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**ACT and Smoking Cessation Using a Smartphone Application
(SmartQuit™)**

A thesis

submitted in partial fulfilment

of the requirements for the degree of

Masters of Social Sciences in Psychology

at

The University of Waikato

by

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THE UNIVERSITY OF
WAIKATO
Te Whare Wānanga o Waikato

2016

Abstract

Acceptance and Commitment Therapy is a third wave behavioural therapy, which encourages individuals to stop fighting their internal experiences (e.g. thoughts, feelings, and memories) and teaches individuals techniques to help them accept these internal experiences for what they are. SmartQuit™ is a smartphone application for smoking cessation based on Acceptance and Commitment Therapy principles. SmartQuit™ consists of eight effective activities, each of which provides the user with techniques to deal with cravings to smoke cigarettes. My first aim was to examine whether using SmartQuit™, would lead to reductions in cigarette intake. My second aim was to determine whether scores obtained on the Commitment to Quit Scale would predict smoking outcomes at post-intervention and follow-up phases. I used a single-subject, A-B-A-C design across 10 participants to examine the feasibility of a smartphone app targeting smoking cessation (SmartQuit™), with a New Zealand population. Most participants showed a significant reduction in cigarette intake and a noticeable reduction in cravings to smoke cigarettes. In conclusion, the results of the current study suggest that SmartQuit™ is well suited for smoking cessation, with a New Zealand population. However, given the small sample size, a larger evaluation may be required.

Acknowledgements

Firstly, I would like to express my gratitude to my supervisors Dr. Rebecca Sargisson and Dr. Nicola Starkey. I appreciate your supervision, ongoing support, patience, vast knowledge, humour, and enthusiasm, throughout the project. Thank you truly.

Thank you, 2morrow, Inc. for giving me permission to use the SmartQuit™ program, and supporting my study. A big thank you to Jo Masterson for being so prompt, and responsive in your emails, as this study would not have been possible without your help.

Thank you to all of the individuals who took part in this study, without your help all of this would not have been possible. I wish you all the best for the future.

Special thanks to my friends and peers for their encouragement, insight, and accepting my antisocial ways. Thank you to my brother for his proofreading.

To my parents, Balwinder and Sarbjit Singh, thank you for being a source of encouragement both throughout my life and during my thesis. Thank you for taking care of me while I was writing.

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Literature Review

Smoking (as a Social Problem)

According to the World Health Organization (2011), tobacco use accounts for the largest (inevitable) cause of death worldwide, with global mortality statistics reporting 100 million tobacco-related deaths, in the 20th century (Ministry of Health, 2009). On an annual basis, a projected 1 billion people smoke, and worldwide the cost of tobacco on society is large, with almost 6 million deaths a year (Roberts, Kerr, & Smith, 2013; World Health Organisation, 2011). Despite the adverse effects of tobacco behavior being common knowledge, it is estimated that smoking trends will continue to rise and the death toll will increase to an estimated 8 million deaths per annum by 2030 (World Health Organization, 2011). Tobacco-related deaths in New Zealand reveal similar patterns, with cigarette smoking accounting for 4500-5000 deaths each year, including deaths from second-hand smoke (Phillips, 2013). The high prevalence of daily tobacco use is illustrated with New Zealand emerging in the sixth position out of 43 countries, countries such as Australia, United States, and Canada reported similar smoking rates (Scollo & Winstanley, 2015).

The smoking epidemic has largely declined over time, with vast reductions recorded during the period of 1980-2012 (Ng, et al., 2014). Tobias, Cavana, and Bloomfield (2010) noted that, around the 1970s in New Zealand, tobacco use peaked, and since then smoking prevalence has dropped from approximately 35% to 21% for New Zealand adults. However, in spite of the hefty and steady decline of 1% each year in developed countries, the absolute smoking consumption remains high, due to population growth (Ng, et al., 2014; Shah & Cole, 2010). While reductions have been observed over time in high-income (developed)

countries (Abdullah & Husten, 2004), smoking rates continue to rise in low-middle income (underdeveloped or developing) countries (Goldberg, 2009). Furthermore, with changes regarding global trends, it is important to consider future projections on the smoking epidemic, signifying the large tobacco-related burden amongst developing countries (Maziak, et al., 2004).

Health costs.

Prolonged exposure to tobacco has the potential to cause harm to all of the systems of the human body and may trigger a wide range of fatal diseases (Caponnetto, et al., 2011). Over time, society has become more aware of the effects of the smoking epidemic. Although, in spite of the knowledge available on the devastating consequences of tobacco use, New Zealanders continue to smoke on a regular basis (Maziak, et al., 2004), with 21% of New Zealanders 15-64-year-olds reporting smoking in 2009 (Ministry of Health, 2010).

Second-hand smoke.

Exposure to tobacco is not only dangerous for smokers, but it also has detrimental health consequences for bystanders, with there being no safe level of exposure to second-hand smoke (Kring, Johnson, Davison, & Neale, 2012). In the year 2000, 347 deaths in New Zealand were attributed to second-hand smoke (Woodward & Laugesen, 2001). Compared to first-hand smoke, second-hand smoke contains much higher concentrations of nicotine, ammonia, tar, and carbon monoxide (Kring, Johnson, Davison, & Neale, 2012) exposing non-smokers to increased risk of medical conditions such as cardiovascular diseases, lung abnormalities, lung cancer, and allergies. The effects of parental smoking amongst children can also result in a number of high risks, for instance, the increased

likelihood of asthma and bronchitis, and greater risks for birth deficits during pregnancy (Kring, Johnson, Davison, & Neale, 2012).

Population differences.

Research reveals that the tobacco epidemic does not affect each ethnic group equally, demonstrated by a higher prevalence of smoking rates among indigenous populations such as Māori and Aboriginal Australians (Glover, et al., 2013). Māori are a high-risk population for smoking, with 45.8% of Māori adults engaging in smoking behaviour, and a two-fold increase for Māori compared to non- Māori. Glover et al. (2013) also reported that consequences attributed to smoking cigarettes, such as cancer and cardiovascular disease, are also higher for Māori when compared to non- Māori.

The Three Phases of Nicotine Dependence (Initiation, Dependence, and Relapse)

Substances, such as tobacco, are used in the hope of altering states of awareness and reducing pain. Practically all people use at least one substance, if not more, whether it be coffee, alcohol, aspirin, or cigarettes. The extensive availability of such substances encourages potential drug abuse. The initial short-term effects of such substances are typically pleasing, for instance; aspirin helps reduce pain, cigarettes and alcohol act as relaxers, and coffee has stimulating properties allowing stay awake (Kring, Johnson, Davison, & Neale, 2012).

Nicotine and tobacco dependence can be understood with a variety of theories and models. The three primary factors that influence tobacco and nicotine use are physical, behavioural, and psychological. Physically, users are addicted to this substance. Behaviourally, smoking is an addictive habit. Psychologically, cigarettes are thought to aid in solving problems, managing stress levels, and act

as a tool to both socialise with others and enjoy life (Peterson, Vander Weg, & Jaen, 2011).

Of all tobacco products, cigarettes are the most widely used (American Psychiatric Association, 2013). In the U.S tobacco use begins from a young age (before 18 years), with evidence showing that by the age of 18 approximately 20% of individuals smoke monthly and most go on to become daily smokers; with starting smoking after the age of 21 years being very uncommon (American Psychiatric Association, 2013).

The number of cigarettes smoked do not directly correlate with addiction, as, sometimes, having one cigarette is enough for someone to become addicted to smoking cigarettes (Peterson, Vander Weg, & Jaen, 2011). Smoking cigarettes is a learned behaviour and is most likely to be encouraged by peer pressure and/or social imitation. For the majority of individuals, it does not take long for this social experiment to turn into a physical addiction (Roberts, Kerr, & Smith, 2013).

The initiation of tobacco use may be precipitated by a variety of factors such as peer pressure, social imitation, and by the personality characteristics of an individual (e.g. sensation seeking and impulsivity). For the vast majority of smokers, this initial experimentation results in nicotine dependence (Little, 2000; Killen et al., 1997). The reinforcing and pleasurable effects of tobacco also play a role in the initiation and maintenance of the substance with tobacco producing a slight euphoria, relaxation, and a slightly pleasurable rush for individuals (D'Souza & Markou, 2011). The acute pharmacological effects of tobacco, such as stimulation of euphoria and discharge from stress and anxiety (Little, 2000) serve as underlying factors for the uptake or experimentation of smoking.

Definition in the DSM5 manual.

In the Diagnostic and Statistical Manual of Mental Disorders, 5th edition (DSM5), tobacco use disorder is defined as a pattern of distress or impairment that has been caused by tobacco use and has lasted for a duration of 12 months. To meet this diagnosis, individuals must meet at least two of the 11 diagnostic criteria: 1) tobacco must have been consumed in larger amounts than was intended; 2) there is no control over tobacco use; 3) large amounts of time is spent to either acquire tobacco or use it; 4) cravings and/ or urges are experienced to use tobacco; 5) tobacco use interferes with other obligations; 6) tobacco is used in spite of interpersonal or social problems being triggered by its use; 7) tobacco use is given more importance than recreational, social or occupational activities; 8) repeated use of tobacco in dangerous situations; 9) continuous tobacco use in spite of having had persistent psychological or physical problems caused by tobacco; 10) tobacco tolerance; and 11) experiencing symptoms of withdrawal (American Psychiatric Association, 2013).

According to the American Psychiatric Association (2013), tobacco use disorder is supported through a number of features, which include smoking on a daily basis, getting up during the night to smoke, smoking within 30 minutes after having woken up, and consuming a high number of cigarettes during the day (American Psychiatric Association, 2013).

Triggers for maintenance and nicotine dependence.

Both regular smoking and nicotine dependence usually follow a long-lasting course, ranging from years to decades (Peterson, Vander Weg, & Jaen, 2011). Factors that maintain nicotine dependence include the reinforcing effects of

nicotine, sensitisation and tolerance to nicotine, conditioning processes, stress, withdrawal symptoms, relapse, and conditioning processes (Little, 2000).

At the social level, both interest and access to substances are strongly influenced by the media, peer behaviour, cultural norms, parents, socialisation, acceptable behaviour (Kring, Johnson, Davison, & Neale, 2012), and by social comparisons (Lapointe, 2008). The social setting then presents frequent cues to the individual to use and purchase tobacco resulting in an increased likelihood for engaging in smoking behaviour (Jha, et al., 2006).

Studies conducted on human and animal substance abuse, and analyses from twin studies show that genetic factors play a role in the susceptibility and the persistence to smoke (Bergen & Caporaso, 1999), nicotine dependence has been recognised as a psychopharmacologic mechanism that upholds cigarette behaviour (Bergen & Caporaso, 1999). Under the pharmacologic theory, addiction is sustained through nicotine, as nicotine acts on receptors in the brain, which release neurotransmitters and dopamine (Little, 2000). Individuals then continue to smoke, as they wish to avoid the neurobiological and physical withdrawal symptoms associated with abrupt cessation (Bergen & Caporaso, 1999; D'Souza & Markou, 2011).

Smoking behaviour is associated with a number of psychological factors that include beliefs, feelings and thoughts about the world, as well as beliefs about oneself, the future and tools for stress management. Stress is considered the most significant factor, as many people believe that smoking assists in reducing and managing stress. However, research suggests that smoking may actually increase stress levels (Peterson, Vander Weg, & Jaen, 2011).

Smoking is something that people *do*, and as a behaviour is subject to principles of behavioural learning and conditioning. For instance, individuals who smoke come to associate smoking with surrounding stimuli; in the future these become triggers (antecedents) for smoking, and consequences, as this social reinforcement maintains the smoking behaviour (Peterson, Vander Weg, & Jaen, 2011). When an individual quits smoking the social reinforcement may be replaced by rejection and negativity (punishment) from peers (Tyas & Pederson, 1998).

For smokers, the social setting in which they operate also has the potential to affect their maintenance of cigarette use. Studies reveal that smokers were more likely to smoke with smokers than non-smokers and that smoking took place outside the house, bars, and restaurants, as opposed to inside other people's houses, and at the workplace, because they could not smoke in those places due to bans (Kring, Johnson, Davison, & Neale, 2012).

Breaking the habit.

Approximately 70-80% of smokers want to quit smoking and regret initiating smoking (American Psychiatric Association, 2013; Peterson, Vander, Weg, & Jaen, 2011; Roberts, Kerr & Smith, 2013; Rondina, Gorayeb, Botelho, 2007). Of those who attempt to quit, 60% relapse within a week and fewer than 5% continue to abstinence (American Psychiatric Association, 2013). These statistics reveal that very few smokers are able to give up successfully. Most individuals will not quit until they are at least 30 years old (American Psychiatric Association, 2013).

It appears that those that do successfully quit smoking require between 5-7 quit attempts before they reach successful smoke-free outcomes (Goldberg, 2009;

Roberts, Kerr, & Smith, 2013). Motivational, psychological, environmental, hereditary, and physiological factors may all have an impact on smoking cessation; the most important factor is motivation, as only 12% of smokers are prepared to quit (Roberts, Kerr, & Smith, 2013).

The consequences of quitting.

Following permanent abstinence, the risk for medical diseases is quick to diminish (Caponnetto, et al., 2011). Stopping smoking has many positive effects on the overall health of ex-smokers, as it has the potential to extend life expectancy, and yield improvements in health (Brannon & Feist, 2009). The age at which a person quits can affect the number of years added to an ex-smoker's life. Individuals who quit earlier are more likely to have a longer life compared to those who quit later (Brannon & Feist, 2009). Jha et al. (2006) reported similar findings and found that those who stopped smoking before the age of 35-69 years were 90% more likely to avoid lung cancer. The risk of lung cancer is lower for ex-smokers who quit at an earlier age (Brannon & Feist, 2009). Evidence suggests that after having quit for 16 years, all-cause mortality rates return to normal and are similar to those of non-smokers. However, ex-smokers are still likely to be at a high risk for cancer mortality (Brannon & Feist, 2009).

Relapse.

Ex-smokers are vulnerable to relapse for a lengthy period, ranging from days, months, to even years following smoking cessation (D'Souza & Markou, 2011). Borland, Yong, Hyland, and Siahpush (2008) suggested that 22% of individuals return to smoking, and smoke cigarettes at a much higher rate than before their endeavour to quit.

Consumption of cigarettes can be triggered by exposure to cues and contexts that were previously associated with tobacco use (D'Souza & Markou, 2011). In some instances, just one cigarette is enough to trigger a relapse, and, in other instances, relapse takes place following extensive periods of self-restraint (Glipman, Pierce, Farkas, & Farkas, 1997). Relapse is also more prevalent for self-quitters. Evidence shows that two-thirds of self-quitter's relapse after two days, and 75% recommence smoking within six months from their quit attempt (Brannon & Feist, 2009). Nicotine dependence can thus be characterised by both frequent and related episodes of relapse.

Evidence-Based Approaches to Quitting Smoking

There are various types of treatments available for smoking cessation, with the main types being: behaviourally, psychologically, and/or pharmacologically based. These interventions can be delivered at many levels, such as at the policy or governmental level, or at the individual level. Smoking cessation interventions may also differ in nature, they can be mainstream, secondary, complimentary, or alternative. The availability of alternative modes of interventions gives rise to individual preferences when selecting interventions, as this facilitates reach, uptake, and choice (Roberts, Kerr, & Smith, 2013). In this section, I will look into the most commonly used evidence-based interventions for smoking cessation.

Tobacco Control Programme New Zealand.

New Zealand has one of the most inclusive tobacco control programmes in the world. This tobacco-control programme is in line with the directives of the tobacco control programme designed by the World Health Organisation. The New Zealand-based programme runs regular media campaigns, makes available smoking cessation programmes, provides health education, works with other

parties to increase tobacco taxation, and has legislated for smoke-free environments. The utility and effectiveness of the tobacco control programme are monitored on a regular basis with surveys (Tobias, Cavana, & Bloomfield, 2010). Self-reported results from the 1996-1997 Census revealed that 25% of the New Zealand adult population identified themselves as daily smokers, but by 2012-2013 this rate declined to 18%. According to Turia (2014), the decline in tobacco consumption and prevalence can be credited to the tobacco control programme. As mentioned above, this programme consists of many components, and it appears that tobacco-related taxes play the biggest role in the rapid decline in smoking prevalence and consumption (Ministry of Health, 2014).

Tobacco price increases.

Taxation on cigarettes is extensively endorsed as an effective population-based strategy, and in 2013, the New Zealand government raised the taxes for tobacco to one of the highest levels in the world (Esther & Ajmal, 2013). Although the underlying aim of taxation may be to influence current smokers to smoke less, and to prevent non-smokers from taking up smoking, individuals respond to taxation in a number of ways. Data compiled from surveys on the effects of tobacco price increases reveal that, while some individuals do quit either on their own or with the help of a Quitline, others will buy cigarettes in bulk to save money (Zhu, Lee, Zhuang, Gamst, & Wolfson, 2012). Alternatively, they might turn to substitutes, such as buying cheaper cigarettes, or the taxation may have no effect on the smoker whatsoever, and as a result, they are subject to financial stress and hardships (Guillaumier, et al., 2014). Data taken on tax-provoked price increases in 1991, 1998, and 2001 reveal that following cigarette price increases, sales declined (Laugesen, 2002). A New Zealand study following

a tobacco price increase in 2010 and 2011 revealed that the price increase influenced a large percentage of individuals of low socio-economic status to quit smoking. However, the relapse rate for this group was high, and those individuals who did not quit successfully managed by reducing their cigarette consumption or by switching to cheaper brands. Based on these findings, Kimura (2012) proposed for a steeper tax increase.

