of day and really encouraged me to use the app most days during my first trimester which is when I think I needed it most.
- I think it is a great resource especially for first time mums. But has definitely made me think about my thoughts & feelings more than I would normally!
- There's a lot of information for one app. And quite a lot of questionnaires or things to answer.
- See previous answer
- I think it's a useful app but how will this target pregnant mums? Most of the pregnant ladies I speak to (I'm a second timer and I'm an antenatal class coordinator so I see a lot of first time mums) really want an NZ Pregnancy App similar to The Bump but with a kiwi twist. I.e., less of the 'woe is us, we're American, we get no maternity cover/care' and more of information about LMC's in NZ, comparable baby sizes (i.e., fruit we've heard of - ha!), what services are available to us as NZ mums, relevant no-go food and info on formula and breastfeeding in NZ. Not info on how to interview a pediatrician or childcare for a 6 week old. I've asked a few about mental health etc. And they've all said that if they had an NZ app then a lot of anxiety or questions they have may be answered.