Young Adult Experiences with a Mobile Smoking Cessation Application: A Qualitative Evaluation of Crush the Crave

by

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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

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Abstract

Canada has had tremendous success with reducing smoking prevalence among its population. However, the decline in rates is not observed equitably among various sub-populations and tobacco continues to cause preventable disease, disability, and death. Young adults have the highest smoking rate compared to all other age groups and many are interested in smoking cessation. Nonetheless, a challenge remains as many young adults perceive traditional smoking cessation resources negatively and prefer not to use pharmacotherapy, counselling, and/or quitline services. Not surprisingly, young adults are also the largest population group who utilize mobile technologies. Mobile applications (apps) are an emerging, tailored intervention that hold promise for health behaviour change. These are known as mobile health (mHealth) technologies. Currently, many applications for smoking cessation exist. However, little is known about Canadian young adults' use and experiences with apps for smoking cessation. To address this research gap, this study evaluated Crush the Crave (CTC), an evidence-based smoking cessation app created specifically for young adults.

Semi-structured qualitative interviews were conducted with 15 Canadian young-adult users of CTC in order to capture experiences and use of the app. Interviews lasted 70 minutes on average and were recorded, transcribed verbatim, and then subsequently analyzed using thematic analysis through NVivo 10 software. Results were presented by the following categories which encompassed various sub-themes: young adults' reasons and experience with smoking, experiences with the use of alternate quitting resources, experiences with the features of CTC, and mechanisms associated with utilizing CTC. Across the interviews, participants found that the app provided an important tracking mechanism that gave the ability to self-monitor progress while quitting. Further, the app provided an important sense of control and was easily accessible by users when needed. However, participants discussed the need for constant reminders and that the constant need to access data or a Wi-Fi network in order to use the app was a barrier. Additionally, it was found that social support via social media was not used by participants as cessation experiences were considered to be private and individuals did not like to broadcast such details on social media.

These findings demonstrate the need for continual research and improvement of mHealth technologies among the intended users. There is also a need for more flexible and dynamic apps that keep users engaged and provide a tailored experience. This thesis contributes to the limited literature on the usability of mHealth apps. Recommendations are discussed, followed by contributions, limitations, and future directions.

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List of Abbreviations

ATP	Alternative Tobacco Products
CMO	Context-Mechanism-Outcomes
CTC	Crush The Crave
IBM	Integrated Behaviour Model
ICT	Information and Communication Technologies
LTPB	Leave The Pack Behind
mHealth	Mobile Health
NRT	Nicotine Replacement Therapy
OS	Operating System
PDAs	Personal Digital Assistants
RCT	Randomized Control Trial
SCT	Social Cognitive Theory
SHL	Smokers' Helpline
TA	Thematic Analysis
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
TTM	Transtheoretical Model
YAs	Young Adults
YATI	Youth Advocacy Training Institute

Chapter 1
Background

Canada has achieved tremendous success in the area of tobacco control with fewer Canadians using tobacco products (Smoke-Free Ontario - Scientific Advisory Committee, 2010). Despite this achievement, tobacco continues to be the leading cause of preventable disease, disability, and death worldwide (Health Canada, 2010; World Health Organization, 2012). Many Canadians continue to smoke and there are differences in smoking rates among various subpopulations (Reid, Hammond, Rynard, & Burkhalter, 2014). Young adults (YAs) continue to have the highest smoking rate compared to all other age groups (Bader, Travis, & Skinner, 2007; Reid et al., 2014). However, young adults indicate interest in quitting and are likely to attempt to quit smoking (Reid et al., 2014).

In addition to having the highest smoking prevalence, young adults are the largest population group who utilize mobile technologies, such as smartphones (Zickuhr & Smith, 2012). Smartphones are extremely appealing as they are personal, interactive, and tailored to the user (Norman, 2012a). Further, smartphones are commonly used in Canada; more than 55% of the Canadian population owns a smartphone device (Catalyst, 2014). As a result, smartphones may be a useful tool in the next stage of tobacco cessation efforts through use of the application feature (also referred to as "apps" in this thesis). In fact, there is increasing interest from academics and clinicians in using mobile apps as a way of providing behavioural interventions for health promotion (Dennison, Morrison, Conway, & Yardley, 2013). Currently, many applications related to smoking cessation exist, but few are evidence-based (Abroms, Lee Westmaas, Bontemps-Jones, Ramani, & Mellerson, 2013). In order to address this research gap, an evidence-based smoking cessation application called Crush the Crave (CTC) was developed for young adult smokers by researchers at the Propel Centre for Population Health Impact, at the University of Waterloo, in collaboration with young adults. A randomized control trial (RCT) is being conducted to determine the effectiveness of CTC in assisting young adult smokers with the quit process relative to a self-help guide intervention.

In order to better understand the effectiveness of smoking cessation applications as an intervention tool, it is important to understand the experiences of young adults who would use such applications. No published work was identified prior to this study that investigates what young adults seek and desire in applications, and how they may use a mobile-based cessation intervention. This study attempted to address this gap in the literature.

The overall purpose of this qualitative evaluation was to gain an in-depth understanding of how CTC was used and the underlying mechanisms of change in a subsample of Canadian young adults (aged 19 – 29). Furthermore, this research identified facilitators and barriers that young adults experienced while using the application. Understanding the meanings that young adults associate when using the CTC app may assist in identifying what may work best for young adults with regards to smoking cessation strategies and tools. Further, this research may inform future programming geared towards young adults. There may also be lessons from the CTC evaluation that are relevant to other smoking cessation interventions or other health promotion interventions for young adults or other populations.

This thesis begins with a review of the current literature on young adult smoking behaviour, the use of cessation resources by young adults, how mobile health (mHealth) technologies may be used in cessation interventions, and key cessation interventions for young adults.

Chapter 2
Literature Review

2.1 Tobacco Smoking

Despite the significant decline in tobacco prevalence and usage over the past few decades, this rate of decline has slowed. Tobacco continues to impact the lives of millions of individuals worldwide through preventable disease, disability, and death (Health Canada, 2010; World Health Organization, 2012). In Canada, approximately 4.6 million (16.1%) Canadians are current smokers (Reid et al., 2014). Further, more than 1,000 Canadians who have never smoked die from exposure to secondhand smoke each year (Health Canada, 2009). Tobacco has an enormous influence on health through the impact on many diseases and conditions and places a huge economic burden in Canada as direct, attributable health care costs are estimated to be $4.4 billion annually (Collishaw et al., 2011). However, the prevalence of tobacco use is not distributed equitably across the population. In particular, Canadian young adults have the highest smoking prevalence compared to all other age groups at 20.3% and 21.8% for ages 20 – 24 and 25 – 34, respectively (Reid et al., 2014). It is important to understand the smoking behaviour, intention to quit, and use of cessation services and resources among young adults to address the higher smoking rates.

2.2 Young Adult Smoking Profile and Behaviour

Young adulthood is typically a period of change as individuals are in the process of creating their identities and making lifestyle choices independently, whereas previously, they were under adult supervision and had less freedom (Bader et al., 2007; Colder et al., 2006; Colder, Flay, Segawa, Hedeker, & TERN members, 2008). Although it is assumed that most individuals try their first cigarette before the age of 18, one in five smokers initiate smoking after this age as they transition into adulthood, showing evidence for late smoking initiation (Colder et al., 2006; Hammond, 2005). Smoking prevalence is highest among young adults and has not decreased substantially over the years (Bader et al., 2007; Health Canada, 2013).

Patterns of smoking among this age group are different from older adults (Hammond, 2005; Reid et al., 2014). Typically, younger adults are lighter smokers as they smoke a lower number of cigarettes per day while older adults tend to be daily smokers (Hammond, 2005; Solberg, Boyle, McCarty, Asche, & Thoele, 2007). This may be related to young adults being more occasional and/or social

smokers rather than daily smokers (Hammond, 2005). Smoking among young adults is frequently associated with social situations. For example, college and university students tend to smoke more on weekends than weekdays due to social events/parties and often pair smoking with drinking (Colder et al., 2006). Young adults often feel that smoking fosters a social connection and a feeling of inclusion among other smokers (Bader et al., 2007; Brown, Carpenter, & Sutfin, 2011). However, this trend does not hold true for all young adults as those who do not attend postsecondary education tend to have higher rates of heavy smoking (Lantz, 2003). Further, many young adults who are occasional or social smokers are likely to transition into becoming daily smokers (Lantz, 2003; Riggs, Chou, Li, & Pentz, 2007). A study by Riggs and colleagues (2007) found that an individual could transition from low levels of smoking in ages 12 to 24 to addictive smoking behaviour in early adulthood (age 26 to 28). In addition, smoking only 2 to 4 cigarettes a week puts an individual at risk of being addicted by early adulthood (Riggs et al., 2007). Overall, young adult smokers are a heterogeneous group of many different types of smokers and many are likely to transition into becoming regular adult smokers (Lantz, 2003; Ling, Neilands, & Glantz, 2009)**.**

Even though young adults have fluctuating patterns of consumption, many indicate interest in quitting smoking (Messer, Trinidad, Al-Delaimy, & Pierce, 2008; Reid et al., 2014; Solberg et al., 2007; J. Wong, 2010). Specifically, according to the Canadian Tobacco Use Monitoring Survey, 61.7% of those aged 20 – 24 and 71.5% of those aged 25 – 34 report an intention to quit within the next six months, whereas only 55.6% of those aged 35 – 44 report the same intentions (Reid et al., 2014). Young adults also report making serious quit attempts (Curry, Sporer, Pugach, Campbell, & Emery, 2007). At the time of survey, 58.0% of those aged 20 – 24 years and 52.9% for those aged 25 – 34 years had made quit attempts in the past 12 months, compared to 47.6% of those aged 35 – 44 years (Reid et al., 2014). Although the data indicates young adults make more quit attempts, there does not appear to be a large difference in quit attempts between age groups.

It is important to note that although young adults show interest in quitting and are making quit attempts, rarely are attempts at quitting successful (Messer et al., 2008; Reid et al., 2014). This challenge is not unique to the young adult population. For instance, only 11.9% (aged 20 – 24), 10.7% (aged 25 – 44), and 16.9% (aged 45+) of those who attempted to quit in the past 12 months were successful at the time of survey (Reid et al., 2014). Another study by Messer and colleagues (2008) reported that of those 18 to 24 year olds and 25 to 34 who attempted to quit, only 10.1% and 9.5%, respectively, maintained the quit attempt for six months (Messer et al., 2008). Like adults,

young adults make numerous unsuccessful quit attempts (Bader et al., 2007). Research by Reid and colleagues (2014) indicated that young adults are interested in quitting but relatively few make successful long-term attempts. This may call into question the types of support available to young adults and suggests that other efforts directed towards cessation are needed to reduce the risk of adverse health outcomes in later life.

2.2.1 Young Adult Use of Cessation Services and Resources

Many young adults express interest in trying to quit on their own without the use of any resources and prefer word-of-mouth advice from family and friends (Bader et al., 2007; Solberg et al., 2007; J. Wong, 2010). Traditional smoking cessation methods, such as pharmacotherapy, counselling, and quitlines, are often promoted for use in cessation among the general adult population and can be effective for both adults and young adults (Suls et al., 2012)**.** However, traditional resources have been viewed negatively by young adults and grossly underutilized (Bader et al., 2007; Solberg et al., 2007; Suls et al., 2012; J. Wong, 2010). For instance, Curry and colleagues (2007) highlighted that significantly fewer young adult smokers are exposed to cessation interventions. The authors found that young adult smokers were less likely to report being asked about their smoking by health professionals or use any pharmacotherapy (including medication, and nicotine patch and gum). In another study, Solberg and colleagues (2007) found that young adults (aged 18 – 24) compared to older adults (aged 25 – 65) were much less likely to use resources such as medication or counselling to assist them in a quit attempt even though they had greater access to these resources.

Several reasons exist as to why young adult smokers are less likely to use available smoking cessation interventions. As many young adults are occasional or social smokers, they do not identify themselves as smokers (Brown et al., 2011; Hoek, Maubach, Stevenson, Gendall, & Edwards, 2013). Young adults may think they are immune to the harmful effects of smoking (Brown et al., 2011) and may also have false beliefs about the effects of available pharmacotherapies, including the belief that they are harmful (Mooney, Leventhal, & Hatsukami, 2006). For instance, Ferguson and colleagues found that out of 900 adult smokers in the United States, 93% were not aware or were not sure that wearing a nicotine patch in conjunction with smoking does not cause heart attacks, 76% that the nicotine gum and lozenge are not as addictive as cigarettes, and 69% that nicotine replacement therapy (NRT) products are not as hazardous as cigarettes (Ferguson et al., 2011). Beyond the beliefs regarding NRT, some smokers do not believe that they are addicted or getting addicted to cigarettes

and are confident that they can control the habit and stop when they are ready (Brown et al., 2011; Hoek et al., 2013).

Given that young adults do not find that traditional smoking cessation methods meet their needs and are more interested in trying to quit on their own, efforts are needed to motivate young adults to quit smoking. This can help prevent progression of smoking status (e.g. from social to daily smoking) and can reduce the risk of adverse health outcomes in later life. Interestingly, more and more young adults are attracted to interventions that are provided in a non-medical setting (Bader et al., 2007; Borland & Schwartz, 2010). Information and communication technologies (ICTs), particularly mobile health technologies, may be a promising strategy in reaching young adults.

2.3 Use of Mobile Technologies in Young Adult Cessation Strategies

2.3.1 What is Mobile Health?

Mobile health, also known as mHealth, is defined as "medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices" (Kay, Santos, & Takane, 2011). New technologies, like smartphones, continue to have advancements such as additional data gathering and manipulation capacity. The widespread diffusion of these technologies and the continual improvements in this technology continue to change how health care information is accessed and delivered (Kay et al., 2011). The evidence in this area is emerging and shows that mobile-phone technologies can support behavioural change.

2.3.2 The Need for Mobile Applications in Delivering Behavioural Interventions

Besides having the highest smoking prevalence, young adults are the single largest population group that use constantly evolving mobile technologies and are the most frequent users of social media tools, such as Facebook (Ipsos Reid, 2011; Norman, 2012b; Zickuhr & Smith, 2012). The current generation of young adults has grown up with the digital age and they are comfortable using such technologies (Forsyth, Kennedy, & Malone, 2013). In the United States, 66% of YAs (age 18 – 29) own a smartphone device (Zickuhr & Smith, 2012). Although there is limited data on Canadian young adult usage of smartphones, more than 55% of all Canadians own a smartphone device (Catalyst, 2014). The features of smartphones include voice calling, e-mail, text messaging, video viewing, wireless internet connections, running programs known as applications ("apps"), and social

networking. Smartphones and various mobile technologies have changed how individuals interact and communicate with one other (Norman, 2012a). They are personal, highly used by young adults, powerful, and are interactive with their multiple features such as integration with social networking (Dennison et al., 2013; Norman, 2012a). Smartphones are also tools that are frequently used to access the Internet (Ghorai, Akter, Khatun, & Ray, 2014). The use of mobile-based applications may appeal to young adults and may encourage their usage of mobile-based smoking cessation support. As a result, mobile devices may be a useful tool in the next stage of tobacco cessation efforts and for health promotion through use of the application ("app") feature. In fact, with the spread of smartphone usage, many applications are being developed for health behaviour change (Ghorai et al., 2014).

Evidence on interactive, online interventions for smoking cessation have shown that they are effective when compared to untailored guides, booklets, or e-mail interventions, and have had high user satisfaction ratings (Shahab & McEwen, 2009). Further, recent evidence from systematic reviews indicate that text messaging delivered through mobile phones for smoking cessation is effective (Free et al., 2013; Whittaker et al., 2012). In particular, Whittaker and colleagues (2012) included five studies that were either a text messaging intervention only, text messaging and web-based support, or text messaging and video messaging support. These studies had at least six month cessation outcomes and showed increases in long-term quit rates compared to the control condition (Whittaker et al., 2012). Text messaging programs have also shown to be effective in the young adult smoking population (Riley, Obermayer, & Jean-Mary, 2008; Ybarra, Holtrop, Prescott, Rahbar, & Strong, 2013). One study combined a text messaging and web-based program for 18 – 24 year old smokers in college (Riley et al., 2008). This intervention was tailored according to the smoker's readiness to change. Results from this study indicated that young adults supported a text-based intervention and even requested an increase in the number of text messages, but underutilized the web-based portion of the intervention (Riley et al., 2008). These findings show how the market to reach young adults has changed from web-based services to mobile-texting and support the idea that this market may now be moving towards mobile phone-based applications.

Apps in mobile devices have the potential to go a step further than text messaging support with functions such as quit planning, tracking and monitoring, education, and linkage to other supports and resources. A 2007 study that used focus groups with young adult smokers found that participants would consider mobile technologies if they were provided with individualized feedback, knew it had a high success rate, was not boring, and was targeted towards young adults (Bader et al., 2007).

Currently, no systematic reviews exist on mobile-based apps and their effectiveness on smoking cessation. However, some studies have assessed the feasibility of a mobile app (Buller et al., 2014) and there are some randomized control trials underway that seek to explore the effectiveness of mobile applications (ClinicalTrials.gov), including, the aforementioned RCT on Crush the Crave (Baskerville et al., 2015), mentioned earlier. In addition, the use of apps for health behaviour change has been briefly explored in young adults to understand the utilization of these apps and the attitudes that young adults bring (Haithcox-Dennis, Brinkley, Richman, DeWeese, & Byrd III, 2012). However, no known research has explored the needs and experiences of young adults with smoking cessation applications. In order to have an impact on health behaviours, it is important that mHealth interventions are desirable and useful to the end user (Bock et al., 2014). The present study will attempt to address this gap in the literature.

There are many reasons why mobile devices may be beneficial as a tool in delivering cessation interventions. First, these devices can be personalized to an individual's needs in behaviour change (Patrick, Griswold, Raab, & Intille, 2008) and end users can self-monitor their own behaviour (Kratzke & Cox, 2012). Secondly, as portable devices, mobile devices tend to stay powered on and with a user all day even if they are extremely mobile (Dennison et al., 2013; Free et al., 2013; Kratzke & Cox, 2012; Patrick et al., 2008). Therefore, this allows device users to be reached at all times, wherever they may be (Patrick et al., 2008). Third, mobile devices facilitate a connectedness as users can connect with health professionals and their peers immediately to interact, share information, or to collaborate (Dennison et al., 2013; Norman, 2012a; Patrick et al., 2008). Device users can also contact others either one-on-one (Norman, 2012b) or contact multiple individuals simultaneously through real time interactions (Bernhardt, Chaney, Chaney, & Hall, 2013; Hayward, Lambraki, Pieters, & Garcia, 2012; Kratzke & Cox, 2012; Norman, 2012a). Last, the ability of mobile devices to have internal sensors allows for automated and timely tracking of health-related behaviours that can influence interventions (Dennison et al., 2013; Patrick et al., 2008). For instance, many mobile devices have location determination capabilities (Patrick et al., 2008). These devices can be used to send reminders to a smoker based on their individual smoking habits at a place where they typically feel triggered to smoke (Bernhardt et al., 2013; Patrick et al., 2008).

Although there are many benefits to using mobile devices in cessation interventions, there are also some limitations. Currently, many applications related to smoking cessation exist, but few are evidence-based (Abroms et al., 2013). A 2013 content analysis of popular smoking cessation

applications on both iPhone and Android operating systems indicated that many applications were not informed by evidence and did not conform to clinical practice guidelines for quitting smoking (Abroms et al., 2013). For instance, no apps reviewed in this study recommended calling a quitline and only 4% of apps recommended using approved cessation medications (Abroms et al., 2013). This may suggest that although many cessation applications exist, they may not necessarily be developed with the proven strategies or the theoretical principles underlying smoking cessation in mind. Further, it is unknown whether mHealth technologies are effective which highlights an area needing further research (J. Wong, 2010). Lastly, many mobile apps on the market have a cost associated with them before a user can utilize the resource.

2.4 Principles and Strategies for Smoking Cessation

Tomlinson and colleagues (2013) argue that mHealth interventions should be guided by a theory of behaviour change and utilize more than one technique to address change, depending on the target behaviour. In the literature, many strategies and principles exist that are effective and work for cessation, which can inform mHealth applications. These include using recommended clinical practice guidelines, having a theoretical basis to an intervention, and using social networks to garner social support.

2.4.1 Clinical Practice Guidelines

In the United States, the 2008 Clinical Practice Guideline on *Treating Tobacco Use and Dependence* outlines key recommendations for effective and validated tobacco dependence treatment and practices (Fiore et al., 2008). These can also be applicable to mHealth interventions. Fiore and colleagues (2008) found evidence that tobacco dependence requires repeated interventions and multiple quit attempts before a smoker is successful at remaining smoke-free. They also found effectiveness for brief tobacco dependence treatment, even if only a few minutes, and for counselling in all forms (individual, group, and telephone) where effectiveness rose with treatment intensity (Fiore et al., 2008). In particular, practical counselling (that which helps with problem solving/skills training) and social support was found to be effective (Fiore et al., 2008). Moreover, telephone counselling was found to have broad reach and was effective with diverse populations (Fiore et al., 2008). Further, many medications were found to be effective that are available and should be encouraged for use by smokers making a quit attempt to enhance success (Fiore et al., 2008; Westmaas, Bontemps-Jones, & Bauer, 2010). These included bupropion, nicotine gum, nicotine

inhaler, nicotine lozenge, nicotine nasal spray, nicotine patch, and varenicline (Fiore et al., 2008). These recommendations are also reflected in the Canadian Smoking Cessation Clinical Practice Guideline (CAN-ADAPTT, 2011). Although both Canada and the United States have clinical practice guidelines, practical guidelines do not exist specific to other methods of delivering cessation interventions, such as online websites or mobile applications.

2.4.2 Behavioural Change Theories

Particular behaviour change theories, such as Theory of Planned Behaviour, Theory of Reasoned Action, the Stages of Change Model, and Social Cognitive Theory, are commonly used to develop smoking cessation interventions. Theory can inform interventions by identifying targets for the intervention, identifying particular behaviour change techniques, and/or identifying particular mechanisms underlying behaviour change (Webb, Joseph, Yardley, & Michie, 2010; Webb, Sniehotta, & Michie, 2010). Webb and colleagues (2010) found that interventions that included more extensive use of theory were associated with increases in effect size for health related behaviours, indicating that interventions may benefit with the use of behaviour change theory (Webb et al., 2010). The following paragraphs explore major behavioural change theories and their key constructs.

The Theory of Reasoned Action (TRA) and the Theory of Planned Behaviour (TPB) are concerned with individual level motivational factors that determine if the intended behaviour (smoking cessation) will be performed (Ajzen, 1991; Fishbein & Ajzen, 1975; Montano & Kasprzyk, 2008). Key constructs that contribute to the intention of quitting smoking include: attitude, which is determined by individual behaviour beliefs of the behavioural outcomes and evaluating those outcomes; and subjective norms, which are influenced by normative beliefs of whether other individuals approve or disapprove of quitting and motivation to comply with the normative beliefs (Montano & Kasprzyk, 2008). In addition, the TPB highlights the role of perceived control, which is governed by control beliefs over potential barriers and facilitators ("control factors") and whether or not the individual perceives power over these control factors (Montano & Kasprzyk, 2008). Together, attitude, subjective norm, and perceived control affect the intention to quit smoking which subsequently may lead to an individual actually engaging in quitting (i.e. behaviour).

Similar to TRA and TPB, the most important determinant of behaviour in the Integrated Behavioural Model (IBM) is the intention to perform the behaviour (Fishbein, 2000; Fishbein, 2008). The IBM includes constructs from TRA and TPB but moves beyond with the following four components. A particular behaviour is most likely to occur if the person has the knowledge and skills

to do so, if the behaviour is salient or important, if there are no or few environmental constraints that prevent performance of the behaviour, and if the person has performed the intended behaviour previously which may make it habitual (Montano & Kasprzyk, 2008).

The Stages of Change, as part of the Transtheoretical Model (TTM), assesses an individual's readiness to change and shows behaviour change as a process that evolves over time (Prochaska & Velicer, 1997; Prochaska, Redding, & Evers, 2008). The theory posits that individuals may move through six stages of change, although not necessarily in a linear fashion. Stage one is precontemplation where individuals do not intend to take action within the next six months (Prochaska et al., 2008). The second stage is contemplation where individuals intend to change their behaviour within the next six months (Prochaska et al., 2008). Next is preparation, where individuals intend to take action within the next 30 days and may take some steps or make plans for their intended behaviour (for example, obtaining self-help quitting materials or purchasing nicotine replacement therapy in advance; Prochaska et al., 2008). The fourth stage is action where individuals have made modifications and are performing the intended behaviour over the next six months (Prochaska et al., 2008). Fifth is maintenance where individuals have made changes for over six months and are working on preventing relapse (Prochaska et al., 2008). Lastly, termination is the sixth stage where individuals have zero temptation to revert to their previous behaviour and 100 percent self-efficacy (Prochaska et al., 2008). The stages of change can be a useful tool in the design of mHealth interventions as information can be tailored to the individual depending on their current stage (for example, targeting those in the preparation stage who are more willing to attempt to quit smoking; Prochaska, 2013).

Social Cognitive Theory (SCT) (Bandura, 1986) shows human behaviour as a complex interplay between personal, behavioural, and environmental influences, known as triadic reciprocity (McAlister, Perry, & Parcel, 2008). This model recognizes that behaviour both influences and is influenced by personal and environmental factors (McAlister et al., 2008). Key constructs include outcome expectations, self-efficacy, incentive motivation, facilitation, and self-regulation. Outcome expectancies depict an individual's beliefs about the likelihood of the intended outcome (McAlister et al., 2008). Self-efficacy is the concept that an individual believes in their personal ability to perform the intended behaviour (McAlister et al., 2008). Next, incentive motivation is the use of rewards and punishments to encourage behaviour modification (McAlister et al., 2008). For example, recognizing that an individual has been smoke-free for a certain number of days or has reduced their smoking by

half through a virtual award can be seen as a reward that encourages smoke-free activities. Facilitation is where tools and resources are provided to assist in the performance of an intended behaviour (McAlister et al., 2008). Lastly, self-regulation depicts the idea that individuals control themselves through monitoring, goal setting, feedback, rewards, instruction, and obtaining social support (McAlister et al., 2008).

2.4.3 Social Networks and Social Support

Engaging and using social networks as a method of offering support for cessation is a strategy in helping smokers quit (Westmaas et al., 2010). A social network is defined as "linkages between people that may or may not provide social support and that may serve functions other than providing support" (Heaney & Israel, 2008). Social support is defined as "the functional content of relationships that can be categorized into four broad types of support behaviours" (Heaney & Israel, 2008). These four types include: emotional support (providing empathy, love, trust, and caring); instrumental support (providing tangible aid and services to assist a person in need); information support (providing advice, suggestions, and information a person can use); and appraisal support (providing information useful for self-evaluation purposes such as constructive feedback; Heaney & Israel, 2008). In theory, social networks and social support may have positive impacts on health directly when networks provide companionship, sense of belonging, and reassurance that quitting is possible (Heaney & Israel, 2008). Positive impacts may also occur indirectly, by changing stress levels and/or changing access to individual, community, and organizational resources (Heaney & Israel, 2008). For example, social networks and social support can increase an individual's ability to access information to help solve a problem (such as their smoking), and that information may help produce desired outcomes that enhance health (such as an individual making a quit attempt) (Heaney & Israel, 2008).

Social support and social networks have been shown to assist smokers with smoking cessation. A study found that the more supporters smokers listed when quitting, the more likely they were to have quit at six-month follow-up, when controlling for the use of other cessation services (Johnson et al., 2009). Another study showed that individuals' who were part of a smokers' social network, influenced smokers to seek professional help such as quitline services (Muramoto, Wassum, Connolly, Matthews, & Floden, 2010). Furthermore, a longitudinal study found that smoking behaviour spread both through close and distant social ties (Christakis & Fowler, 2008). Christakis and colleagues (2008) suggest that smokers act under collective pressures in a network to quit smoking, and those who do not quit, move to the periphery of a network. Finally, a larger online

smoking cessation community, known as QuitNet, found that participants who were involved in any type of support community were more than three times as likely to quit and four times as likely to be abstinent for 2 months or longer (Cobb, Graham, Bock, Papandonatos, & Abrams, 2005).