Smoke-free legislation.

Smokers are given incentive and support to quit smoking, with numerous laws that now restrict people from smoking in public places. In 1990, legislation to prohibit smoking in indoor offices was enforced and New Zealand was the first in the world to do so. In 2003, this act was revised, and the indoor environments list was made to include all work settings, including licenced premises, and public settings (Kring, Johnson, Davison, & Neale, 2012; Ministry of Health, 2015). Strong evidence exists in favour of smoke-free policies, particularly for an improved air quality, and a lessened exposure to second-hand smoke. The success of this policy is primarily due to the high level of support and compliance with the smoke-free legislation, by key stakeholders and the public. The smoke-free legislation also increases smokers' level of motivation to quit smoking and decreases socially prompted smoking (Ministry of Health, 2006). Although, the effects of smoke-free legislation at the population level are unclear due to methodological issues, such as uncertainty for compliance for the enforcement of the Smoke-free Environments Amendment Act (Edwards, et al., 2006).

Pharmacotherapy.

Under the clinical practice guidelines, pharmacotherapies are considered first-line smoking services (Zhu, Lee, Zhuang, Gamst, & Wolfson, 2012). The

three key forms of available medication include NRT (nicotine replacement therapy), bupropion, and varenicline.

Nicotine Replacement Therapy (NRT).

Ucar and colleagues (2014) evaluated the effectiveness of pharmacologic therapies and found that NRT was the most effective pharmacologic tool for smoking cessation (Jha, et al., 2006). NRT encompasses a range of products, such as nicotine patches, nicotine spray, nicotine gum, nicotine lozenges, and e-cigarettes. With the exception of the inhalers and the nasal spray, all other NRT forms can be purchased over the counter, providing individuals who want to quit freedom to select the type of tool they would like to use (Perkins, Conklin, & Levine, 2008). Nicotine replacement targets smoking cessation through releasing small doses of nicotine into the body, and through allowing the individual to transition from larger to smaller doses, until they are no longer nicotine dependent.

A disadvantage of NRT is that it does not cater to individuals with low socioeconomic status, who are high-risk populations. The cost for NRT may be reduced with a Quitcard subscription, offered through Quitline, however not everyone has access to this subscription, and therefore a combination of a Quitcard and a Quitline subscription are required, as opposed to a sole intervention (The QuitGroup, 2015). Each of the nicotine replacement therapy products have probable side effects, such as sleep disturbances, nausea, and light-headedness (Brannon & Feist, 2009). A major implication for NRT is that it may serve as a mere replacement for nicotine, thus making it easy to overdose on this product and become addicted (West & Shiffman, 2007).

Nicotine-free inhalators.

Nicotine-free inhalators act as a replacement for smoking cues and rituals, through serving as a coping mechanism for hand-to-mouth actions. These inhalators are particularly useful for individuals for whom tobacco use is influenced by behavioural characteristics (Caponnetto, et al., 2011).

E-cigarettes.

The health consequences linked with traditional cigarettes gave rise to the introduction of e-cigarettes, as recreational substitutes for cigarettes. E-cigarettes produce vapour made from nicotine-infused liquid, providing smokers with the sensation of smoking and satisfying their need for nicotine (Babin & Harris, 2015; Dockrell, Morison, Bauld, & McNeill, 2013; Wagener, Slegel, & Borrelli, 2012).

Unlike normal cigarettes, e-cigarettes are not harmful to bystanders and they do not let off smells (Shaw, 2014). The potential harms of e-cigarettes have been subject to debate, with its increasing popularity, as little literature is available on e-cigarettes. A counter argument is that individuals who use e-cigarettes do not give up smoking, as these individuals still crave nicotine (Shaw, 2014). It has been suggested that e-cigarettes encourage continued smoking, as nicotine may continue to be consumed in places where regular smoking is banned (Hales, 2014). The United States Food and Drug Administration (FDA) is yet to approve this substance as it contains unknown carcinogens, and due to poor manufacturing practices used in the development of e-cigarettes (Odum, O'Dell, & Schepers, 2012). Consequently, many cities in the U.S have placed restrictions on where the product can be used (Babin & Harris, 2015).

Pharmacologic (no nicotine) Bupropion.

Bupropion is an antidepressant medication that is available on prescription. In recent years, this medicine has been licensed by the FDA to be used for smoking cessation (Lewis, 2010). It is hypothesised that bupropion inhibits dopamine reuptake in the brain, particularly the reward centre which is also known as the mesolimbic dopamine system (Jorenby et al., 2006).

Evidence suggests that the key role of bupropion is to improve dopaminergic and noradrenergic activity, which is most commonly experienced by individuals who smoke nicotine. These activities are of importance as both norepinephrine and dopamine play a vital role in the mediation of withdrawal symptoms such as negative affect and irritability. Bupropion medication then works to attenuate these symptoms (Perkins, Conklin, & Levine, 2008), as it works to mimic the nicotinic properties of noradrenaline and dopamine. Through provoking nicotinic receptors, bupropion may prevent relapse (Warner & Shoaib, 2006). However, according to Warner and Shoaib (2005), the exact mechanistic action of bupropion in smoking cessation is unknown, as a result, health practitioners are less likely to recommend bupropion to patients and the general public (Anczak & Nogler, 2003). Additionally, bupropion has only been shown to help relieve withdrawal symptoms, and does not work to stop smoking (Wikes, 2008).

Varenciline (Champix, Chantix).

Varenciline is the most current pharmacological intervention, introduced in 2006 (Joernby, et al., 2006). The fixed action of varenciline is to stimulate nicotinic receptors, with a particular focus on the $\alpha 4\beta 2$ nicotinic acetylcholine receptor. Evidence suggests that the $\alpha 4\beta 2$ subtype is a key mediator of nicotine

dependence, due to its dependence-generating properties. Through its antagonising properties, hypothetically, this medicine offers relief to cigarette craving, and to nicotine withdrawal (Jorenby, et al., 2006).

Joernby and colleagues (2006) compared the effectiveness of varenicline with a placebo, and with bupropion. It was noted that varenicline was an effective treatment for smoking cessation, in both the long and short-term, and its efficacy exceeded placebo and other pharmacologic treatments such as bupropion. However, a comparative study examining the risk of suicide, depression, and self-harm behaviours associated with NRT, varenicline, and bupropion, revealed that the relative risk for these behaviours were significantly higher for those taking varenicline. In a sample of 2925, 90% of the individuals allocated to varenicline condition reported negative feelings (Bland, 2012).

Perkins, Conklin, and Levine (2008) suggest that counselling should be used alongside these first-line medications, as counselling has the potential to address psychological issues associated with smoking abstinence, as well as maintaining smoking abstinence in the absence of medication.

Complementary and alternative interventions.

Acupuncture.

Acupuncture entails inserting fine needles into the body. Acupuncture can be used to reduce the desire to smoke, as it has the potential to affect the taste associated with tobacco. Acupuncture can also be used to reduce withdrawal symptoms that follow abstinence (He, Medbo, & Hostmark, 2001). White, Rampes, Liu, Stead, and Campbell (2014) evaluated the effects of acupuncture compared to treatments such as NRT, advice, counselling, and sham treatments. Sham treatments use one of two key techniques, dummy needles or needles that

have no active effect. Overall, inconsistent evidence was found for the feasibility of acupuncture and related therapies, although in the short term these techniques are better than no treatment. It was also found that acupuncture was less effective than NRT, and there was no evidence to show that acupuncture was a superior alternative to counselling (White, Rampes, Liu, Stead, & Campbell, 2014).

Hypnotherapy.

Hypnotherapy works to increase an individual's concentration and acts on their fundamental urges through strengthening the client's will to quit and or deteriorating their desire to smoke. The primary aim of hypnosis is to induce relaxation and modify the state of consciousness for clients. A disadvantage of this intervention is that there is no single standardised method for delivering hypnotherapy for smoking cessation, making it problematic to compare and contrast the efficacy of this treatment (Blomgren, 2003).

A Cochrane review carried out by Barnes, Dong, McRobbie, Mehta, and Stead (2010) concluded that the evidence for the feasibility of hypnotherapy was conflicting, and little effect was found when hypnotherapy was compared to psychological treatments (White, Rampes, Liu, Stead, & Campbell, 2014).

Quitlines.

A number of factors attract individuals to use Quitlines, such as anonymity, privacy, convenience, and cost-effectiveness of these interventions. Additionally, counselling sessions can be easily organised, and the anonymous nature allows the client to open up faster and it helps the counsellor in gaining an accurate picture of the client. According to Lichtenstein, Zhu, and Tedeschi (2010), Quitlines appeal to members of the public who are usually underserved.

However, Quitlines are not effective as sole interventions and require collaborative action (Lichtenstein, Zhu, & Tedeschi, 2010).

Aversion therapy.

Aversion therapy is a treatment in which pleasurable stimuli associated with cigarettes (smoking) are paired with unpleasant stimuli (nausea or shock), and this pairing works to overwhelm urges to smoke. Hajek and Stead (2000) reviewed 24 studies that compared the effects of aversive therapy. Insufficient evidence in support for the efficacy of this technique was found, and no recommended dose levels were established (Hajek, & Stead, 2000).

Smartphone delivered interventions.

The dawn of new technology facilitates access to many more interventions, through modes of delivery such as internet access and smartphones. In 2014, 252 smartphone applications (apps) targeting smoking cessation were identified on the apple market and 148 were identified on the android market. Abroms, Padmanabhan, Thaweethai, and Phillips (2011) suggested that current apps could be improved through integration with evidence-based practice. Research conducted on iPhone smoking cessation apps revealed that, in 2009, the level of adherence to the apps was quite low. The most downloaded apps had lower adherence scores compared to other quitting smoking apps that were less frequently downloaded (Abroms, Padmanabhan, Thaweethai, & Phillips, 2011; Roberts, Kerr, & Smith, 2013).

A survey conducted in 2013 revealed that, in New Zealand, 59% of the adult population either had access to or owned a smartphone. For individuals in the 18-54 years age group, 71% had access to or ownership of a smartphone (Patel et al., 2015).

The use of mobile phones to deliver smoking cessation leads to double the quit rate for smoking (Abroms, Padmanabhan, Thaweethai, & Phillips, 2011). This is partly due to mobile phones being easily accessible (within arm's reach), versatile, and universal. The privacy that comes with smoking cessation programmes on smartphones may also play a role in the high quit rates accounted by smartphone cessation programmes (Abroms, Padmanabhan, Thaweethai, & Phillips, 2011; Whittaker, et al., 2012).

STOMP.

STOMP is a text-to-quit intervention in which smokers who want to quit receive automated messages for 4 weeks, five messages a day. Within this intervention, individuals are taught behaviour-change techniques, such as access to distractions such as trivia and quizzes to avoid cravings to smoke, users are also given the opportunity to text STOMP for feedback on how to cope with their craving to smoke (Kong, Ells, Camenga, & Krishnan-Sarin, 2014). STOMP is effective in providing short-term smoke-free outcomes but not long-term outcomes, thus, relapse rates for this intervention are high (Bramley, Riddell, Whittaker, Corbett, & Lin, 2005).

WebQuit®.

In 2010, Bricker et al. compared a web-based ACT intervention for smoking cessation called WebQuit® with another web-based intervention called smokefree.gov. WebQuit® is a self-paced 8-part package and includes pharmacotherapy advice, social support, and planning advice for quitting. The comparison intervention, smokefree.gov, was the most widely used website at the time. Bricker et al. reported that participants in the WebQuit® condition engaged with WebQuit® at higher rates and were more satisfied with the website.

Furthermore, data taken at a 3-month follow-up revealed that 23% of the individuals from the WebQuit® condition had given up smoking for a period of at least 30 days, whereas for the smoke-free condition the quit rate was 10%. Increases in acceptance levels were also seen for individuals in the WebQuit® group.

Behavioural interventions.

Behavioural interventions are designed to help guide successful quit attempts through incorporating advice, encouragement, and discussion. Behavioural techniques commonly address key aspects of smoking cessation such as self-efficacy and motivation (Roberts, Kerr, & Smith, 2013). Fiore and colleagues (2008) suggested that behavioural treatments are effective for tobacco cessation and thus, should be the primary treatment for smoking cessation.

Cognitive Behavioural Therapy (CBT).

Currently, the most frequently used (gold standard) behavioural intervention is Cognitive Behavioural Therapy (CBT). The underlying goal of CBT is to teach individuals the skills required to cope with internal and external cues to smoke, with internal cues being cravings and external cues being viewing other people smoke cigarettes. CBT uses strategies such as helping those who smoke to reduce or avoid internal cues to smoke (Hernandez-Lopez, Bricker, Montesinos, Luciano, & Roales-Nieto, 2009).

Acceptance and Commitment Therapy (ACT).

Acceptance and Commitment Therapy (ACT) is a recent innovation to behaviour therapy and has grown out of the behavioural tradition. The foundation of ACT is formulated on a functional contextualism program of Relational Frame Theory (RFT). RFT offers a theoretical account of human language, cognition,

and basic research. The underpinnings of ACT are based on this very account (Harris, 2009), however ACT takes a new and improved path, as instead it encompasses human language to take a fresh look at human suffering and pain (Hayes, 2004) through aiming to change the function and the context of the problem (Beharry, 2008).

The primary therapeutic goal of ACT is to increase psychological flexibility, defined as contacting the present moment, and successfully preserving or varying behaviour in the provision of achieving valued outcomes. This goal is achieved through decreasing experiential avoidance (EA), the process of suppressing and avoiding unwanted feelings, sensations, thoughts, and other secretive events (Bach & Moran, 2008). EA has short-term positive rewards and is reinforced from an early age. Also given the link of EA with language, individuals are more likely to engage in it, as through language relations are formed between language and thoughts (Hayes et al., 1996).

Under an ACT framework, clients are commended to not fight or avoid challenges (which is the normal approach), and they are instead taught to embrace and accept their difficulties, whilst accepting their discomfort in life, and acting on their fundamental values (Hayes, Luoma, Bond, Masuda, & Lillis, 2006). Also under an ACT framework, mindfulness, and value-congruent living is given preference over symptom reduction, as the aim is to change the person's relationship with their symptoms so that they can live a better life (Harris, 2009).

ACT can be understood and defined by six core therapeutic processes. These six core processes are interrelated and together they make a 6-faceted diamond, called psychological flexibility (Bach & Moran, 2008; Hayes et al., 2006).

Acceptance refers to a readiness to experience without any defence; this entails making room for urges, emotions, painful feelings and sensations, rather than resisting them (Harris, 2009). With reference to smoking cessation, an ACT therapist would support the client to accept previously avoided stimuli to quit smoking (Gifford, et al., 2004).

Defusion is a technique used to decrease the unhelpful effects of cognition and language. Defusion refers to detaching images, memories, and thoughts of oneself (Harris, 2009). This process is important, as it allows clients to act in accordance with their values, and their environment (Bach & Moran, 2008). An ACT therapist would teach individuals defusion techniques such as the identification of internal and external cues associated with smoking, and strategies to deal with and manage these triggers. Clients would also be taught to see in actuality, in that they would see thoughts to smoke as mere thoughts, rather than as reasons to smoke cigarettes (Hernandez-Lopez, Bricker, Montesinos, Luciano, & Roales-Nieto, 2009).

Contact with the present moment refers to the act of becoming aware of the surroundings and events happening around the individual's body (Bach & Moran, 2008).

Committed action is when behaviour is in line with the individual's chosen values. An example of this would be an individual engaging in overt responses that are both important to them and hold clinical relevance, these overt responses aid them to bring their life back on track (Bach & Moran, 2008). An ACT therapist would support the client to commit to their identified values, e.g. a smoke-free lifestyle (Hernandez-Lopez, Bricker, Montesinos, Luciano, & Roales-Nieto, 2009) and act on the identified values.

Self-as-context refers to pure awareness, in that there are two distinct elements to our minds, the observing self and the thinking self (Harris, 2009). When looking at the 'self' as a perspective, three distinct categories must be examined; self-as-content, self-as-context, and self-as-process (Bach & Moran, 2008).

Values serve as chosen life directions (Bach & Moran, 2008). Values also provide the best context for a person, as they allow the person to step outside of rigid and refined roles and live freely, without being controlled by culture (Hayes & Smith, 2009). An ACT therapist would support the client in identifying values that align with their personal choices of a smoke-free and meaningful lifestyle, such as choosing a quit date, and selecting a method to quit smoking (Hernandez-Lopez, Bricker, Montesinos, Luciano, & Roales-Nieto, 2009).

ACT is an ideal treatment for individuals for whom tobacco use is maintained by a struggle to both avoid and modify negative stimuli, which in this case would be withdrawal symptoms. Evidence suggests that 'avoidance' provides the smoker with negative reinforcement, which then serves to maintain nicotine dependence (Gifford, et al., 2004).

To summarise, the 'acceptance' component of ACT, makes efforts to help individuals to identify and accept inner triggers to smoke, and not avoid withdrawal symptoms. The 'commitment' component, emphasises the articulation of personal values and committing to stop smoking (Mak & Loke, 2015).

According to Herbert and Gaudiano (2005) under an ACT framework, low acceptance of internal experiences is the issue, as low acceptance is equivalent to high experiential avoidance. Those with low acceptance levels feel distressed when aroused and will attempt to reduce and avoid internal experiences. These

negative processes then lead to a disruption in behaviour, as such techniques disrupt one's ability to live a quality life. Also taking an ACT-based approach Gifford et al. (2004) accentuates that the underlying mechanism for smoking is negatively reinforced avoidance. Under an ACT-based approach, the issue is the way in which the individual responds to their internal states. It was found that these very individual responses were predictive of smoking cessation outcomes, with a negative response, inflexibility and withdrawal symptoms acting as predictors.

Usefulness of ACT.

With ACT being a recent innovation, evidence on the usefulness of ACT is still growing, and thus very few studies have examined the effects of ACT on smoking cessation. ACT has shown promise for treatment of many psychological disorders, such as depression, anxiety, substance abuse, psychosis, stress, and chronic pain (Hernandez-Lopez, Bricker, Montesinos, Luciano, & Roales-Nieto, 2009). Though these disorders differ in their functions, they all share a common feature being that the individuals with these disorders all try to reduce or control private aversive events, such as pain, cravings, anxiety, sadness, and delusions. Evidence suggests that this attempt to control may work in the short run; however, it is not a long-term alternative (Hernandez-Lopez, Bricker, Montesinos, Luciano, & Roales-Nieto, 2009).

ACT is suitable for wide range of populations and conditions. For instance; it can be suitable for conditions such as depression, social phobia, anxiety, chronic pain, drug use, weight control, workplace stress, smoking cessation, and much more (Harris, 2009).

Lopez et al. (2009) used a quasi-experimental design, where, in the ACT condition, the exercises used by clients concentrated on the individuals' motivations and values to quit smoking, on enhancing the willingness to experience urges to smoke, and on internal distress associated with being smoke-free. Forty-three individuals were allocated to the ACT group, and 38 individuals to the comparison condition (CBT). Each of the two treatments was delivered, once a week for 7 weeks, and each session lasted for 90 min. The authors concluded that ACT was just as feasible as CBT as a treatment for smoking cessation. ACT participants were satisfied with the treatment, attended sessions, practised the ACT techniques taught during treatment sessions regularly, and found the effects of the treatment satisfying. Although the CBT condition revealed similar treatment effects, it was found that the ACT condition produced a higher abstinence rate, which was 5.13 times higher than the CBT abstinence rate (Hernandez-Lopez, Bricker, Montesinos, Luciano, & Roales-Nieto, 2009).

In a CBT and ACT analysis it was noted that individuals who were allocated to the CBT condition displayed greater relapse rates, and it was also found that CBT was not as cost-effective as the comparison condition, ACT (Hernandez-Lopez, Bricker, Montesinos, Luciano, & Roales-Nieto, 2009).

Gifford et al. (2004) compared the effectiveness of ACT with NRT (Nicotine replacement therapy). They allocated 76 nicotine-dependent individuals to one of two treatment conditions (ACT vs. NRT). In spite of there being no differences between the people assigned to the two conditions at posttreatment, individuals who were in the ACT condition showed better long-term outcomes at a 1-year follow-up and enhancements were also revealed in participants' acceptance-related skills.

SmartQuit™.

SmartQuit™ is a mobile phone application based on Acceptance and Commitment Therapy principles, and compares well to all other smoking cessation apps. SmartQuit™ includes eight effective activities that provide techniques for dealing with urges to smoke cigarettes, other features of the app include; an urge counter, a counter for tracking urges that have passed, a calendar, an anytime coaching section, and a quit plan. Features such as accessibility, ease of use, use of evidence-based practice, and absence of physiological side effects, sets this app apart from others. However, further research is required to determine its efficacy. The underlying goal of SmartQuit™ is to teach individuals techniques to accept their urges, and over time, these urges fade. The programme begins by introducing users to a quit plan, which is completed before starting the activities within the app. This quit plan can be updated at any time, and it contains many personal questions which provide a basic understanding of the user's behaviours and attitudes toward smoking, along with their stress levels, and the amounts of money spent on smoking both daily and per packet. Following completion of the quit plan, the user tracks their urges to smoke on the app on a daily basis.

Alongside tracking urges, the user completes daily exercises. It is recommended that these daily exercises be completed more than once before moving to the next activity. There are total of eight exercises to complete and each time one activity is completed, another is unlocked. For every 10 urges recorded and for every activity completed, a badge is received. The app also includes a section for anytime coaching which includes stories of others, tips to manage urges, an 'ask a coach' section and many more areas. The quit date for smoking cessation can be reset before approaching the quit date, and after having quit, as a notification is

sent asking how the quit went and, if unsuccessful, the user is given the option to reset the date and try again.

QuitGuide®.

QuitGuide® was developed by smokfree.gov and released in 2010. This app can be accessed via a smartphone or computer and is free of charge, making it accessible and transparent in nature (ICF international, 2015). QuitGuide® is similar to SmartQuit™, which also has a counter for recording cravings to smoke, and provides guidance and strategies for how to both become smoke-free and maintain it, as does SmartQuit™ in the personalised quit plan. A factor that sets this app apart from SmartQuit™ is that QuitGuide® also features a mood tool, which is used when cravings are experienced, and the tips on the mood tool are used to manage the smoker's mood when they are experiencing a craving (ICF international, 2015).

Many features distinguish SmartQuit™ from QuitGuide®. For instance, QuitGuide® provides smokers with tips and skills to escape cravings to smoke cigarettes, these can be possibilities for replacement behaviours or keeping busy, information on FDA- approved medications, and encouragement for the smoker to dig deep and write a list of reasons for why they want to quit. Features these apps share in common include the widely available skills and tips for how to deal with slip-ups, and the feature of connecting to social communities for extra support, e.g. to share experiences and to read others' stories (Bricker et al., 2014).

Bricker et al. (2014) evaluated the effectiveness of SmartQuit™ with QuitGuide®, with a sample of 196 smokers randomly allocated to each of the conditions. Bricker and colleagues reported that the SmartQuit™ app was opened an average of 37.2 times, whereas, QuitGuide® participants only opened the

application 15.2 times. For participants assigned to the SmartQuit™ condition, acceptance of cravings increased after using the SmartQuit™. Results obtained from Bricker and colleagues pilot study demonstrated lower levels of adherence with the QuitGuide® app (Zeng, Vilardaga, Heffner, & Bricker, 2015). When compared with QuitGuide® (developed by the National Cancer Institute), individuals using SmartQuit™ accessed the app at significantly higher rates than those individuals who were in the QuitGuide® condition. Another major finding was that the quit rates were higher for individuals in the SmartQuit™ condition, which were 13%, whereas the quit rates for those assigned to the QuitGuide® condition were 8% (Zeng, Vilardaga, Heffner, & Bricker, 2015).

The Current Study

Gifford et al. (2011) suggest that, although most people want to quit smoking, only 50% try to quit and only a further 2.5% are successful every year. These statistics suggest that smoking cessation interventions with a new focus are required. While the already present smoking cessation interventions look to address the high prevalence of smoking, they do not fully incorporate factors such as evidence-based practice, accessibility, compliance, active support, and long-term smoke-free outcomes.

Using a single-subject, A-B-A-C design, I aimed to investigate the effectiveness of the SmartQuit™ app, based on ACT principles, with a New Zealand sample. I also aimed to determine whether scores obtained on the Commitment to Quit Scale would predict smoking outcomes at post-intervention, and follow-up phases. I expected that that participants would smoke fewer cigarettes after the intervention. Secondly, I hypothesised that those participants who obtained high scores on the Commitment to Quit Scale would have better

chances for smoking noticeably less than what they did during the baseline phase. Thirdly, as SmartQuit™ is ACT based, and the goal of ACT is to increase acceptance and willingness of internal experiences, I expected that acceptance levels (embracing internal experiences, e.g. thoughts, and feelings) would increase, and experiential avoidance (avoiding unwanted internal experiences) would decrease. Examining acceptance levels is of importance as the literature reviewed above shows that higher acceptance increases quality of life. Finally, I measured cravings, to see if they would change after the intervention.

A small-N, within-subjects design was used in this study. I chose this design, firstly because this meant that all subjects received the intervention. Secondly, inter-subject variability was reduced, as each subject served as his or her own control. Thirdly, this research design allowed repeated measures at baseline and post-intervention, thus providing stable assessments. Fourthly, there was no need for group percentages as the success of the intervention could be determined through individual characteristics (Butler, Sargisson, & Elliffe, 2011). Finally, this design allowed for flexibility in time, meaning that participants could work through the intervention at their own pace and take as much time as they needed.

Method

Participants

I recruited participants in response to fliers (Appendix A). I posted fliers primarily on social media, in newspapers, and in various tertiary institutions in the Waikato and Bay of Plenty areas. I also gave fliers and information sheets which described the research to various medical centres (Appendix B), and health practitioners were asked to recommend the SmartQuit™ programme to individuals wanting to quit smoking. The Heaviness of Smoking Index (HSI)

(Appendix C) was used to screen participants for the current study, and one participant was excluded because they obtained a score of less than four on this measure (a score of less than four falls in the no or little dependence range). A further two more individuals were excluded because they were using other smoking cessation tools in an attempt to stop smoking. These individuals were excluded so that the interventions they were using would not interfere with the intervention offered in the current study. Each participant was provided 6 months' free access to SmartQuit™, which usually costs \$60 when purchased from the app store. The study procedures gained ethical approval from the University of Waikato School of Psychology Ethics Committee (ethics approval number #15:40).

I determined selection and suitability into the current study using an eligibility survey (Appendix D). The requirements to take part in the study were; 1) participants had to be at least 18 years of age; 2) had smoked at least 10 cigarettes per day in the past 12 months; 3) had a score of four or higher on the (HSI); 4) wanted to quit smoking in the near future; 5) had access to a smartphone, that was compatible with the SmartQuit™ programme; and 6) they consented to not use any other interventions or medication throughout the intervention phase. Individuals were excluded if they were 1) under the age of 18 years; 2) obtained a score of less than 4 on the HSI; 3) presently seeking or undergoing psychological treatment e.g Cognitive Behavioural Therapy; 4) a non-English speaker; 5) using nicotine replacement products in an attempt to quit smoking; and 6) no access to a smartphone. Twenty-eight individuals expressed an interest in taking part in the current study. However, thirteen out of this 28 either declined to take part or did not respond further. Thirteen completed the

screening survey, and three were excluded for not meeting the study criteria. Ten individuals participated in the study (they did not receive course credit or any compensation for taking part) Five of the participants were female, and five were male. Participant ages varied (Table 1) and ranged from 25 to 54.

Table 1

Summary of Demographic Details for Participants Who Fully Completed the Study

ID	Sex	Age	Ethnicity	Daily cigarette intake	Number of years smoking	Number of quit attempts
1	M	33-44	Māori	20	5 years	3+
2	M	33-44	European/Pakeha	25	21 years	3
3	M	33-44	European/Pakeha	10 to 20	11 years	10
4	M	33-44	European/Pakeha	20	30 years	2
5	M	45-54	European Indian	20	17 years	3
6	F	45-54	Māori	10	30 years	10
7	F	25-33	European/Pakeha	10 to 20	11-12 years	2
8	F	25-33	European/Pakeha	20	12 years	1
9	F	33-44	European/Pakeha	8 to 14	20 years	8
10	F	33-44	European/Pakeha	10	30 years	5+

Apparatus

I provided participants with an information sheet, an eligibility survey, a consent form, and a series of questionnaires. These questionnaires were completed in the baseline phase and again at the post-intervention phase. I also gave participants notebook-sized journals, to record daily counts for cigarettes and cravings to smoke. To gain full access to the app used in this study, participants were provided with individual and unidentifiable login details along with a demonstration of how to use the smartphone app.

Measures

The Heaviness of Smoking Index (HSI).

The Heaviness of Smoking Index (HSI) is a 2-item measure, based on the FTND (Fagerström test for Nicotine Dependence) (Appendix C). Evidence suggests that these two items hold more predictive power in terms of quitting smoking behaviours, than the other items included in the FTND (Borland, Yong, O'Connor, Hyland, & Thompson, 2010). The summing of the two items provides a total score on this measure, with a score of four or higher being suggestive of high nicotine dependence. For the other category which is the heavy smoking category, the number of cigarettes per day must be 20 or more (Lim, et al., 2012). Internal consistency was evaluated by Etter (2005) and Cronbach alpha coefficients of 0.63 were reported.

The Cigarette Dependence Scale (CDS).

To assess nicotine dependence, I used the Cigarette Dependence Scale (CDS) (Appendix E). The CDS is a 9-item measure, which uses a 5-point Likert scale (Courvoisier & Etter, 2010). The scores on this scale range from 0-60, with higher scores on the CDS anticipating successful smoking cessation (Okuyemi, et al., 2007). The cut-off score for low cigarette dependence is a score of 12. The instruments covered in this measure are based on the definitions of dependence in the DSM-IV and the ICD-10 manual (Okuyemi, et al., 2007). The CDS has excellent reliability, demonstrated by its high internal consistency of .90 and moderately high test-retest reliability of $r = .84$ (Wittekind, Feist, Schneider, Mortiz, & Fritzsche, 2015). Etter (2008) compared the validity of the CDS with the Fagerström which is currently the most commonly used measure of nicotine dependence. Etter (2008) reported that the CDS had greater validity and reliability

when compared to the Fagerström. Etter also reported that the CDS had great internal consistency, greater content validity, and was a better predictor of withdrawal symptoms when compared to the Fagerström. Finally, it was noted that when compared to the Fagerström, the CDS was more sensitive to change over time.

Commitment to Quitting Smoking Scale (CQSS).

Motivation to quit smoking was a dependent variable in the current study, and without a strong motivation to quit, giving up smoking can be difficult. To assess this variable, I used the Commitment to Quitting Smoking Scale (CQSS) (Appendix F). The CQSS is an 8-item questionnaire and the items on this questionnaire are rated on a 5-point Likert scale, with one indicating strongly disagree and five indicating strongly agree. Scoring for this questionnaire is based on the total score and is calculated by summing the eight items (Kahler et al., 2007). Kahler and colleagues (2007) observed the psychometric properties of the CQSS in a sample of heavy drinkers, and they noted that this measure had high test-retest reliability, avoided ceiling effects, and the construct and content validity of this measure were immune from changing over time (Etter, Houezec, & Perneger, 2003; Kahler, et al., 2007). Kahler and colleagues (2007) also noted that this measure had good internal consistency, demonstrated by the Cronbach alpha value of .91 (Kahler, et al., 2007).

The Acceptance and Action Questionnaire (AAQ-2).

Acceptance was a key variable in this study and was measured by the Acceptance and Action Questionnaire (AAQ-2) (Appendix G). The AAQ-2 is a 7-item self-report questionnaire, designed to assess constructs such as experiential avoidance, acceptance, action, and immobility. This measure uses a 7-point Likert

scale to rate items, with one indicating never true and seven indicating always true. On this measure, a high score reveals excessive immobility and experiential avoidance and a low score reveals excessive action and acceptance (Ciarrochi & Bilich, 2006). The psychometric properties of this measure were evaluated by Bond et al. (2011), and this measure revealed good psychometric properties which were reflected by its good test-retest reliability of .81 for testing taking place at 3- and 12-month periods and also by its good validity and good reliability, reflected by the alpha coefficient value of .84.

Design

I used a single-subject, A-B-A-C design consisting of four phases, and each participant entered the study at different times. Phase A was the baseline phase, Phase B was the intervention phase, Phase A was the post-intervention phase, and Phase C were the follow-up phases.

Procedure

Pre-baseline.

Individuals who wished to participate contacted me via email, and information sheets detailing the research aims and procedures (Appendix H) were sent to these individuals. I emailed eligibility surveys to those individuals who responded to the information sheet with an interest to take part in the study (Appendix D).

Baseline (A).

During this phase, I arranged a time and place to meet with those individuals who had met the study criteria, and during this meeting informed consent (Appendix I) was obtained and queries that participants had about the study were answered. Also during this meeting, I asked participants to complete a

demographic questionnaire (Appendix J), and three brief measures were administered; one measured the level of nicotine dependence, one measured motivation to quit, and the other measured acceptance and mindfulness levels. Cigarette dependence was assessed by the CDS (Appendix E), the level of motivation to quit was assessed by the CQSS (Appendix F), and acceptance levels were assessed with the AAQ (Appendix G). I also provided each participant with a mini wallet-sized notebook that could be conveniently carried around. I asked participants to continue with their normal smoking behaviour and respond to cravings as they usually would, to write down each time they smoked a cigarette, and each time they experienced a craving to smoke. Once participants started recording data they informed me, and from that date onwards at the end of each day, I text messaged each participant for their daily counts for cigarette intake and cravings to smoke, during this period. Text messages were sent between 9pm and 11pm each day. The baseline phase stopped once consistent patterns of cigarette smoking could be seen. The duration of this phase varied for each participant and took from 3-21 days.

SmartQuit™ (intervention) (B).

Once participants had completed the baseline phase, they were asked if they were ready to begin the intervention. Each participant was provided with instructions to download the SmartQuit™ app, along with an individual unidentifiable login ID and password, to gain full access to the app, free of charge.