2.5 Cessation Interventions

Many cessation interventions have been developed and implemented to assist smokers to quit successfully. However, not many are targeted to young adults specifically. The following provides a brief overview of key cessation interventions targeted both to the young adult population and to the general adult population.

Leave The Pack Behind

Leave the Pack Behind (LTPB) is a tobacco control program that began in 2000 in Ontario (Leave The Pack Behind, 2014). This program targets young adults to offer cessation and prevention information, personalized support, and resources for quitting (Leave The Pack Behind, 2014). It is funded by the government of Ontario through the Ministry of Health and Long-Term Care (Leave The Pack Behind, 2014). Programming is provided through college and university campuses by a student-led team. Components of programming include outreach activities, brief tobacco interventions, peer-to-peer social support, web and book based resources, campus toolkits, referrals to campus health services, carbon monoxide monitoring, and an annual quit-and-win contest (Borland & Schwartz, 2010; J. Wong, 2010). Importantly, LTPB, with support of the Ministry of Health and Long-Term Care, provides free nicotine patch or gum to young adult smokers through an online order form or in-person at campus health clinics (Leave The Pack Behind, n.d.). Leave the Pack Behind is considered the provincial best practice for tobacco control in young adults (Borland & Schwartz, 2010; Leave The Pack Behind, 2014; J. Wong, 2010). LTPB has been continually evaluated for successes, weaknesses, and improvements based on feedback from young adults (Lawrance & Lawler, 2008; Lawrance, Travis, & Lawler, 2012; Travis & Lawrance, 2009).

Youth Advocacy Training Institute

The Youth Advocacy Training Institute (YATI) is a program of the Ontario Lung Association initiated in 2005 (Youth Advocacy Training Institute, 2013). This program provides learning experiences and training to youth, young adults, and adults with the knowledge and skills to prevent and reduce tobacco use for positive change through youth engagement (Butson & Scott, 2012; Youth Advocacy Training Institute, 2013). Activities include training programs, conferences, and

educational materials in order to educate, build partnerships, and to advocate for tobacco free and healthy lifestyles (Butson & Scott, 2012). A 2012 – 2013 evaluation found that YATI influences behaviour change in youth and communities across Ontario for prevention, that trainings showed an increase in knowledge, and that youth and adults are empowered to engage their communities to make positive change (Butson & Scott, 2012). However, there are no specific tobacco use outcomes.

Smokers' Helpline

Smokers' Helpline (SHL) is a free, confidential service operated by the Canadian Cancer Society for adults, 18 and above (Canadian Cancer Society, 2012). This is a telephone-based quitline that offers services in both English and French and serves six provinces and one territory in Canada (Canadian Cancer Society, 2012). SHL provides support, evidence-based information, and counselling on tobacco use and quitting (Canadian Cancer Society, 2012). SHL also offers an online quit program (Canadian Cancer Society, 2012).

2.6 Summary

This literature review addressed issues related to the study population, the application of mobile health technologies, and components of effective cessation interventions. It is evident that the young adult smoking population is complex and current cessation interventions are not reaching this group. Based on the literature reviewed, it may be important to consider mHealth applications as a mode of reaching and delivering a cessation intervention to young adults. Research is beginning to emerge in this area; however, more information is needed about how individuals use mHealth applications. Young adult smokers who intend to quit are in the unique niche of providing highly rich data on the experience of using a smoking cessation application.

Chapter 3
Description of the Intervention

Crush the Crave is an evidence-based smoking cessation app created for young adults. CTC was developed in 2012 by a comparative analysis of existing mobile apps on smoking cessation, consulting a group of experts in smoking cessation and social media, and conducting focus groups with young adult smokers to inform the content and to test the design and functionality of the app. The app has been previously beta tested by young adult smokers for utility. For reference, a visual of the different pages and layers of CTC are provided in Appendix A.

CTC is based on a framework of using persuasive technology for behavioural change of which social support is a key component (Fogg, 2003; Fogg, 2009b). The design and principles for persuasive technologies, such as Crush the Crave, are explored below.

3.1 Persuasive Technology Design Principles

Literature in the area of computer science highlights that interactive information technology that is designed to change users' attitudes or behaviours is known as persuasive technology, such as mHealth applications (Fogg, 2003; Oinas-Kukkonen & Harjumaa, 2008). Four main features are suggested for the design of persuasive technological systems. These include primary task support, dialogue support, system credibility, and social support (Oinas-Kukkonen & Harjumaa, 2008). Primary task support allows the user of an application to carry out their main task, such as assisting with a quit attempt. The main principles behind task support include: reduction (reducing a complex behaviour into simple, manageable tasks); tunneling (where the application guides users through the process to persuade changes in behaviour and attitude); tailoring information to a user's specific needs; personalization of the application; self-monitoring capabilities; simulation (where users can see the cause and effect in regards to the behaviour); and the ability for users to rehearse a behaviour can assist in changing a behaviour in the real world (Oinas-Kukkonen & Harjumaa, 2008). Next, dialogue support encourages communication between the smartphone system and the human to move a user towards the target behaviour. Principles behind dialogue support include: praise to provide positive feedback, virtual rewards to credit users for reaching milestones in their target behaviour, reminders, suggestions, similarity of the application to the target demographic, an application that is attractive and liked by the user group, and an application that has a social role persuades users to use the application (Oinas-Kukkonen & Harjumaa, 2008). Third, system credibility principles describe how

an application should be designed so that it is more credible and persuasive to end users. Components for system credibility include: trustworthiness, expertise, surface credibility, real-world feel, authority, respected third-party endorsements, and verifiability of the content in the application by offering external links (Oinas-Kukkonen & Harjumaa, 2008). Finally, social support principles in mHealth applications can motivate users as it leverages social influence (Oinas-Kukkonen & Harjumaa, 2008). This can be done through social learning (e.g. by observing the behaviours of others), social comparison, normative influence, social facilitation, cooperation, competition, and/or recognition (Oinas-Kukkonen & Harjumaa, 2008).

CTC aligns with the four features described, in order to encourage a change in smoking behaviour. Features in CTC include a customizable quit plan, awards given to users as milestones are reached, a visual representation of progress including a health calculator, notifications of health improvements attained and money saved, direct links to additional supports such as the quitline or to information on quit aids (such as nicotine replacement therapy), and the ability to connect with others for social support. Crush the Crave has built a social media presence with a website (http://www.crushthecrave.ca), Facebook page (https://www.facebook.com/CrushTheCrave), a Twitter page (https://twitter.com/CrushTheCrave), and a YouTube presence (https://www.youtube.com/user/crushthecrave). Figure 1 depicts specific components in CTC that coincide with the four design principles.

CTC is currently available for download on iOS and Android devices in both English and French, free of charge.

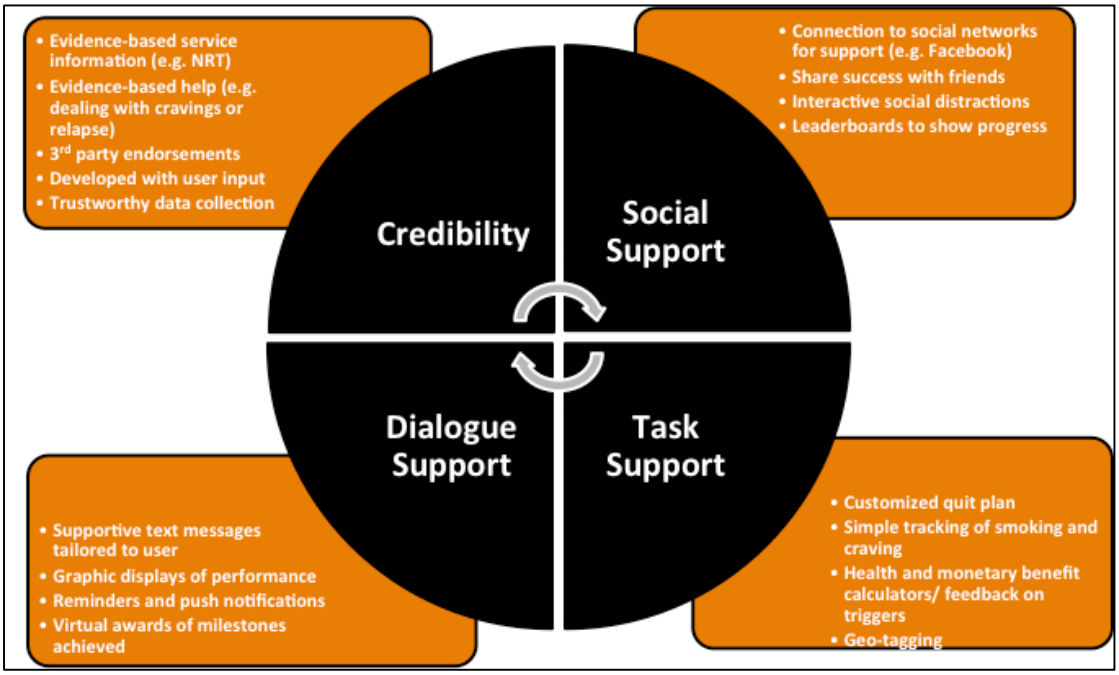

Figure 1: Evidence Informed Design of Crush the Crave

3.2 Randomized Control Trial on CTC

A randomized control trial (RCT) on CTC is currently underway. The aim of the RCT is to determine the effectiveness of CTC on reducing smoking prevalence among young adults at six months (Baskerville et al., 2015)**.** The design is a six-month, two-arm, parallel RCT to evaluate the effectiveness of the intervention (Baskerville et al., 2015). All investigators and data collectors were blinded to the assignment. Eligibility criteria for the RCT include young adult daily Canadian smokers (between ages 19 to 29) who were considering quitting smoking in the next 30 days, have an Android or iPhone OS device, were able to provide informed consent, can comprehend English, and were not referred to the study by an existing participant (Baskerville et al., 2015). Those in the control condition participated by using a self-help guide intervention, known as "On the Road to Quitting" whereas the intervention group participated by using CTC (Baskerville et al., 2015). The self-help guide was developed in 2012 by Health Canada for young adult smokers.

Crush the Crave works by allowing users to customize their quit plan as they will choose a quit date and decide if they will quit immediately or reduce the number of cigarettes they smoke until their quit date. Reminders are given to users to help users stay on track by indicating how much money they have saved and how much their health is improving over time. These milestones are tracked as

rewards, which users of CTC share with their social network. CTC can be linked with Facebook and Twitter. Users of the application are also provided with supportive messages based on their individualized quit plan and where they are in the quitting process. Tracking is also available in the application as users will be able to track their daily smoking habits and cravings by recording when, where, and why they were smoking. This can help users understand their triggers for cravings. The mHealth application also provides distractions to help smokers during a craving such as linking to videos, music, and opportunities to chat with friends. Finally, the application connects with evidence-based information and evidence-based cessation services, such as quitlines and information on NRT.

Participants in the RCT will complete a baseline questionnaire, and three and six-month follow-up questionnaires (Baskerville et al., 2015). The present study (a qualitative evaluation) intends to complement the RCT by understanding the use of a smoking cessation app through consideration of the facilitators and barriers. Subsequent references to this RCT in this thesis will be referred to as the "Smartphone RCT".

3.3 Sensitizing Concepts

Sensitizing concepts were first discussed by Blumer (1969) as concepts that give you initial ideas to pursue and sensitize you to ask certain questions about your topic (Charmaz, 2006). Charmaz (2006) states that sensitizing concepts are only a beginning to assist with data collection and analysis as they "provide us with such points of departure for developing, rather than limiting, our ideas" (Charmaz, 2006), p. 17). Even though these points of departure assist in the research process, it is important that researchers remain open to the directions the data may lead (Charmaz, 2006).

Based on the literature review and the framework guiding CTC, several propositions and sensitizing concepts were identified for this study. Specifically, the literature related to young adult smoking characteristics, the use of mHealth applications for behaviour change, and the design of persuasive technological systems were used to develop these concepts. Sensitizing concepts were used in the construction of the interview guide as they represent a starting point for qualitative inquiry. They are identified in Table 1 below. Examples of questions that were asked to inquire about specific concepts are highlighted.

Table 1: Summary of Sensitizing Concepts

Concept	Description	References	Example Interview Questions probing on the concept
Tobacco use	For young adult smokers, tobacco use is typically associated and affected by the social environment (such as their peers, colleagues, family, and/or social events)	(Bader et al., 2007; Colder et al., 2006; Hammond, 2005; Solberg et al., 2007)	Could you describe your smoking on a regular basis? (i.e. with who, where) When did you first start smoking? And why?
Interest in quitting	Young adult smokers are highly interested in quitting, and many make quit attempts but do not desire to use resources, such as quitlines, pharmacotherapy, or counselling.	(Curry et al., 2007; Messer et al., 2008; Reid et al., 2014; Solberg et al., 2007; J. Wong, 2010)	Have you made a quit attempt before? If so, could you describe your previous experiences? Tell me what you used to help you quit. Is there anything you feel is important to better support young adults with quitting?
Use of mobile technologies	Young adults are a dynamic group interested in emerging technologies and use many features available on smartphones.	(Ipsos Reid, 2011; Norman, 2012a; Norman, 2012b)	Could you describe how you use your mobile device? Do you use your mobile device for social networking or any other health-based applications?

Concept	Description	References	Example Interview Questions probing on the concept
Personalization and tailoring of quit support	Adapting a quit plan may interest young adults' in an intervention as they would have more control and ability to monitor their behaviour, and can see the benefits. This relates to primary task support.	(Bader et al., 2007; Kratzke & Cox, 2012; Patrick et al., 2008; Shahab & McEwen, 2009)	Did you personalize your quit attempt using CTC? How?
Trustworthiness of tobacco interventions	For tobacco users, knowledge of how, why, and who developed an app may be an important factor in the perceived integrity and usefulness of an app. This relates to system credibility.	(Bader et al., 2007; Oinas-Kukkonen & Harjumaa, 2008; Shahab & McEwen, 2009)	How important is it to you that you know who developed an app and you know where the information is coming from?
Social support in quitting	The social environment around a young adult smoker may affect tobacco behaviour, including quit attempts. Social support will provide more motivation, affirmation, and advice for young adults making a quit attempt.	(Cobb et al., 2005; Fiore et al., 2008; Heaney & Israel, 2008; Johnson et al., 2009)	How did you feel about the connecting features available on the app to social media outlets? Did you share any of your experiences with this app to other individuals? How?
Application-User Communication	Integrating communication to the young adult user via the smartphone application persuades the user to move towards quitting behaviour. This may include supportive visuals, messages, and reminders. This relates to dialogue support.	(Fiore et al., 2008; Riley et al., 2008; Shahab & McEwen, 2009; Whittaker et al., 2012)	Could you tell me how the look and the feel of the app, like the visuals and messages you may have seen, affected your smoking?

Chapter 4
Study Rationale

Canada's Federal Tobacco Control Strategy for 2012 to 2017 highlights YA smoking as an area of concern and where action is necessary (Health Canada, 2012). In alignment with the federal goal, this research intended to understand the experiences of using the mobile-based smoking cessation application Crush the Crave in young adults, aged 19 – 29 in Canada. No current literature exists that explores the use of an app with young adults. The findings from this study are anticipated to gain insights and assist in understanding mechanisms associated with using CTC. Further, it is expected that improvements to the CTC intervention are identified that indicate how to best approach this population, which may improve the cessation rate among young adults, and contribute to the literature.

To accomplish this research, the following objectives and associated research questions were developed, listed in order of priority.

Objective 1: To describe and evaluate how young adult smokers use CTC and how CTC has influenced the quit experience for young adults.

> **Research Question 1:** What attitudes and experiences do users have towards the applications' features and characteristics?
>
> **Research Question 2:** What are the facilitators and barriers of using a smoking cessation application?

Objective 2: To explore how and why a mHealth application can contribute to behavioural change.

> **Research Question 3:** What are the key mechanisms of change associated with using the application for smoking cessation?

Objective 3: To document the experience of tobacco use and quitting history among young adults who used CTC.

> **Research Question 4:** What factors are associated with tobacco use in young adults?
>
> **Research Question 5:** What are the main reasons behind using or not using other quit aids (not CTC) and what do these previous quit attempts look like?

Chapter 5
Methods

5.1 Epistemological and Theoretical Perspectives

A critical realist approach for qualitative research was used to inform the research design, data collection, and analysis associated with the use of CTC in young adults. Critical realists maintain,

> an ontological realism (there is a real world that exists independently of our perceptions, theories, and constructions) while accepting a form of epistemological constructivism and relativism (our *understanding* of this world is inevitably a construction from our own perspectives and standpoint) ((Maxwell, 2012), p. 5, italics in original)

By maintaining an ontological realism and epistemological constructivism focus, this research was approached with the assumption that an objective reality exists independently and outside of our aim at knowing it and that what we know about our reality is shaped by social experiences. These assumptions are important as each participant in the study understood their world through their own social experiences and their understanding of this reality is through their perceptions. Thus, the critical realist approach reflects that there is no single correct interpretation of the world and accepts that alternative interpretation into the world may provide valuable insights (Maxwell, 2012).

In this research, the researcher was interested in real young adults, their interaction and experiences with the CTC intervention, and their reality of smoking. The researcher intended to understand participants' experiences in order to describe how and why this intervention worked or did not work (G. Wong, Greenhalgh, Westhorp, Buckingham, & Pawson, 2013). Consistent with this lens, this realist inquiry is anticipated to uncover the mechanisms in the context-mechanism-outcome (CMO) configurations to answer the question 'what works for whom and under what conditions' (Blamey & Mackenzie, 2007; Pawson & Tilley, 1997). Further details on mechanisms will be discussed in the analysis section. Knowledge was acquired in this topic area through interviews to elucidate the 'how' and the 'why'.

Axiological perspectives in this research considered the role of values in the research process (Creswell, 2013; Denzin & Lincoln, 2005). The researcher encountered a practical problem where individuals with direct experiences were asked to provide insights and these values were respected throughout the research process. The researcher took responsibility to accurately depict the findings

that stay true to these insights, including any differing perspectives. Typical of qualitative approaches, data analysis was both inductive (knowledge emerging from the analysis of specific interview data) and deductive (confirming or verifying initial insights of the research, moving from specific notions to more general lessons), occurring simultaneously between data collection and analysis. From a methodological perspective, clear research questions were identified, interviews were used for data collection, and procedures for the protection of credibility, trustworthiness, and rigour were observed. Following data gathering and initial inductive and deductive interpretations, abductive and retroductive reasoning were also used to inform the analysis and discussion sections of the thesis. These terms are discussed and defined in Section 5.6: Data Analysis.

5.2 Study Design

Consistent with the theoretical perspectives presented, a qualitative approach was taken to evaluate the experiences of young adults with CTC. A qualitative inquiry allowed the researcher to collect rich data to get an in-depth understanding of the participants' experiences. Further, this approach also allows the reader to understand these experiences in detail due to the thick description provided in qualitative research that engages the reader with a realistic account of the participants' experience (Creswell, 2013). This qualitative inquiry used the researcher as a key instrument in data collection and analysis, and in inductive and deductive data analysis (Creswell, 2013; Thorne, 2000).

A qualitative approach was selected as the use of mobile apps for smoking cessation in young adults is novel. It is critical to hear the voices of individuals to explore the needs, desires, and experiences of young adult smokers using this app. This level of detail can only be achieved by directly talking to young adult smokers who have used CTC and allowing them to share their experiences. Rather than developing an elaborate theory or framework, following a grounded theory orientation, this study aimed to understand and be grounded in the experiences of young adult smokers. Although a phenomenological inquiry may also uncover these experiences, a realistic account assists in ascertaining the specific mechanisms that may or may not contribute to the quit experience of young adult smokers. These aspects are identified in sensitizing concepts that informed the development of the data gathering instrument. A realistic qualitative approach is an appropriate methodology for this topic due to the focus on understanding the experiences, identifying the specific mechanisms, and evaluating the use of CTC by young adults. By hearing from participants, this research informs future strategies to better target and help young adult smokers in the quit process.

5.3 Ethics Approval

Full ethics approval was obtained from the University of Waterloo, Office of Research Ethics, on March 30, 2015. The data gathering instrument (the interview guide) was then piloted with a small group of young adults to ensure that participants understood the questions and were able to answer the questions that were developed. Following this, a modification to the initial ethics application was submitted to accommodate for changes to the interview guide. Clearance of these modifications was received on May 28, 2015, prior to conducting interviews for the study. Informed consent was completed by each study participant prior to beginning the interview or at the beginning of the interview. As e-mail was the primary method of communication with participants, e-mailed consent to participate was considered acceptable. Otherwise, consent was obtained verbally over the phone and recorded prior to the interview. Consent included individuals agreeing to participate in the study, to have the interview audio recorded, to allow use of the survey data from the Smartphone RCT, and to the use of anonymous quotations in this thesis or any publications. Participants were made aware that they could refuse to answer certain questions or end their participation at any time. Anonymity was ensured by replacing names of participants with identifiers for organization and a pseudonym for presenting quotations. Only the researcher and her thesis advisory committee had access to the data.

5.4 Sampling and Recruitment Procedures

In line with qualitative approaches, only young adults who were "experts", that is those who used the CTC app, were recruited for the study. These individuals were best suited to provide the answers to the research questions as the young adults have direct experience with the study area.

5.4.1 Study Population and Eligibility Criteria

The target population of this research was daily smokers (those who smoke at least once per day) aged 19 – 29 years who live in Canada, own a mobile device that can support apps, speak English, and have used the CTC app through the Smartphone RCT. Given that individuals must have used the CTC app in order to share their experiences for the present study, the sample was drawn from the treatment group of the Smartphone RCT. Participants in the Smartphone RCT completed a baseline survey, a three-month survey, and a six-month survey. For the purposes of this research study, potential participants were contacted only after completion of the six-month survey. It was estimated that approximately 12 to 20 interviews would be conducted, although the final number of interviews would depend on obtaining data saturation, or until no new concepts emerge. Contact information,

such as e-mail addresses and phone numbers, were available from the Smartphone RCT. Prior ethics clearance was obtained before contacting any potential participants.

5.4.2 Sampling

In the present study, a purposeful sample was obtained as it allowed for the deliberate selection of participants to provide data that was thought to be relevant to the study (Creswell, 2013). Individuals were contacted purposefully after completion of the six-month Smartphone RCT survey. The six-month Smartphone RCT survey included a question where participants were asked if they would be willing to participate in an interview to discuss their experiences with the app. Those individuals who said 'yes' to this question were notified that they may be contacted by a researcher for the present study.

The total number of interviews and the interview guide were determined based on the incoming data gathered through interviews to determine saturation and through discussions with the thesis advisory committee. The process of data saturation involved collecting and analyzing data to see if the emergent findings are missing part of the story (Creswell, 2013). If so, returning to collect more data from participants is critical in presenting a holistic account of the experience (Creswell, 2013). Once saturation was reached, data collection stopped as data gathering no longer revealed new information (Creswell, 2014). Other research has indicated that saturation often occurs within the first 12 interviews, with basic elements of themes present as early as six interviews (Guest, Bunce, & Johnson, 2006).

5.4.3 Recruitment

Potential participants were contacted via e-mail to ascertain interest in the study and were asked to contact the student researcher to learn more about the study details **(**Appendix B: Recruitment E-mail). Up to two follow-up e-mails and three follow-up phone calls were made in order to reach the potential participant (see Appendix C: Telephone Recruitment Follow-up). If the researcher was unable to reach the participant through these means, a final e-mail notification was sent to the individual.

Once participants indicated interest in participating, they were given an information letter and consent form (see Appendix D: Information Letter and Consent Form). The information letter had information on the purpose of the study, the role of the participant, the risks and benefits of participation, the remuneration participants could expect, voluntary participation, right to withdraw

from the study, confidentiality, and the contact information of the researcher. After the letter had been reviewed, a consent form was presented to the potential participant. Participants were encouraged to return their consent via e-mail or provide verbal consent at the beginning of the interview (see Appendix E: Verbal Consent Script and Interview Guide). A date and time for the telephone interview were set up at this time based on the participant's availability.

Incentives were utilized in this study. Participants were offered up to $50 via mail if they participated and completed the interview. Although $50 appears to be high, this number was selected as participants would be spending approximately one hour providing in-depth experiences over the phone. Furthermore, in the Smartphone RCT, participants were provided $10 – $15 for completion of the surveys which were 10 – 15 minutes in length; this is consistent with current literature that states incentivizing quitting may be effective (Hoffman & Tan, 2015). Given that a similar pool of participants were used for the present study, it was deemed that $50 was appropriate given the length of the interview.

5.5 Data Collection Instrument & Procedures

5.5.1 Interview Guide

Data were collected through semi-structured interviews to elucidate the experiences of young adult smokers with CTC. An interview guide was drafted prior to the proposal of the thesis project and was reviewed by the thesis advisory committee. The guide was informed by various components of the CTC app and the sensitizing concepts. "Thought experiments" were conducted with the interview guide where the researcher placed herself in the interviewee's place and pictured how she might react to the questions (Maxwell, 2012). Following the successful defense of the thesis proposal, the interview guide was piloted with a small group of young adults to ensure that participants would understand the questions and be able to answer them (see Appendix E). The purpose of the pilot test was to provide insight into the design of the interview instrument so that questions asked of potential participants were clear and understandable.

For the pilot, participants were contacted after completion of the three-month Smartphone RCT survey to ascertain interest in testing the data gathering instrument (see Appendix F: Pilot Recruitment E-mail). Individuals were conveniently sampled at this time and were provided with an information and consent letter for the pilot phase (see Appendix G: Pilot Information Letter and Consent Form). A telephone interview was scheduled following receipt of e-mail consent from the

participant. The pilot interview involved talking to participants about question wording and what they thought the question was asking (see Appendix H: Pilot Verbal Consent Script and Pilot Questions for a list of questions that were asked). The researcher wrote down the thoughts participants shared regarding the interview questions. Data from the piloting phase were not used in subsequent analysis, but were used to modify the interview guide for the present study. Two participants were involved in the pilot phase that occurred between April and May 2015, and were offered $20 remuneration for their time. The final interview guide used for data collection can be found in Appendix I: Revised Verbal Consent Script and Interview Guide.

The interviewing method was selected as the researcher would be able to hear first-hand from participants how they experienced CTC in terms of which features they utilized, what facilitators and barriers they experienced, and if the app worked for them and why. Such detailed and rich information can only be obtained through interviews rather than observations or documents since the researcher wishes to understand the participants' perspective in relation to CTC.

5.5.2 Interviewing Procedures

After verification that individuals met the eligibility criteria and a time for an interview was set up, the interview took place over the telephone. Although face-to-face interviews would have been ideal, telephone interviews were required in this research given that participants may come from all over Canada. Those without access to a telephone were not of concern in this research as individuals required a mobile device in order to use the CTC app. It was anticipated that interviews would be approximately 60 minutes in length and generate approximately 25 pages of text when transcribed verbatim. The researcher conducted all interviews with participants one-on-one.

During the interview, participants were asked again about their willingness to participate in this research study and have the interview recorded, and verbal consent was obtained. Individuals were also notified that there were no correct answers to the questions being asked and that the researcher was simply interested in their experiences and opinions. The interview then proceeded according to the interview guide (see Appendix I). This guide was used in a flexible manner depending on the responses provided by the participant. During the interview, the researcher reflected and asked participants if she was interpreting what they were saying correctly. Further, the researcher took notes during the interview of significant statements and of any follow-up questions that arose during the interview. After the interview, the researcher took notes on the interview and reflected immediately

on the data that was obtained at that time. This allowed the researcher to consider factors for subsequent interviews.

Following the interview, the audio recording was downloaded and transcribed by a third-party transcription service. Participants were mailed a $50 check to an address they supplied and were provided with a thank-you letter for their participation via e-mail and regular post (see Appendix J: Thank-You Letter). Fifteen interviews were conducted between June 2015 and August 2015.

5.6 Data Analysis

Once an interview was completed and transcribed verbatim, analysis of the data could begin. In this study, thematic analysis (TA) was the method of choice as a way of fragmenting the data and then weaving the story back together to obtain both the themes and CMOs. NVivo 10 was used to assist in the management and organization of the data for analysis (Bazeley & Jackson, 2013; QSR International, 2012). Background information provided by participants and the survey data from the Smartphone RCT was summarized to provide sample description and context for this study.

All analyses were conducted by the researcher and verified by a member of the thesis committee. The findings of this study emerged from the data, making the analysis an inductive process; however, it was also a deductive process as emergent findings and data categories were checked against the propositions and sensitizing concepts identified earlier.

Thematic analysis was utilized as it allowed the researcher to answer the identified research questions by highlighting the various perspectives that participants provided. Various themes from the data that answer one research question may show how these perspectives differ among individuals. Further, TA helped uncover knowledge about how people think and feel about their experiences towards CTC and these interpretations in the themes were supported by data. In addition, by identifying mechanisms, the analysis was explanatory in nature showing what might generate change in young adult smokers who use the CTC app. Since mechanisms that create change are not directly observable, they are identified in the analysis by the researcher. The following describes the analytic procedures undertaken for this thesis project.

5.6.1 Step 1: Familiarization with the Data

The overall process of TA involved a broad reading of the data (i.e. in this study, the interviews) that moved towards the discovery of patterns, and ultimately, themes. Initially, interviews were read

and listened to by the researcher for familiarization with the data and to be immersed in the data (Braun & Clarke, 2006). This process allowed the researcher to get an overall sense and impression of the data (Creswell, 2014). During this phase, the researcher took notes and marked ideas that may be useful for subsequent coding phases (Bazeley & Jackson, 2013; Braun & Clarke, 2006). Familiarization with the data occurred simultaneously during data collection as transcribed interviews were returned to the researcher. This phase continued until all interviews had been completed, all transcripts were read, and all recordings had been heard.

5.6.2 Step 2: Coding

Two stages of coding were used to analyze the data which involved initial, open coding, followed by focused coding, which included axial and selective coding (Charmaz, 2006). Although these coding procedures are typically depicted in the grounded theory literature, they are also used in other qualitative analyses (Berg & Lune, 2011; Braun & Clarke, 2006).

In initial coding, the entire dataset was coded in which the codes generated were directed by the content of the data (Braun & Clarke, 2006). This involved closely examining the most basic segments of the raw data. Action-focused codes, or gerunds (i.e. words ending in –ing), were assigned to each piece of data as this allowed the researcher to stay close to the data and the participants' voices (Charmaz, 2006). NVivo 10 was used for the coding and in this software, codes are referred to as nodes (Bazeley & Jackson, 2013). Throughout the coding process, data underwent constant comparative analysis. This involved the data constantly being compared as new data from interviews as they came in, in order to find similarities and differences in participants' shared experiences (Thorne, 2000). Further, codes and themes were adapted and revised as data gathering continued.

In focused coding, categories and sub-categories were developed to group patterns in the coding. Relationships and links between codes were suggested. The purpose of this procedure was to sort, synthesize, and organize the large number of codes resulting from initial coding (Charmaz, 2006). Nodes were organized into a branching tree system in NVivo 10, where the heading at the top described the contents of the nodes below (Bazeley & Jackson, 2013). The organization of the data was an on-going process throughout data analysis as new data and insights were incorporated into the coding framework. For instance, sometimes nodes were grouped together and placed under a new heading and at other times, other nodes were expanded to include related nodes.

5.6.3 Step 3: Theming

The coding processes identified above assisted in inductively identifying overarching findings, themes, and sub-themes in the data according to the research questions posed. A researchers' judgement is critical in determining what a theme is as a theme is not easily quantifiable (Braun & Clarke, 2006). Additionally, the development of themes required interpretive work to examine underlying ideas, assumptions, and conceptualizations (Braun & Clarke, 2006). Themes were identified, constantly reviewed and refined, and organized into a coherent story according to the three research questions developed.

5.6.4 Identifying Mechanisms

Consistent with a realistic perspective, data collected was seen as evidence for real phenomena that are not available for direct observation but with which we can make inferences about (Maxwell, 2012). Through the above coding procedures of initial and focused coding, mechanisms were uncovered to make these inferences. The mechanisms identified in this research considered what created change in the operation of the app, but also those towards the application. Mechanisms were discovered through the processes of abduction and retroduction.

Abductive reasoning is the process of finding reasonable or best explanations based on data from participants' even though individual participant data may not reflect the conclusion (Meyer & Ward, 2014). Retroductive reasoning involves going beyond what is observable in the data by the researcher asking questions and developing concepts and hypotheses that are critical to understanding how the phenomena might operate (Meyer & Lunnay, 2013; Meyer & Ward, 2014).

In program evaluation, action and causal theory are two common terminologies. An intervention or a program, such as Crush the Crave, is the action theory and the context that allows a mechanism to occur for a particular outcome, such as abstinence after using CTC. The mechanisms were identified or "teased" out from the data with analytic procedures. The analyst considered questions such as what is it about CTC, or components of CTC, that created change or responses to this intervention (Blamey & Mackenzie, 2007). As an example of a mechanism, we may see that the social support connections to Facebook and/or Twitter may provide users of the app with motivation and affirmation (the mechanisms) as they make a quit attempt (the outcome). This example is illustrated in the following diagram.

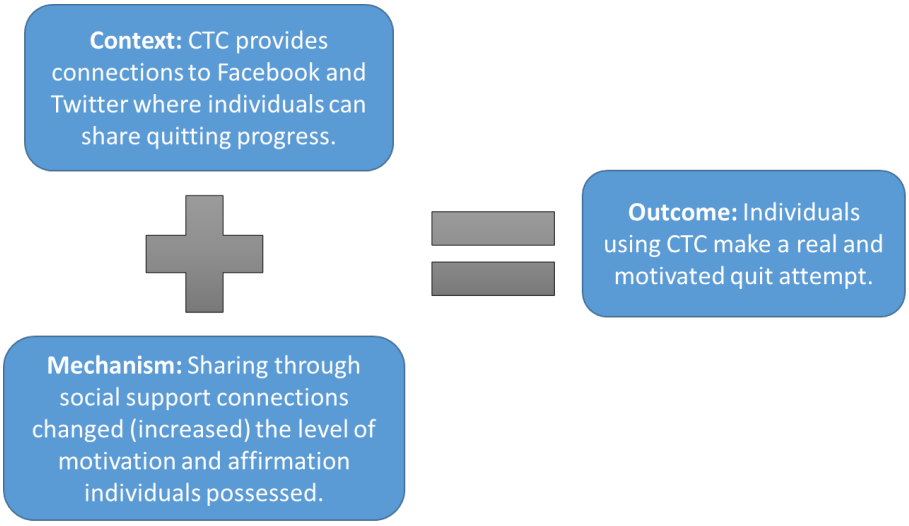

Figure 2: Sample CMO: Social support provides motivation and affirmation for making a quit attempt

The discussion chapter of this thesis also employs abductive reasoning to consider the findings from this thesis in light of two key behavioural change theories (i.e. Theory of Planned Behaviour and Social Cognitive Theory). Furthermore, retroduction also occurred to consider what was insightful from this study, what more might be needed, and what directions research might take in the future. Additional mechanisms were identified in the discussion regarding what created change towards smoking and the process of quitting.

5.7 Reflexivity and Memo-Writing

Throughout the process of analysis, the researcher engaged in memo writing to keep track of any observations in the data, to document the process of coding, what may be missing, and what still needed to be collected to create a complete account (Charmaz, 2006). Memos were spontaneously developed and informal, as they were used to capture the researchers developing ideas, to articulate frustrations and challenges encountered, and to make connections in the data (Charmaz, 2006). The memos were also used to immediately write down any interpretations or thoughts the researcher had on the direction of research as the analysis occurred and they served as a tool for reflexivity.

Reflexivity is an important component of qualitative research as the researcher is one of the key instruments in the study. It contributes to the integrity of the research, enhances and evaluates the

quality and rigour of the research process, methods, and outcomes, and examines the impact the researcher has on the study (Finlay, 2002). The process involved the researcher reflecting on her role in the study and how her background and experiences may have shaped her interpretations and direction of the study (Creswell, 2014). This evolved from knowing how one knows something to recognizing "how [one] actively construct[s] our knowledge" and questioning how these interpretations have come about (Finlay, 2002). Thus, reflexivity should occur throughout the research study from beginning to end.

In this study, the researcher critically examined her own assumptions that may lead the inquiry in a particular direction and these assumptions were clearly articulated (see Section 5.1). Throughout the study, a reflexive journal was maintained that included the memos written, especially during data collection and analysis. This journal helped contribute to keeping a careful account of the steps in the research process and was written in a free style without worrying about style or correctness of the entries (Bazeley & Jackson, 2013). Memo writing assisted in the reflexive process as it captured the researcher's thoughts, connections, and directions to pursue in the study (Charmaz, 2006). Lastly, any experiences were explicitly stated in terms of how they affected the interpretation and the course of the study (Creswell, 2014).

5.8 Data Quality and Rigour

In order to establish data quality and rigor, a study must be considered trustworthy. The main criteria for data quality and rigour in qualitative research are credibility, transferability, dependability, and confirmability (Creswell, 2013). Credibility assesses whether the results of the research are believable to participants, whether the researcher is familiar with the topic, whether there are clear links between data and the analysis, and if there is enough data to support the claims (Creswell, 2013; Krefting, 1991). Credibility was ensured by confirming the researchers' interpretation of what the participant shared during the interview. In addition, rich data were obtained through the process of interviewing, the researcher immersed herself in the data, initial coding stayed close to the data, and analysis and results were supported by comments participants actually shared during the interview (Creswell, 2013; Krefting, 1991). Transferability indicates if the research is transferable between the researcher and the participants (Creswell, 2013). This was ensured by providing rich, thick description so that readers can decide if findings are transferrable and actually transfer the findings to other contexts (Creswell, 2013). The notion of dependability is that findings are subject to change and are variable (Creswell, 2013). As such, variable perspectives were included in this research in order to

look at a range of experiences (Krefting, 1991). Furthermore, the exact procedures used for data gathering, analysis, and interpretation were clearly articulated. Lastly, confirmability establishes the value of the data which is increased by decreasing the distance between the researcher and the participant (Creswell, 2013; Krefting, 1991). Confirmability was ensured by engaging with participants in the interview process and by the researcher remaining true to the data. The reflexive journaling process was essential in this process as the researcher was aware of her influence on the data and kept track of these instances. Furthermore, all procedures were outlined and the data was checked and re-checked throughout the study. The researcher's supervisor also conducted a check and asked hard questions of the methods, analysis, and findings by playing the role of "devil's advocate" (Creswell, 2013).

Chapter 6
Results

6.1 Sample Description

The researcher contacted 33 individuals to partake in this study. Twenty-six individuals responded from which, two declined participation, six did not maintain contact to conduct an interview, and three did not answer for a scheduled interview and did not communicate further. In total, 15 interviews were conducted with young adults across Canada. The largest group of participants resided in Ontario (N = 5) followed by those living in Newfoundland (N = 3). Ages of the participants ranged from 20 to 29 years, with an average of 23.7 years. The sample included eight males and seven females. All interviews were conducted in English. At the time of the interview, four individuals were not smoking, eight were cutting down or trying to quit, and three were still smoking. Years of smoking ranged from 1.5 to 15 years, with an average of eight years. The majority of participants used CTC with an iPhone device (N = 9), followed by an Android device (N = 5), and one individual using a tablet. The following table describes the characteristics of each study participant.

Table 2: Participant Characteristics by Interview Order

Interviewee Number	Age	Gender	Location of Interviewee (Province)	Smoking Status at Time of Interview	Years Smoking	Smart Device Type
01	21	Male	Manitoba	Cutting down	8	iPhone
02	20	Male	PEI	Trying to quit	6	iPhone
03	22	Female	Saskatchewan	Not smoking	7	iPhone
04	25	Female	Ontario	Cutting down	11	Android
05	23	Male	Newfoundland	Trying to quit	4	iPhone
06	20	Female	British Columbia	Not smoking	1.5	iPhone
07	24	Male	Quebec	Smoking	7	iPhone
08	24	Male	Newfoundland	Not smoking	3	iPhone
09	29	Female	Ontario	Trying to quit	15	Android
10	24	Male	Ontario	Not smoking	12	iPhone
11	28	Female	British Columbia	Cutting down	7	Android
12	23	Female	Ontario	Smoking	8	Android

13	25	Female	Ontario	Cutting down	9	iPhone
14	26	Male	Newfoundland	Smoking	14	Android
15	22	Male	Ontario	Not smoking	7.5	Tablet

Interviews with participants occurred between June and August 2015. The interviews varied in length. On average, interviews were 69 minutes long, included approximately 10,500 words per transcript, and were 33.30 pages long. This resulted in almost 500 pages of data. The following table characterizes the interviews and transcripts by each study participant.

Table 3: Description of Interviews and Transcripts

Interviewee Number	Date	Length of Interview (minutes)	Transcript (words)	Transcript (pages)
01	June 15	64:19	10,095	34.75
02	June 17	65:20	10,585	29.00
03	June 24	64:29	9,679	31.50
04	July 3	73:48	12,831	35.50
05	July 4	66:56	10,406	28.00
06	July 4	63:03	9,717	37.50
07	July 6	73:15	9,741	24.50
08	August 6	75:27	12,392	36.00
09	August 10	63:03	9,543	33.75
10	August 12	77:42	12,381	35.00
11	August 15	74:34	13,410	38.75
12	August 21	69:02	10,539	30.50
13	August 24	75:04	13,759	33.50
14	August 25	72:52	11, 388	37.25
15	August 26	64:30	12,973	34.00
Total		**1043:24**	**158,051**	**499.50**
Average		**69:34**	**10,537**	**33.30**

6.2 Analysis Process and Structure

All analyses were conducted by the researcher and later reviewed by the researchers' supervisor. The first phase of analysis involved familiarization with the data, which was followed by coding of the data. Codes were created throughout the process and were also edited to better suit the data. Although the majority of codes were created during the coding of the first five transcripts, it is important to note that codes were added during subsequent transcripts as well. The reason for this was use of CTC often differed by participants (i.e. one participant may use one section of the app that another person did not) which added codes throughout the process. The analysis was organized and connected in a meaningful hierarchy in NVivo 10. Overall, the data was organized into 9 trees with 47 branches, 154 twigs, 142 leaves, and 10 buds. The table in Appendix K displays the structure of the analysis.

6.3 Description of Emerging Findings in Relation to Research Questions

The emergent findings from the analysis are described in detail below to tell the story of participant experiences. The data are organized in an order that was most logical to the researcher, and by the research questions. First, data regarding young adults' reasons and experiences with smoking are presented, followed by experiences with using quitting resources in previous quit attempts, experiences with CTC, and finally, the mechanisms associated with using CTC are detailed. Pseudonyms (not interviewee's proper names) are used to aid in the presentation of quotations (see Appendix L: List of Pseudonyms).

6.3.1 Tobacco Use and Reasons for Smoking

To learn about a participants' smoking history and reasons for smoking (i.e. to align with research question 4), the researcher asked several "getting to know you" introductory questions. Participants' shared when they started smoking and the circumstances around smoking initiation to describe their smoking habits. The findings in this section were from the introductory questions and Table 4 shows the relevant nodes along with the decreasing number of sources (number of transcripts the node is coded in) and mentions (the number of references in the data to the node).

Participants were asked at what age they began smoking which ranged from 8 years of age to 21 years. However, only two individuals started before the age of 10 with the majority stating they started smoking during their teen years (N = 12). The amount each individual smoked was variable depending on the circumstance and context the individual found themselves in, but varied between a

couple of cigarettes per day to an entire package of cigarettes per day. The researcher also inquired as to the use of alternative tobacco products (ATPs) and marijuana. ATPs are tobacco products other than cigarettes such as cigars, cigarillos, roll-your-own tobacco, smokeless tobacco, and hookah. Seven participants stated that they had smoked cigars and/or marijuana, or had mixed tobacco and marijuana together. This was illustrated by Charlie,

> Ever since I started high school I smoked a lot of pot, and I always mix my pot with tobacco…I didn't want pot without it and even when I quit smoking cigarettes, I would still smoke pot with tobacco, like I would get rolling tobacco or something, and it was a terrible, terrible addiction.

Table 4: Nodes for Tobacco Use and Reasons for Smoking

Name	Sources	Mentions
Reasons for smoking	15	67
Social pressure & sharing smokes	13	34
Feeling stress	10	14
Drinking & smoking	8	11
Fitting in	6	8
When and where smoking occurred	15	45
To be social with others	13	31
Smoking throughout the day	10	14
Smoking network around individual	15	40
Family smokes	11	20
Friends smoke	10	20
Amount smoked	15	31
Starting to smoke	15	21
Use of Alternative Tobacco Products (ATPs) and Marijuana	7	15
Tobacco & marijuana together	5	7
Cigars	2	5
Using marijuana first	2	3

Eleven participants stated that they had family members who smoked or had smoked in the past, and nine indicated having friends who smoked or who wanted to try smoking together at the time of smoking initiation. Christina explained smoking in the family as a reason for starting:

> I decided to try smoking because my sister was smoking and she is younger than me and I just wanted to know what it was all about and kind of mama beared her… I didn't like it, but I was like I might as well figure out what this is all about. If she is going to do it, I am going to do it.

In terms of when and where participants smoked, many stated smoking all the time and/or socially (N = 15). This was eloquently described by Edward:

> …When you are smoking habitually like that you pretty much smoke any chance you get, right. Like there is not really, like social smokers I could see that…when you are at this person's house, you are having a drink there, something like that. …but somebody who smokes all the time, you just get in your car, you get out of a building, you grab a coffee in the morning, like it doesn't really matter. You are going to be smoking.

The theme of social pressures as a reason for smoking emerged from thirteen of the fifteen interviews. This included being offered a smoke by a friend, sharing a smoke with another, or establishing a "common ground" when getting to know others. Furthermore, drinking and a party-like atmosphere encouraged heavier use of cigarettes and made individuals feel a stronger craving (N = 8). Rachel articulated the effect of social pressure on her: "*I can go days without cigarettes, but when I am around other smokers is really when I take it up the most, or at a bar or places like that where you do see people smoke more often*".

The last two major reasons for smoking included dealing with stress and fitting in with the crowd. Stressful factors included dealing with death, illness, school, and relationships and like Rachel, many "*used [smoking] as kind of a stress relief*". Jennifer also described how smoking let her "*have five minutes of quiet…I started associating going for a smoke [as] having five minutes to myself*". This reason was common among participants as 10 individuals' stated using tobacco for stress relief. Fitting in was described by six participants as smoking was "*the cool thing to do*". Unfortunately, this often led to heavier tobacco use over time as shared by Patricia:

> I just wanted to be cool, and fit in with the cool kids outside of school. I just smoke[d]… for show, casually, and then I started smoking more and more, and when I was like partying and drinking, and I [have] smoked on and off since.

6.3.2 Experiences with Quitting

In order to describe the findings related to research question 5, this section will be organized into three sub-headings: reasons for wanting to quit, strategies for quitting and use of quit aids, and reasons for relapse (Table 5). It is important to note that the quit attempts discussed in this section are prior to the use of CTC as participants' were asked to reflect on previous experiences.

Table 5: Nodes for Experiences with Quitting

Name	Sources	Mentions
Reasons for wanting to quit		
Noticing impact on health	11	26
Feeling pressure and/or encouragement from family & friends	7	13
Smoking is an expensive habit	6	9
Strategies for quitting and use of quit aids		
Quitline services not used	15	21
Making multiple quit attempts	14	26
Reasons for not using pharmacotherapy	13	22
Not wanting to put more chemicals in body	9	11
Lacking confidence in pharmacotherapy being successful	4	5
Not having money for pharmacotherapy	1	4
Not knowing how medication works	1	1
Not using medication for quitting	12	16
Desiring more information about quitline	10	16
Speaking with health professionals	10	16
Using NRT for quitting	8	25
Trying e-cigarettes or vaporizers	8	15
Health professionals providing prescriptions & information	8	9
Not using online resources	8	8
Experiencing negative effects from NRT	7	13
Not accessing health professionals for support	5	5
E-cigs not as satisfying & not cutting cravings	4	9
Using medication for quitting	3	10
E-cigs replace one habit with another & create another trend	3	3
Experiencing negative effects from medication	2	5
Reasons for picking up smoking again		
Being around other smokers & social gathering	11	19
Craving and withdrawal effects	5	8
Drinking and smoking	5	5
Feeling stress	4	5

1. Reasons for wanting to quit

During the interviews, participants were asked if there was a reason behind their past quit attempts and what made them actually try. Although a number of reasons were cited, there were three major themes for wanting to quit.

The majority of participants (N = 11) stated that they noticed the impact smoking had on their health. Daniel reported significant health concerns that may have an impact in the long-term:

> I noticed like unregular heart beating. I used some drugs in my life sometimes, so and smoking cigarettes with that, I guess it was really hard for my young body to assimilate all those things. I know some

> people in my family might already have some heart problems, so when I became a little bit older, [I] stop[ped] doing drugs, and start[ed] to quit cigarettes. I was smoking pot too… smoking pot was like one of the things that [made] me stop cigarettes because I had some like anxiety…so that is when I feel my heart going a little bit weird, even if I am smoking a cigarette, that was like, whoa.

Others, like Christina, explained the effect smoking had on playing sports and remaining active on a daily basis: "*I am very active, and I especially noticed like you know my lungs were burning all the time from walking upstairs, and you know things that never should happen*".

Another reason stated by seven participants was feeling pressure from other individuals to quit. Edward shared that,

> I was mostly doing it at that time because my girlfriend at the time was pressuring me into it. She hated the fact that I smoked, so at that point I didn't actually want to quit. I was doing it because I was told to. So inevitably that failed.

Others received more support and encouragement like Brian, where they would "*quit with either peers or a group of friends…so that way [they] could support each other through it*".

The last major reason for wanting to quit was the cost associated with smoking. Six participants identified that the habit was quite expensive. Robert stated that it, "*costs a lot of money and it is not good to smoke… I definitely did the math. I can't believe I did it. Not really good at math*". Other participants saw the rise in cigarette costs over time as Rachel explained, "*for the most part it was just the cost of it, with the prices going up so many times and it is just really expensive for just one pack, so yea it is the cost that mostly got me*".

2. Strategies for quitting and use of quitting resources

To elucidate past quitting history, participants were asked if they had tried to quit smoking before and to detail these experiences in terms of how they quit and their use of any quitting aids.

Almost all individuals (N = 14) had made multiple quit attempts over time in order to try to be smoke-free. Charlie shared that, "*I have tried to quit, I can't even count, could be like a hundred times*". Individuals cited making quit attempts that were both impromptu and/or planned and had different levels of commitment for each quit attempt. The use of resources for quitting varied among participants and the reasons for their use (or non-use) are explored in the following paragraphs.

Quitline services were not used by any of the YAs interviewed. Some individuals already had support from other individuals, like Brian, who reported that, "*I have always had really educated and resourceful people in my life that [I] have been able to call*". Other individuals did not wish to speak with a stranger and did not fully understand the quitline as Heather explained:

> I would rather talk to people I know. I think about it… I never really understood like whether, what the quit line did, like I have never read about it, or I know about it, and I have heard about it, but I don't understand the concept. I feel that I can just do that with like I can call up one of my friends, and do the same thing.

Even though the participants in this study did not use the quitline, some individuals indicated that they may try it in the future. However, before doing so, additional information regarding the quitline was desired. For instance, Susan had a number of questions:

> I heard that it exists, but I never, nobody could ever tell me if there are actual ex-smokers there, or there are non-smokers there. Who are the people on the quit line? ... I wanted to use the quit line, but then I was thinking, did those people ever actually smoke? Do they know how I feel? Are they actually helping with the legitimate advice, or will it just be some you know, random research that they made, and will just tell me that, oh yea, taking a shower will actually help you, but they never actually tried it themselves.

Preferring someone who had actual experience with quitting was echoed by many other participants. Furthermore, participants wished to know more about the person on the line to increase familiarity and comfort. To help increase comfort, participants like Rachel suggested "*someone who could be there more than once*" on the line who knows them and their history.

Pharmacotherapy included medication and NRT. Three individuals had tried and used medication. One individual tried Wellbutrin (otherwise known as bupropion) and two individuals tried Champix (otherwise known as varenicline). Those who used medication found the "*physical urge to smoke [wasn't] there*", however, some individuals also experienced side effects. Edward found that the medication turned him "*into a monster…and not just angry, but also horribly depressed*" and he could not sustain the change to his personality. On the other hand, Robert found that medication gave him really vivid, bad dreams where he was unable to sleep. Those who did not use medication cited that costs were too high, not wanting to put in additional chemicals into their bodies, and not wanting to rely on a pill. NRT was used by eight individuals and included both the patch and gum forms. However, individuals also experienced negative effects with the NRT. Vincent mentioned that the

patch made him "*feel really sick, so I never tried anything again after that*". Others mentioned that during the warmer months, the patch would not stick to the skin and would fall off. Those who tried the gum hated the taste and often felt nauseated by the contents. Individuals stated similar reasons for not using NRT including not wanting to put another source of nicotine in the body and not believing that NRT might be helpful as participants heard from others who had unsuccessful experiences.

Ten participants interacted with health professionals when quitting and primarily, this interaction focused on discussing the negative effects of smoking and the prescription of pharmacotherapy, and less on cessation counselling and/or support. Kevin reported that, "*I talked to my doctor, and he… said it wasn't good to smoke and it has a lot of bad side effects… but he just told me what it could do and what not and that is really it*". Some participants also mentioned that they were not necessarily told they need to or should quit or were not encouraged to. Other individuals did not access health professionals (N = 5) for cessation support as they knew they would only be given a prescription.

E-cigarettes were used by eight participants including those like Charlie, who thought they were "*supposed to be better for you and… supposed to help you quit smoking*". Some individuals tried e-cigarettes as their peers were using it to quit smoking and were having some success. Participants found that using the e-cigarette did not cut down on the cravings they felt and did not feel as satisfying as a real cigarette. Jennifer mentioned that "*it was the act of knowing it wasn't a real cigarette because they can mimic it as close as possible, but… I know it is not*". Furthermore, participants felt that an e-cigarette was not an adequate solution as you could still be addicted to nicotine, it was a half measure, and they might as well smoke a real cigarette. Edward illustrated that, "*the vaporizer…for me I feel like [I'm] probably going to start smoking again at some point. It needs to be a firm whole decision to get it out of your life. I can't be tiptoeing around it*".

Overall, participants had varying degrees of success with quitting resources that were available to them. Some suffered negative effects, could not afford the resource, or were not comfortable accessing the resource. Many also wanted to quit by themselves without relying on items that intended to replace cigarettes (e.g. medication, NRT, e-cigarettes) as this involved taking something to quit smoking. Interestingly enough, individuals did not use online resources (such as websites) to help them with a quit attempt. Given these experiences, other quitting resources (such as CTC) may be needed. Implications of this will be uncovered in the discussion (Chapter 7).

3. Reasons for relapse

During the interviews, participants were asked if there was a reason they started smoking again during their quit attempt. The most prevalent theme was that individuals (N = 11) were around other smokers and social gatherings which encouraged them to pick up smoking again. The party and drinking atmosphere was also mentioned by five individuals as a reason that contributed to their relapse. Jennifer stated that it was as simple as:

> a very generous smoker…would just offer me one every time, and I was so good about saying no for a little while there, and then I was like, well one is not a big deal. We are out. We are drinking. It is fine and you know, it wasn't fine. Then I started to feel guilty about taking cigarettes all the time, and then I bought them, and then it was too late.

Other reasons for relapse included the cravings and withdrawal symptoms individuals (N = 5) felt when stopping intake of cigarettes and dealing with stress (N = 4). Kevin clearly shared both the stressful and social aspects of relapse: "*I would either like get into a stressful situation, or it would be around me like someone would have cigarettes around me or something, so it would just be easily accessible*".

6.3.3 Experiences with Using CTC by App Feature/Characteristic

The experience of using CTC constituted the majority of the findings from the analysis phase regarding YA experiences with a mobile app and is the primary focus of this thesis. These findings are related to research questions 1 and 2 and explore experiences, facilitators, and barriers with a variety of app components**.** To aid in the presentation of the findings, this section is organized with subheadings that are broken down by various app features and characteristics, as follows. First, the reasons individuals used CTC to quit provides an introduction to the participants' experience with CTC. The next section describes perceptions of using the app in general such as when and how long, as well as the visuals and text in the app. Third, how participants used and felt about the personalization features in the app are discussed. It is important to note that perceptions of general use and personalization refer to the entire app and were not unique to one app feature. Next, usage of each of the specific app components is described: the home page trackers and summary information, progress pages, quit help information, distractions, awards, and connecting to social media. Any additional findings from the interviews are also reported. Finally, participants shared feedback on how they thought CTC was different from other quitting resources.