At the beginning of the programme, participants were provided with an introduction (Appendix K). Following this, participants completed a personalised quit plan, on the app, which could be updated at any stage of the programme

(Appendix L). Next participants used the urge tracker (Appendix M) to track their urges to smoke on a daily basis. Participants were also expected to complete daily exercises and there was a total of eight exercises to complete and each time one activity was completed, another was unlocked. A badge was received for every 10 urges recorded and for every completed activity. Once participants had completed all of the activities, then, the urge tracker was replaced with a tracker for counting urges that had passed (Appendix N). Participants used this tracker to count urges until they reached their quit date. If participants were not satisfied with the outcome of the intervention they were given the opportunity to try again (Appendix O), provided it was within six months of app access, as that was how long the app was available for. The length of this phase varied for each individual as it was dependent on how long it took participants to reach their quit date, and whether or not they reset their quit date. This period varied from two weeks up until 6 months.

During the intervention phase, I avoided contact with the participants so as not to interfere with the app. That is, I intended to measure the effectiveness of the app on its own, without additional interventions. Additionally, to ensure the app was being used on a regular basis I was given access by 2morrow, Inc. to an administrator's page (Appendix P), on which the activation date, progress and last activity of each participant could be viewed. I contacted those participants who had not accessed the app for a period of 7 days via text message or a phone call.

Post-intervention phase (A).

This phase took place immediately after completing the requirements of the app, which were completing all of the required activities and having reached the set quit date. This phase was similar to the baseline phase, as the notebook

was used again to record cigarette urges and/ or cravings and intake. Also during this phase, I met each participant, and I re-administered the CDS (Appendix E), CQSS (Appendix F) and the AAQ-2 (Appendix G). This was so that a comparison measure could be provided to compare whether SmartQuit™ had an effect on the frequency of cravings to smoke, the number of cigarettes smoked per day, and on acceptance and experiential avoidance levels. The duration of this phase took a maximum of 21 days, the period varying for each individual. Debriefing also took place within this phase, and participants were provided with the opportunity to ask any questions in regards to the nature of the research study.

Follow-up phase (C).

During this phase, participants were asked to complete two follow-up surveys (Appendix Q), which measured satisfaction with treatment and smoking outcomes. These surveys included open and closed questions, and all participants were asked about their experience with the intervention. Surveys were sent via email, and the first follow-up survey was administered a month following the completion of the app and the second follow-up survey was administered a month after the first follow-up survey.

Results

Five male and five female participants took part in this study. Participant characteristics are given in Table 1. The mean cigarette intake at baseline was 16.61 per day ($SD = 7.41$). The number of years individuals had been smoking cigarettes ranged from 5-30 years, and all participants had attempted smoking cessation prior to the current study.

Daily Cigarette Consumption

Figure 1 presents the daily cigarette intake for male participants taken at baseline and post-intervention plotted against the number of days for which cigarette intake was recorded.

Figure 1 shows that all male participants had high levels of variable cigarette consumption during the baseline phase. During the post-intervention phase, cigarette consumption for Participants 1 and 3 had neither increased nor decreased. Cigarette consumption for Participants 2 and 5 during the post-intervention phase decreased to zero, and a rapid decrease was seen for Participant 4 during the post-intervention phase. Overall, all male participants displayed high levels of cigarette consumption during the baseline phase, and during the post-intervention phase, three of the five male participants smoked notably less.

In Figure 2, daily cigarette consumption for female participants taken at baseline and post-intervention was plotted against the number of days taken to reach stable smoking patterns. Data for two post-interventions was plotted in Figure 2 (as one participant, Participant 9, relapsed after the first post-intervention phase, so data was taken twice for this participant).

Figure 2 shows that all female participants had high levels of cigarette consumption during the baseline phase, however, the number of cigarettes was lower than for male participants, both at the group and individual level. During the post-intervention phase, cigarette consumption levels for all female participants decreased by half and were close to zero. Consumption levels during the baseline phase were variable, and these levels were more stable during the post-intervention phase.

Also seen in Figure 2, Participant 9 successfully gave up smoking at post-intervention, but then relapsed, and although Participants 9 and 10 were only smoking two cigarettes per day during the follow-up phase, they did not achieve smoking abstinence again.

Intervention comparisons.

To evaluate the effectiveness of the intervention on cigarette intake, I conducted a paired-sample *t*-test with mean cigarette consumption data taken across baseline and post-intervention phases for all participants. There was a significant decrease between the mean cigarette intake before, $M = 16.61$, 95% CI [11.47, 23.42], compared to after, $M = 5.74$, 95% CI [0.90, 11.85]; $t(9) = 3.59$, $p = 0.01$, $d = 1.47$). The effect size of ($d = 1.47$) met Cohen's (1988) criteria for a large effect ($d = .80$). The significant difference indicates lower daily cigarette consumption at post-intervention.

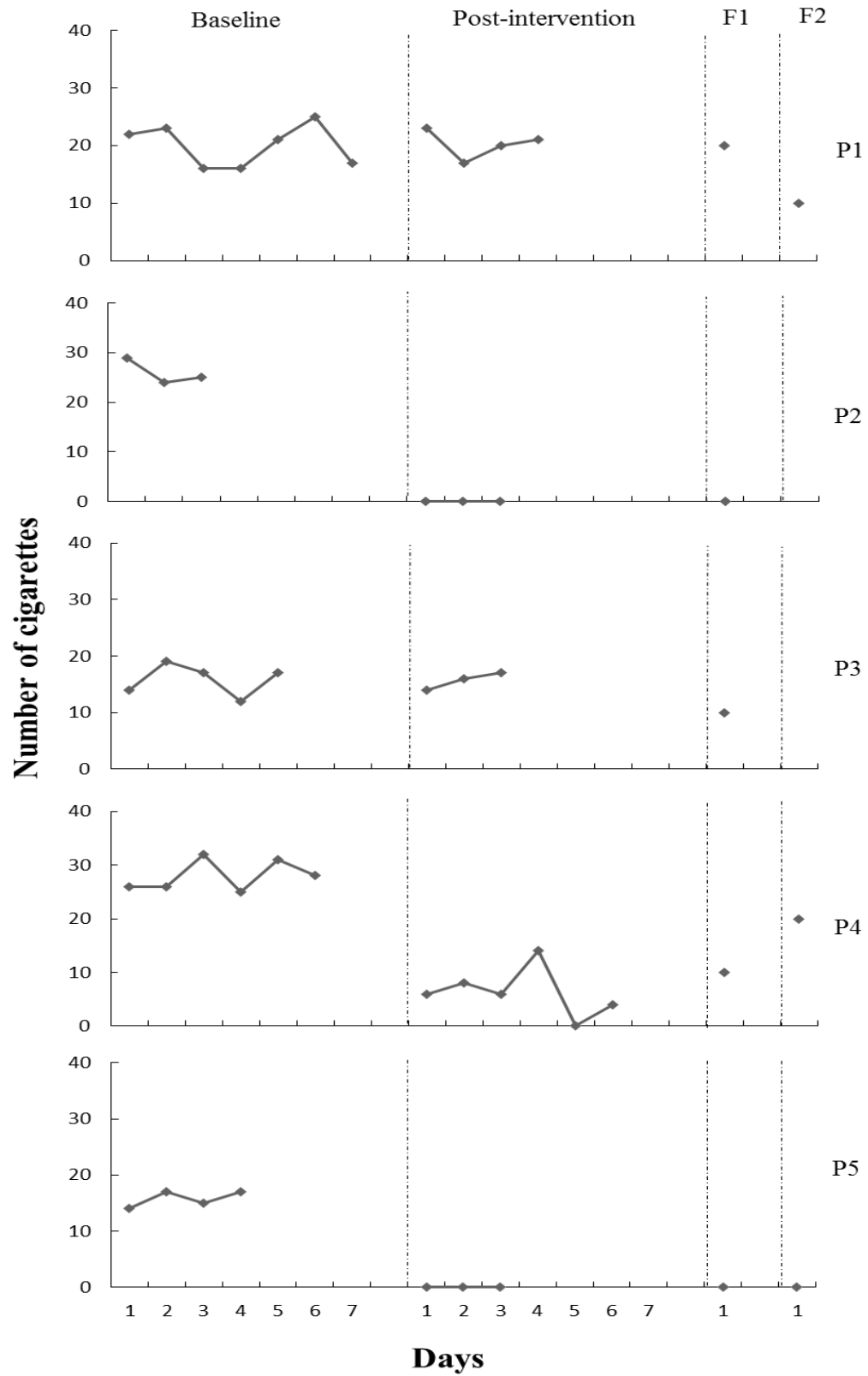


Figure 1. Daily cigarette smoking intake for male participants at baseline and post-intervention, and average data points taken during the follow-up phases.

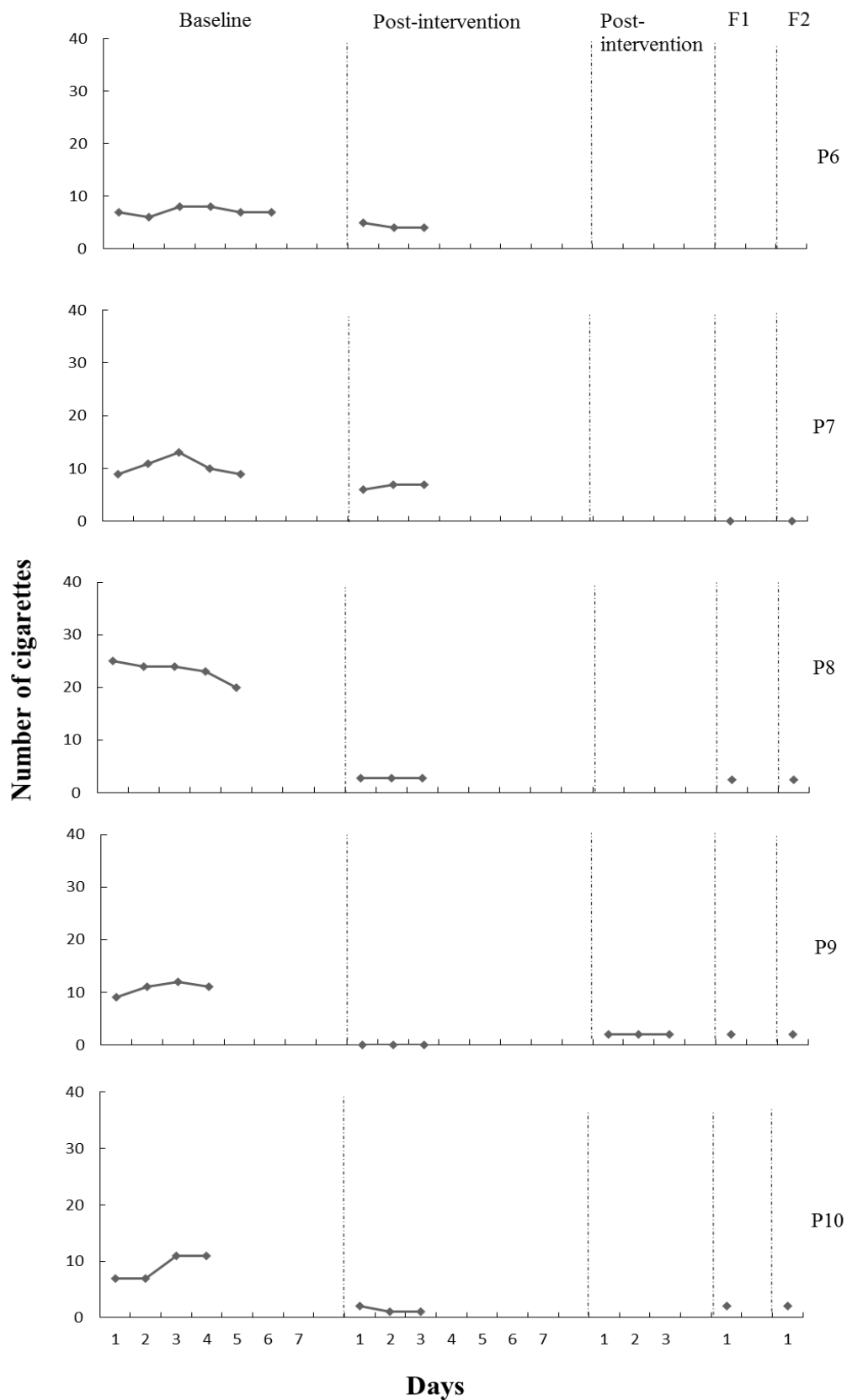


Figure 2. Daily cigarette smoking intake for female participants at baseline and post-intervention, and average data points taken during the follow-up phases.

Cravings to Smoke

Figure 3 presents cravings to smoke cigarettes at baseline and post-intervention for male participants. Participant 1 reported low levels of cravings to smoke at baseline, and during the post-intervention, their cravings increased and were greater than the cravings reported during baseline. For Participant 3, cravings to smoke during the baseline phase were intermittent, and although no change in the frequency of cravings was seen during the post-intervention phase, their cravings fluctuated less during the baseline phase, when compared to cravings reported at post-intervention.

Participants 2, 4, and 5 had variable cravings at baseline, and during the post-intervention phase, cravings to smoke for Participant 2 decreased slightly, and cravings to smoke for Participants 4 and 5 decreased by half. Overall, Figure 3 demonstrates that, during baseline, all participants had high levels of cravings to smoke, and following the intervention the frequency of cravings to smoke cigarettes decreased by almost half for three of the five male participants.

Figure 4 shows cravings to smoke cigarettes at baseline and post-intervention for female participants. Figure 4 reveals that, during the baseline phase, all of the female participants experienced irregular cravings to smoke, and a low frequency of cravings to smoke cigarettes. At post-intervention and follow-up, no obvious change was seen in cravings to smoke cigarettes.

Intervention comparison.

To evaluate the effectiveness of the intervention on the frequency of cravings to smoke cigarettes, I conducted a paired-sample *t*-test with mean cravings experienced across the baseline and post-intervention phases for all participants. There was a non-significant decrease between the mean level of

cravings to smoke before, $M = 14.18$, 95% CI [9.13, 19.23], compared to after, $M = 9.19$, 95% CI [5.44, 12.94]; $t(9) = 0.187$, $p = 0.09$, $d = 0.68$). The effect size for this analysis was large (Cohen1988). The lack of statistical significance can be explained by the low power.

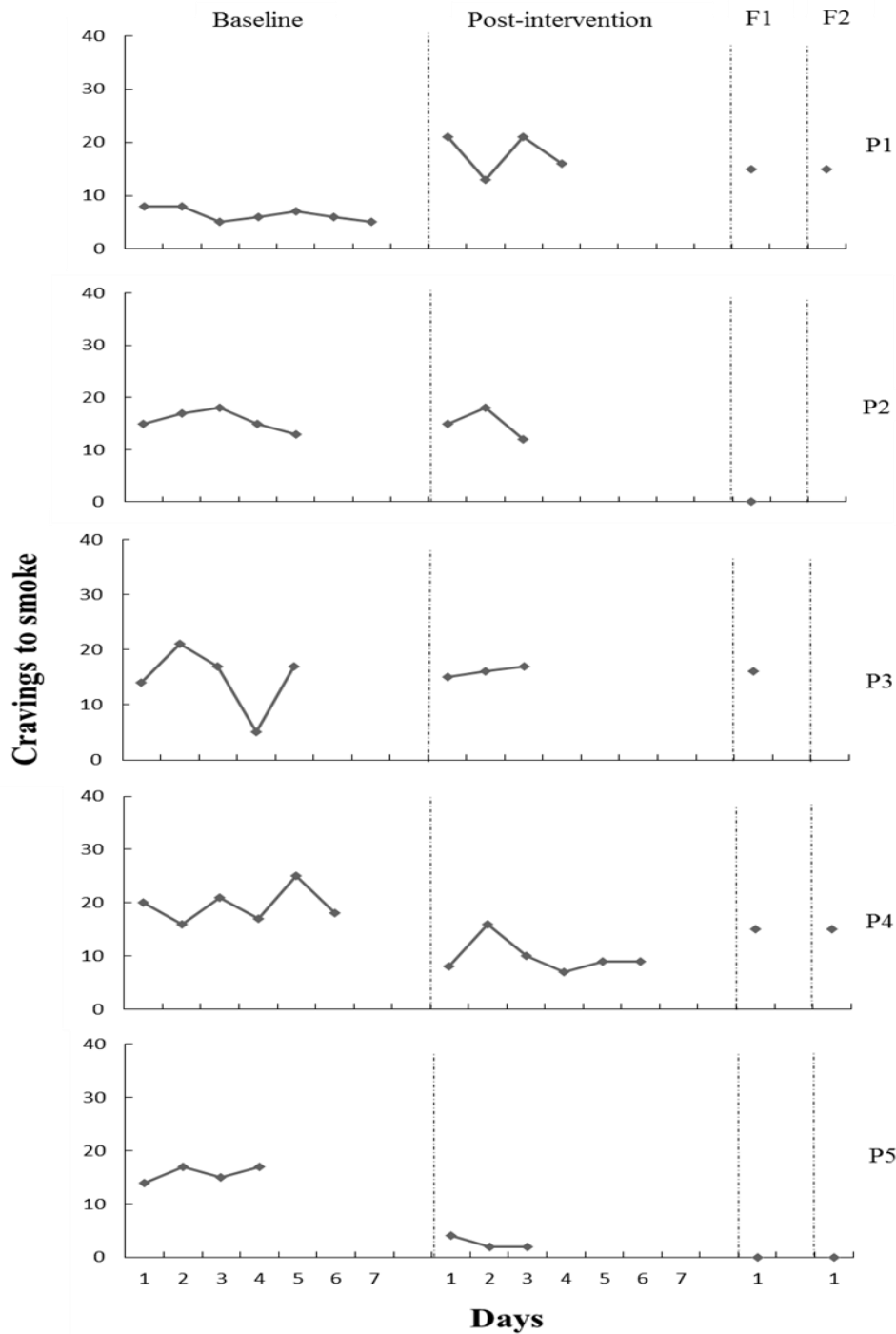


Figure 3. Cravings to smoke for male participants at baseline and post-intervention, and average craving data points taken during follow-up phases.