6.3.3.1 Reasons for Quitting with CTC

Participants were asked to share their reasons for quitting with CTC (Table 6). The following reasons remained consistent with reasons at earlier quit attempts (see section 6.3.2): noticing smoking had an impact on health (N = 12), feeling pushed and/or encouraged by others to quit (N = 5), and that smoking was a costly habit (N = 9). However, additional insights were also obtained that differed from earlier quit attempts.

Table 6: Nodes for Reasons for Quitting with CTC

Name	Sources	Mentions
Noticing impact on health	12	18
Smoking is an expensive habit	9	14
Already interested and/or attempting to quit	7	15
Different environment	7	10
Motivated by Smartphone RCT & this new tool	6	7
Wanting to quit for yourself	6	7
Being pushed or encouraged by others	5	7

First, seven participants noted that they were already interested in quitting at the time and they came upon CTC, like Charlie, who reported that, "*I ha[d] been trying to quit at the time when I heard about [Crush The Crave], so it was just kind of like why not give it a try… there would be no harm in it*". On the other hand, others were actively searching for a way to quit due to unsuccessful attempts with other quit aids. Robert shared that, "I *tried the Champix and then the Champix wasn't doing it for me, so I tried looking online and looked online and found [Crush The Crave]*".

The next reason for wanting to quit noted by seven participants was that they were in a different environment. Typically, this involved a change in the home environment (such as moving to a new location or going away to school) and/or a change in ones' social environment. This often provided a good opportunity to attempt to quit. Brittany mentioned that she had changed schools where she was not "*hanging out with the same type of people*" who smoked and had new, non-smoker friends.

Six participants were motivated to quit because of the new tool (i.e. CTC) and by the Smartphone RCT study itself. Kevin articulated that "*it was something I never heard of, and just wanted to see if it would work*". Rachel echoed these sentiments with, "*the whole app survey thing… that kind of inspired me to quit at the time, because I didn't really have an intention [to quit]*".

Lastly, six participants highlighted that they really wanted to quit for themselves as Christina eloquently illustrated: "*I have to be committed myself, because I also know that you can't change for*

people. You have to change for yourself". This method was preferable over quitting due to social pressures as it was a less judgmental space where others could provide more support.

6.3.3.2 Perceptions of General App Components

In order to understand how the app was used, participants were asked more general questions including how often it was used, how they remembered to use it, when they used the app, and how the app looked and felt, and their opinions on how the app communicated with them (Table 7). Challenges with general app usage were also explored. Approximately half of the participants (N = 7) made an effort to go through the entire app initially as it helped them see what options were available and how the app might work for them.

Table 7: Nodes for Perceptions of General App Components

Name	Sources	Mentions
Duration of use & when the app was used		
Duration of use	10	15
Using the app every day	10	11
Going through the whole app initially	7	9
Using app when on your phone or feeling bored	6	8
Low use of app	5	15
Using app to replace habits	4	6
Using the app every few days	1	2
Remembering to use the app		
Forgetting to use it	8	11
Not receiving notifications	3	3
Wanting to make a real attempt	6	8
Using your phone already	5	6
Enjoying information in the app	5	5
When craving to replace habits	4	6
Look & feel of app		
Good graphics & visuals	9	10
Logo & name were empowering	6	6
Colours were appealing	6	6
Depressing to see dark colours & wanting more colour	5	11
Looks did not affect quitting experience	5	5
Finding it easy to move around the app	3	8
Finding the app to be cluttered & difficult to find aspects	2	8
How the app communicated with the user		
Was understandable & simple	8	10
Feeling that it was written for young adults	8	8
Keeps encouragement going with positive language	3	4

Technological challenges		
Always needing data or Wi-Fi connections	4	9
Experiencing slow speed & buttons not working	2	5
Not reconnecting to your account with a new smart device	2	4
Assumes you have not smoked if no data has been inputted	2	2

Two-thirds of the participants used the app every day and attempted to be consistent with viewing and inputting data into CTC. However, duration of app usage varied significantly between participants as this depended on how the app worked for the individual, if they could remember to use the app, and if they had successfully quit and did not need to visit the app anymore. The time varied between one week and six months. Others used the app less often and often encountered challenges with app usage. Six participants accessed the app when they were already on their mobile devices which was often precipitated by feeling boredom. As Charlie shared,

> Probably use[d] it more like if I was in the car, like if someone is driving… I am usually on my phone a lot. So that definitely would be when I would be using it, just whenever I am using my phone in general.

Others used the app to replace the habit of smoking (N = 5). Brian illustrated this with, "*if I was having a bad day, and wanted to have a cigarette… I would open the app and it would… deter me from it, so I think that was my mid-day, like oh open the app, deter yourself*".

Participants were also asked how they remembered to use CTC. Some echoed (N = 4) that remembering to use the app went hand-in-hand with feeling a craving which triggered their memory. Kevin shared that, "*it became kind of a habitual… thing. I replace[d] the habit with the app*". Also, already being on a mobile device jogged the memory of participants (N = 5). Six individuals indicated that their desire to truly stop smoking is what reminded them to use the app. This was articulated by Heather when she said,

> To try and give it an actual shot, like to be motivated to use it, and to remember to use it so that I didn't slip up or forget about it… at the beginning I was motivated to remember to use it, and to give it a shot and actually try.

Five others indicated that they remembered to use the app because they thought the app "*was kind of cool*" with its information and features which encouraged them to continue going back. However, using the app was not without its challenges as eight individuals found they would forget to input their data and would like to see reminders or notifications from the app to their mobile device. This was a major barrier for some participants which hindered their usage as illustrated by Christina:

> The only thing that didn't help me at all was not knowing that the app was there. The forgetting… was really kind of a difficult thing… just not remembering that it was there was the hardest part. I just really wanted it to remind me… if it was more in my face, it would have helped me… way more. Like I am not kidding. I probably would have just quit smoking. Like it is a great app. I am not just saying that. It is a fantastic method to quit smoking. If I used it more, I truly believe I could have quit smoking. It is just… it wasn't there enough for me. Like it wasn't in my face enough.

In terms of how the app looked and felt, overall, participants (N = 10) stated that the app looked good and was easy to use and navigate. Daniel shared that the app, "*looks good. It feels good. Easy to use… There is not much artificial stuff that you don't need… you want some tricks to help you quit. You go there, you got lots of choice*". Furthermore, Daniel articulated how the app logo and name was empowering: "*I know the logo of Crush the Crave is nice… you see the fist punching the cigarette down… it is a strong image*". These thoughts of determination and power resonated with five other participants. Participants also liked the colours the app employed (N = 6) and specifically, it was mentioned that a black background with lighter text made the app easier to view. Lastly, navigating through the user interface was clear to some participants (N = 3). Brian felt,

> That was actually one of the reasons why I looked more into the Crush the Crave app versus some of the other quitting apps I had been looking at. I enjoyed the layout. I found it was easy to navigate. I liked how simple it was, but as you went into the tabs, there was plentiful resources, and a lot of modules, so it wasn't very boring. It wasn't simple, simple, but it was simple in the fact that it was just easy to navigate.

Although the look and feel of the app was generally viewed positively, there were areas that participants felt could have been improved. Some individuals (N = 5), like Brittany, found "*dark colours to be less motivating. If it had been brighter, [it] would have been better. It would have encouraged me more*". Edward also found that "*the menu system at times could be kind of hard to find what I was looking for*" as it appeared "*cluttered…but what I did want was there*". Overall, participants cited that they would like the app to be laid out clearer (avoid buttons within buttons) and to have more colour that can be customizable. Vincent shared how this could be achieved:

> The thing that bugs me the most is it was just orange and black. You know if there were different colours, then like I see that colour, and be like, hey what is over here… but it is just orange and black… It is pretty plain. I wouldn't expect to find any games in there. The pictures were kind of colourful, but it is just a picture on an orange

> and black screen, right. It was bland, very bland. It just made me not want to look through it, because I don't know what I am looking through anymore. Am I clicking on the same thing? You know if there was a big pink, colourful video game controller option at the bottom, I would click on that pink video game controller, thinking there must be video games here.

Lastly, participants were asked to share their opinions on how the app communicated with them and the majority (N = 11) found it to understandable, written for the YA population, and positive in that it kept encouragement going. Brian found that "*it was very simply written, but in a good way, like I think most things that are aimed at a wide audience should be*". Susan also mentioned that the app did not *"[speak] down to me…the way it was written was comforting*". The language in the app was also "*motivational*" so participants actually desired even more messages in the app that should be positively worded to keep encouragement flowing.

Some participants expressed encountering technological challenges when utilizing CTC or concerns with how the app operated. First, participants noted (N = 4) that the app seemed to always need a connection to data or Wi-Fi in order to work. Edward detailed,

> That was my biggest problem with it. I really wish you were able to access it and I don't see why you are couldn't. You are just registering, [the app] could do the uploads while you were in a Wi-Fi centre.

Other participants also indicated that the app should be able to open so that they could track their 'smokes' and 'craves', and view their Progress and Awards. Robert mentioned that many times he had to go without the app, because he needed to be "*online all the time in order for it to work*". Another challenge was that the app assumed users had not smoked if 'smoke' or 'crave' had not been clicked. Jennifer described that she had used the app, and then had stopped for two months. When she returned two months later, the app showed her how much money she had saved when in reality, she had been smoking for those two months and that was money she had spent. She said, "*If I didn't enter a smoke that I had had, then it assumed that I hadn't had one. There is it congratulating me when I know, no, no, no*". Furthermore, some individuals experienced that when using a new phone, the app would not allow the profile to be switched over from the old to the new phone. Christina reported that,

> I needed to be able to switch it onto my phone. I would still like to have it on my phone but I can't put it on my phone. And that is

> something that I really, if you guys ever get that bug fixed, I would love to have it again.

In this scenario, participants had to create a brand new account that did not include data entered into the app earlier from another account. Finally, individuals cited that at times the app could be slow or certain buttons were not working for users. For example, one participant noted that the 'smoke' and 'crave' buttons would not work and thus, he was not able to track any this information and was seeing Progress and Awards achieved even though he was smoking.

6.3.3.3 Personalization

Several participants described making use of the personalization features available on the app. These included 1) choosing your own quit plan, 2) changing the photographs on the app, and 3) writing personal affirmations. Six individuals reported choosing their own quit plans which involved choosing to quit right away, setting a future quit date, or reducing the number of cigarettes smoked over time. Personal photos were inputted by two individuals of their family and friends as motivation to quit smoking. The app had a built-in affirmation which five individuals changed to a more personal affirmation. Participants (N = 8) felt that personalization features were important in reminding themselves about their quit reasons. Heather noted that this feature "*helped kind of reiterate to myself why I was doing it, and like the purpose behind using the app and quitting*". Edward also extended this sentiment to share that these features reminded a person that it was their decision and not someone else's. The following quote exemplifies this:

> It was really helpful… A lot of the times when you quit smoking, for me, and I would imagine a lot of other people experience it too, you get these bouts where you are thinking that society wants me to quit, like I don't want to quit. I want to kill a puppy to let me smoke, I would do anything for it, and all the reasons that I am quitting smoking are because other people and forces are telling me to. So having that there, and you can look at it… that is my reason for [quitting]. It is fantastic… Because that is what quitting smoking is. You have to make the decision to quit. It is not once. You are quitting smoking every second of every day until, for like a year. You have to make that decision over and over and over.

In addition, individuals (N = 8), like John, stated that personalization allowed them to have a "*sense of control*" over their quit attempt and their smoking. Heather explained that,

> I felt I had more in control of it, rather than I was being forced to do it by a certain day, and there was a little bit of leeway… [I was] able to make my own decisions of when and how.

Although not everyone reported utilizing personalization features, most were aware that these options were available. Furthermore, some also felt that the default settings for the quit plan, photographs, and/or affirmation were sufficient and thus, did not input this information on their own. On the other hand, some individuals (N = 6) were not aware that the affirmations, photos, and quit plans could be modified based on their needs and thus, did not personalize the app.

6.3.3.4 Home Page with Trackers and Summary Information

All participants indicated that they accessed the Home Page of the app and used components of this feature (Table 8). The Home Page of the app includes a 'crave' tracker where individuals click 'crave' when they are feeling the need to smoke. In addition, a 'smoke' tracker can be clicked by a participant when they have a cigarette and then individuals are prompted to enter data such as who they were with, where, and how they are feeling. Participants inputting data into 'crave' and 'smoke' serves to inform other aspects of the app. The Home Page also contains a summary of the money saved so far by not consuming cigarettes and a count of the number of days that a person has been smoke-free.

Table 8: Nodes for Home Page

Name	Sources	Mentions
How was this used?		
Logging smokes and craves	15	34
Seeing amount of money saved	7	12
Not using the crave tracker	5	8
Knowing how long it has been through days smoke-free	4	6
How did this affect the quit experience?		
Seeing your own progress	11	13
Keeping tracking of the numbers for you	7	15
Feeling motivated to keep to keep trying & pushing forward	6	10
Frustrating to log the info	5	8
Having an idea of smoking habits	4	5

Every person used the 'crave' and/or 'smoke' trackers to keep track of their behaviours. Some individuals referred to the trackers as "*counters*" or "*calculators*" as well. Participants understood that they had to input this information for the app to work properly. John stated that he inputted the information the app asked for because he "*felt like it was necessary… to give a sense of what kind of smoker you are*". Individuals like Brian "*used [the trackers] every day for its tracking modules*".

However, not everyone was able to use it consistently as they might forget or were not "*able to whip out my phone every time I have a craving*", as shared by Jennifer.

One unique experience reported by Susan was that she used the 'crave' tracker to track both smokes and craves. The reason she did not input her smokes into the 'smoke' tracker was because "*then it screws up [the] progress graphs*". Susan recognized that she was "*cheating*" herself but felt that "*the crave didn't seem as bad as an actual smoke*".

Five participants expressed that they did not use the 'crave' tracker, even though they used the 'smoke' tracker. Individuals articulated that this was because they had a hard time identifying cravings and could not possibly log every single craving that they were feeling and it was "*somewhat unrealistic*" to expect that smokers could log all cravings. Charlie detailed this experience:

> If I had a craving it wasn't like I craved a cigarette for a minute. I would want it and then I would want it for like an hour or two kind of thing, and I would always think like is that one craving or is that considered like five cravings?

The Home Page also provided money saved information and seven participants reported looking at this information. Four individuals accessed the Home Page to view the number of days they had been smoke-free as it was often difficult to remember this information on your own.

Participants gave light to a number of facilitating factors that using the Home Page provided. Eleven individuals believed that the components of the Home Page allowed them to see their own progress. Robert illustrated that, "*I liked those two trackers because it showed you how much you were smoking or how many times you actually didn't smoke… It just made me realize that I was not smoking as much and that felt good*". Others also echoed these sentiments because they could see their progress which made them feel like they accomplished something and also that this progression gave them "*a boost*".

Another enabling mechanism that seven participants cited was that this feature could keep track of the numbers on their behalf. Heather recognized that typically "*I wouldn't have a count of how many I had that day, the day before, [it is] not something that I would usually pay attention to*". Awareness was a key factor that tracking could potentially provide CTC users, as illustrated by Edward in the following situation:

> My car is kind of a mess and I was looking through it when I am cleaning it up, and I saw like eight packages of cigarettes… That is

> frigging crazy, that is eighty cigarettes! I go through that in a week, well a little bit more, so being able to track it and look and see, wow that is how many, and also the amount of money you save was so cool and the little things that come up as you are going along.

Third, six individuals found that using the Home Page kept them motivated to keep trying to be smoke-free. This was related to having awareness about the number of cigarettes smoked which encouraged further progress. Kevin articulated that *"[the trackers] give you motivation, like at least you are doing well and you are proud of yourself for making it this far*". Vincent stated how this made him want to keep trying with the following analogy:

> It is like if I was studying for a test. I did so much studying and I knew all this stuff that I truly felt I didn't know, [that I] didn't need to know. I am going to that test, and go 100% all the way. I didn't come this far just to turn back, so seeing how far I got, I didn't want to turn around.

In this example, Vincent is sharing how he put all this effort into quitting and tracking his information, which gave him positive information that he was doing well. Because he could see this progress, he did not want to waste his efforts but continued to push himself further instead of reversing his progress.

Furthermore, inputting smoking information gave individuals (N = 4) an idea of their smoking habits which then allowed them to modify their behaviour. Kevin expressed,

> I had problems identifying my triggers and what they were I think. Once I kind of realized what those were, I was able to try to remove those. For example, in the morning it would be a routine that I would have a coffee and a cigarette. So instead of drinking a coffee and cigarette I just decided I will do something else instead. I will go and just go out somewhere and have a burger or something, pick up something to eat when I am going to work.

Some individuals (N = 5) found that logging the information was frustrating and time-consuming. Vincent mentioned that inputting the information also made him feel "*weak*" because then his progress would be reversed and the app would put "*days without smoking right down to zero*" after having one cigarette. However, Vincent also felt that "*filling out the things for my cigarettes made smoking a lot less exciting*", so he would not smoke in order to avoid filling out the trackers.

6.3.3.5 My Progress

The My Progress portion of CTC is a tab that users can access to view their developments (Table 9). This information is presented through a line graph with three lines. There is a line tracking each of the following: smoking, craves, and allowance. The smoke and crave lines are informed by the 'smoke' and 'crave' trackers that are present on the app's Home Page. The allowance line is populated if CTC users decide to cut down their cigarette intake (as opposed to quitting immediately). The app gradually cuts down the number of cigarettes an individual is allowed to have on a daily basis and graphs this information. The My Progress Page also has a "health calculator" button that users can access to view more detailed information such as their smoking triggers, number of cigarettes not smoked, tar from cigarettes crushed, and the time most vulnerable for craving, among other information.

Table 9: Nodes for My Progress

Name	Sources	Mentions
How was this used?		
Looking at the graphed information	11	15
Checking the health calculators	5	6
Not using the progress page	3	3
Not using the health calculators	1	1
How did this affect the quit experience?		
Informing yourself on progress & feeling good about it	9	20
Feeling encouraged to keep going	8	13
Understanding your own behaviour	6	10

In the My Progress tab, eleven participants reported accessing the graphs and five reported checking the health calculators. The main benefit of the graph was recognized by Edward: "*the graph gave a visual representation of your progress [which] was my favourite part of it*". Visuals were a key aspect of this component as they provided CTC users information without confusing text. As Brittany shared, "*the graphs are pretty simple. They kind of helped me keep track of everything*". For the health calculators, Brian illustrated that,

> I think the most, more than anything, like how much tar from a cigarette have you crushed I think it quoted on the app. It actually calculated that based on how many you hadn't smoke, which I think was like tangible evidence…was really good for me realistically, because I could imagine it and visualize.

This was an important aspect as the information presented was specific to the individual who was using the app, rather than being about general statistics.

Three participants reported not using the My Progress pages and one participant did not use the health calculator. Reasons for not using this component included that two individuals had low use of the app overall and thus, did not access some features of the app. One individual encountered challenges when attempting to use My Progress, related to the technological difficulties uncovered in Section 6.3.3.2.

An important factor associated with My Progress was that it helped inform the participant about their progress (N = 9). Rather than seeing that they were smoking less or the number of craves, it provided concrete information that participants could make meaning with. Brian expressed how enlightening and competent this information made him feel:

> There is familiar words like the tar or something, we all know is in cigarettes … it is like the bad black stuff in cigarettes… but to visibly see a weight of it, like a measurement of it, and then visualize how much that is, is just a lot more educational I found for me at least. It really made me realize how much those numbers mean and what those numbers actually are, since you don't really see them on the packs… Empowerment, not even, [it] made me feel skillful almost in the sense that I kind of felt, like when I first learned how to read a food label and realized that my favourite junk food has a lot of sugar in it and I can actually put a number into how much that was. It was like wow, I can actually see the cigarette being unhealthy versus if everyone is saying it is unhealthy.

With the My Progress, Brittany described a key component of knowing things for herself: "*I knew exactly where I was, what was my position exactly. Where I needed to improve and when I could just continue with what I was doing or should I change something*". In addition to informing participants about their progress, another mechanism was that the information also helped individuals understand their own behaviours and habits (N = 6), because they were actually able to see what they were doing through the representation in My Progress.

Another supporting aspect that was identified from the interviews was that the visual and health calculator information empowered participants (N = 8) to continue their smoke-free efforts. Heather shared that she was motivated by the information whether it was positive or negative: "*It was very motivating to be able to see the progress and whether it was actually progressing or regressing. If it was regressing, being able to be like okay, I need to do better to get it back up*". Brian stated that the information also made him "*not want to smoke*" because he saw his improvement and that *"reinforced wanting to quit*".

6.3.3.6 Quit Help Information

The Quit Help information provided in the app constituted a number of pages within this tab and some of these pages had multiple options within them. The following list depicts each of these pages with their sub-options:

- Quitline
- Distract the Crave (options: games, text quit buddy, music, or videos) (see section 6.3.3.7)
- Quit Aids (includes NRT and medication information)
- Crave Crushers
- Crave Control (options: handling triggers, withdrawals & cravings, or handling slips)
- Crave Expectations (options: weight gain, tobacco & alcohol, other tobacco, or marijuana)
- Online Resources (options: Leave The Pack Behind, Quit4Life, Canadian Cancer Society, or Smoker's Helpline)
- The Crave Community (options: Facebook or Twitter)
- My Quit Plan

Overall, these pages intended to provide CTC users with a wealth of information and/or resources as they quit. Note that Distract the Crave, otherwise known as the 'Distractions' portion of the app, is discussed in the next section (section 6.3.3.7) as it was deemed that distractions were a separate concept from providing information (i.e. it was more quit support). Table 10 displays the relevant nodes, and the number of sources and mentions.

Table 10: Nodes for Quit Help

Name	Sources	Mentions
How was this used?		
Looking through the quit help info	9	20
Not using the quit help function	6	10
Seeing info that is already known or available online	5	10
Not interested in looking at quit help info	3	3
How did this affect the quit experience?		
Learning info, tips, & tricks to help	3	5
Reading info gave something to do instead of smoking	2	6

Nine individuals indicated that they accessed the Quit Help information. It is important to note that since there were many options available to users, it is not necessary that each individual accessed each of the nine tabs, but may have connected to those they found most relevant. Some individuals learned something new while reading this information, as described by Brittany:

> I liked the crave expectations. They were informative. There were a lot of things I didn't know about. Like somebody like me wouldn't consider smoking hookah as a part of... I wouldn't consider it as

> smoking or e-cigarettes as smoking, but these things you know, kind of changed my views and opinions.

Susan also shared that,

> I really like the crave control… it had three little things inside. It had handling triggers, withdrawal and cravings, and handling slips. So what I used the most is withdrawal and craving, because I would actually get very, very hungry, and I would have, I would be very, very angry, so this was like a reminder that I am normal, that I am not going completely insane… I would get so frustrated with myself, and then I would read that and it would say that it is normal, so that would actually calm me down, because I would realize that I am not angry because I am a bad person. I am angry because the nicotine is getting out of my system and that is okay.

Six individuals reported that they did not use the Quit Help pages. For those who did not use it, some participants mentioned they initially went through these pages but then did not access them again. Next, five participants stated that the information in the Quit Help was content they were already aware of and heard many times before as Edward articulated: "*I read it and then I never really looked back again because I already kind of know most of this stuff... I didn't really find it useful because I know the health risks that are involved in smoking*". Robert further explained that,

> It depends. For a person who wants to like really look in-depth to [know] everything about it, then it is helpful, but for some people that know about it and don't really want to see it. We know the damage that it is doing to our lungs. It is just as bad as the Surgeon General warnings [are]. Obviously we know what it is doing to your bodies.

Although some individuals did not access the Quit Help frequently or felt that they knew a lot of the information, they "*wouldn't get rid of it*". Heather explained how it could still be beneficial for others: "*for me it didn't work, but for someone else it could very well be the best thing for them. Just in my case it didn't, because I was like okay I know this [information]*".

An important factor associated with using the Quit Help was that it helped individuals learn tips and kept them aware of what expectations they might have as they quit. Kevin noted that, "*I liked that it would kind of give you insight into why you are smoking, and different methods of quitting or just different tips"* since Kevin had trouble identifying his triggers. Furthermore, he stated that *"it was helpful because I wanted to keep learning. That way I could be confident enough to like overcome the addiction. I felt it was adding tools to me so I can overcome that barrier*". Another factor included

that reading the Quit Help actually distracted participants from smoking as their attention was focused on learning more about quitting.

6.3.3.7 Distractions

Distractions were available to be accessed by CTC users from two places (Table 11). First, when individuals click 'crave' on the app's Home Page, a 'distract me' option is presented that individuals can click. Second, under the Quit Help, there is a Distract the Crave option which links to the same distractions. Four distractions are presented to the user: 1) Games, 2) Text Quit Buddy, 3) Music, and 4) Videos. If an app user selected Games, they would be redirected to their mobile device's app store to download a game. For Music and Videos, these options would be displayed via YouTube. Lastly, if a person wanted to text their quit buddy, the app would redirect to the text messaging function of the mobile device with the text buddy's phone number already in place for receiving text messages.

Table 11: Nodes for Distractions

Name	Sources	Mentions
How was this used?		
Playing game, listening to music, and/or watching videos	9	21
Not texting a quit buddy	5	6
Not using distractions	4	5
Texting a 'quit buddy'	2	6
How did this affect the quit experience?		
Getting distracted in the moment & forgetting to smoke	5	12
Having to look for games, install, and then play	3	9
Not needing the app for these type of distractions	3	6
Wanting to see all aspects contained in the app	3	6

Games, music, and videos were utilized by nine participants. Brian appreciated that the distractions were "*tabbed together and not just basically spread apart everywhere, and it was a good variety*". Distractions also helped individuals (N = 5) do something instantly to forget amount smoking. Christina found that,

> It was really great for like games and distractions. It instantly brings up a game, like download game app thing... it was more, just taking a minute, did not think about having a cigarette anymore. Taking a minute to not be frustrated, and so it was like the music was great. I could just turn on my music… even just getting to a game and picking the game was enough sometimes to get over the hump if that makes sense, like it was just like getting over that, oh I got to have one now.

Although distractions were available and accessed by participants, individuals found this feature frustrating. Patricia articulated,

> I would go to the games and there weren't games through the app. It was leading me back to Google Play to download other games that I could get any other way, and it consumes data, so that was a downfall.

Others, like Susan, echoed these sentiments since they already had apps like YouTube and games on their phones, so they could do these distractions on their own without the app. Downloading games was particularly challenging to participants, as Heather also illustrates:

> I found that when I was like, if it said to play a game, I found it was more frustrating, because I had to like then look through a bunch of games and then find one, and then install it, and then wait for it to load, and then, like it was really slow, and kind of tedious to have to like go through and install a game, once I find one that looks like it would be fun to play, and then go from there… whereas like the music videos were almost instantaneous and there was no time to be frustrated with it, like because it was there, like it was instant.

Individuals, like Patricia, would have liked to see games that were "*included and exclusive*" to CTC as this would be a unique feature to the app. This would encourage the distractions component to be contained within the app, rather than referring to other apps.

Two participants indicated that they used the Text Quit Buddy function as they had someone they felt they could lean on for support and text at any time. However, similar opinions regarding this option were expressed as individuals could text a buddy without using CTC. For those who did not use this function (N = 5), it was because they did not feel they had could get the type of support needed from others, they did not want to bother someone, or they had support from others directly (i.e. face-to-face).

Lastly, four individuals reported that they did not use the distractions through the app as they either had their own distractions they used, such as playing video games, or they had not explored the distractions option.

6.3.3.8 Awards

My Awards was a section in the CTC app that was organized with three sub-headings depending on the type of award that could be achieved: 1) Days Smoke-free, 2) Money Saved, and 3) Health Achieved. Individuals could click on the various awards to see more information such as what the

award entails, if they received it, and if they had not, the award listed their progress towards achieving that award (e.g. "you are 64% of the way to getting this award") (Table 12).