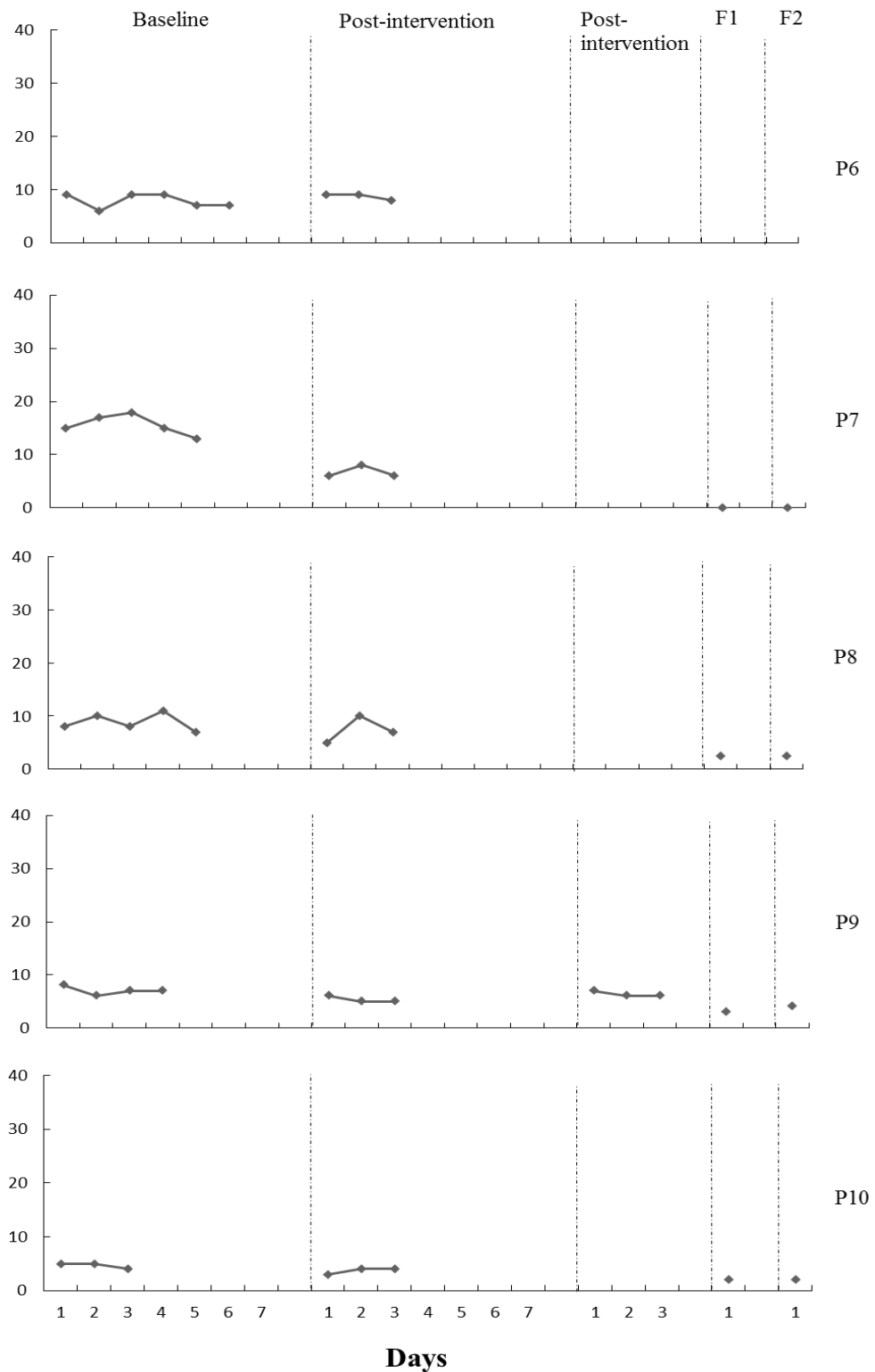


Figure 4. Cravings to smoke for female participants at baseline and post-intervention, and average craving data points taken during follow-up phases.

Cigarette Dependence Scale Scores

Figure 5 presents Cigarette Dependence Scale scores, for both female and male participants at baseline and post-intervention. CDS scores reflect low and

high levels of cigarette dependence, with higher scores on this measure indicating high dependence, and lower scores indicating low or no dependence. All participants had higher dependence scores during baseline, indicating greater cigarette dependence. Also seen in Figure 5, during the post-intervention phase, CDS scores decreased for all participants. For Participants 1, 6, 7, 3, 9, 4, and 5 the decrease in CDS scores between the phases was small. In contrast, the post-intervention CDS scores obtained by Participants 2, 8, and 10 were noticeably lower. Overall, Figure 5 shows that the mean CDS scores at baseline were relatively high, and during post-intervention these scores decreased, thus dependence decreased.

A paired-sample *t*-test showed a significant difference between the mean CDS scores before, $M = 49$, 95% CI [46.27, 51.73], compared to after, $M = 38.10$, 95% CI [31.08, 45.12]; $t(9) = 3.72$, $p = 0.005$, $d = 2.76$). The effect size for this analysis was large according to Cohen's (1988) criteria. The decline in CDS scores indicates lower levels of cigarette dependence at post-intervention.

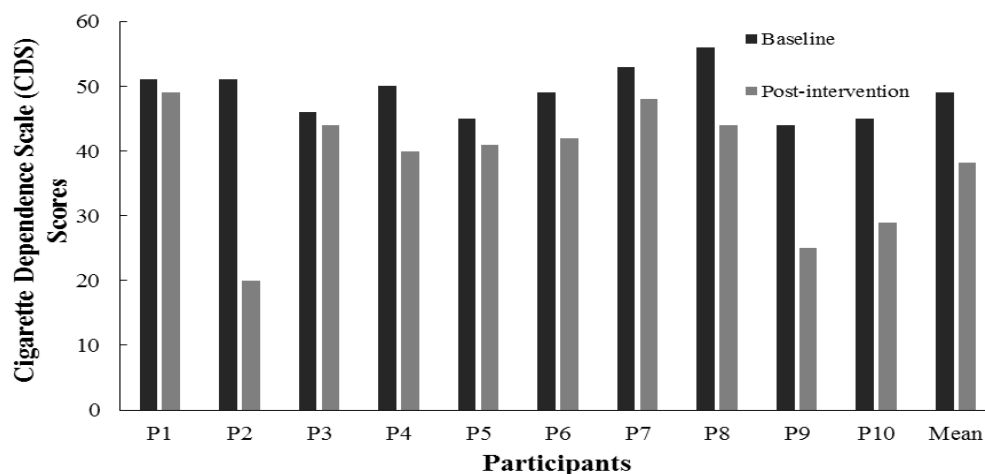


Figure 5. Individual and mean scores obtained on the Cigarette Dependence Scale at baseline and post-intervention.

Commitment to Quitting Smoking

Figure 6 presents the scores on the CQSS, for female and male participants at baseline and post-intervention. CQSS scores reflect the degree of commitment one has to quit smoking, with low scores on this measure indicating low commitment, and high scores indicating a high commitment to quit. Figure 6 shows fluctuations in CQSS scores. During baseline, Participants 1, 6, 3, 4, and 5 initially had obtained low scores on the CQSS, and during the post-intervention phase, CQSS scores for these participants increased. Also seen in Figure 6, Participants 2, 7, 8, and 10 obtained low scores during the baseline phase, and higher scores on this measure during the post-intervention phase.

A paired-sample *t*-test showed a non-significant difference between the mean CQSS scores before, $M = 29.40$, 95% CI [23.70, 35.10], compared to after, $M = 27.50$, 95% CI [21.64, 33.36]; $t(9) = 0.72$, $p = 0.49$, $d = 0.23$. The effect size for this analysis was found to meet Cohen's (1988) criteria for a small effect ($d = .20$). The decrease in CQSS scores indicates that individuals were less committed to quitting at post-intervention, and the difference was not statistically significant.

Acknowledging the small sample size, I conducted a regression to determine whether scores obtained on the CQSS at baseline predicted the number of cigarettes smoked at post-intervention. A regression model showed that CQSS scores were not a significant predictor for cigarette intake after the intervention ($F(1, 8) = .03$, $p = .86$, $R^2 = .04$). Given the small sample size, the chances for this regression being significant were unlikely, however, this regression still shows that with every increase of 1 in the commitment to quit score, participants are predicted to smoke 0.151 fewer cigarettes per day.

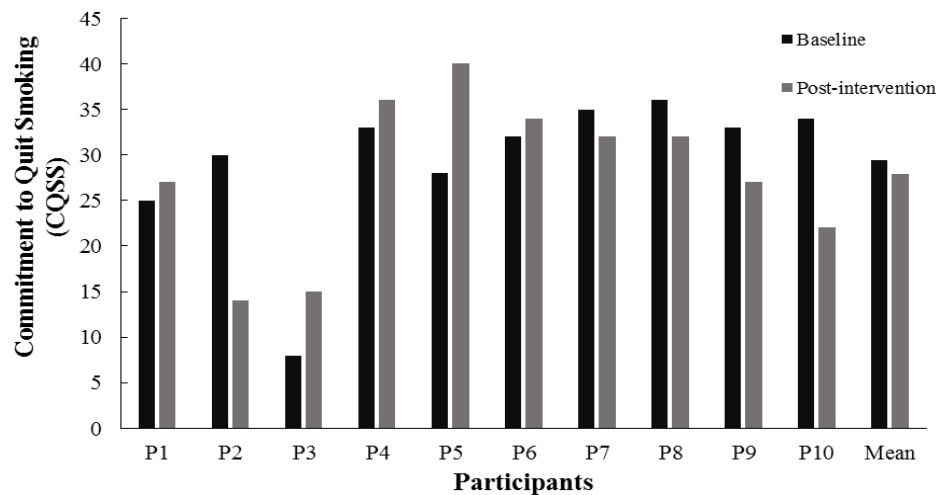


Figure 6. Individual and mean scores obtained on the Commitment to Quit Scale at baseline and post-intervention

Acceptance

Figure 7 presents the AAQ scores, for both female and male participants at baseline and post-intervention. AAQ scores reflect both psychological flexibility, and experiential avoidance, with low scores on this measure indicating high acceptance or psychological flexibility, and high scores indicating high levels of experiential avoidance. Figure 7 demonstrates that the scores obtained on this measure were variable. During the baseline phase, Participants 1, 2, 9, and 5 obtained low scores, and, during the post-intervention phase, these participants obtained scores that exceeded their baseline scores on this measure. Also seen in Figure 7, Participants 6, 7, 8, 3, 4, and 10 had decreasing scores from baseline to post-intervention.

A paired-sample *t*-test showed a non-significant difference between the mean AAQ scores before, $M = 21.80$, 95% CI [13.43, 30.17], compared to after, $M = 20.90$, 95% CI [13.71, 28.09]; $t(9) = 0.31$, $p = 0.76$, $d = 0.07$. The effect size for this analysis was found to meet Cohen's (1988) criteria for a small effect ($d = .20$). There was no correlation for AAQ scores with cigarettes smoked, and no

significant increases or decreases were seen for AAQ scores from first to last administration.

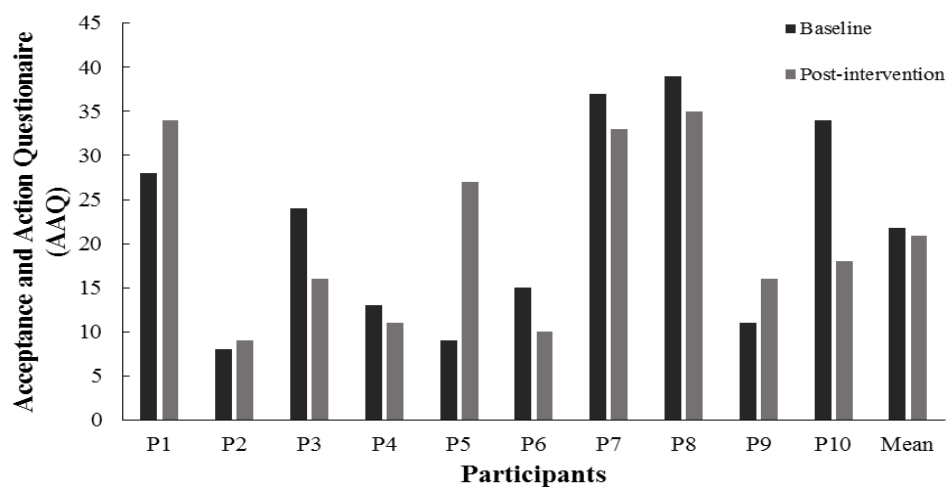


Figure 7. Individual and mean scores obtained on the Acceptance and Action Questionnaire at baseline and post-intervention.

The Effects of SmartQuit™ on Self-Report Measures

A series of correlations were carried out to assess the relationship between all of the measures used in this study, and the difference between baseline and post-intervention for number of cigarettes smoked per day, number of cravings per day, CDS scores, CQSS scores, and AAQ scores are plotted in Table 2.

Table 2 shows that the difference in cravings to smoke cigarettes is strongly related to the difference in cigarette intake, from baseline to post-intervention, and as cravings to smoke increased, cigarette intake decreased. The difference in cigarette dependence levels was significantly related to the difference in cigarette intake, from baseline to post-intervention, and as cigarette dependence levels increased, cigarette intake decreased. The difference in cigarette dependence levels were significantly related to the difference in cravings to smoke cigarettes from baseline to post-intervention, thus as cigarette dependence levels increased cravings to smoke also increased. A strong significant relation was found between the difference in CQSS and CDS scores

from baseline to post-intervention, so as commitment to quit levels increased cigarette dependence levels also increased.

A non-significant relationship was found between the difference in cigarette intake and CQSS scores, between cigarette intake and AAQ scores, between cigarette intake and AAQ scores, between AAQ and CDS scores, between AAQ and CQSS scores, between CQSS scores and cravings to smoke, between AAQ scores and cravings to smoke. Demonstrating that each of these variables were unrelated, and had weak correlations.

Table 2

Correlations for all Self-Report Measures

	Difference in intake	Difference in cravings	Difference in CDS	Difference in CQSS	Difference in AAQ
Difference in intake	1				
Difference in cravings	-0.72*	1			
Difference in CDS	-0.77*	0.52**	1		
Difference in CQSS	-0.38***	0.14***	0.83*	1	
Difference in AAQ	0.32***	-0.29***	0.11***	0.48***	1

***p< .005. **p< .05. *p< .10.

Engagement and satisfaction with SmartQuit™

Table 3 depicts each participant's overall engagement and progress with the smartphone app (SmartQuit™). The percentages in the progress column are based on the number of activities each participant completed. Those participants who completed all of the core requirements of the app gained a certificate of completion.

Although each of the ten participants entered the post-intervention phase, not all participants completed all of the requirements of the app and therefore did not receive certification. Table 3 shows that Participants 7, 8, 3, and 5 did not complete all of the activities provided in the app. However, two of these three

individuals successfully gave up smoking despite not completing all of the activities in the app.

Table 3 reveals that Participants 2,7, and 5 were all successful in quitting smoking. Also seen in Table 3, the length of time spent using the app varied for all individuals. The shortest time was 2 weeks and the longest 16 weeks. Of the three individuals who quit smoking, Participant 2 used the app for two weeks, Participant 7 used the app for 16 weeks, and Participant 9 used the app for 7 weeks.

Table 3

Summary of Details for Participant's Engagement with SmartQuit™

ID	Progress	Smoking status	Time using SmartQuit™
1	100%	Smoking	8 weeks
2	100%	Quit	2 weeks
3	45%	Smoking	2 weeks
4	Certified	Smoking	11 weeks
5	36%	Quit	7 weeks
6	100%	Smoking	4 weeks
7	86%	Quit	16 weeks
8	95%	E-cigarettes	2 weeks
9	Certified	Quit	25 weeks
10	Certified	Smoking	5 weeks

Satisfaction (follow-up measured at one and two month periods).

To assess smoking cessation, participants were invited via email to answer questions on their current smoking patterns. Eight of the ten participants completed two of the follow-up surveys, and two participants took part in neither of the follow-up phases.

During the follow-up phase, seven of the eight participants indicated that they had reset their quit date, the average time for resetting quit dates ranged between 1-4 times. Five of the eight participants relapsed at least once.

At the first follow-up, three participants had quit smoking, and they had maintained abstinence at the second follow-up. Participant 1 and Participant 3 had shown no change in smoking at post-intervention, and showed similar smoking intake at both follow-ups, therefore, no change took place. The five individuals, participants 4,6,8,9, and 10 who showed reductions in smoking intake at post-intervention but did not quit, reported low smoking rates at both follow-up phases as well, which suggests that these participants maintained their new smoking patterns.

Of the eight participants who completed the follow-up phases, six indicated that the SmartQuit™ programme was appropriate for them, and Participants 1 and 3 disagreed or were indecisive about this statement, and these were the only two participants to show no change in smoking intake following the intervention.

With the exception of Participant 3, all participants reported that their urges to smoke cigarettes had reduced, additionally one individual reported that their urges had ended completely. In contrast, Participant 3 reported that their urges had increased. During the second follow-up phase, Participant 7 had successfully quit smoking, and as a result reported that their urges to smoke cigarettes had ended completely.

With the exception of three participants, each participant was happy with their progress on the SmartQuit™ app. The three participants who were unhappy were Participants 3, 9, and 10. Participant 3 did not quit, and Participants 9 and 10

reported being unhappy as, although they were both smoking 2-3 cigarettes at post-intervention and during the follow-up phases, they expected to be smoking zero cigarettes but reported not being able to break the habit.

In the follow-up surveys, participants were asked to comment on aspects that they preferred the most and the least preferred about the app. Aspects that encouraged participants to use the app were as follows. The ease of use of the app; the pictures and tips included in the app, the techniques provided to manage cravings, ownership and accountability of urges, notifications, acknowledging urges and tracking the urges, and allowing urges to pass and tracking these on the urges that have passed tracker.

Least preferred aspects which triggered less app use included; the lack of clarity on when to complete each activity, the completion certificate not acting as a motivator or reward to continue app use or quit, the length of time it took to navigate through the app, that there was no way to track urges when driving or when phone was not in reach, the isolation (no friend or social aspect to feel connected), no locks on the exercises allowing them to be opened before having completed the previous exercises more than three times, and not being able to reset the urge counter and the urges-that-have-passed tracker.

When participants were asked what triggered them to use the app, two key themes were revealed: 1) receiving notifications, and 2) needing to record urges. They reported that the best strategies learnt from SmartQuit™ were learning how to identify urges, learning to take ownership of urges, and controlling these urges. Participants found the river, tug of war, and the urge monster exercises (Appendix Q) as the most useful for dealing with urges.

Five participants commented that no improvements were needed, and those participants who commented that there was room for improvements suggested the addition of voice activation as a way to engage with the app, an incentive such as a badge for smoke-free days, a lock on the exercises so that exercises could only be unlocked after a day or so of practicing the previous exercise, a peer aspect to feel connected, and a diary of accountability.

Individual Analyses

During this study, two participants stopped using cigarettes, and used alternative products instead. At post-intervention Participant 8 changed to e-cigarettes. At the second follow-up Participant 1 reported that they had changed to cigars.

Participants 2,7,9, and 5 quit smoking, and smoking abstinence was maintained by Participants 2,7, and 5 from post-intervention up until the second monthly follow-up, while Participant 9 relapsed shortly after the post-intervention phase, they managed to reduce their cigarette intake down to two cigarettes per day.

Although Participants 4, 6, 8, 9, and 10 did not quit smoking, they showed great reductions in their cigarette intake and were successful in maintaining these reductions in the follow-up phases. Participant 1 and 3 showed no changes whatsoever in their smoking intake.

Figure 5 shows that each participants score achieved on the CDS decreased from baseline to post-intervention. Thus, overall cigarette dependence decreased.

Figure 6 shows that there was a lot of variability in CQSS scores from baseline to post-intervention. For Participants 1, 6, 3, 4, and 5 commitment to quit

increased. Whereas, commitment to quit levels for Participants 2,7,8, 9, and 10 decreased.

Figure 7 shows that scores on the AAQ measure slightly increased from baseline to post-intervention for Participants 1, 2, and 9, and for Participant 5 the AAQ score increased from 9 to 30. For Participants 6, 7, 8, 3, 4, and 10 the AAQ scores decreased. Table 2 shows that there was no correlation between AAQ scores and a decrease in cigarette intake, and there was no correlation between AAQ scores and cravings to smoke cigarettes at the group level.

Summary of Outcome Measures

To summarise, cigarette intake and cigarette dependence levels significantly decreased but cravings to smoke did not decrease to a significant extent. Although most people were happy with the app, some suggestions for improvements were reported.

Discussion

My aim was to examine whether SmartQuit™ would be a successful treatment for smoking cessation with a New Zealand sample. Firstly, I hypothesised that SmartQuit™ would lead to a decrease in daily cigarette intake. Secondly, I hypothesised that those participants who obtained high scores on the Commitment to Quit Scale would have better chances for smoking noticeably less than what they did during the baseline phase. Thirdly, as SmartQuit™ is ACT based, and the goal of ACT is to increase acceptance and willingness of internal experiences, I expected acceptance levels (embracing internal experiences, e.g. thoughts, and feelings) to increase, and experiential avoidance (avoiding unwanted internal experiences) to decrease. Finally, I measured cravings to smoke, to see if they changed after the intervention.

Overall, the data suggest that SmartQuit™ is effective at reducing cigarette intake, decreasing experiential avoidance, increasing acceptance, and helping quit smoking. I will discuss these findings below.

Daily Cigarette Consumption

The effects of the acceptance-and-commitment-based smoking cessation intervention (SmartQuit™) were examined and noticeable reductions in cigarette intake and cravings to smoke were apparent. The average number of cigarettes smoked decreased from 16.6 to 5.74 per day, and the average number of cravings to smoke decreased from 14.8 to 9.19 per day. Eight of the ten participants had reduced their cigarette smoking levels at post-intervention. Three were no longer smoking during the post-intervention phase. At each of the two monthly follow-up phases, the three individuals who had quit had maintained abstinence. Thus, SmartQuit™ was effective overall in reducing the number of cigarettes smoked.

As expected, the results indicated a significant reduction in cigarette intake at the group and at the individual level, as most individuals revealed a change, this finding was further supported by its large effect size.

Consistent with my findings, Bricker and colleagues (2014) also reported reductions in cigarette intake and an increase in smoking abstinence for participants who used SmartQuit™, Bricker and colleagues included a comparison app (QuitGuide®), and individuals assigned to SmartQuit™ had higher quit rates than those who used QuitGuide®. Also consistent with my findings Brewer et al. (2011) found reductions in cigarette intake at post-intervention, using Mindfulness Training, and these reductions were maintained during the follow-up phase.

Cravings to Smoke Cigarettes

Previous research evaluating mindfulness practice has suggested that individuals learn to respond to cravings with awareness, and not automatically respond to cravings (Marcus & Zgierska, 2009). In striking contrast, Cognitive Behavioural Therapy focuses on attempting to reduce the number and intensity of cravings, through teaching clients to distract themselves from the cigarettes, and through cognitively restructuring thoughts associated with cravings to smoke (Forman, et al., 2007). Therefore, the focus of CBT-based approaches is to decrease and eliminate cravings, whereas, ACT-based approaches focus to help clients accept and not act on cravings, and under this approach cravings may or may not decrease. Given that the focus of ACT is not necessarily to decrease cravings, I examined the direction of the number of the cravings to smoke at post-intervention.

From baseline to follow-up, the number of cravings to smoke cigarettes reduced, although not significantly, and cravings ended completely for those individuals who had quit smoking. With that said, given the reduction in cigarette use, one may also expect that cravings would be higher at post-intervention. This was not the case in the current study, possibly because the mindfulness-based exercises provided in SmartQuit™ assisted participants to become more accepting of their cravings, and to let these cravings pass as opposed to giving in to them and smoking cigarettes.

Cigarette Dependence

I used the Cigarette Dependence Scale to assess the level of cigarette dependence. Scores achieved on the Cigarette Dependence Scale significantly decreased over the intervention. The decrease in cigarette dependence is evident at

both the group level, suggesting that after using the intervention, participants were less dependent on cigarettes. To the best of my knowledge, the current study is the first to have used the Cigarette Dependence Scale as a tool to assess cigarette dependence at post-intervention, as previous studies have used the CDS to assess smoking outcomes at baseline only.

I found no relation between cigarette dependence and a reduction in cigarette intake. Nor did the CDS predict smoking intake.

Caponnetto and Polosa (2008) suggested that individuals who obtain scores of greater than seven on the FTND are less likely to succeed, due to being more likely to experience early relapse and intense withdrawal symptoms. Thus, excessive cigarette dependence levels can hinder success and make it harder to quit. High cigarette dependence levels may have hindered success in the current study, as only individuals with high cigarette dependence were recruited.

Girma, Assefa, and Deribew (2010) when assessing intention to quit, found that as the level of nicotine dependence increased, the likelihood for successful smoke-free outcomes decreased (Girma, Assefa, & Deribew, 2010; Lund, 2015). They also reported that individuals who had high levels of cigarette dependence had no intention to quit, thus cigarette dependence is not the only important factor, as the intention and commitment to quit also plays an important role. However, Borland and colleagues (2010) noted only moderate support for the possibility that higher levels of cigarette dependence predisposed individuals to relapse. Thus, it is possible that dependence levels were not the only factor that may have influenced treatment outcomes.

Commitment to Quit Scale

I expected that participants with higher scores on the Commitment to Quit Scale during the baseline phase would have better smoking outcomes, however, this was not the case. Commitment to Quit scores did not predict smoking outcomes, and those individuals who did successfully quit smoking did not score higher on the Commitment to Quit Scale than other participants who did not quit.

At the group level commitment levels decreased, however, this was not the case at the individual level, as scores for two of the three individuals who quit decreased, and two showed no change in smoking patterns, both receiving the lowest scores on this measure during the baseline phase. Thus, although higher scores did not predict successful outcomes, lower scores revealed an association with unsuccessful outcomes. These findings give rise to the idea that perhaps CQSS scores need to be above a certain level for someone to be successful in quitting. High levels of commitment to quit would make sense, given how hard it is to stop smoking. For one participant (Participant 3) the low CQSS score was related to the period of time they spent engaging with the app, which was 2 weeks, and was one of the shortest periods. There was also an association with how often this participant engaged with the smartphone application, which was once per day. For Participant 1, I found no relationship between the low CQSS score and length of time spent engaging with the SmartQuit™ programme, or how frequently they opened the application. That being said Participant 1 had difficulty engaging with the app and did have periods where they stopped using the app as a result. The same was found for Participant 3 who also found the application difficult to navigate. Daily app use for Participant 1 was also relatively low as was the case for Participant 3, with daily app use at twice a day, whereas all other

participants used the app from 3-20 times a day. Also, these two individuals were the only two to disagree with the statement asking whether SmartQuit™ was appropriate for them.

Psychological theories propose that motivation to quit predicts successful smoking cessation. Borland and colleagues (2010) examined whether motivation had a predictive relationship in quit attempts, and in abstinence. They concluded that although motivational factors played a role in encouraging individuals to initiate action to quit smoking, motivational factors did not serve as predicting variables for quitting smoking and abstinence (Borland, et al., 2010). Borland et al. also suggested that both quitting smoking and maintaining smoke-free outcomes is not a matter of commitment only, and also applies to volitional control. Thus, a number of other factors were also required.

Kahler et al. (2007) reported a significant increase in commitment to quit smoking scores at quit date, and these higher levels of commitment were linked with greater smoking odds, at post-intervention, 16, and 26 weeks following participants' quit dates. They also reported that the CQSS measure predicted smoking outcomes at post-intervention over and above cigarette dependence level, the importance of quitting, and self-efficacy for abstinence.

Kale, Gilbert, and Sutton (2015) found that motivation may not successfully predict smoke-free outcomes, as those individuals who have high levels of motivation to quit smoking are usually those who are strongly addicted to nicotine, as, in spite of having a strong desire to quit smoking, they persist in smoking. It was then concluded that a high level of motivation to quit serves as a prompting factor to initiate quitting, rather than as a factor for maintaining abstinence, and they instead concluded that the level of cigarette dependence is

more important for smoking abstinence, particularly lower cigarette dependence levels.

Acceptance

Acceptance is a central component of ACT, with high levels of acceptance suggesting that individuals are no longer engaging in avoidant and control strategies in an attempt to reduce their internal experiences. I expected that acceptance levels from baseline to post-intervention would decrease. I measured this hypothesis with the AAQ. The intervention comparisons support the hypothesis, however, the decrease in AAQ scores was non-statistically significant. The effect size for this analysis ($d = 0.07$) was found to meet Cohen's (1988) criteria for a small effect.

Scores obtained on the AAQ measure were of importance in this study, as lower scores on this measure indicate high acceptance, and higher scores on this measure indicate high experiential avoidance. For the purposes of this study, higher acceptance relates to quitting success, as it means that participants were more accepting of internal experiences. In contrast, prior to the intervention participants obtained higher scores on the AAQ thus indicating that they were avoiding internal experiences. With the focus of both the framework of ACT, and the framework of the app being on increasing acceptance, and decreasing experiential avoidance, this finding was very important, in spite of the difference being non-significant. The reason for the reduction in acceptance levels not being significant could be attributed to the small sample, and the large variance in scores,

At the individual level, those individuals who had obtained low scores on the AAQ measure during the baseline, scored high during the post-intervention,

and those individuals who obtained high scores during the baseline phase obtained low scores at post-intervention. This is an example of regression to the mean, whereby when measured again, extreme scores are closer to the mean (Bland & Altman, 1994).

Beharry (2008) in her study on the use of ACT to target public speaking reported that the mean AAQ scores had significantly decreased when the AAQ was administered last, following the intervention. Gifford et al. (2004) also found a decrease in experiential avoidance, and an increase in acceptance. Using SmartQuit™, Bricker et al. (2014) also reported that acceptance increased over the course of the intervention. They also found that participants who obtained low scores on the AAQ at baseline had better smoking outcomes (smoked less). However, the second finding was not found in the current study. Finally, Farriss, Zvolensky, DiBello, and Schmidt (2015) also reported higher acceptance levels. The findings of the current study were somewhat comparable with the findings from these studies, as these studies also noted an increase in acceptance and a decrease in experiential avoidance, however, these studies found a significant increase whereas I did not. Overall, I found an increasing trend in acceptance levels, and a majority of studies also favour this upward trend. Thus treatment outcomes for smoking cessation may be associated with ACT based change.

Lacaille and colleagues (2014) in evaluating the effects of mindfulness skills on chocolate cravings mentioned that individual differences may influence individual abilities to learn the content offered by acceptance and commitment based therapies and that changes in acceptance cannot be attributed to the intervention. In respect to the current study, it could be that participants understood the intervention to different degrees.

The aim of ACT is not to eliminate or reduce the number of cravings to smoke cigarettes or relieve the distress produced by cravings. Rather the goal of acceptance-based strategies is to foster readiness to experience what cannot be controlled, while promoting behaviour that aligns with the desired goal. In respects to smoking cessation, the goal is not to change and avoid cravings but rather notice and accept cravings to smoke (Forman, et al., 2007). Therefore, the success of the SmartQuit™ program is not determined or dependent on whether cravings to smoke increase, decrease or remain constant.

Engagement with SmartQuit™

When selecting a quit date at the beginning of the programme, a 7-14-day period was suggested. In the current study, all of the participants with the exception of one found this timeframe to be unrealistic, as each participant reset their quit date.

The length of time spent engaging with the app, and the number of exercises completed on the application, were unrelated to whether someone was successful or not.

Two participants who had not completed all of the exercises provided in SmartQuit™ gave up smoking and maintained abstinence. This suggests that not all of the activities are required and what is required is techniques and exercises that work with the user. However, a clinical trial revealed that those individuals, who completed all of the requirements of SmartQuit™, were 10 times more likely to quit smoking, compared to those individuals who did not complete all of the requirements (Bricker, et al., 2014).

Also within the follow-up phase participants informed me of the exercises which were the most and least effective. The urge monster, the tug of war, and the

river exercises were reported as being the most useful. Instead of reporting which exercises were less useful, participants reported less useful aspects of the app instead. Therefore, there were no exercises that were thought as being less useful. The least preferred aspect of SmartQuit™ was that all eight of the exercises were readily available, in spite of the instructions suggesting that each exercise should be practiced two to three times before moving to the next exercise. Participants mentioned that for future users these exercises should be locked, and should be accessible on completing the previous exercise for the recommended two to three times. Good aspects of the app were ownership of urges to smoke, and tips on how to deal with urges to smoke. Bad aspects of the application were time to navigate through the application and having no lock on exercises.

Strengths

There were several advantages of using a small-N, within-subject design. Firstly, there was no control condition, so all participants received the intervention and they each acted as their own control. Secondly, inter-subject variability was reduced. Thirdly, repeated measures allowed for stable assessments. Fourthly, individual characteristics could be used to determine the success of the intervention (Butler, Sargisson, & Elliffe, 2011). Fifthly, a strength for using a single subject design is its ability to cater to individual needs, for instance, individuals could take as long as they needed to complete the intervention. Sixthly, it was easier to keep environmental variables constant both across participants, and conditions, and the effects of the intervention were observed relatively early. Finally, with individuals entering baseline and treatment conditions at varying stages, daily changes in behaviour could be observed first

hand, and if changes needed to be made, then there was time to make them early on in the study (Barker, Pistrang, & Elliot, 2002; Bryman, 2008).

To measure daily smoking consumption, cravings to smoke, cigarette dependence, commitment levels, and acceptance and action levels, self-reported data were used. Self-reports help make phenomenological information available, which are otherwise unavailable, such examples include individual experiences and idiosyncratic states (Bryman, 2008).