Table 12: Nodes for My Awards

Name	Sources	Mentions
How was this used?		
Checking for awards received and those upcoming	11	17
Not viewing the awards	4	5
How did this affect the quit experience?		
'shocking' to see how much money was saved	10	23
Feeling more confident to keep trying	9	17
Seeing your progress through awards	8	13
Understanding how quitting improves your health	7	10
Having smaller, more manageable goals	5	7

Eleven individuals indicated that they checked the Awards for those they received and those upcoming. Edward expressed that the awards "*made me feel special*". He further explained that,

> It kind of added that personal touch. This is actually an achievement… because when you are quitting smoking, you are just like, I could have a cigarette right now and it would be so fucking awesome. So with the awards and the little bits of information that were available, you are looking at, this is what is going on. This is, like cool, I haven't smoked in three days, and my phone just was like, 'hey man, good job'.

Brian also shared that, "*I really liked how it separated the little successes, and ha[d] them unlock for me, so I could actually reach my one-day goal, my three-day goal*". The Awards function was not used by four participants because they were already motivated by the other app components, they could keep track of their health and financial gains by themselves, or they had not explored this option.

There were a number of enabling factors that were associated with using the Awards. First, the money saved goals were very important to some individuals (N = 10) as money was one of their main reasons for wanting to quit. As Vincent stated, "*I had money on my mind 24/7*". Patricia articulated how the money savings gave her motivation and information because "*you don't realize how much you're spending, because you just go in and buy a pack. You don't realize what it adds up to*." Furthermore, Rachel illustrated how the money saved information impacted her:

> It was kind of shocking, because yea it does add up, even not smoking that much. It is kind of crazy how much like each cigarette costs. You never think of those things… It was alarming. It was

> definitely shocking to see how much, how much that you would save… because those kind of facts aren't really well known at least when you are smoking per cigarette, like smaller amounts, you know how much a pack costs, but you don't really think about how much a couple of cigarettes a day would.

Another benefit was that the awards instilled confidence in participants (N = 9) that they wanted to continue quitting. This was illustrated by Brian:

> It was like excitement to get the award and then you kind of can't wait. It motivates you to not smoke for that day so you can be one day closer to your next award, so it definitely worked as motivation… I found those affirming and a little sense of fulfillment, seeing that, oh I am either this far away from my quit date, or I haven't smoked this many cigarettes. Or it has been this many days since I have had a cigarette. Just not having to think those things, but actually just having them there and seeing them, I felt gave me a better sense of completion or on the road to completion.

Charlie explained a different situation where he wasn't motivated but then that changed: "*I wasn't very motivated first because I don't have any [awards], but once you start to get a few of them, you want to keep going"*.

The third factor was that the Awards showed individuals (N = 8) their progress. As Robert said, Awards show people "*what they have done*" which is an accomplishment. Jennifer emphasized that it was:

> Just a little positive reinforcement. It was nice to feel kind of proud of yourself, even for something silly and little. Oh, your heart rate dropped 3%, like that was kind of cool, and it was nice. I would be like, I am going to keep this going, because look at this. I have progress here… It was nice to see it the other way around.

Other factors included that participants (N = 7) could understand how quitting improved their health because of the awards. The health awards resonated with Jennifer, as shown in the following quote:

> I kind of thought about health was like seeing that it was ten days, oh well one cigarette doesn't matter, but once you log that one cigarette, it is like, oh look at all this that you have undone. Your pulse is way higher. Your lungs are having trouble. You have got all this carbon monoxide in your system. It listed all of the health things that came with it, which made it easier to be like, no, one cigarette is a big deal.

The last benefit noted by five participants was that the awards reduced a scary task (i.e. quitting smoking completely) into smaller and more manageable steps and goals that they could achieve. Heather mentioned that,

> I thought the awards page was pretty cool to see like the progress or see something to work towards. like mini goals, so it wasn't like overwhelming, but it wasn't overbearing either. It gave me a little bit of a short term goal to complete like to see if I was close to completing one thing, like okay I really want to get that done. Smaller goals are something that works for me, also having like a short term goal repeatedly throughout the process, so like okay you've reach this, so the next step is to do it, but a little bit better, and slowly go up from there.

6.3.3.9 Social Media and Social Support

As noted earlier, CTC has a large social media presence with a website, Facebook page, Twitter page, and a YouTube presence. In addition to these aspects, the CTC app has the ability to allow participants to connect and share their progress on Facebook and Twitter. For example, if an app user received an award, they could share that they received this award via Facebook. This section describes who used this feature, who did not, and participant opinions on this feature that intended to provide social support (Table 13). Next, the sharing of experiences with the app by participants is reported.

Table 13: Nodes for Social Media and Social Support

Name	Sources	Mentions
Social Media Connectivity		
Not wanting to connect to social media (Twitter and/or Facebook	15	21
Believing that it is a good option if you need & have support from others	13	21
Connecting to Facebook	5	17
Not wanting to share as it is a private, personal journey	4	12
Would rather speak to people directly who care	4	5
Not using Facebook often or in this manner	4	4
Involves broadcasting failures to everyone	3	7
Depending on progress, would only share with select individuals	3	6
Believing it's great that it's your choice to connect, not automatic	3	3
Could be unmotivating if others are not supportive	2	4
Getting support		
Through family & friends	7	15
Not getting support as others don't care or are negative	4	7

Sharing app experiences in other ways		
Telling friends face-to-face, verbally, or through text about your experience with the app	14	20
Suggesting or going to suggest the app to others who may benefit	4	12

Five individuals indicated that they connected to the app with the Facebook option. This meant that individuals used their Facebook information as their log-in identification, instead of creating a new user ID and password. Although one-third of participants logged in using Facebook, none of these participants shared their quit smoking progress via the sharing options available on the app. Furthermore, none of the participants shared progress via Twitter as it seemed from the interviews that Facebook was the primary social media outlet that interviewees used.

A number of reasons for not sharing progress with the app were cited. Some participants were unaware that they could share progress from the app directly but indicated they would use it as they thought that would be a "*really awesome*" feature. These individuals were willing to let friends on their social network see and share in their progress, as expressed by John: "*to let know that I am taking the journey with them*". Other individuals (N = 4) used their social media accounts for specific purposes and did not wish to connect their quit smoking progress to these other pursuits, like Brian, who used Twitter for the "*dance world*", or Vincent, who used Facebook professionally. On the other hand, some participants were not dedicated Facebook users, such as Charlie, who "*never really put anything on Facebook*" and did not want to start. Several individuals (N = 4) indicated that quitting smoking and smoking was something personal and that they did not want their information broadcasted more widely. Patricia described that many people would be aware of sensitive information if she used this feature: "*I don't like sharing my dirty laundry on Facebook. I am very discrete. A lot of people don't know that I smoke, or that I have financial issues and I wouldn't want that to be publicized*". Jennifer further articulated how everything is visible on Facebook: "*you know if I post on your wall, your friends can see it, and my friends can see that I posted on your wall. That still doesn't feel very private to me*". A couple of participants indicated that they did not know how their friends on Facebook might respond to posting quitting smoking progress. Susan expressed that,

> It would depend if your community is supportive because I know some of my friends… Acquaintances would tell me 'oh you will never quit, you will keep smoking'. This is temporary. And that was very, that was partially unmotivating because I would think 'shit they're true, they're lying', I will probably never quit. But then on the other hand it was even more motivating because I would think 'f*ck you', who are you to tell me what I can and can't do… my

> brain was very conflicted because I thought if I post on Facebook how I'm progressing, some people would still be telling me oh that this is temporary. That would actually bring me down.

Participants also described interest in speaking to those who care directly (N = 4), rather than using Facebook. Lastly, individuals felt (N = 3) that in the event they were not able to successfully quit, everyone might be aware of their failures. Heather detailed that,

> I didn't want to broadcast to everyone that I was doing this, and then it fail, like an off-chance that I did fail with it, I didn't want everything to be like, 'oh so how are you doing with this', and I would be like, 'I am not doing very well'…it was more letting people down, that if I posted something and then it didn't follow through completely on the whole thing, I would not feel good.

Others echoed these sentiments and would rather show only successes or more general information that was not specific to themselves.

Related to only showing successes, participants noted (N = 3) they might use the social media feature depending on the type of progress they are making. In this case, they would be interested in sharing progress with certain individuals where they could select the specific individuals from their Facebook friend list. Although this feature was not used by participants, almost all (N = 13) felt that if CTC users had a network who could provide support and could actually use the support, then using the social media connection would be helpful. Charlie articulated an example:

> I think it would encourage… it would help you quit kind of thing, like I know a friend of mine… He quit drinking a couple of years ago, and he always put up posts like, I am six months sober, or one year sober, whatever, and stuff like that. He would always get a whole bunch of likes and comments, everybody saying congratulations, and stuff like that. One day we were talking about it, and he says it feels really good to know that everybody supports you like that.

Participants (N = 3) also appreciated that the CTC app provided the option of sharing your progress and that it was not mandatory or automatic in sharing this information. Vincent illustrated that,

> The decision is important because I feel like if I would have had it just randomly posted up there all the time, you know I would feel like, I would just not want it up there. I would feel like an attention seeker, you know so I wouldn't want it going up there at all unless I wanted it to.

Since participants did not use social media connections to the app, participants were asked where and if they obtained support from others. Seven individuals reported having support from their friends and family. However, four individuals indicated that they were unable to get support because they do not have a lot of support, others may not care, or might be negative about quitting, especially if their social network primarily included smokers.

Sharing app experiences with others was done by almost all participants (N = 14). Although social media was not a popular way of sharing experiences or the app itself, many spoke directly to others. Primary methods of communication included face-to-face, through a phone verbally, or texting others about the app. Individuals expressed (N = 4) that they would encourage others to try the CTC app if the other person stated they wanted to quit smoking, but would not encourage others voluntarily. Kevin described,

> I would be hanging out with them, and they would ask, well how did you manage to do it this long, and I am like man well I have been trying this app, it has kind of been helping me to get through where I'm at so far… it was more them, because they see me not smoking with them and they are like, why is he not smoking? I have had three or four smokes now, and he has not had one… I wouldn't blatantly go and share something to someone that might offend them.

6.3.3.10 Other Findings - Credibility

Participants were asked if it is important that they know who created an app and where information is coming from. Thirteen individuals indicated that this information was important. However, what is interesting to note is, that out of these thirteen, only six individuals checked where the CTC information was coming from. Seven individuals thought credibility was important, but had not actually looked for this information. Finally, two individuals suggested that seeking information about the developer was not important to them but viewing the reviews from other app users was more critical.

6.3.3.11 How was CTC different from other quit aids?

Participants in this study commented on how they felt CTC was unique from other quit supports (such as the quitline, NRT, medication, etc.) (Table 14).

Table 14: Nodes for How CTC was Different

Name	Sources	Mentions
Keeping track of progress through app features & visuals	15	22
Feeling that it was always accessible, personal, and you are in control	7	10
Doesn't involve taking in chemicals	5	5
Using other quit smoking apps	2	15

All participants stated that the ability to track your own behaviour was a critical component and the ability to see this progress on a physical screen was important. Heather articulated these thoughts:

> If I am not writing it down or keeping track, I don't pay attention. Like it is not something that is on my radar. [The app] gave like progress, so it was written down, kept track of. You could see what progress you were making, and having the visual of like a graph or how many you had or not had or how much money you were saving. Having that visual, I think actually really helped and having it on your phone was beneficial, because everyone has a phone on them all the time.

Next, seven individuals felt that accessibility was a key element along with the ability to make CTC individualized and personalized. Furthermore, participants mentioned that the app doesn't involve in-taking chemicals as they would like to completely stop the smoking behaviour. Jennifer said, "*I don't like the medication thing. I think it is the same as giving a heroin addict methadone or something. I don't like that. If I am trying to get off it, I am trying to get off it*".

Daniel summarized nicely how CTC was different for all the aspects mentioned previously. He showed how it is possible to quit on your own, but how the app provides a helpful hand and how other supports can still be helpful in conjunction with the app. This is illustrated below:

> It is accessible for almost everybody, like if somebody [doesn't] have the app, and want[s] to keep note of okay it has been a week since I [bought] any cigarettes, people can write in the book and just keep note of how many the monies she saved or she says they saved. Just keeping track in the book, but with the app, it is easy to see it and calculate all by itself. It is fun to see with the graphic[s] and if you are using… the gum at the same time, it could be even easier like you want to quit smoking, and you want to take the gum because it is helping you, take a gum or open the app at the same time, and just hit the crave button… If you use multiple things at the same time, it could be good and yea, the, I like to use the app, because like I told you, I don't really like to use medication, and/or patch or gum, so the app is nothing like those things.

It is interesting to note that two individuals in this study had attempted to use other quit smoking applications available on the market. These participants cited that other apps tended to be more gamed based, were very rushed, everything was pre-planned and decided for the users, were full of advertisements, and did not use reputable sources. Both Brian and Jennifer reported that CTC had important benefits over these other apps. These included that CTC had a clear focus, had more substance and content, gave the user control, had no advertisements, and was free to the user.

6.3.4 Self-Reported Mechanisms Associated with Using CTC

Many participants described the various mechanisms that encouraged use and reason for the use of the CTC app (related to research question 3). In the discussion section that follows, the relationship between various mechanisms and behavior changes theories are discussed. An important self-reported mechanism related to the use of CTC as a whole was the increased availability and accessibility that using a mobile application provided. Participants noted that CTC was a quit support aid that was with them at all times and never left their side. In some cases, participants stated that a mobile app was a more reasonable approach to quitting in a younger adult age group. This was described by Brian:

> Everybody is different, but I would say the more school based approaches and all the big pan flitting and brochuring of that doesn't really advertise the small little app things, or the small web sites or the small things that kids actually have accessible right in their palm twenty-four hours a day. I don't think a lot of kids want to call and talk to someone all the time… you have a lot more freedom and you feel like you are doing something yourself and achieving it yourself.

In a sense, by being available and accessible, individuals found that the app provided an "*essential support*" that they could not get anywhere else or as immediately.

With the tracking, progress, and health information CTC provides, another mechanism associated with CTC was the ability to actually compare progress between friends. Although only a minority of participants had friends who also utilized CTC, this may be a limitation of CTC being a new product. For those who did have friends using CTC, the tangible numbers and information the app allowed for easy comparison among friends and to make quitting smoke "*a game*" to see how each individual was progressing. Rachel shared that it "*kind of inspired me to quit at the time because I didn't really have an intention, and then my friend showed me… we grouped together to see how it sent…almost like a game to see who was doing what*".

There were a number of important mechanisms related to inputting your personal info into the app. First, this allowed individuals to feel a sense of ownership over their own quitting plan and progress. This feeling of control was precipitated by being able to see one's own information reflected in CTC. Susan articulated how this made her feel: "*They were relating to me personally and they were not just about some other random person… the progress, and then how my body feels, it was actually very close to, to the health-achieved awards*". Brian also shared how he could personalize the app:

> I could [do it] on the app itself which was what I really liked. It had so much input option[s] and me being able to add the information myself. It allowed me to make my plan on the app while using the app.

Second, inputting information allowed for tracking of behaviours to be done by the app. This was a significant mechanism to participants as they had not encountered any other quitting tool that actually kept track of their behaviours. Heather cited that "*if you are not paying attention or having it written down, you don't really think about it*". Lastly, related to the two above mechanisms, seeing one's own progress towards their ultimate goal (to be smoke-free) was an important mechanism. This was because participants could tangibly view their progress through the text and graphics in the app. In addition, viewing progress, mobile decides, and the app itself reinforced participants' decisions to quit. Edward expressed how the various components of CTC helped him see progress and kept reminding him to continue quitting:

> The visuals, the graphs, charts, and little information tidbits is where you are and what is now happening to your body, now that you quit smoking. [These] are all little bits reinforcing this decision that you are forced to make through the duration of your quit time.

Another mechanism was that the app provided a middle ground measure in that it had supportive features, but it allowed individuals to quit on their own without contacting other individuals or in-taking medication/NRT. Kevin expressed: "*I wanted to do it on my own… but yet still have the support from others. So I felt like the app was a way of kind of finding a median*". CTC's features and the type of information it provided was helpful to Kevin since it still provided him with support but he was still able to quit on his own. Participants felt that the app was an extension of quitting by yourself.

Although a number of facilitating mechanisms were identified during the analysis, there was one critical mechanism that hindered use of CTC. Forgetting to utilize the app and input information was

highlighted by a number of participants. This was significant because even though the app was available, since they were not utilizing and inputting information, they could not realize the benefits the app had to offer. Participants mentioned that other apps have reminders and push notifications to reach the user and encourage usage. Christina shared the impact of not remembering had on her usage:

> [I used it] like once a month, because it just didn't remind me. It was like I would try really hard for the first little while, it was all the time… people like me, who actually need that reminder, who would like seriously love to be reminded once a day, or twice a day… that would be great.

Although Christina indicated having reminders a couple time of day, others like John expressed that more frequent reminders may be needed: "*it would… be nice to have at least thirty minute reminders… just so like that it will say, 'hey I am here, don't forget me'*". Some individuals were able to remember to use the app without reminders, but others needed more of a push in that regard.

Chapter 7
Discussion

It is clear from the diversity of information shared during the interviews that no single experience with the use of CTC was more significant than the other. All experiences differed based on the individual, their realities and context, their attitudes, and their environment. Participants had unique ways of understanding and using the application. By taking these complex interactions into account, it allows for better insight into the perceptions of those that these applications are designed for.

This chapter starts by summarizing key findings and comparing them with existing literature. Next, the results are discussed in relation to existing behavioural change theories. Furthermore, the recommendations, contributions, and limitations of this thesis are detailed. Finally, suggestions are made for further research.

7.1 Summary of Key Findings

This study was guided by five research questions as part of three research objectives. An answer to each of these research questions will be discussed.

7.1.1 What are the Characteristics/Context of Tobacco Use in Young Adults?

For the young adults involved in this study, smoking was primarily a social experience that allowed them to interact with others; it was a commonality individuals had with their peers (i.e. that they could smoke together). For many, smoking offered something to do during breaks from school or the workplace. It was a reason to stop what they were doing, go outside, have a break, and just talk. Also, smoking often went hand-in-hand with drinking alcohol and was something to do at parties and various social gatherings. This finding is consistent with the literature that shows those who realize they are social smokers often concurrently use cigarettes and alcohol (Jiang, Lee, & Ling, 2014)**.** In this study, encountering social situations where smoking commonly occurred was one of the main reasons why those who attempted to quit relapsed and started to smoke again.

According to all participants, they already knew individuals who smoked when they initiated smoking. For some these were family members and for others, they were friends. Since everyone knew someone who smoked, it made smoking something that was appropriate to do and acceptable. Some young adults stated that since their peers already smoked, they almost felt a social pressure to smoke and needed to do so in order to fit in and be part of the in-crowd. Even though some

participants did not like the taste of cigarettes, they continued to smoke in order to feel accepted within the group. Slowly, smoking behaviour moved from experimentation and social smoking to heavier reliance and dependence on tobacco.

Stress and dealing with emotions was another factor associated with smoking. Individuals often encountered difficult situations or moments in their daily lives where they handled that stressor by smoking. This allowed for the young adults to cope with the situation and have a few moments of downtime. Stressors were often variable and could include things like moving, dealing with exams and assignments, feeling alone, and encountering challenging situations in the family home.

These factors may make young adults ideal users of interventions such as CTC due to social and community features that they offer. Users have the option of connecting with other users which may include their peer network. If more and more of a smokers' network used apps like CTC where they could see each other's progress and compare milestones, they may instead feel social pressure to quit smoking and have more success.

7.1.2 What are the Main Reasons Behind Using or Not Using Other Quit Aids (Not CTC) and What Do These Previous Quit Attempts Look Like?

Individuals were acutely aware of the dangers of smoking and could see the impact that smoking had on their general health and finances. Silla and colleagues (2014) found that smokers primarily desired to quit due to health consequences of smoking. In the current study context, finances were also an important factor because the YA population may have less disposable income, and lower wages, making them more price-sensitive. The participants in this study attempted to quit smoking multiple times showing how interested they were in eventually being smoke-free. What differed among the various quit attempts made was the level of commitment and preparation. Some individuals made impromptu decisions to quit smoking, which invariably failed, as they did not have adequate support for quitting or resources to help with withdrawal effects. Others succumbed to smoking, as they did not have strategies in place to avoid tempting situations.

Young adults were aware of a variety of quitting resources, some of which were used. No participant had utilized quitline services in the past, consistent with BinDhim and colleagues (2014), who found that the majority of participants (88.7%) in their study had not contacted quitline services. In many cases, individuals believed that speaking with an unknown person would not be helpful to them as a stranger would not know or understand their realities and past history. Furthermore,

although individuals were aware of the quitline, many did not know what to expect from the quitline service and did not know of others who had direct experience with the quitline. Increased familiarity with the quitline services and quitline counselors behind the scene may be helpful to young adults who desire knowing someone before engaging with them. Similar to the quitline services, participants did not access health care professionals for cessation counselling and support due to a lack of familiarity. There was also a lack of support provided by health care professionals who often reinforced fear-based messaging and suggested use of pharmacotherapy, which many participants did not want to utilize.

On the other hand, some participants did use pharmacotherapy through health care professionals as they are the avenue to acquiring prescriptions. Those who tried the medication and/or NRT did so because they knew of other individuals who had used these products and found them successful. However, most participants who tried pharmacotherapy had negative experiences with how the product operated or the effects the product had on their bodies. For individuals who did not utilize pharmacotherapy, lack of familiarity with the product was one reason but in addition, these young adults did not want to put more chemicals/nicotine in their bodies, wanted to avoid reliance on another product, and wanted to avoid high costs. These reasons suggest that education on pharmacotherapy could be more prominent in the app to counter misinformation. Silla and colleagues (2014) also found that smokers were worried about transferring their addiction to NRT which affected if participants adhered to instructions on NRT administration, frequency of use, and dosage. Furthermore, cost of cessation resources was a barrier and other research has shown that YAs who are offered free NRT are encouraged to use the product initially (Buller et al., 2014; Silla, Beard, & Shahab, 2014).

E-cigarettes were also used by half of the sample since they were aware of peers who had used the product and these peers found it helpful for quitting. However, contrary to beliefs, the e-cigarette was not helpful in reducing cravings and did not help change the actual behaviour due to the mimicking nature of e-cigarettes with a real cigarette. This is consistent with Camenga and colleagues (2015), who found that high school and college students perceived e-cigarettes would lead to persistent cravings and the desire to still smoke a cigarette. Further, college-aged students who utilized e-cigarettes were also not successful with complete cessation while using e-cigarettes (Camenga et al., 2015). This is likely because e-cigarettes are not necessarily designed to wean smokers off cigarettes.

Overall, ongoing use of quitting resources in the app was highly dependent on whether smokers knew anyone else who had experience with the resource. These influenced participants' beliefs on whether the resource might be successful and useful for their own quit attempt. This finding has implications for the marketing of smoking cessation apps. If young adult smokers are interested in using resources that others have experience with, they may be more inclined to use apps for behaviour change that their peers utilize. In addition, apps on the market have a reviews function where users can rate the app and provide their feedback. This may be particularly useful as it may inform smokers of the experiences other individuals had with a smoking cessation app. CTC may encourage app users to post reviews to help other smokers' make informed decisions.

7.1.3 What Attitudes and Experiences Do Users Have Towards the Applications' Features and Characteristics?

Individuals approached quitting with CTC in a positive manner as most already had an interest in quitting at the time they began participation in the Smartphone RCT. Participants shared that they were willing to try anything that may potentially help them quit and especially those resources that did not require additional chemicals or costs, like CTC. Upon downloading and activating a CTC account, young adults made efforts to explore the entire app in order to find out what this resource really offered and how it might align with their needs during quitting. Participants really cared to know what the app was all about as for many, an app to help them quit smoking was unheard of and a great way they might be able to quit.

Participants had unique experiences in terms of how they utilized the app. For some, it was a way of gathering resources and tools for a future quit date. In this scenario, the app was used to track current smoking habits. Others decided to quit right away or cut back their smoking gradually for a future quit date. For this reason, individuals used the app for a variable duration. However, this was also impacted by whether an individual remembered to utilize the app to track smoking behaviour. This was a critical factor as not accessing the app to view or input information impacted the tracking mechanisms. Motivation was a key component of remembering to use the app. Another qualitative study found that participants believed motivation and willpower to be the most important factors when quitting (Silla et al., 2014). In this study context, those who were really motivated to quit always had quitting smoking on their minds and would not forget to use the app. However, for those who were not as invested or experienced heavier withdrawal symptoms, they may forget to use CTC. Smoking cessation apps might motivate users by rewarding individuals for their progress, no matter

how small, by providing interaction graphics and visuals, and by being appealing to their target audience.

In general, individuals had positive attitudes towards the look and feel of the app and could find the information they were looking for. Those who used the app found there was sufficient contrast in the display of CTC features and that the information was both readable and understandable in the manner presented. Opinions on the colour of app varied based on personal preference, as some individuals preferred a multitude of colours while others enjoyed the duo chrome currently present. Interactivity was a key component as the app could host both static and interactive text, pictures, video, and sound, and connect to internet resources.

When asked about using customizable features, participants did not necessarily realize that these were the personalization features even though they had utilized them. This may be because these type of features were expected to be present in the app. However, it is important to note that of the two individuals that utilized other smoking cessation apps, both of them stated that other apps did not offer tailoring. These participants felt this was an important part of CTC. This aligns with a meta-analysis in the health communications literature that has found tailoring of messages to be effective in encouraging health behaviour change (Noar, Benac, & Harris, 2007). For those who did not personalize CTC, they were unaware that this option was available as they did not come across this information during the tutorial or app usage.

As the Home Page of the app was the central screen from which the app operated, all individuals accessed this page. Experiences with the information on this page were positive as the page contained a quick snapshot of progress that gave individuals enough information without accessing other features in the app. Participants particularly appreciated seeing the number of days they had been smoke-free and the amount of money they had saved to date. It was important that the ‘smoke’ and ‘crave’ trackers were visible and easily accessible to the app users so that they could track their behaviours. However, when utilizing the ‘smoke’ tracker, the app requested information on who they were with, where, and how they are feeling to inform individuals about their smoking triggers. Sometimes inputting this information was cumbersome and not quick enough and participants desired that inputting this information be optional as long as the actual ‘smoke’ is tracked. Another unique experience with the trackers was when a participant utilized only the ‘crave’ tracker for both smokes and crave. For this young adult, this was the only way to use the app without feeling extremely bad

about smoking. This also encouraged this individual to keep moving forward as they would see good progress, even though it was fake, and this ultimately helped them become smoke-free.

Other sections of the app, including My Progress, Quit Help, Distractions, Awards, and Social Media, were used to varying degrees depending on participant perspectives and needs. Those who did not use certain features found they either already had enough support already from the app or had not discovered a certain feature. Furthermore, some individuals had lower use of CTC overall as they had lower motivation to quit at the time or encountered challenges in the operation of the app.

Visuals that were provided in the other sections of CTC were particularly useful to the young adults in the study as it helped them understand their own progress and behaviour. Furthermore, it was evident to participants that other sections of the app were based on real evidence and that the awards and calculators on the app tabulated pertinent information that were packaged in a manner that made sense to them. This was an interesting finding as participants were not necessarily aware of established clinical practice guidelines, but realized that CTC was based on evidence, unlike other smoking cessation applications as documented in the literature (Abroms et al., 2013; Hoeppner et al., 2015). Seeing the daunting task of quitting smoking broken down into smaller steps was beneficial as this made the end-goal seem more achievable with a step-by-step approach. In addition, individuals found it helpful that CTC coordinated and organized relevant resources, distractions, and support. This was important since these tools were readily accessible without having to spend significant time searching on their own. The Quit Help portion of the app was liked by many but also disliked by many. Some individuals learned new information or read information they already knew as a comforting tool to know they were on the right path. Others felt they knew most of this information already and were not interested in reviewing it. However, participants did not wish to remove the Quit Help as without it, an important section of the app would be missing. Many facts were present in this section which participants were aware of and knew they could access if they needed more information. Furthermore, young adults in the study felt that others may benefit from some or all of the information in the Quit Help. The Social Media connections in the app were not utilized by participants as they state quitting and smoking was a personal and private affair but they may have been affected by negative social norms towards smoking. This was an interesting finding since it was hypothesized that young adults would use the social media features to obtain social support. Instead, participants preferred more direct interaction when looking for support. This suggests that social support is still an important aspect of quitting smoking, but perhaps not in the way that the app is

currently designed. A CTC Community is suggested as a method of providing social support (discussed in Sections 7.1.5 and 7.2.1).

Lastly, credibility of the app was considered to be important to most participants of this study. However, many individuals did not practically check who developed and supported the creation of CTC. Research by BinDhim and colleagues (2014) similarly found that 77.5% of their sample had never checked the credibility of health app publishers before downloading an app. This could be potentially problematic as many apps on the market are not necessarily evidence-based and if users are not checking for the credibility, they will unaware of the sources behind an app. In fact, researchers have identified that pro-smoking apps are available on the app market that the tobacco industry may use as promotional mechanism (BinDhim, Freeman, & Trevena, 2014).

7.1.4 What are the Facilitators and Barriers of Using a Smoking Cessation Application?

For the young adults in this study, several factors acted as facilitators or barriers when using CTC. First, the facilitators are discussed, followed by the barriers.

It was clear to all participants in the study that CTC was a modern way to quit that aligned with current technology and life as they experience it in their daily lives. The "modern-ness" of the app allowed this type of smoking cessation method to resonate with YA users and made this method more accessible to the individual at any time and any location. This was a major facilitator as the app was right in the palm of their hands rather than being something where they have to make an appointment, call a counsellor, or go to the store to fill a prescription. Other research has similarly found that participants are interested in finding help within new mediums that are more accessible and not from quitlines or health professionals (BinDhim, McGeechan, & Trevena, 2014). Furthermore, given that the cost of cessation resources can be a concern for smokers, it was beneficial that CTC could be downloaded free of charge. Theories such as diffusion of innovations (Rogers, 2003) suggest that a resource has greater adoption if individuals are easily able to try the new resource.

The logo and name of the app, Crush the Crave, was empowering and attractive to participants. Enjoying the name and overall look of the app was a key technique of keeping individuals interested in utilizing the app. For many, the meaning of the app name itself resonated with wanting to quit smoking and completely 'crush' this habit. The app icon also provided similar meaning to participants.

Another advantage was the personalization features built into the app. This is consistent with recent literature that found using personalized feedback was an incentive to increasing compliance within a program (Bälter, Fondell, & Bälter, 2012). For participants in this study, this allowed them to make CTC their own decisions but more importantly, it gave control by reminding them that they wanted to quit and it was their decision. Furthermore, the ability to decide on how they wanted to personalize their version of the app was critical. As a related concept, participants appreciated that CTC allowed the user to decide if they wanted to connect to Facebook or Twitter, rather than automatically requiring this feature to be enabled. These findings suggest that there may be opportunity to improve the design of the personalization features and feedback that individuals receive through the app which may increase compliance with the CTC quit smoking program.

For all participants, being able to see progress was desirable. Visuals were a key component of being able to see progress. Knowing ones' progress shared information that individuals did not necessarily know beforehand such as habits, triggers, and the effects their actions were having on achieving smoke-free status. This encouraged the feeling of accomplishment with the young adults in this study. Related to this, keeping track of actual numbers, and tabulating and displaying personal information was another facilitator of the app. Without this, participants did not know how to track their actual smoking and cravings, financial savings, and health benefits as they achieved these milestones. Furthermore, since the app separated out the different types of benefits and steps, it made the end goal seem more achievable by reaching smaller mini-goals in the process. These findings align with the documented literature that self-monitoring is an important method for smokers to understand their behaviours and progress (McFall, 1970; Piasecki, Richardson, & Smith, 2007), and CTC helps facilitate this self-monitoring process.

Lastly, the tips and resources that the app provided was a facilitator as it provided important facts. It was clear to participants that both the information tidbits that popped up throughout the app and those in the Quit Help information were based on evidence, but at the same time, were practical enough for them. Another important aspect regarding this information was that it was worded positively which made participants feel more capable, compared to fear-based messaging. The Distractions in CTC were also valuable as they helped individuals forget to smoke but more importantly, the app was not solely focused on distractions but included distractions as one component of many. Some individuals mentioned that other smoking cessation apps were strictly distraction apps, which left them desiring more information and the ability to track their behaviours.

There were a number of barriers associated with using the app usage in its current form. First and foremost was the lack of notifications. Participants found that the app did not provide push notifications that reminded them to input their 'smoke' and 'crave' information or notifications with general information and tips, like other apps do. Without these reminders, those in the study would forget to use CTC, which impacted the effectiveness this novel tool had on helping users with cessation.

The colours of the app were a mental barrier to some participants as a black background felt intuitively demotivating. Although personalization in the app was a facilitator, lacking personalization for colour schemes was a barrier as different colours were motivating for different individuals. Furthermore, the personalization features already present in the app were missing from the tutorial and general messaging as individuals were not necessarily aware that they could customize the app.

The reliance of CTC on a data connection, or Wi-Fi, was another major hurdle. This was particularly concerning as participants were unable to access the app in any capacity if a data connection was unavailable. This barrier was especially relevant for individuals who were not within reach of data signals or could not afford data on a mobile device; they were unable to use the app at these times. Participants understood that certain components of the app may not be functional without data, such as posting on social media or referring to external resources on the web, but participants struggled with why they could not view the tracking information, such as money saved or the days smoke-free.

The next barrier experienced was that if the app remained unused by a participant, the app assumed that no smoking had occurred or no cravings had been felt for the duration that the app remained unused. This did not necessarily reflect actual behaviour as the progress CTC assumed had not actually occurred. In addition, the app would not recognize the same user account on a new mobile device. In this case, participants had to create new accounts, which meant that they lost tracking information that their old user account contained. Furthermore, some functions did not work for certain participants. It is likely that the app is optimized for certain mobile devices and operating systems, which may impact overall functionality.

Another obstacle encountered was the time-consuming nature of inputting information into CTC. For some of the young adults in the study, they realized that not all data the app asked for was necessary to track behaviours and see progress. Furthermore, individuals found inputting similar

information each time to be frustrating. This hindered usage of these trackers as individuals avoided inputting smokes and craves in order to escape from recording some the data the app asked for.

Finally, the last impediment faced by participants in this study was that the Distractions were not part of the app itself but referred to other apps like YouTube, the game store, and the messaging app. This was significant as the Distractions were not instantaneous when waiting for these other apps to function and many desired distractions promptly to curb their cravings.

Overall, there were a number of benefits and drawbacks with using CTC. In general, benefits tended to focus on certain app features while the drawbacks centered on overall app functionality.

7.1.5 What are the Key Self-Reported Explanations about the Mechanisms of Change Associated with Using the Application for Smoking Cessation?

Participants reported several explanations/insights about how and why CTC could contribute to smoking cessation. For many YAs in the study, the increased availability and accessibility of a mobile app helped lead to smoking cessation since it was a support they could always have with them.

Second, using CTC allowed individuals to compare progress with others. This might be particular useful to app users because smoking itself was found to be social activity. If users can interact with others in a social way to quit when using the app, this may facilitate the quitting process. With a CTC community, individuals may be more inclined to quit if others join them to talk and compare any developments. If this option was implemented and used by CTC users, it could offer an opportunity for YAs to learn from each other and support one another (Haines-Saah, Kelly, Oliffe, & Bottorff, 2015).

Next, a feeling of ownership and control was seen to be a key mechanism that contributed to smoking cessation as the app felt more internal and local to the individual, which encouraged utilization. The tracking and progress information in the app contributed to the sense of ownership over their quit plan. What was particularly helpful was the fact that the app allowed for control, but at the same time, drew upon existing evidence and supports that individuals could access.

Lastly, the aspect of forgetting to use the app was a major mechanism that did not contribute to cessation. It might be worth noting that those who did remember to use the app on their own might have been more ‘ready’ or motivated to quit at the time. These individuals might have had more positive experiences and success with CTC due to their existing willingness to quit. However, not all individuals will be completely ready or committed to quit and may need certain motivators to help

them reach that stage. For example, some may not have been ready to take action and were more contemplative about quitting. These individuals may have needed more reminders from the app as a motivation tool. Other research supports the need for push-notification services in apps to help increase use and response by participants (BinDhim et al., 2014). By providing a 'bigger push', these individuals may move toward actively quitting and being more willing to do so.

7.2 Contextualizing Findings to Behavioural Change Theory

Changing health behaviour is the aim of many public health programs and interventions. However, it is important to understand how changes observed relate to key theoretical constructs. Theories often explain behaviour and suggest ways that behaviour can be changed or modified. In this section, how the findings of this study relate to existing behavioural change theories are considered. In particular, it is contemplated how the findings support theoretical constructs in what we might expect for behavioural modification. These constructs provide additional mechanisms for how and why CTC contributed to smoking cessation, from the perspective of the individual (rather than the app).

It is important to recall that CTC was designed based on persuasive technology principles, which are interactive technologies that intend to change users' behaviours (Fogg, 2003; Oinas-Kukkonen & Harjumaa, 2008). These principles were highlighted in the literature review (section 3.1). According to Fogg and Hreha (2010), smoking cessation is a BlackPath behaviour since it involves getting individuals to quit smoking forever. In contrast, a BlueSpan behaviour is one where a behaviour is maintained for a period of time (e.g. to quit smoking while visiting family members on vacation), while a GrayDot behaviour is where a behaviour is decreased one time (e.g. to buy less cigarettes right now; Fogg & Hreha, 2010). This type of thinking comes from Fogg's Behaviour Model (FBM) which identifies three principal factors that control whether a behaviour is performed: motivation, ability, and triggers (Fogg, 2009a). FBM identifies 15 ways in which behaviour can change. Of interest is that the authors assert that all BlackPath behaviours have similar underlying psychologies implicated in stopping a behaviour forever.

The researcher considered a number of relevant behavioural change theories in the literature, including Theory of Reasoned Action, Theory of Planned Behaviour, Integrated Behaviour Model, Transtheoretical Model, and Social Cognitive Theory. In consultation with the researchers' primary supervisor, it was determined that the TPB and SCT together provide a comprehensive list of theoretical constructs that are critical to attitude and behaviour modification.

7.2.1 Theory of Planned Behaviour

The three constructs that will be explored from TPB are attitude, subjective norm, and perceived control. First, an individual's **attitude** towards performing the behaviour is important (Montano & Kasprzyk, 2008). In this study, participants had varying attitudes towards smoking cessation. There were a number of behavioural beliefs participants had regarding the outcomes of quitting smoking; these included improving health, having more finances available for other necessities, greater social acceptance, and being bothered less by others for smoking (mostly, these were non-smokers who placed pressure). These behavioural beliefs were important mechanisms that were affected by participants' personal histories and experiences with smoking and quitting, which impacted the degree of motivation for quitting.

Although participants shared many of the same behavioural beliefs, the evaluation of these beliefs were diverse between individuals. The weighting of the potential behavioural outcomes was critical as certain individuals placed more importance on the outcomes compared to others (Montano & Kasprzyk, 2008). Some participants strongly asserted that they had to quit because of how smoking was affecting their health and/or finances. These individuals often paid very close attention to how their health and finances fluctuated with smoking behaviour. They were also more likely to be smoke-free or were very invested in the process of becoming smoke-free. However, other individuals thought health and finances were important, but appeared to monitor these aspects less often or more readily accepted negative changes to health and financial status. In these cases, participants may have returned to smoking after a slip-up more easily whereas others used slip-ups to re-assert themselves to quit smoking.

These findings suggest that although attitude and beliefs are critical to becoming smoke-free, the weight of those beliefs also need careful consideration. It is important to note that the participants of this study had positive beliefs towards smoking cessation as all individuals were interested in quitting in some capacity but smokers outside this study who do not wish to quit, may hold negative beliefs.

As CTC is a cessation tool for smokers, user attitude may have implications for how the app is utilized and promoted. Potential users will need to be interested in quitting before downloading a mobile app. Those who do not wish to quit will likely not download an app intended for cessation. As such, programs and services need to focus on getting smokers interested in quitting and seeing the drawbacks of smoking, rather than cessation itself. Furthermore, the app can target its messages to encourage users to continue on their quitting journey, especially for those who place less weight on

the potential outcomes. For example, the app can stress the importance of users reasons for quitting, such as the health and financial outcomes of quitting, and display this information on a regular basis so that users may place more emphasis on the positives.

The next construct in TPB is **subjective norm**, which considers whether persons around the smoker approve or disapprove of the smoker being smoke-free (known as normative beliefs) (Montano & Kasprzyk, 2008). In turn, individuals must be motivated to comply with the beliefs of others (Montano & Kasprzyk, 2008).

In this study, many participants had friends and family members who disapproved of smoking and encouraged them to become smoke-free. Participants often complied with these beliefs and these friends and/or family were their motivational reasons for quitting. However, some participants had social circles, families, or lived in communities where smoking was very much the cultural norm and an activity that everyone did. These groups did not necessarily approve or disapprove of smoke-free actions overtly, but in their actions, disapproved those attempting to make a quit attempt by continually urging them to join them for smokes. In addition, for some participants, they lost a major social activity if they did not smoke with the group. In some cases, these groups opposed smoke-free efforts of the participant by stating they should not quit and refusing to assist the participant with quitting. For example, smoking in the same room as the participant and not moving to another place even when requested. In these scenarios, participants of this study decided not to comply with the beliefs these groups had as they desired to quit smoking themselves. However, this was a process participants embarked on for a long-time as they had "given-in" to the triggers during earlier quit attempts.

These findings suggest that the normative beliefs others hold heavily influence the actions of smokers as they respond to what others believe to be the best course of action. Typically, this involved supporting the beliefs of those surrounding them, but some participants, over time, were able to overcome the negative beliefs of some and attempt quitting anyway. This implies that the subjective norm is influenced by other constructs such as attitude (discussed above) and control (discussed below).

For CTC, since the beliefs of others can influence an individual as they quit, the feature of a CTC community may be critical. A community of CTC users may share similar beliefs that being smoke-free is a desirable behaviour. Through the ability to link to and talk to other app users who are interested in quitting and share similar beliefs, CTC users may be determined to comply. Since

participants in this study did not use the CTC community, it may be helpful in the future to see how a community of users affects the subjective norm that app users possess. This feature may contribute to another important mechanism for behaviour change that the current study was unable to explore.

The final construct in TPB is **perceived control** which is determined by control beliefs over the potential facilitators and barriers ("control factors") individuals may encounter as attempting to quit (Montano & Kasprzyk, 2008). These beliefs are then weighted by the perceived power an individual believes they have over the control factors to influence their quitting behaviour (Montano & Kasprzyk, 2008).

In this study, there were a variety of facilitators and barriers participants' thought existed that affected quitting behaviour (these were explored in section 7.1.4). Having CTC on a mobile device was a cross-cutting facilitator as participants believed they had a tool that would be with them at all times to assist with cravings, tracking, and to give them information. These provisions by CTC helped increase the participant's perceived control over their intended behaviour (i.e. to quit smoking). As such, having the app was a contingency plan for many when dealing with barriers such as not wanting to intake chemicals and having something to do when they felt a craving. Participants faced many specific facilitators and barriers with previous cessation experiences; however, the perceived power over these factors differed among individuals. For instance, participants faced many withdrawal and craving symptoms with earlier quit attempts and did not necessarily have a plan to deal with those occurrences. However, when they used the app, this barrier was alleviated as the app and its features (such as Distractions) provided an activity to participants. This increased the perceived power over controlling the bothersome withdrawal effects from smoking.

7.2.2 Social Cognitive Theory

SCT also has a number of constructs that we might consider in the context of this study. The first concept to consider is **outcome expectations** and evaluation of outcomes (aspects of attitude towards a behaviour) which are an individual's beliefs into how likely they are to achieve smoking cessation and how valuable that end goal is to them (McAlister et al., 2008).

Most participants in this study desperately desired to be smoke-free for health and financial reasons. However, some participants were more conscious of the health and financial benefits they encountered as they cut down their smoking or quit which continued to motivate them further. Others had more tenuous beliefs regarding whether they could be smoke-free and were easily influenced by

triggers. Further, some individuals found that nothing really helped them quit and stated that perhaps they had not made a completely committed effort. Interestingly, some participants had more tenuous beliefs that were made stronger through use of app as they felt various components of the app encouraged them and told them they could be successful. As stated earlier, this suggests that the app can target its messages to continue to encourage users to quit and deal with triggers and slip-ups, which may make the end goal seem more achievable.

The next concept in SCT, **self-efficacy**, depicts that an individual believes in their personal ability to be smoke-free (McAlister et al., 2008). This concept is similar to perceived control in TPB and is an important mechanism since individuals must believe they can be smoke-free. The third construct in SCT is **incentive motivation**, which indicates the use of rewards and/or punishments to encourage behaviour modification (McAlister et al., 2008). In this study, this was a critical mechanism as the CTC app provided a number of awards to users to encourage them to continue making progress to be smoke-free. Participants felt these were great positive reinforcers which suggests that the awards helped modify participant behaviour and thoughts towards smoking cessation. Providing incentives through awards was also related to two other mechanisms identified earlier; that is, awards allowed participants to track their behaviour and see progress. Although punishments were not given by the app itself, some participants created their own. For example, some participants set aside extra money when they smoked to deter from continual smoking.

The fourth concept is **facilitation**, which describes that individuals need tools and resources that make quitting smoking easier to achieve (McAlister et al., 2008). Participants felt the features of the app helped them to become smoke-free because they could track their behaviours and see progress through the app. Although the Quit Help section of the app was a major resource, it was not utilized by many participants as they felt they knew the information. However, it is present and able to facilitate for those who needed it and participants who did, felt they learned helpful information as they attempted to quit.

The fifth construct is **self-regulation**, which is related to goal attainment and depicts that individuals control themselves through monitoring, goal setting, feedback, rewards, and instruction, and by obtaining social support (McAlister et al., 2008). CTC enabled many of these self-regulators, as shared by participants. Monitoring of behaviour was achieved through inputting tracking information. Goal settings and rewards were obtained through the Awards function as the complex end goal was broken into smaller steps and they were rewarded for reaching each individual steps.

Self-instruction depended on the user as they had to consider themselves how they would use the app in their quitting process. Finally, CTC had social support features; however, these were underutilized. As shared earlier, participants were not interested in sharing progress more broadly on their social networks. Instead, participants enlisted support on their own with specific individuals who encouraged them in their process. This suggests that although social support was not used in the app, participants still acquired social support themselves. The finding still supports SCT as individuals needed the social support in order to control themselves as they quit.

Social Cognitive Theory (SCT) (Bandura, 1986) shows human behaviour as a complex interplay between personal, behavioural, and environmental influences, known as triadic reciprocity (McAlister, Perry, & Parcel, 2008). This model recognizes that behaviour both influences and is influenced by personal and environmental factors (McAlister et al., 2008).

Although CTC did not have push-notification services, the final concept of **triadic reciprocity** might shed light on the interplay between personal, behavioural, and environmental influencers for such notifications. In the case that notifications are implemented in CTC, they should promote use of the app which creates a different environmental condition as more individuals may utilize the app (thus, changing the user's behaviour with the app). This can allow for the mechanisms identified in this thesis to operate as more individuals will utilize the app, instead of forgetting. Notifications have the potential to change the current environmental conditions in the app, in order to influence both the health of the person and their behaviour.

7.3 Recommendations

The findings of this thesis suggest a number of recommendations in the area of mHealth interventions for smoking cessation. First, it is paramount that applications possess a notification feature as this will allow the app to communicate frequently with the user. A variety of notifications should be employed. Notifications within CTC can remind users to access the app when it has not been used recently, can congratulate users when a new award or milestone is unlocked, can provide educational resources and tips, can inform users of app features they may not be aware of (e.g. "Did you know you can customize your quit plan?"), and can provide progress information (e.g. "Did you know you were on track to saving $3,456 this year?"). Notifications should "pop-up" and go to the notification centre that are present in mobile devices. In addition, app users should have the option to adjust the frequency and to turn these notifications "on" or "off".

Second, apps should be available for monitoring of behaviour without a data connection. Basic elements of inputting information, viewing progress and visuals, and reading information can be achieved without data as these should be ingrained into the app. External links and supports can be accessed when a data connection is available. Further, information that a user has inputted into the app while offline can be updated to the server once online.

Next, participants in this study indicated wanting most features to remain native to the host application. CTC may benefit from having in-house distractions such as an interactive quiz that asks users interesting questions and considers items they had not given thought to before. These questions should not necessarily be directly related to smoking as the goal should be to distract users. Interactivity in the app will be enhanced with this type of feature, along with the notifications. Further interactive components can be embedded with the awards as the could potentially celebrate success with the user (e.g. fireworks or movement).

Fourth, to increase the reach and appeal of these novel tools, additional personalization options may be necessary. With CTC, colour customization may be useful as app users can select a colour that makes them feel the most positive. Although customization of affirmations, photos, and quit plans were available through CTC, it is necessary to market these options. This can be done through an app tutorial and through notifications, highlighted above.

CTC, and other similar tools, should also encourage users to post reviews regarding their experience. Testimonies from other individuals seem to be particularly important to YAs so reviews may serve as a gauge of credibility. This may help other smokers' make informed decisions about which app to download. Other methods of promoting these apps could be through Facebook and Instagram generated advertisements, among other internet-based tools.

Finally, there may be a need for continual updates to an application. These could be small changes in look or design, and in content (e.g. updating resource information, adding new awards, or changing the layout). This is an important strategy in keeping a technologically inclined population engaged.

7.4 Contributions

This thesis makes several substantive, theoretical, and methodological contributions. Substantively, this research provided an enhanced understanding of how YAs used and perceived a mobile health app for smoking cessation. As identified in the literature review, this research fills a gap in the area of mHealth since little is known about YAs in how they use such apps for health behaviour change.

Furthermore, participants came from diverse backgrounds and locations in Canada, and all had varying degrees of use and comfort with technology. Participants were able to describe their smoking history, use of the app, and information regarding cessation supports by sharing their experiences. Furthermore, facilitators and barriers could be identified that impacted participant usage and barriers can be considered for further improvements to CTC.

Theoretically, this thesis provides an in-depth understanding of how and why a mHealth app can contribute to behavioural change through the use of a realist approach. This approach assisted in identifying mechanisms that contributed to using CTC. Mechanisms were teased out from the data and attempted to explain the causal theory behind CTC.

Methodologically, sensitizing concepts were used by the researcher to provide useful initial areas of inquiry to assist in the research process. A purposeful sample was intentionally used to select participants who could provide rich descriptions to help answer the research questions in this thesis. Next, qualitative interviews were well matched with the realistic approach in order to uncover mechanisms. Although these findings are not generalizable to the broader population, it is a truthful account of the participants in this study that should resonate with other similar individuals. Furthermore, the qualitative methods employed allowed for an in-depth understanding of each participant regarding their use of CTC. These experiences could inform future iterations of CTC or other mHealth research in this age group. In addition, at the proposal stage, the researcher and the advisory committee had concerns that participants may be influenced by the researcher's purpose and may provide socially desirable responses. To minimize this possibility, the researcher informed each participant at the beginning of the interview that the purpose was to understand their experiences with the app, whether positive or negative. Participants were reminded of this throughout the interview as well, as needed. Finally, the researcher remained reflexive throughout the research process in order to acknowledge her role and to maintain a focus on the participant voices. The researcher remained transparent by using quotations in the thesis in the voice of the participant.

7.5 Limitations

There are limitations to this research. The sample consisted of 15 individuals, which included eight males and seven females. Even though purposeful sampling of these individuals allowed the researcher to obtain participants who provided rich description, the results cannot be generalized to the broader population. However, the findings do provide practical implications and lessons for

researchers and practitioners. In addition, those recruited may have been individuals who were most likely to respond and may have been either overly positive or negative about their experiences. The researcher made all efforts to provide equal opportunity for those contacted to participate in this research. This was done by consistently providing one recruitment e-mail, two follow-up e-mails, up to three phone calls, and a final reminder.

Second, telephone interviews were the primary method of collecting data. With telephone interviews, the researcher might have missed important visual cues and non-verbal gestures. However, given that participants were from across Canada, this was an unavoidable limitation. Further, respondents may have felt more comfortable and relaxed in sharing information over the phone. A study by Sturges & Hanrahan (2004) states that there is no significant difference in interview quality between in-person and telephone interviews.

Another limitation is that during the data collection phase, the researcher often had to guide the discussion in the interviews. Participants sometimes had trouble articulating experiences or remembering these use of the app. The researcher made all attempts to help participants remember and to guide the discussion in a meaningful way that would provide rich data without directly leading participant responses.

Member checks with participants were not conducted at the end of the study to review findings. Although this would have been beneficial, given the difficulties in reaching the YA population in this study and time constraints, the researcher conducted member checks during the data collection process. For example, during the interviews, the researcher reflected on what participants stated and asked if she was interpreting correctly what they were sharing. This allowed the researcher to confirm that they understood the meaning so that she could reflect it accurately in this thesis.

Finally, it is likely that the analysis and interpretation of the qualitative data can be subject to bias. However, every effort was made by the researcher to avoid this by remaining reflexive, having the researchers' supervisor checking these procedures, and staying true to the voice of participants, through the use of quotations.

7.6 Knowledge Translation and Dissemination

Presentations from the results of this study at academic conferences are expected. A presentation will be conducted at the annual meeting for the Society for Research on Nicotine and Tobacco and an abstract has been submitted for presentation at the Canadian Public Health Association. Furthermore,

the results will be submitted to a peer-reviewed journal for publication to share findings with the broader research community. Lastly, the results will be used to inform Crush the Crave in the future as mobile health technologies are a rapidly evolving area that must meet the demands of the consumer.

7.7 Future Directions

This research was exploratory in nature with a diverse group of young adults. Future studies may include conducting a larger study to compare different cases in order to examine if the findings of the current research apply in various contexts. Such research may identify different mechanisms and/or facilitators and barriers that are experienced by certain cases or populations that this thesis was unable to identify. For example, there may be an issue of health literacy in mHealth apps that immigrant populations may experience. Focus group interviews and/or face-to-face interviews may be particularly informative in conducting this research.

Second, additional qualitative research can be done on individuals who have utilized CTC but not necessarily through the Smartphone RCT. These smokers may have different and unique experiences, and may not necessarily be young adults. Further, it may be useful to explore the extent of motivation for smoking cessation in CTC app users through the stages of change, from the TTM. Such research could identify theoretical constructs before data collection and include questions that assess which stage an app user is in. In addition, research on CTC may occur with a theoretical lens before data collection and this may identify additional sensitizing concepts to be explored. The findings from this study can also serve as sensitizing concepts for future studies (e.g. self-monitoring of tracking/progress). It may also be useful to investigate other smoking cessation apps to identify if individuals have similar or varying experiences with the function and operation of these apps.

Next, app developers and expert opinion should also be explored in relation to app development and to understand the realities in creating these novel tools. Fourth, it may be useful to track data from users interacting with a mobile app to investigate what is being utilized and for how long. This type of information could be complemented with qualitative data to explore the thoughts of the users.

Finally, it is unknown how useful a smoking cessation app will be with the general Canadian young adult population. Results from the Smartphone RCT and other study protocols from mHealth apps may provide some insight into the effectiveness of health behavioural change apps. This type of app may also be used and easily modified for other tobacco and nicotine products in the future.

In conclusion, the current research explored young adult experiences with a mobile smoking cessation app, known as Crush the Crave. This thesis contributes to the limited literature regarding the use of an app and user experiences. It is evident that usability is influenced by the interactive components, tracking mechanisms, and ability to self-monitor progress. However, the functionality of mobile apps also presents some barriers including needing access to data and not remembering to use the tool. Subsequently, further research will be necessary to inform practice in order to evaluate whether mobile apps are useful in sustaining health behaviour change. However, this research contributes substantially to knowledge about young adult smokers using a smoking cessation app.