In the present study, I was present at the time at which the questionnaires were completed. Thus, I addressed any difficulties faced with answering the questions, I checked questionnaires after completion for missing data, and I was aware that the questionnaires were completed by the right person.

A strength of delivering interventions through smartphones is the availability of the intervention for individuals. More so, the exercises provided in SmartQuit™ provided autonomy and freedom to participants, as the exercises were self-paced, and structured to meet the needs of each participant.

Limitations

Limitations of the current study must be acknowledged. Firstly, majority of the data were self-reported. Self-reported data can be problematic in that there is potential for integrity to be compromised because individuals may be lying or mistaken, lack the words required to express their responses, and their responses may be exaggerated (Barker, Pistrang, & Elliot, 2002). Some of these self-report data limitations were avoided, as I was present when participants completed the questionnaires, and this provided participants with the opportunity to ask any questions.

As outlined by Bryman (2008) there are several disadvantages for self-completed questionnaires, for one, self-completed questionnaires prevent researchers from prompting, and probing for more information. Secondly, self-completed questionnaires are not appropriate for all respondents. Thirdly, self-completed surveys do not allow additional data to be collected. Fourthly, self-completed surveys pose a risk for missing data, and difficult questions, and finally, there is no knowing who completed the questionnaires.

Another issue could be that asking participants to record their intake and cravings to smoking may itself have lowered smoking and craving rates, as when we are asked to track our behaviour, we have a tendency to attempt to make the behaviour seem more socially acceptable as we are aware that someone will see it (Donaldson, & Grant-Vallone, 2002). Future research could look into using objective measures of smoking in addition to self-report.

Secondly, the sample size of 10 participants was relatively small, and having a small sample size means that the effects of the intervention may be hard to generalise. However, recruiting a large sample would have been difficult. I note that while results failed to meet statistical significance, small-N designs are typically subject to graphical analysis. Freeman and Tyrer (2006) suggest that although the common approach for group studies is to use inferential statistics for analysing the effectiveness of treatment, visual inspection of graphs is enough, as each participant in a small-N design are assessed both frequently and intensively, so the effect is probably real, and thus there is no need for inferential statistics or significance.

Thirdly, a lot of the discussion about the SmartQuit™ program took place after the questionnaires in the post-intervention phase was completed. This is

problematic because these discussions were not recorded, thus they could not be included in the results. However, these conversations did provide an insight into participant's thoughts on the SmartQuit™ program. Future research could consider interviewing participants to capture this data.

Finally, while a large number of participants initially expressed an interest to partake in the current study, only 10 completed the intervention, as the other 18 either did not meet the criteria of the study, declined to take part in the study, or did not start the study. Factors that may have influenced dropout include commitment and motivation (Branstetter, Horn, & Zhang, 2009). Sidani (2014) stated a low readiness to quit, and schedule conflicts as factors for pre-inclusion attrition. Factors such as health, their appraisal of the treatment, and feeling they may not be meeting the study requirements were reported to influence post-inclusion attrition. Curtin et al. (2000) noted that dropout rates were higher in pre-inclusion at 30-50%, and for post-inclusion, the dropout rate was 10-50%. In my study, a higher attrition rate was observed at pre-inclusion as well. Future research could look into contacting the people who did not take part and ask them why.

Research on smoking cessation using an ACT framework and smartphones could be extended by including smokers with low cigarette dependence and low commitment to quit, as literature suggests that individuals who score higher on these two measures face better smoking outcomes (Rohsenow, Martin, Tidey, Monti, & Colby, 2013). I excluded individuals with low scores from the current study, thus no comparison could be made with individuals who have high scores on these measures. Future research could also compare SmartQuit™ to another smoking cessation method, measure cravings for a longer period to assess whether smoking abstinence reveals a decrease in cravings over time.

Conclusions

Using a single subject A-B-A-C design I explored whether SmartQuit™ would be a useful treatment for smoking cessation for a New Zealand population. Following the SmartQuit™ programme, participants smoked fewer cigarettes, reported fewer cravings to smoke, and had lower scores on the Cigarette Dependence Scale (lower cigarette dependence). However, the Commitment to Quit Scale did not predict smoking outcomes. Overall, the findings of the present study support SmartQuit™ as a good option for smoking cessation.

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Appendix A

Poster



Stopping smoking using SmartQuit™

Are you a smoker who would like to quit smoking? Are you 18 years of age or older? Do you smoke more than 10 cigarettes a day? Do you own a smartphone? If this sounds like you, then put that cigarette down and contact me via email on: sks42@students.waikato.ac.nz where you will find out more about the study.

I will investigate the effectiveness of the use of ACT (Acceptance and Commitment Therapy), with a particular focus on reducing cigarette cravings and intake. Participation will involve taking part in 5 phases, in which I will ask you to record your smoking urges and intake, complete brief questionnaires, and download SmartQuit™ (free of charge).

My name is Satvir Singh and this research is a part of my Master of Social Sciences degree, supervised by Dr Rebecca Sargisson and Dr Nicola Starkey. This research will be supported by 2Morrow, Inc. and has received ethical approval from the School of Psychology Research and Ethics committee, University of Waikato.

Appendix B

University of Waikato
School of Psychology

INFORMATION SHEET- STOPPING SMOKING USING SMARTQUIT™ FOR HEALTH PRACTITIONERS

My name is Satvir Singh, and I am a Master's student at the University of Waikato. I would like to talk to you about my research study. I require your help with discussing and actively promoting my research study with clients at your health care centre.

About this study

I seek to not only recruit participants from the general public but also to undertake socially just research, by ensuring that Māori individuals and Māori perspectives are included in each phase of this programme. Research shows that Māori are highly represented in smoking statistics (Glover, Fraser, & Nosa, 2012). Therefore, as a group, Māori may benefit from smoking cessation interventions.

Within this study I will test the effectiveness of a smoking cessation smartphone application (SmartQuit™), which is based on acceptance and commitment therapy principles, at reducing smoking craving and cigarette consumption. This will be achieved through five phases. I expect that the results will be consistent with those of Bricker and colleagues (2014) who found this smartphone app to be highly effective in reducing cravings, urges and the number of cigarettes smoked.

Information about the smartphone app (SmartQuit™)

SmartQuit™ was developed by Johnathon Bricker in 2014. Which is an evidence-based smartphone application that uses acceptance commitment therapy techniques as a means of delivering smoking cessation. The underlying goal of SmartQuit™ is to teach individuals techniques to deal with and accept their cravings and urges to smoke. This app differs from other smoking cessation apps in that it goes beyond tracking how many cigarettes have been smoked and instead tracks urges to smoke cigarettes.

SmartQuit™ will be offered free of charge within this study for six months for each participant and can be used at the person's own pace. The programme begins with an introduction and access to a personalised quit plan, which can be updated at any time of the programme. Following the quit plan, the user tracks their urges to smoke on a daily basis. The user is also expected to complete daily exercises. There is a total of eight exercises to complete and each time one activity is completed, another is unlocked. Additionally, for every 10 urges recorded and for every activity completed, a badge is received. The app also includes a section for anytime coaching which includes; stories of others, tips to manage urges and ask a coach section.

Do you know of any clients that meet these criteria?

The requirements to partake in the study will be as follows; 1) 18 years of age or older, 2) must smoke more than 10 cigarettes per day in the past 12 months, 3) they must want to quit smoking in the near future, 4) they must have access to a smartphone, that is compatible with the smartphone app (Smart Quit), 5) they must consent to not use any other interventions or medication throughout the experimental phase, and 6) they must agree to partake in the follow-up phase and complete the follow-up surveys.

If you know of clients that meet the criteria mentioned here and have expressed an interest to quit smoking, then could you please mention my study to them, and if it sounds interesting to them then have them contact me on the details mentioned below.

Kind regards,

Researcher: Satvir Singh
Department of Psychology
University of Waikato
sks42@students.waikato.ac.nz

Here are details for both of my supervisors as well as the convenor of the ethics committee. Feel free to contact myself or my supervisors if you have any further questions regarding the nature of the research. Also, should you have any concerns about the ethical conduct of the researcher then please feel free to contact James Mc Ewan.

Supervisor: Doctor Rebecca Sargission
School of Psychology
University of Waikato
Email: rebeccas@waikato.ac.nz

Supervisor: Doctor Nicola Starkey
School of Psychology
University of Waikato
Email: nstarkey@waikato.ac.nz

This research project has been approved by the School of Psychology Research and Ethics Committee of the Faculty of Arts and Social Sciences, University of Waikato. Any questions about the ethical conduct of this research may be sent to the convenor of the Research and Ethics Committee (currently Dr James McEwan, phone 07 838 4466 ext. 8295, email: jmcewan@waikato.ac.nz)

Support of this study

This research study will be supported by 2Morrow, Inc.

Appendix C

The Heaviness of Smoking (HSI)

The heaviness of smoking index consists of FTND item 1 and item 4, using the same response scales and calculating the total score using the sum on those two items.

- 1) How soon after you wake up do you smoke your first cigarette?
 - a) Within 5 minutes
 - b) 5-30 minutes
 - c) 31-60 minutes
 - d) 60+ minutes

- 2) How many cigarettes do you smoke?
 - a) 10 or less
 - b) 11-20
 - c) 21-30
 - d) 31 or more

Appendix D
Eligibility Survey

Please circle the response that best applies to you.

1. How old are you
15-24 25-34
35-44 45-54
55-64 65+

2. Indicate the number of cigarettes you smoke per day in the past 12 months;
0-10 11-20 21-30 31 or more

3. How soon after waking up do you smoke your first cigarette?
Within five minutes 6-30 minutes 31-60 minutes After
60 minutes

4. Do you want to quit smoking in the near future?
Yes
No

5. Do you have access to a smartphone?
Yes
No

6. Are you currently using medication or an intervention (e.g nicotine replacement products) in an attempt to quit smoking?
Yes
No

7. Can you speak and understand English?
Yes
No

8. Are you currently seeking or undergoing psychological treatment?
Yes
No

9. Have you been diagnosed with a psychotic or affective disorder?
Yes
No

Appendix E

The Cigarette Dependence Scale

Below you will find a list of statements. Please circle the response that applies to you.

- 1) Please rate your addiction on a scale of 0-100
 I am NOT addicted at all=0
 I am extremely addicted to cigarettes=100
 - a) 0-20
 - b) 21-40
 - c) 41-60
 - d) 61-80
 - e) 81-100

- 2) On average, how many cigarettes do you smoke per day, based on the last 12 months?

0-5	6-10
11-20	21-29
30+	

- 3) Usually, how soon after waking up do you smoke your first cigarette, based on the last 12 months?

0-5	6-15
16-30	31-60
61+	

- 4) For you, quitting smoking would be

Impossible	Very difficult
Fairly difficult	Fairly easy
Very easy	

Please indicate whether you agree with each of the following statements:

- 5) After a few hours without smoking, I feel an irresistible urge to smoke

Totally disagree	Somewhat disagree
Neither agree or disagree	Somewhat agree
Fully agree	

- 6) The idea of not having any cigarettes causes me stress

Totally disagree	Somewhat disagree
------------------	-------------------

- | | |
|---------------------------|----------------|
| Neither agree or disagree | Somewhat agree |
| Fully agree | |
- 7) Before going out, I always make sure that I have cigarettes with me
- | | |
|---------------------------|-------------------|
| Totally disagree | Somewhat disagree |
| Neither agree or disagree | Somewhat agree |
| Fully agree | |
- 8) I am a prisoner of cigarettes
- | | |
|---------------------------|-------------------|
| Totally disagree | Somewhat disagree |
| Neither agree or disagree | Somewhat agree |
| Fully agree | |
- 9) I smoke too much
- | | |
|---------------------------|-------------------|
| Totally disagree | Somewhat disagree |
| Neither agree or disagree | Somewhat agree |
| Fully agree | |
- 10) Sometimes I drop everything to go buy cigarettes
- | | |
|---------------------------|-------------------|
| Totally disagree | Somewhat disagree |
| Neither agree or disagree | Somewhat agree |
| Fully agree | |
- 11) I smoke all the time
- | | |
|---------------------------|-------------------|
| Totally disagree | Somewhat disagree |
| Neither agree or disagree | Somewhat agree |
| Fully agree | |
- 12) I smoke despite the risks to my health
- | | |
|---------------------------|-------------------|
| Totally disagree | Somewhat disagree |
| Neither agree or disagree | Somewhat agree |
| Fully agree | |

Appendix F

Commitment to Quitting Smoking Scale

Below you will find a list of statements. Please rate how true each statement is for you by circling a number next to it. Use the scale below to make your choice.

- 1 – Strongly disagree, 2 – Disagree,
3 – Neither disagree nor agree, 4 – Agree,
5 – Strongly agree

- 1) I am willing to put up with whatever discomfort I have to in order to quit smoking.
1 2 3 4 5
- 2) No matter how difficult it may be. I won't let myself smoke once I quit.
1 2 3 4 5
- 3) Feeling very anxious or restless won't prevent me from quitting smoking.
1 2 3 4 5
- 4) Even if I really want one. I won't let myself pick up a cigarette once I quit.
1 2 3 4 5
- 5) No matter how much I crave a cigarette when I quit. I'm going to resist the urge to smoke.
1 2 3 4 5
- 6) Feeling very depressed or sad won't prevent me from quitting smoking.
1 2 3 4 5
- 7) I'm not going to let anything get in the way of my quitting smoking.
1 2 3 4 5
- 8) Feeling very angry and irritable won't prevent me from quitting smoking.
1 2 3 4 5

Appendix G

Acceptance and Action Questionnaire

Below you will find a list of statements. Please rate how true each statement is for you by circling a number next to it. Use the scale below to make your choice.

1 – Never true , 2 – very seldom true , 3 – Seldom true ,
 4 – Sometimes true , 5 – Frequently true , 6 – Almost always true ,
 7 – Always true

- 1) My painful experiences and memories make it difficult for me to live a life that I would value.
 1 2 3 4 5 6 7
- 2) I'm afraid of my feelings.
 1 2 3 4 5 6 7
- 3) I worry about not being able to control my worries and feelings.
 1 2 3 4 5 6 7
- 4) My painful memories prevent me from having a fulfilling life.
 1 2 3 4 5 6 7
- 5) Emotions cause problems in my life.
 1 2 3 4 5 6 7
- 6) It seems like most people are handling their lives better than I am.
 1 2 3 4 5 6 7
- 7) Worries get in the way of my success.
 1 2 3 4 5 6 7

Appendix H

University of Waikato
School of Psychology

Information Sheet - Stopping smoking using SmartQuit™

My name is Satvir Singh, and I am a Master's student at the University of Waikato. I would like to invite you to participate in my study, which will be using a smart phone app (SmartQuit™) to help reduce and stop smoking. SmartQuit™ is based on principles called acceptance and commitment therapy (ACT) which has been shown to help reduce cigarette cravings, urges and intake. Previous research has found that people do not want to smoke as much after using SmartQuit™.

What will be required of you:

This study will consist five parts:

1. You and I will meet to complete questionnaires that will collect information, such as your age, gender, ethnicity, nicotine dependence, smoking behaviours and your commitment to quit smoking. During this meeting, you will also be given a wallet sized notebook in which you will be asked to collect information on your smoking amount, cravings and urges for a period of 3-21 days.
2. During this time, I will contact you daily via text message to ask you for your counts for the day.
3. After you have completed your notebook I will contact you again and give instructions to download SmartQuit™ free of charge. This programme will prompt you to complete a quit plan, complete daily exercises and choose a quit date.
4. When you have reached your quit date, you will again be asked to record your smoking, cravings and urges for another period of 3-21 days, and to send these to me via text message.
5. A month after this, you will be asked to complete a follow-up survey, which will assess your satisfaction with SmartQuit™ and your smoking outcomes. This survey will be repeated again a month later.

What will be done with your information:

Your name will be coded and will not be attached or linked to any of your collected data. This is to ensure that in no way data will be traceable to you. All information provided by you will be stored securely at the School of Psychology at the University of Waikato, for a period of 5 years. The findings from this study will be published as a written report as requirements for my Master's thesis, these findings will be made available at the School of Psychology office. A summary of the findings will also be sent to you should you request it, on the consent form.

Can I withdraw

Participation in this study is entirely voluntary (your choice) and should you change your mind, then you may withdraw without any penalty.

If I am not happy with my outcomes, can I try again?

You will have free access to the smart phone app for 6 months and, after reaching your quit date, you will receive a notification asking how your quit went and whether you were successful or not. If you were not successful then the app will allow you to reset your quit date and start again, you may do this as many times as you like, provided it is within the 6-month time frame.

What's next

If this sounds interesting to you and you would like further information or you would like to take part in this study, then please contact me via email and we can negotiate a time to meet.

Kind regards,

Researcher: Satvir Singh

Department of Psychology

University of Waikato

sks42@students.waikato.ac.nz

Here are details for both of my supervisors as well as the convenor of the ethics committee. Feel free to contact myself or my supervisors if you have any further questions regarding the nature of the research. Also should you have any concerns about the ethical conduct of the researcher then please contact James Mc Ewan.