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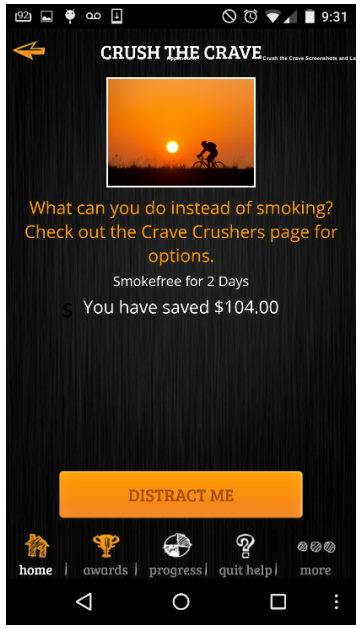
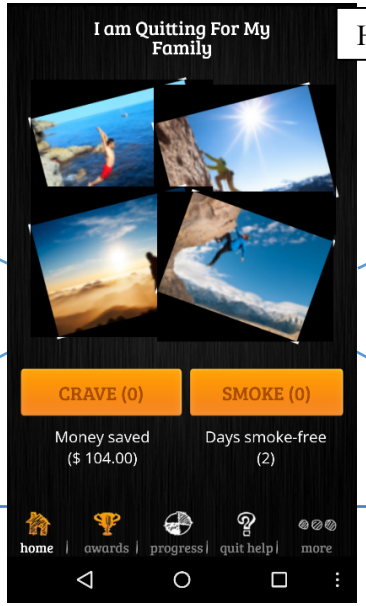
Appendix A
Crush the Crave Screenshots and Layers

CTC First Layers

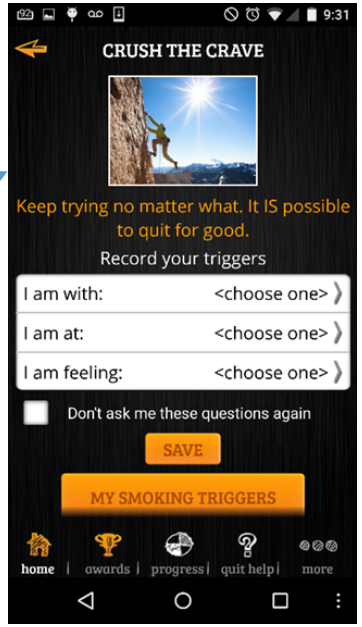


Click CRAVE

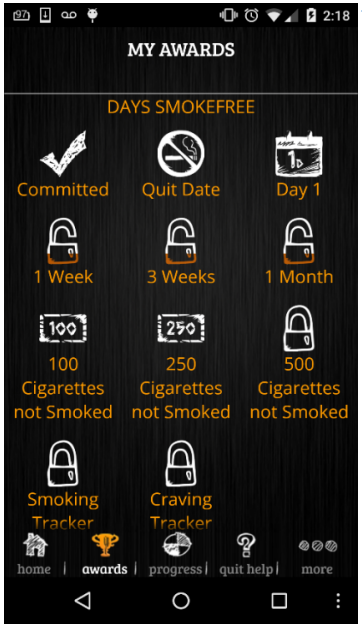


Home Page

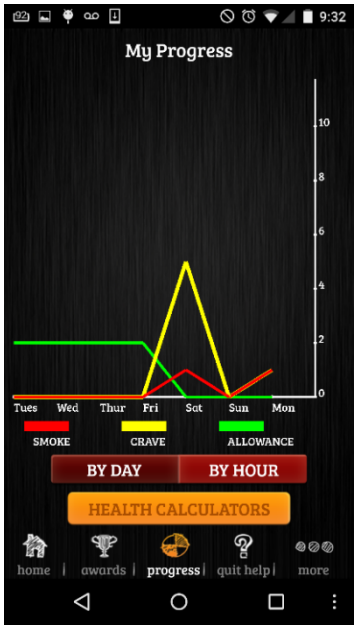
Click SMOKE



Click Awards

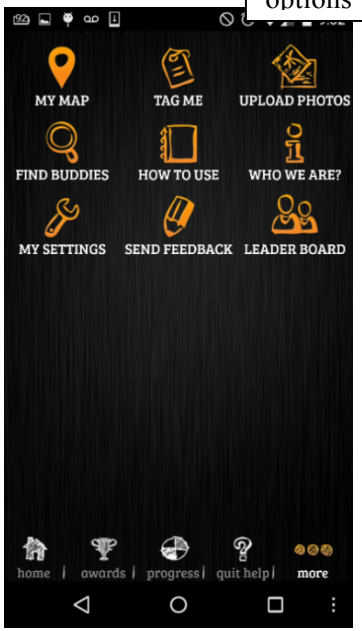


Click Progress

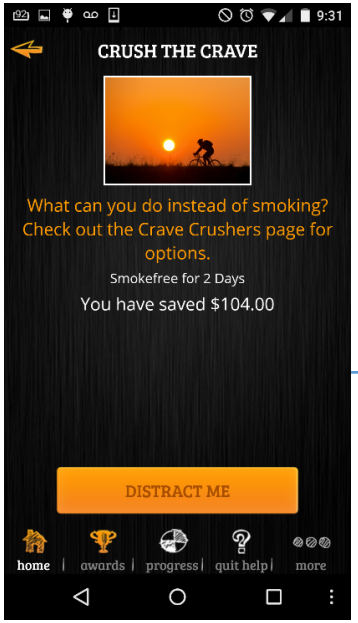


Click Quit Help, additional options for quitting smoking

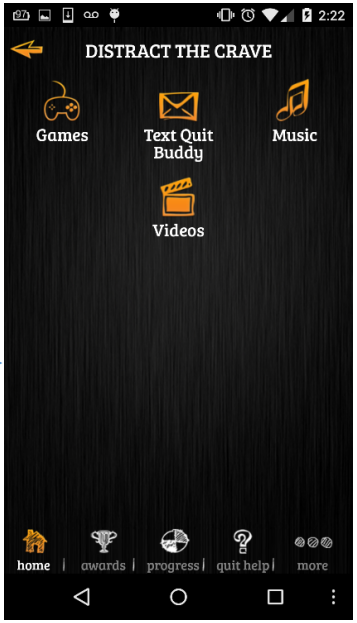
Click More for more options

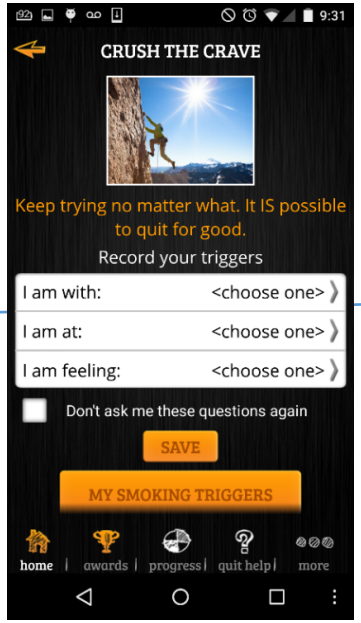


Crush the Crave Second Layers

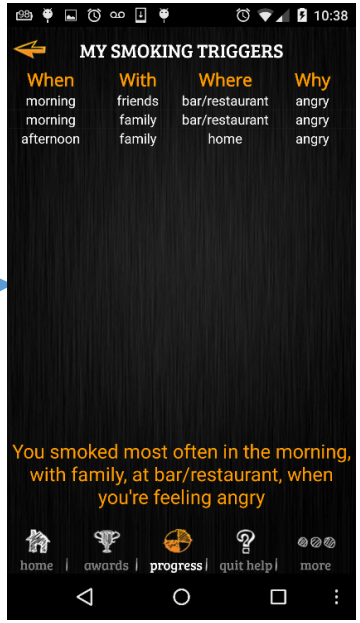


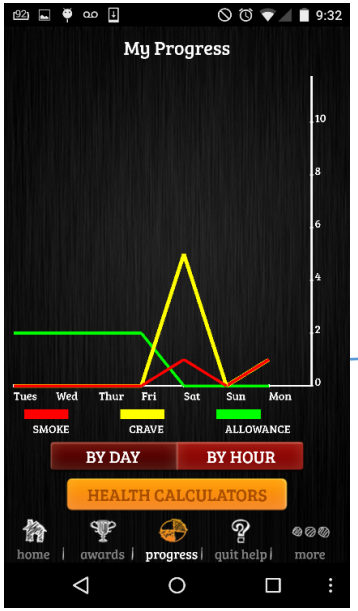
Click Distract Me



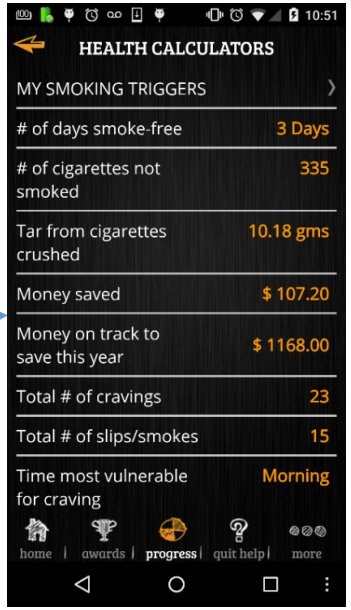


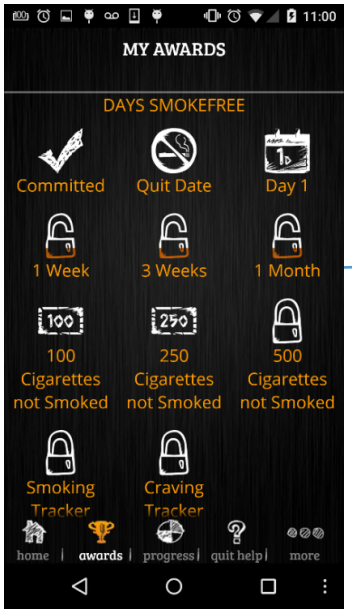
Click Save different options, and then when you click My Smoking Triggers, it will show your history of triggers



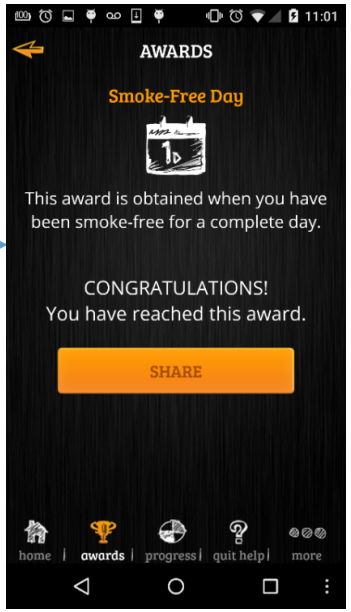


Click HEALTH CALCULATORS
Displays all the variable values

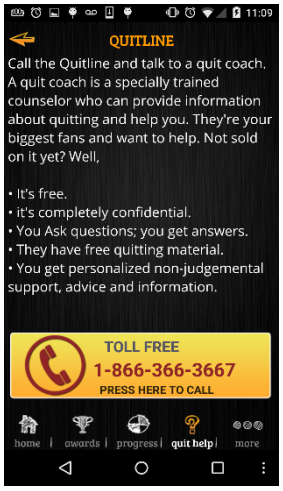


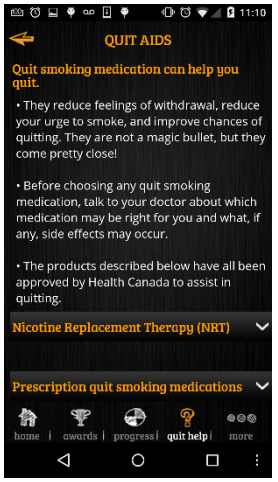


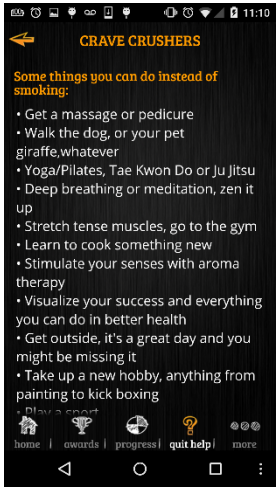
Check for various awards



Quit Help page expanded







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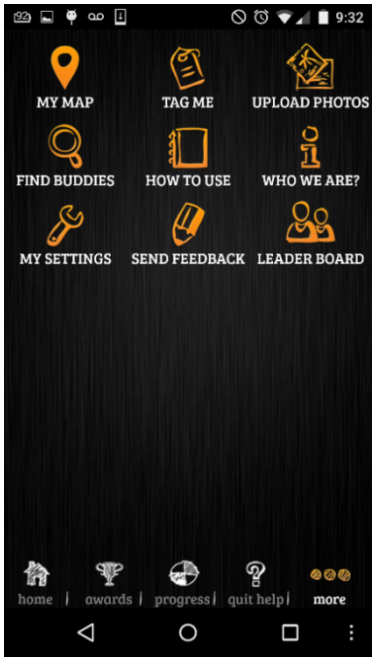

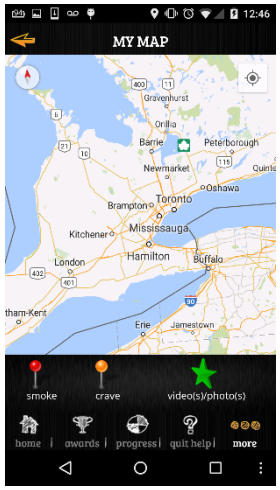

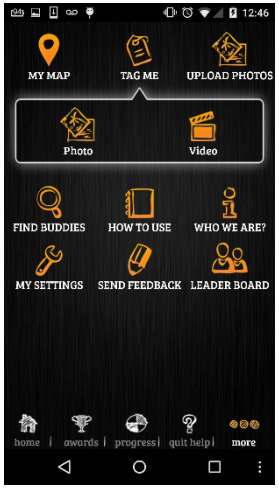

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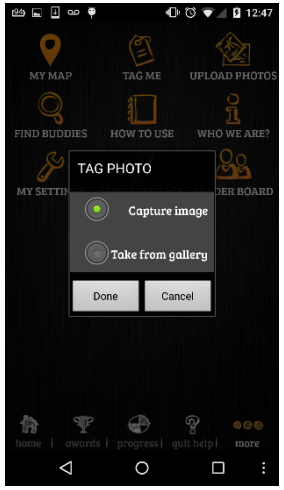
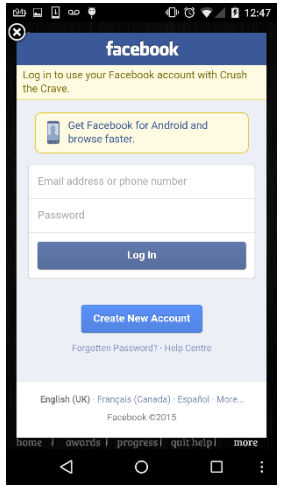
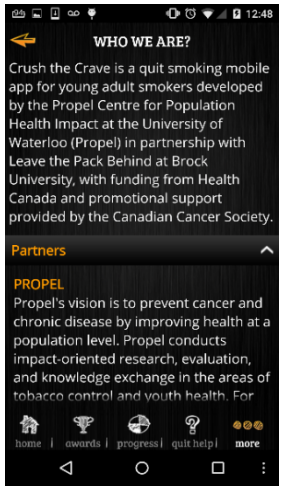
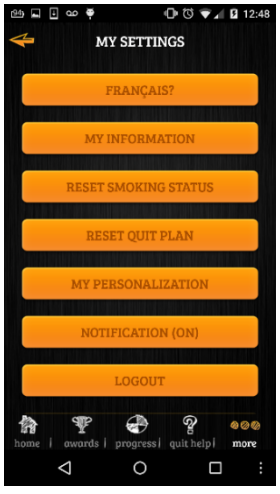
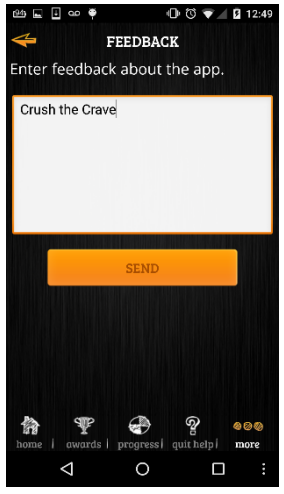


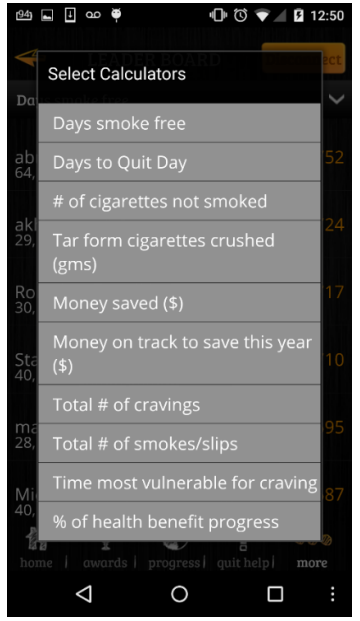








Crush the Crave Third Layers



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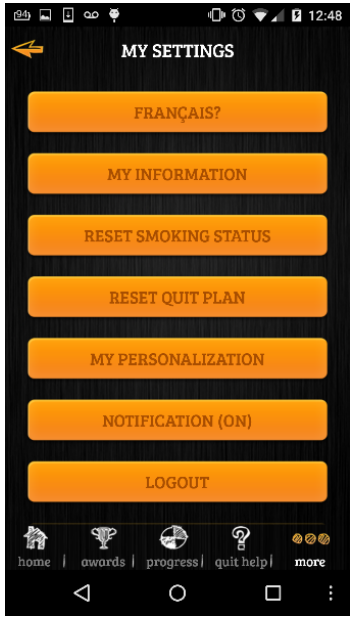

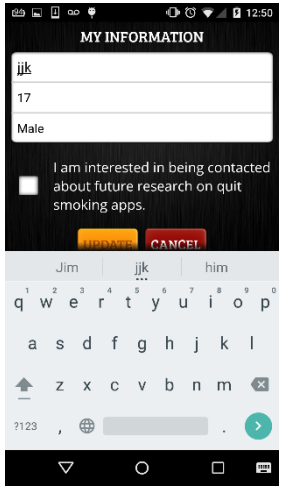

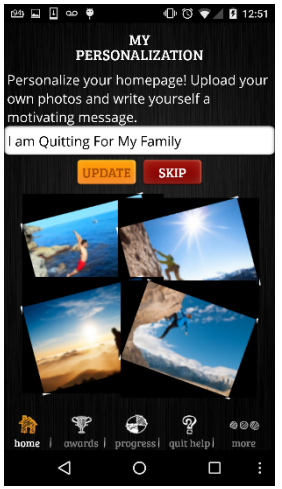

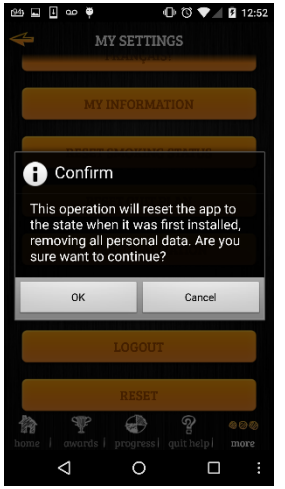

Appendix B

Recruitment E-mail

E-mail Title: Quit Smoking Study – [Insert Name], participate in an Interview for Crush The Crave

Hello [Insert Name],

My name is Darly Dash and I am a Master's student working under the supervision of Dr. John Garcia in the School of Public Health and Health Systems at the University of Waterloo and Dr. Bruce Baskerville in the Propel Centre for Population Health Impact at the University of Waterloo.

Why I'm Contacting You
I am contacting you because you have recently participated in Dr. Bruce Baskerville's Young Adult Quit Smoking Study that involved using **Crush the Crave**, a mobile-based application that helps smokers to quit smoking.

You had agreed to further contact in the Quit Smoking Study survey and indicated interest in participating in a telephone interview.

About This Study
I am interested in a study to learn more about your recent experiences with using Crush the Crave and would like to invite you to participate in a 60-minute telephone interview. I'm interested in hearing what worked well and what didn't, as that will help me understand how to improve strategies for young adults who are trying to quit. In appreciation of your time commitment, you will receive a $50 honorarium. This study is part of my master's thesis.

If you're interested…
in participating in this study, or if you would like to learn more, please contact myself, Darly Dash, at 519-888-4567, ext. 36631 or by e-mail at ddash@uwaterloo.ca.
I will reply to confirm your e-mail and provide you with additional study details and the consent form. You may also contact my supervisor, Professor John Garcia at 519-888-4567, ext. 35516 or e-mail at john.garcia@uwaterloo.ca.

This study has received ethics clearance through a University of Waterloo Research Ethics Committee.

Sincerely,

Darly Dash
Master's Student
School of Public Health and Health Systems
University of Waterloo
Office: LHN 2721
Phone: 519-888-4567 x36631
ddash@uwaterloo.ca

Appendix C

Telephone Recruitment Follow-up

Hello, may I please speak to [name]?

My name is Darly and I am a Master's student at the University of Waterloo working under the supervisor of Drs. John Garcia and Bruce Baskerville. I'm calling you today because you recently participated in the Quit Smoking Study by Dr. Bruce Baskerville where you used Crush the Crave. In this study, you indicated interest in participating in a follow-up telephone interview.

I'm following up on an e-mail I sent you a few days ago asking if you would be interested in participating in this study. I would like to provide you with more information about this project as I think your experiences with the app will be an important contribution to this project and future projects. Is now a good time to provide you with this information?

Participant: No, not interested in participating (thank them and end the call); No, call back later (agree on a time and call back); Yes, this is a good time (continue)

I'm interested in learning about your experiences with using Crush the Crave, a mobile-based application that intends to help smokers quit smoking. If you agree to participate, I would ask that you complete a consent form and participate in a 60-minute recorded telephone interview. In appreciate for your time commitment, you would receive $50. Your participation in this study is entirely voluntary and up to you. You can decline to answer any interview questions that you do not feel comfortable answering, and you may stop the interview at any time you wish.

Do you have any questions about this study?

With your permission, I'd like to e-mail you a copy of the information letter and consent form for this study. This has all the information to help you make a decision about your participation.

Participant: No, not interested in participating; Yes (confirm e-mail)

Thanks for your time. May I call you in 2 or 3 days to see if you are interested in participating? You can also e-mail me regarding your decision at ddash@uwaterloo.ca or at (519) 888-4567 ext. 36631.

Appendix D

Information Letter and Consent Form

INFORMATION LETTER

Date

Address

Dear [insert name],

This letter is an invitation to consider participating in a study I am conducting as part of my Master's degree in the School of Public Health and Health Systems at the University of Waterloo under the supervision of Drs. John Garcia and Bruce Baskerville. I would like to provide you with more information on this study and what your participation would involve if you decide to take part.

The main purpose of this research is to understand your experiences with using *Crush the Crave*, a mobile-based application that helps smokers to quit smoking. You have been selected to participate in this study as you have recently participated in Dr. Bruce Baskerville's young adult quit smoking study using *Crush the Crave*.

In order to take part in this study, you are being asked to participate in a **60 minute** audio-recorded telephone interview at a mutually agreed upon time with myself. The intent of this interview is to discuss your use of the application, any potential facilitators/barriers you have faced, and your perceptions on mobile-based health-related applications. To thank you for your participation in this study, **you will receive $50** following the telephone interview. The amount received is taxable. It is your responsibility to report this amount for income tax purposes.

Your participation in this study is completely voluntary and will not affect your participation in any other study. You may decline to answer any of the interview questions, if you so wish. Further, you may decide to withdraw from this study at any time without any negative consequences by telling the interviewer that you would like to stop. If you do stop, you will still receive remuneration for your time, however, the amount will be pro-rated. For example, if you complete half the interview, you will receive half of the dollar value.

With your permission, the interview will be audio recorded to facilitate in the collection of information, and later transcribed for analysis. Also, with your permission, you will be asked if your survey data from the Quit Smoking Study can be used for this study so as to avoid asking you the same questions repeatedly.

After the interview, if you choose, you may request a copy of the transcript for your own records. At this time, you may be contacted to check the information you provided and to confirm findings.

All information you provide is completely confidential. Your name will not appear in any thesis, presentations, or publications resulting from this study. However, with your permission, anonymous quotations will be used.

Audio and paper data collected during this study will be retained for 7 years in a locked office, in a password protected file after which, it will be deleted. Electronic data will be retained indefinitely with the data de-identified and in a secure location. Only researchers associated with this project will have access.

There are no known or anticipated risks to you as a participant in this study. Although there are no direct benefits immediately to you through participation, this study may benefit you as it allows you to share your experiences and options, and will benefit other individuals using mobile health applications and the broader research community.

If you have any questions regarding this study, or if you would like more information, please contact me at 519-888-4567, ext. 36631 or by e-mail at ddash@uwaterloo.ca. You may also contact my supervisor, Professor John Garcia at 519-888-4567, ext. 35516 or e-mail at john.garcia@uwaterloo.ca.

This study has received ethics clearance through a University of Waterloo Research Ethics Committee. However, the final decision about participation is yours. In the event that you have any comments or concerns regarding your participation in this study, please contact Director, ORE at 519-888-4567, ext. 36005 or maureen.nummelin@uwaterloo.ca.

I look forward to speaking with you and thank you in advance for your assistance in this project.

Yours sincerely,

Darly Dash

Master's Student
School of Public Health and Health Systems
University of Waterloo
E-mail: ddash@uwaterloo.ca
Phone: 519-888-4567 ext. 36631

CONSENT FORM

By signing this consent form, you are not waiving your legal rights or releasing the investigators or involved institutions from their legal and professional responsibilities.

I have read the information present in the information letter about a study being conducted by Darly Dash from the School of Public Health and Health Systems at the University of Waterloo, under the supervision of Drs. John Garcia and Bruce Baskerville. I have had the opportunity to ask any questions related to the study, to receive answers to my questions, and any additional details I wanted.

I am aware that I have the option of allowing my interview to be audio recorded to ensure accurate recording of my responses.

I was informed that I will be asked to provide permission to use the survey data from the Quit Smoking Study for this study.

I am aware that excerpts from the interview may be included in the thesis, presentations, and/or publications from this research, with the understanding that the quotations will be anonymous.

I was informed that I may withdraw my consent at any time without penalty by informing the researcher.

I was informed that I may be contacted at a later date to confirm the content of my interview and/or to review findings from the study.

This study has been reviewed and received ethics clearance from the University of Waterloo Research Ethics Committee. I was informed that if I have any comments or concerns regarding my participation in the study, I may contact the Director, Office of Research Ethics at 519-888-4567, ext. 36005.

With full knowledge of all foregoing, I agree, of my own free will, to participate in this study.

☐YES ☐NO

I agree to have my interview audio recorded.

☐YES ☐NO

I agree to the use of the survey data from the Quit Smoking Study.

☐YES ☐NO

I agree to the use of anonymous quotations in any thesis or publication that comes of this research.

☐YES ☐NO

I agree to be contacted at a later date to check the findings from this study.

☐YES ☐NO

Participant Name: _____ (Please print)

Participant Signature: _____

Witness Name: _____ (Please print)

Witness Signature: _____

Date: _____

Appendix E

Verbal Consent Script and Interview Guide

Thank you for agreeing to participate in this study that is examining experiences with the use of Crush the Crave. My name is Darly and I am a graduate student at the University of Waterloo. You were contacted because you participated in the Quit Smoking Study using the Crush the Crave app and I am interested in hearing your perspectives on this mobile-based application. What I'm hoping to do is to understand what different features of the app may or may not have worked for you in assisting you with your quitting process, what facilitated your progress and what barriers may have existed, and what improvements can be made. Also, I'd like to understand how your experiences with this app can inform other strategies to help young adult smokers quit smoking. I'm simply interested in what you think. There are no wrong or right answers so please feel free to share openly.

As noted on the consent form, I would like to audio record this interview to ensure that I capture all the information that you provide. This interview should last about 45 to 60 minutes. Any responses that you provide will be confidential. The only people who will have access to this recording and transcript are my research committee members and myself.

Do you agree to have this interview audio-taped?

With your permission, the survey answers you provided from the Quit Smoking Study will be used. If you do not agree, I will ask you a few basic demographic questions at the end of our interview.

Do you agree to the use of your survey data from the Quit Smoking Study?

Anonymous quotes from this interview will be included in the final thesis report, and in future presentations/publications. Your identity will not be attached to anything you may say in any report.

Do you consent to the use of anonymous quotations from our discussion?

During the interview, you may decline to answer any of the questions if you do not wish to answer them and if you wish to stop the interview or your participation at any time, please let me know.

Do you have any questions for me before we begin?

Okay. I'm going to turn on the recording function now. You will hear a message indicating that this call is being recorded. [Turn on recording]

<u>Section 1: General Questions</u>

1) When did you first start smoking? What prompted you to smoke?
2) Could you describe your smoking on a regular basis? (Prompt: with who, where, when)
3) Have you ever tried or attempted to quit smoking before?
    - If so, could you describe your previous experiences?
        - Prompts: Was there a reason you wanted to stop smoking? What made you want to try to quit? (e.g. friends, family, health) How important were your reasons for

attempting quitting? Is there a reason for trying to quit at that time? Were there certain goals you were hoping to achieve?