Supervisor: Doctor Rebecca Sargission

School of Psychology

University of Waikato

Email: rebeccas@waikato.ac.nz

Supervisor: Doctor Nicola Starkey

School of Psychology

University of Waikato

Email: nstarkey@waikato.ac.nz

This research project has been approved by the School of Psychology Research and Ethics Committee of the Faculty of Arts and Social Sciences, University of Waikato. Any questions about the ethical conduct of this research may be sent to the convenor of the Research and Ethics Committee (currently Dr James McEwan, phone 07 838 4466 ext. 8295, email: jmcewan@waikato.ac.nz)

Support of this study

This research study will be supported by 2morrow, Inc.

Appendix I
Consent Form
Participant Copy

Research Project: Stopping smoking using SmartQuit™

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 know not to use any other interventions or medications such as nicotine replacement products, during all phases of the study.		
9. I agree to being approached to complete two short follow-up surveys. The first follow-up will be completed one month after the completion of the app, and the second will be completed a month after the first follow-up.		
10. I wish to receive a copy of the findings		
Email address:		
Or postal address if you want to receive a hard copy:		

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 James McEwan, Tel: 07 838 4466 ext. 8295, email: jmcewan@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.

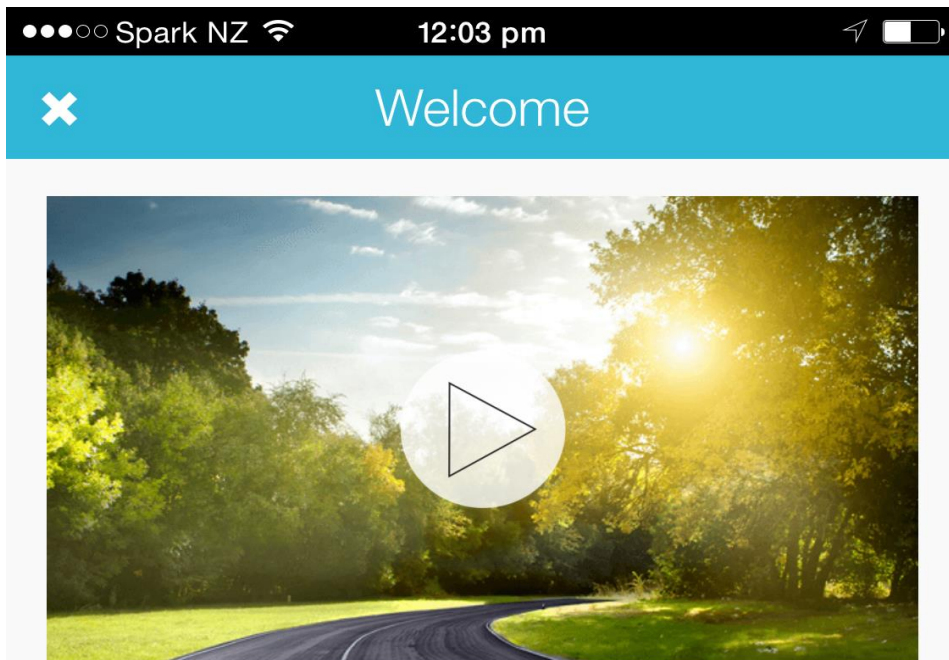
Researcher's name (Please print):

Signature:

Date:

Appendix K

Introduction to the SmartQuit™ Programme



The image shows a mobile application interface. At the top, there is a black status bar with 'Spark NZ' and a Wi-Fi icon on the left, '12:03 pm' in the center, and a location arrow and battery icon on the right. Below this is a blue header bar with a white 'X' icon on the left and the word 'Welcome' in white text. The main content area features a video player with a play button icon overlaid on a scenic image of a road winding through a forest at sunset. Below the video player, the text reads: 'Welcome to SmartQuit', 'Think of what we are doing in this program as a car journey. You are the driver and this program is like a front seat passenger, helping you navigate your way.', 'In the backseat, are your back seat passengers—they are the urges, emotions, and thoughts that can distract you from your path and trigger you to smoke.', 'Yet, as the driver of this car you have the freedom to choose:', and a bulleted list: '- in what direction you want to go', '- how fast you want to move, and', '- who you choose to listen to'.

Welcome to SmartQuit

Think of what we are doing in this program as a car journey. You are the driver and this program is like a front seat passenger, helping you navigate your way.

In the backseat, are your back seat passengers—they are the urges, emotions, and thoughts that can distract you from your path and trigger you to smoke.


Yet, as the driver of this car you have the freedom to choose:

- in what direction you want to go
- how fast you want to move, and
- who you choose to listen to

●●●○ Spark NZ 2:54 pm

×

Welcome



Wherever you decide to go, this program is here to help.

You may have already noticed that SmartQuit is quite different from other programs and parts of it may feel a bit strange. Try to keep an open mind and see which exercises are helpful to you. In a clinical trial, smokers who practiced the exercises in this program were 16 times more likely to quit smoking than those who did not.

WHAT TO DO NEXT: Each day, use SmartQuit to view the daily exercise and track your progress. Over the next week or two you will become more aware of your urges and then learn new ways of dealing with them.

To complete the full program, you will need to create a quit plan (done), practice all 8 daily exercises, track your progress and visit the anytime coaching section whenever you need extra help or motivation. If you are ready, you can start now with the first exercise or come back tomorrow.

Appendix L

Personalised Quit Plan (completed example)

The image shows a mobile application interface for a personalised quit plan. At the top, there is a status bar with 'Spark NZ' and '1:23 am'. Below the status bar, the app title 'Health Spirituality' is partially visible. The main content is divided into three colored sections: a green section for the quit date, a blue section for 'Once I Quit...', and another green section for 'Support'. Each section contains specific details about the user's quit plan, such as their quit date, current and future activities, and the support they have.

Health Spirituality

My Quit Date

May 27, 2015 Wednesday

Once I Quit...

I currently spend **300** minutes each day smoking. In the future I will spend it **Gyming**

I currently spend **\$585** per month on cigarettes. In the future I can spend it on **paying off bills**

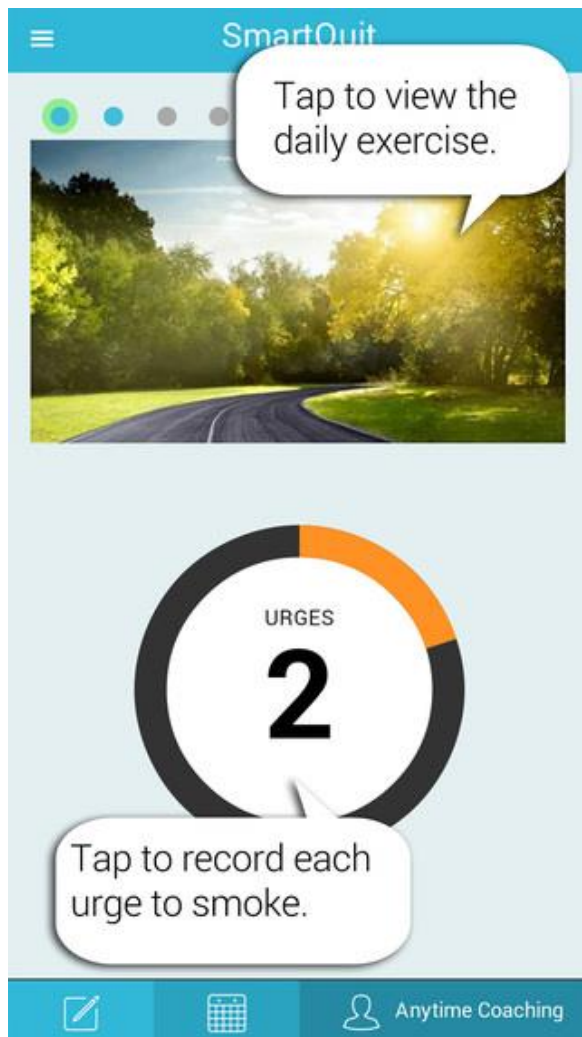
Support

These are people who support my efforts to quit:
Mum

How they can help:
Cheer me on for trying to quit.
Be available to talk, especially when I really want to smoke.
If I have a slip, just remind me of why I am quitting and praise my progress so far.

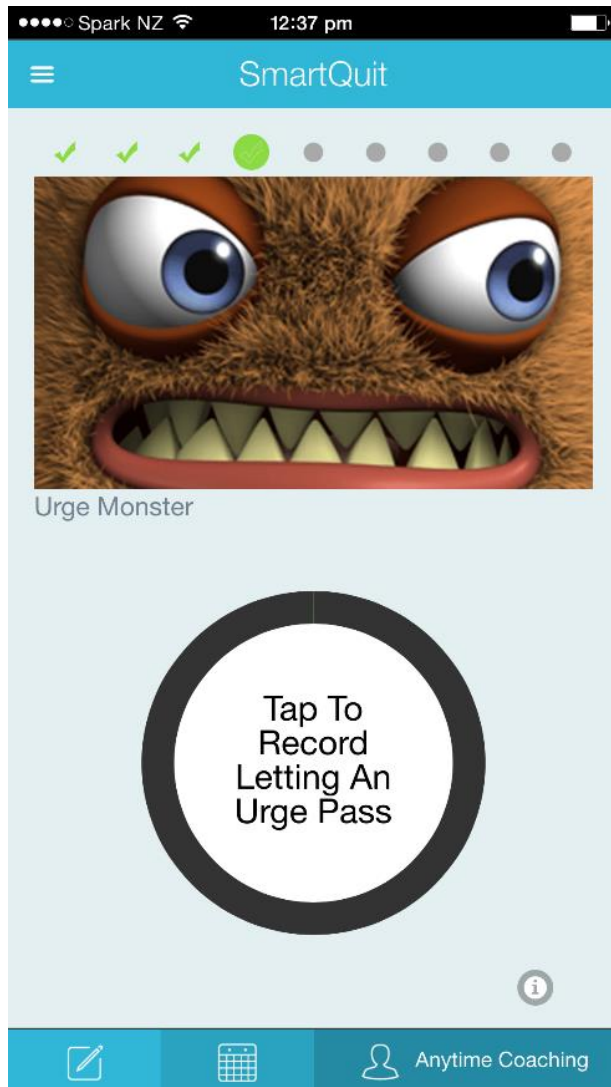
Appendix M

Urge Tracker



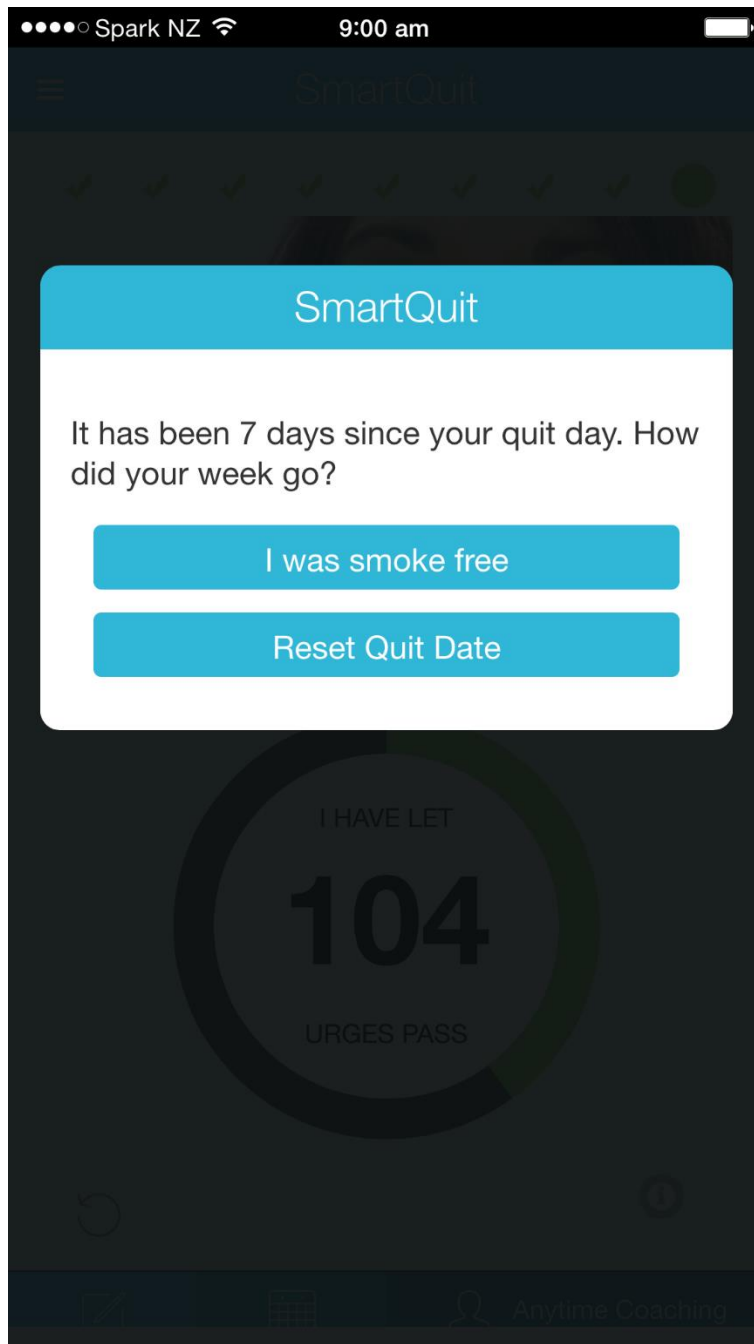
Appendix N

Tracking Urges that have passed



Appendix O

Notification to Reset Quit Date



Appendix Q

Follow-up Survey

Please circle the response that is the best fit for you. Circle only one response for each statement.

1. How many cigarettes do you have per day;
 0 5+ 10+ 20+
 other _____

2. Smoking status;
 I quit I did not quit

3. I reset my quit date?
 Yes No

4. I relapsed while using Smart Quit:
 Yes No

5. If answered yes to the question above, how many times did you reset your date
 0-2 2-4 4-6 6-8 8-10

6. I am happy with my progress
 strongly agree agree
 undecided disagree
 strongly disagree

7. My thoughts on smoking have changed;
 strongly agree agree
 undecided disagree
 strongly disagree

8. My family and friends noticed a difference in my smoking behaviours;
 yes no maybe

9. I still experience cravings and urges to smoke;
 strongly agree agree
 undecided disagree
 strongly disagree

10. If agreed with the statement above, then how strong are these cravings and urges to smoke;
 1 2 3 4 5 6 7 8 9 10

11. How do you cope with these cravings and urges on a scale of 1-10:
 1 2 3 4 5 6 7 8 9 10
12. Are there particular situations that trigger urges and cravings
 strongly agree agree
 undecided disagree
 strongly disagree
13. If answered yes, then please describe
 it/them _____
14. Is there a particular time when your cravings and urges are high
 yes no maybe
15. My urges to smoke have;
 reduced increased ended completely
16. SmartQuit was appropriate for me;
 strongly agree agree
 undecided disagree
 strongly disagree
17. How many times on average did you open the app each
 day _____
18. How many times on average did you open the app each
 week _____
19. What aspect of the app did you like the
 most _____
20. What aspect of the app did you dislike the
 most _____

21. Name two strategies that you learnt within this programme that you
 thought were the most
 effective _____

22. Would you recommend this programme to anyone in the future; yes no
23. I completed each activity; once, twice, three times, and +four before
 beginning the next activity.
24. What type of person would you recommend this programme to; light
 smoker, medium smoker or a heavy smoker.

25. I used the programme; on a regular basis, only when I needed to record urges when I received notifications only

26. What factors made you use the app more _____

27. What factors made you use the app less _____

28. Do you think that there is room for improvement in the app;
strongly agree agree
undecided disagree
strongly disagree

29. If you agreed to the statement above, then please describe where _____

Appendix R

Summary of SmartQuit™ Exercises

Exercise name	Exercise description
Awareness	<p>When preparing to quit smoking, one must become aware of their normal smoking patterns, e.g cravings, and what their usual approach to dealing with urges is. In this exercise, users are asked to pay attention to each urge they have to smoke, and record this urge on the urge tracker provided in the app.</p> <p>Learning to become aware of cravings to smoke, is a useful technique later on the app, as the SmartQuit™ program teaches new strategies to deal with cravings later on.</p>
Don't think	<p>The aim of this exercise is to not think. As attempting to stop thinking about smoking, increases smoking related thoughts, and persistence to smoke cigarettes. An increased awareness will increase chances for success in the SmartQuit™ programme. In this exercise asks users to notice what happens when they try not to think about smoking, and whether this increases cigarette intake, and urges to smoke.</p>
Urge Monster- Drop the Rope	<p>Users are first asked to visualise that their urges to smoke are similar to a monster, an urge monster. Next users are to visualise that they are having a tug match with the urge monster, and in-between the monster and the user is a bottom less pit, and should the user fail or lose then they will fall into the pit. The goal of this exercise is to learn to stop pulling the rope and drop the rope.</p>
Are you willing	<p>Users are taught that the battle with the urge monster may be won in the short run, but this win is not long lasting, as the monster will come back.</p>
5 Senses	<p>The user is asked to see their smoking urges in relation to their five senses.</p>

Leaves on a Stream	The idea of this activity is to consider thoughts related to smoking as leaves, and to let them float down a stream. Practicing this exercise leads to a seven times higher chance of quitting.
Finger trap	The user is asked to imagine that life is like a finger trap, and the more the user pulls on the trap the more restricted they will be.
Having the Thought	Labelling urges as urges and thoughts as thoughts can provide the user with a sense of control.