- Tell me what you used to help you quit.

4) Could you describe your reasons for attempting to quit this time using the quit study app (Crush the Crave)?
    - Prompts: Was there a reason you wanted to stop smoking? What made you want to quit? (e.g. friends, family, health) How important were your reasons for quitting? Is there a reason for trying to quit this time? Were there certain goals you were hoping to achieve? How did you try to quit?

<u>Section 2: Using Crush the Crave</u>

5) Could you tell me how you used Crush the Crave (CTC) over the past few months?
    - How often did you use the app? What made you remember to use the app?
        - Prompt: Was there certain things that motivated you to use the app?
    - When did you use the app?
        - Prompt: certain time of day or during a particular activity
    - Which features did you use? Which features did you like? Was there any particular reason you liked them?
        - List of features (to prompt):
        - Home page – Cigarette tracker, Craving tracker;
        - Quit Help – My Quit Plan, Info Pages, Online Resources, Quitline, the Crave Community, Distractions (games, music, videos, text buddy);
        - Awards page;
        - My Progress page – Health Calculators page;
        - More page – My Map feature, Leaderboard feature
    - Did you personalize your quit attempt using CTC? How? (e.g. writing your own affirmations, photographs, choosing a quit plan)
        - Prompt: Did you like having control over some of the aspects in your quit attempt? Was this helpful or not as you tried to quit?

6) What features of Crush the Crave helped or didn't help you with attempting to quit?
    - What made these features helpful or not helpful?
        - List of features (to prompt):
        - Home page – Cigarette tracker, Craving tracker;
        - Quit Help – My Quit Plan, Info Pages, Online Resources, Quitline, the Crave
            1. *Prompt:* Were there certain tools or resources or visuals that helped you when you tried to quit? By seeing your progress, benefits, and money saved, did that help you? Were you and did you control certain aspects of your quit attempt (i.e. tracking, goal setting)
        - Community, Distractions (games, music, videos, text buddy);
        - Awards page;
            1. *Prompt*: Did the awards you achieved throughout your experience help motivate you? Was there any particular reasons that the awards motivated you or not? Did these awards make you want to try harder to quit or no? Did they change how you approached your quit attempt?
        - My Progress page – Health Calculators page;

        - More page – My Map feature, Leaderboard feature
    - Could you tell me how the look and the feel of the app, like the visuals and messages you may have seen, affected your smoking?

7) How did you feel about the connecting features available on the app to social media outlets?
    - Did you use the feature that connected the app to your Facebook or Twitter account?
        - Prompt: Was there any particular reason you do or did not?
    - How do you feel about this connecting feature?
        - Prompt: Do you want people to see and know your progress as you try to quit?
    - How does connecting your progress to Facebook encourage or take away from quitting?
        - Prompt: Does it support or not support quitting? (e.g. from people seeing the posts, do you feel supported?) Did people provide support through these features? What kind of support did you get?

8) I'd like to learn a bit more of your use of the sharing features in the application. Did you share any of your experiences with this app or the app itself to other individuals such as friends, family, other smokers, or colleagues?
    - If yes, how did you share the app with others? (e.g. Clicking "share" through the app to Facebook, Twitter, or to quit buddy; word-of-mouth; text; e-mail; phone; etc.)
        - Was there any particular reason you shared or didn't share your experiences?
        - What kind of things did you share?
        - How did these other individuals respond?
    - If no, was there any particular reason you didn't share your experiences in the app?

9) Have you used any other supports to help you quit? (i.e. NRT, medication, quitline – SHL, medical advice, other apps or guides, other people)
    - If yes, which ones did you use?
        - Was there any particular reason you used those supports?
        - How did using these particular supports help or not help you with the quit process?
          (E.g. did these supports provide you with something the app could not? What was that? How did that kind of support make you feel as you tried to quit?)
        - Were any of these supports accessed through the Quit Help function of CTC? What role did CTC play in helping you (i.e. introduction to NRT)?
            1. Did you know about these supports before CTC?
            2. Did CTC encourage or take away from accessing these apps? Did you feel you needed other supports while trying to quit?
    - If no, was there any particular reason you did not use these supports?
        - How did not using other supports help or not help you with the quit process?
        - What would motivate you to use other supports for quitting?
        - Do you have any recommendations of how these other supports can be improved or changed that would encourage you to use them?
    - Is there anything special or unique about CTC that you feel these other supports don't have? (I.e. is there a gap that CTC fills that other resources don't?)

<u>Section 3: Closing</u>

10) How important is it to you that you know who developed an app and you know where the information is coming from?

11) Is there anything you feel that can be done to better support young adults, such as yourself, with quitting smoking?
    - What resources would be the most helpful?
    - What would these supports ideally look like?
    - Is there something that you would like to see that isn't currently happening?

12) Is there anything you feel is important about your experiences that I've missed and that you'd like me to know?

13) Do you use your smartphone for any other health-related activities? (e.g. apps on nutrition, fitness, etc.)

Those are all the interview questions I have for you today. I just have a few other short questions to ask you.

1) Could you state your age?
2) Do you speak any other languages?
3) When did you start smoking? How long have you been smoking OR how long were you a smoker (if they have quit)?

If participant DOES NOT consent to the use of Quit Smoking Survey data, then ask these questions:

I realize you didn't agree to use of your survey data from the Quit Smoking Survey. I just wanted to ask you a few basic questions, similar to the background or demographic questions you were asked in that study. Just let me know if you don't feel comfortable answering any or all of them.

1) What is your gender? (Male, Female, Transgender, Other)
2) Presently are you: Single, Married, Common Law, Separated, Divorced, Widowed, Prefer not to answer, Don't know
3) What is the highest level of education you have completed?
   (Less than high school; High school diploma/certificate/equivalent; Some post-secondary education without degree/certificate/diploma; Registered apprenticeship or other trades certificate/diploma; College, CEGEP, other certificate/diploma; University degree; Refused; Don't know)
4) What is your best estimate of your total household income for the last 12 months before taxes and deductions?
   (<$15,000; $15-29999; $30-44999; $45-59999; $60-79999; $80-99999; $100-119999; $120000+; Don't know; Prefer not to answer)
5) Are you currently employed for any paid work?
   (Yes – full time, part time, paid leave, paid sick or disability leave;
   No – student, unemployed
   Other
   Don't know
   Refused)

6) What population group do you identify with?
   (Aboriginal, Arab, White, Chinese, South Asian, Black, Filipino, Latin American, Southeast Asian, Japanese, West Asian, Korean, Other, Don't know, Refused)
7) In which province or territory do you live?
8) Before you started the study, how many cigarettes did you smoke each day? How about now?
9) How soon after you wake up do you smoke your first cigarette?
10) Does your partner, spouse, or significant other currently smoke?

Thank you again for speaking to me today. The information you shared is very interesting and I look forward to analyzing the data to write the final report. If I have any questions while I'm analyzing the data, would it be okay to contact you for clarification? This wouldn't be another interview but just some brief questions via e-mail.

Once I have completed all the analysis from all participants, I would potentially like to get your feedback about what the results show. Would you be willing to potentially participate in a short, feedback interview?

Do you have any final questions for me? Thanks again for your time.

Appendix F

Pilot Recruitment E-mail

Hello [Insert Name],

My name is Darly Dash and I am a Master's student working under the supervision of Dr. John Garcia in the School of Public Health and Health Systems at the University of Waterloo and Dr. Bruce Baskerville in the Propel Centre for Population Health Impact at the University of Waterloo.

I am contacting you because you are participating in Dr. Bruce Baskerville's **Young Adult Quit Smoking Study** that involved using *Crush the Crave* and have recently completed the 3-month follow-up survey.

Currently, I am interested in pilot testing a survey we've developed that asks about your experiences with using the Crush the Crave app. It will take about 20 minutes of your time over the phone, and in appreciation of your time commitment, you will receive $20.

If you are interested in participating in this pilot test, or if you would like to learn more, please contact myself, Darly Dash, at 519-888-4567, ext. 36631 or by e-mail at ddash@uwaterloo.ca in the next 3 – 4 days. I will reply to confirm your e-mail and provide you with additional study details and the consent form. You may also contact my supervisor, Professor John Garcia at 519-888-4567, ext. 35516 or e-mail at john.garcia@uwaterloo.ca.

This study has received ethics clearance through a University of Waterloo Research Ethics Committee.

Sincerely,
Darly Dash
Master's Student
School of Public Health and Health Systems
University of Waterloo
E-mail: ddash@uwaterloo.ca
Phone: 519-888-4567 ext. 36631

Appendix G

Pilot Information Letter and Consent Form

Date

Address

Dear [insert name],

This letter is an invitation to consider participating in a study I am conducting as part of my Master's degree in the School of Public Health and Health Systems at the University of Waterloo under the supervision of Dr. John Garcia in the School of Public Health and Health Systems at the University of Waterloo and Dr. Bruce Baskerville in the Propel Centre for Population Health Impact at the University of Waterloo. I would like to provide you with more information on this study and what your participation would involve if you decide to take part.

The main purpose of this research is to get your reaction on questions we've developed that ask about experiences with using *Crush the Crave*, a mobile-based application that helps smokers to quit smoking.

In order to take part, you are being asked to participate in a **20-minute** telephone interview at a mutually agreed upon time with myself. The intent of this interview is to discuss these questions we have developed and your thoughts on the clarity, structure, and wording of these questions. To thank you for your time, you will receive $20. The amount received is taxable. It is your responsibility to report this amount for income tax purposes.

Your participation is completely voluntary and you will not be able to participate in future studies involving the questions we've developed on *Crush the Crave*. All information you provide is completely confidential. Any information you provide will be used to modify the existing questions for improvement. Data that you share will be written during the interview and will be retained electronically indefinitely, with the data de-identified and in a password protected file. There are no known or anticipated risks to you as a participant in this study. Although there are no direct benefits immediately to you through participation, your help will benefit research in the area of smartphone applications for behaviour change. You may withdraw your consent to participate at any time or decline to answer any question, if you feel uncomfortable.

If you have any questions regarding this study, or if you would like more information, please contact me at 519-888-4567, ext. 36631 or by e-mail at ddash@uwaterloo.ca. You may also contact my supervisor, Professor John Garcia at 519-888-4567, ext. 35516 or e-mail at john.garcia@uwaterloo.ca.

This study has received ethics clearance through a University of Waterloo Research Ethics Committee. However, the final decision about participation is yours. In the event that you have any comments or concerns regarding your participation in this study, please contact Director, ORE at 519-888-4567, ext. 36005 or maureen.nummelin@uwaterloo.ca.

I look forward to speaking with you and thank you in advance for your assistance in this project.

Yours sincerely,

Darly Dash

Master's Student
School of Public Health and Health Systems
University of Waterloo
E-mail: ddash@uwaterloo.ca
Phone: 519-888-4567 ext. 36631

CONSENT FORM

By signing this consent form, you are not waiving your legal rights or releasing the investigators or involved institutions from their legal and professional responsibilities.

I have read the information present in the information letter about a study being conducted by Darly Dash from the School of Public Health and Health Systems at the University of Waterloo, under the supervision of Drs. John Garcia and Bruce Baskerville. I have had the opportunity to ask any questions related to the study, to receive answers to my questions, and any additional details I wanted.

I am aware that there will be a telephone interview to ask about my perceptions on interview questions.

I was informed that the information I provide may be used to modify interview questions for future research by considering clarity, wording, and question structure.

I was informed that I may withdraw my consent at any time without penalty by informing the researcher.

This study has received ethics clearance through a University of Waterloo Research Ethics Committee. I was informed that if I have any comments or concerns regarding my participation in the study, I may contact the Director, Office of Research Ethics at 519-888-4567, ext. 36005.

With full knowledge of all foregoing, I agree, of my own free will, to participate in this study.

☐YES ☐NO

Participant Name: _____ (Please print)

Participant Signature: _____

Witness Name: _____ (Please print)

Witness Signature: _____

Appendix H

Pilot Verbal Consent Script and Pilot Questions

Thank you for agreeing to participate in this study that is asking for your reactions on questions we've developed about Crush the Crave, a mobile-based application that helps smokers to quit smoking. My name is Darly and I am a graduate student at the University of Waterloo. You were contacted because you are participating in the Quit Smoking Study using the Crush the Crave. What I'm hoping to do is to understand your thoughts on the clarity, structure, and wording of these questions. I'm simply interested in what you think. There are no wrong or right answers so please feel free to share openly.

As noted on the consent form, this interview should last about 20 minutes. Any responses that you provide will be confidential and will be used only to modify the existing questions for improvement. The only people who will have access to this recording and transcript are my research committee members and myself.

Do you agree to participate in this interview?

During the interview, you may decline to answer any of the questions if you do not wish to answer them and if you wish to stop the interview or your participation at any time, please let me know.

Do you have any questions for me before we begin?

Okay. We'll get started with the questions.

The following questions will be asked regarding each question in the interview guide.

1) What do you think this question is asking? (Is the question clear?)
2) What do you think about the wording of this question? Could it be worded differently?
3) Do you feel the question suggested how you should reply?
4) Does this question flow with the direction of the interview?
5) Should the question be changed?

Thank you for your time and providing your insight into these questions. Your answers will be helpful in the design of such questions for future studies.

Appendix I

Revised Verbal Consent Script and Interview Guide

Thank you for agreeing to participate in this study that is examining experiences with the use of Crush the Crave. My name is Darly and I am a graduate student at the University of Waterloo. You were contacted because you participated in the Quit Smoking Study using the Crush the Crave app and I am interested in hearing your perspectives on this mobile-based application. What I'm hoping to do is to understand what different features of the app may or may not have worked for you in assisting you with your quitting process, what facilitated your progress and what barriers may have existed, and what improvements can be made. Also, I'd like to understand how your experiences with this app can inform other strategies to help young adult smokers quit smoking. I'm simply interested in what you think. There are no wrong or right answers so please feel free to share openly.

As noted on the consent form, I would like to audio record this interview to ensure that I capture all the information that you provide. This interview should last about 45 to 60 minutes. Any responses that you provide will be confidential. The only people who will have access to this recording and transcript are my research committee members and myself.

Do you agree to have this interview audio-taped?

With your permission, the survey answers you provided from the Quit Smoking Study will be used. If you do not agree, I will ask you a few basic demographic questions at the end of our interview.

Do you agree to the use of your survey data from the Quit Smoking Study?

Anonymous quotes from this interview will be included in the final thesis report, and in future presentations/publications. Your identity will not be attached to anything you may say in any report.

Do you consent to the use of anonymous quotations from our discussion?

During the interview, you may decline to answer any of the questions if you do not wish to answer them and if you wish to stop the interview or your participation at any time, please let me know.

Do you have any questions for me before we begin?

Okay. I'm going to turn on the recording function now. You will hear a message indicating that this call is being recorded. [Turn on recording]

<u>Section 1: General Questions</u>

1) When did you first start smoking? What prompted you to smoke?
2) Could you describe your smoking habits? (Prompt: how often, how regularly, with who, where, when)
3) Have you ever tried or attempted to quit smoking before?
    - If so, could you describe your previous experiences?

- Prompts: Was there a reason you wanted to stop smoking? What made you want to try to quit? (e.g. friends, family, health) How important were your reasons for attempting quitting? Is there a reason for trying to quit at that time? Were there certain goals you were hoping to achieve?
- Tell me what you used to help you quit.
- Was there a reason you started smoking after quitting?

4) Could you describe your reasons for attempting to quit this time using the quit study app (Crush the Crave)?
   - Prompts: Was there a reason you wanted to stop smoking? What made you want to quit? (e.g. friends, family, health) How important were your reasons for quitting? Is there a reason for trying to quit this time? Were there certain goals you were hoping to achieve? How did you try to quit?

Section 2: Using Crush the Crave

5) Could you tell me how you used Crush the Crave (CTC) over the past few months?
   - How often did you use the app? What made you remember to use the app?
     - Prompt: Was there certain things that motivated you to use the app?
   - When did you use the app?
     - Prompt: certain time of day or during a particular activity
   - Which features did you use? Which features did you like? Was there any particular reason you liked them?
     - List of features (to prompt):
     - Home page – Cigarette tracker, Craving tracker;
     - Quit Help – My Quit Plan, Info Pages, Online Resources, Quitline, the Crave Community, Distractions (games, music, videos, text buddy);
     - Awards page;
     - My Progress page – Health Calculators page;
     - More page – My Map feature, Leaderboard feature
   - Did you personalize your quit attempt using CTC? How? (e.g. writing your own affirmations, photographs, choosing a quit plan)
     - Prompt: Did you like having control over some of the aspects in your quit attempt? Was this helpful or not as you tried to quit?

6) What features of Crush the Crave helped or didn't help you with attempting to quit?
   - What made these features helpful or not helpful?
     - List of features (to prompt):
     - Home page – Cigarette tracker, Craving tracker;
     - Quit Help – My Quit Plan, Info Pages, Online Resources, Quitline, the Crave
       1. *Prompt:* Were there certain tools or resources or visuals that helped you when you tried to quit? By seeing your progress, benefits, and money saved, did that help you? Were you and did you control certain aspects of your quit attempt (i.e. tracking, goal setting)
     - Community, Distractions (games, music, videos, text buddy);
     - Awards page;
       1. *Prompt*: Did the awards you achieved throughout your experience help motivate you? Was there any particular reasons that the awards motivated you or not? Did these awards make you want to try harder

to quit or no? Did they change how you approached your quit attempt?
        - My Progress page – Health Calculators page;
        - More page – My Map feature, Leaderboard feature
    - Could you tell me how the look and the feel of the app as a whole, affected your quitting or smoking? What did you think of the look and feel?
        - What did you think of the visuals and how did that affect your quitting/smoking?
        - What did you think of the messaging and how did that affect your quitting/smoking?

7) How did you feel about the connecting features available on the app to social media outlets?
    - Did you use the feature that connected the app to your Facebook or Twitter account? Did you share any of your progress on Facebook or Twitter?
        - Prompt: Was there any particular reason you did or did not?
        - What kind of things did you share?
    - How do you feel about this connecting/sharing feature?
        - Prompt: Do you want people to see and know your progress as you try to quit?
    - How does connecting your progress to Facebook encourage or take away from quitting?
        - Prompt: Does it support or not support quitting? (e.g. from people seeing the posts, do you feel supported?) Did people provide support through these features? What kind of support did you get?
    - Who did you talk to about your experiences with this app? (Friends, family, other smokers, colleagues, etc.)
        - How did you tell them about your experiences with the app? Was there ways outside of Facebook/Twitter that you shared the app?
          (Facebook, Twitter, quit buddy options, word-of-mouth, text, e-mail, phone)
        - Was there any particular reason you shared or didn't share your experiences?
        - What kind of things did you share?

8) Have you used any other supports to help you quit? (i.e. NRT, medication, quitline – SHL, medical advice, other apps or guides, other people)
    - If yes, which ones did you use?
        - Was there any particular reason you used those supports?
        - How did using these particular supports help or not help you with the quit process?
          (E.g. did these supports provide you with something the app could not? What was that? How did that kind of support make you feel as you tried to quit?)
        - Were any of these supports accessed through the Quit Help function of CTC? What role did CTC play in helping you (i.e. introduction to NRT)?
            1. Did you know about these supports before CTC?
            2. Did CTC encourage or take away from accessing these apps? Did you feel you needed other supports while trying to quit?
    - If no, was there any particular reason you did not use these supports?
        - How did not using other supports help or not help you with the quit process?
        - What would motivate you to use other supports for quitting?
        - Do you have any recommendations of how these other supports can be improved or changed that would encourage you to use them?

- Is there anything special or unique about CTC that you feel these other supports don't have? (I.e. is there a gap that CTC fills that other resources don't?)

Section 3: Closing

9) How important is it to you that you know who developed an app and you know where the information is coming from?

10) Is there anything you feel that can be done to better support young adults, such as yourself, with quitting smoking?
    - What resources would be the most helpful?
    - What would these supports ideally look like?
    - Is there something that you would like to see that isn't currently happening?

11) Is there anything you feel is important about your experiences that I've missed and that you'd like me to know?

12) Do you use your smartphone for any other health-related activities? (e.g. apps on nutrition, fitness, etc.)

Those are all the interview questions I have for you today. I just have a few other short questions to ask you.

1) Could you state your age?
2) Do you speak any other languages?
3) When did you start smoking? How long have you been smoking OR how long were you a smoker (if they have quit)?

If participant DOES NOT consent to the use of Quit Smoking Survey data, then ask these questions:

I realize you didn't agree to use of your survey data from the Quit Smoking Survey. I just wanted to ask you a few basic questions, similar to the background or demographic questions you were asked in that study. Just let me know if you don't feel comfortable answering any or all of them.

1) What is your gender? (Male, Female, Transgender, Other)
2) Presently are you: Single, Married, Common Law, Separated, Divorced, Widowed, Prefer not to answer, Don't know
3) What is the highest level of education you have completed?
   (Less than high school; High school diploma/certificate/equivalent; Some post-secondary education without degree/certificate/diploma; Registered apprenticeship or other trades certificate/diploma; College, CEGEP, other certificate/diploma; University degree; Refused; Don't know)
4) What is your best estimate of your total household income for the last 12 months before taxes and deductions?
   (<$15,000; $15-29999; $30-44999; $45-59999; $60-79999; $80-99999; $100-119999; $120000+; Don't know; Prefer not to answer)
5) Are you currently employed for any paid work?
   (Yes – full time, part time, paid leave, paid sick or disability leave;
   No – student, unemployed

Other
Don't know
Refused)

6) What population group do you identify with?
(Aboriginal, Arab, White, Chinese, South Asian, Black, Filipino, Latin American, Southeast Asian, Japanese, West Asian, Korean, Other, Don't know, Refused)
7) In which province or territory do you live?
8) Before you started the study, how many cigarettes did you smoke each day? How about now?
9) How soon after you wake up do you smoke your first cigarette?
10) Does your partner, spouse, or significant other currently smoke?

Thank you again for speaking to me today. The information you shared is very interesting and I look forward to analyzing the data to write the final report. If I have any questions while I'm analyzing the data, would it be okay to contact you for clarification? This wouldn't be another interview but just some brief questions via e-mail.

Once I have completed all the analysis from all participants, I would potentially like to get your feedback about what the results show. Would you be willing to potentially participate in a short, feedback interview?

Do you have any final questions for me? Thanks again for your time.

Appendix J

Thank-You Letter

Dear [name],

I would like to thank you for your participation in this study. You will be mailed a cheque for **$20 (pilot participants) / $50 (present study participants)** in the next few days. The amount received is taxable. It is your responsibility to report the amount received for income tax purposes.

[Include if it is the Pilot Thank You]
As a reminder, the purpose of this study was to pilot test a survey that asks about your experiences with the Crush the Crave app. Your involvement in this study will help us improve the survey questions for further research.

Please remember that any data pertaining to you as an individual will be kept confidential. Once all the data has been collected and reviewed, the data will be used to modify the survey questions.

[Include if it is the Present Study Thank you]
As a reminder, the purpose of this study was to learn about your use of *Crush the Crave* to understand what about the application was important and any facilitators or barriers you faced. Your involvement in this study will contribute to a better understanding of smoking cessation in young adults and what works for this age group. This may help other organizations and groups provide effective services to young adult smokers or for other health promotion interventions.

Please remember that any data pertaining to you as an individual will be kept confidential. Once all the data is collected and analyzed, we plan on sharing this information through my master's thesis, conferences, presentations, and publications. You may be contacted at a later date to review the results from the study.

If you have any questions or concerns regarding this research, please contact me at 519-888-4567, ext. 36631 or by e-mail at ddash@uwaterloo.ca. You may also contact my supervisor, Professor John Garcia at 519-888-4567, ext. 35516 or e-mail at john.garcia@uwaterloo.ca.

This study has received ethics clearance through a University of Waterloo Research Ethics Committee.

Sincerely,

Darly Dash

Master's Student
School of Public Health and Health Systems
University of Waterloo
E-mail: ddash@uwaterloo.ca
Phone: 519-888-4567 ext. 36631

Appendix K

Tree Branch Structure

Table 15: Tree Branch Structure of the Analysis

Tree	Branch	Twig	Leaf
Smoking History	Starting to smoke		
	Amount smoked		
	Smoking network around individual	Family smokes	
		Friends smoke	
		High smoking rates in community	
		Friends who don't smoke	
	When & where smoking occurred	To be social with others	
		Throughout the day	
		By oneself	
		When travelling/commuting	
		Smoking mostly in the morning	
	Use of Alternative Tobacco Products (ATPs) and Marijuana	Tobacco & marijuana together	
		Cigars	
		Using marijuana first	
Reasons for Smoking	Social pressure & sharing smokes		
	Feeling stress		
	Drinking & smoking		
	Fitting in		
	Other reasons for starting	Enjoying the smoking experience	
		Trying because family members smoked	
		Craving cigarettes, 'it 'felt good'	
		Feeling bored	
		'five minutes to myself'	
		Feeling more mature	
		Addiction from ATPs	

Tree	Branch	Twig	Leaf
Previous Quit Attempt Experiences	Reasons for wanting to quit	Noticing impact on health	
		Feeling pressure &/or encouragement from family & friends	
		Smoking is an expensive habit	
		Other reasons	Knowing it isn't a good habit
			Unintentional quit due to circumstance
			Not feeling proud around others
			For the children
			Noticing addictive behaviour
			Attractiveness & physical performance
			Using other substances in the pact
			Quit aids available for free
			To see if it was possible
			Smoking friends not around
			Unknown
	Quitting on your own		
	Cutting down	Falling back into a regular pattern	
		Quitting helped reduce intake	
	Having to quit with no quit aids		
	Not purchasing cigarettes as a strategy		
	Quitting only one tobacco product		
	Making multiple attempts		
	Reasons for picking up smoking again	Being around other smoking & social gatherings	
		Craving & withdrawal effects	
		Drinking & smoking	
		Feeling stress	
		Smoking identity	

Tree	Branch	Twig	Leaf
		Quitting aids didn't help	
		Not being ready to quit	
		Losing willpower	
		Lack of danger to children & stress in child rearing	
		Frustrated with quit process	
		Trying a new smoking trend	
		Lack of reasonable resources for quitting	
		Lack of coping strategies	
Quit Attempt with Crush The Crave	Reasons for quitting with CTC	Noticing impact on health	
		Smoking is an expensive habit	
		Already interested &/or attempting to quit	
		Different environment	
		Motivated by RCT & this new tool	
		Wanting to quit for yourself	
		Being pushed or encouraged by others	
		Other reasons	Disliking addictive behaviour & smell
			Growing up
			To renew self & show others you can quit
			Not feeling pressured to quit or judged
			Not feeling proud around others
			Knowing it isn't a good habit
			Looking for & having the tools
			Others don't know about smoking habits
			Controlling your own behaviour
			Unknown
	Strategies for quitting	Not purchasing packs of cigarettes	
		Quit plan with reduction, distractions, & coping strategies	
		Easier to quit tobacco & ATPs together	
		Not telling many others about quitting	

Tree	Branch	Twig	Leaf
	Current smoking status	Cutting down	Making smoking more difficult for yourself
			Setting a quit date
		Not smoking	
		Smoking	
		Trying to quit	
	Challenges	Other smokers around	Tempting situation
			Quitting with others but quit experience differs
		Cravings	
		Dealing with judgement	
		Gaining weight	
		Given up on quitting	
		Seeing cigarettes	
		'small minded people' in small towns	
Using Crush The Crave	How the app was used	Duration of use and how often	Daily
			Every few days
			Low use of app ➢ (bud) Believing the app could help ➢ (bud) Lacking self-control ➢ (bud) Feeling that you could do what the app does on your own ➢ (bud) Feeling it was silly to use
		When the app was used	When on the phone or bored
			When craving to help replace habits
			In the evenings
		Remembering to use the app	Wanting to make a real attempt
			Forgetting to use it
			Using your phone already
			Enjoying information in the app
			When craving
			Not receiving notifications

Tree	Branch	Twig	Leaf
			App reminding you that you want to smoke
			Quitting with a friend who uses the app
		Going through the whole app initially	
		Using the app quickly, get in, get out	
		Using the app to gather resources & then make it your own	
	Look & feel of the app	Good graphics and visuals	Needing more animation ➢ (bud) To display success & celebrate with user
			Wanting more gamification & childishness
			Looks outdated
		Logo & name were empowering	
		Colours were appealing	
		Depressing to see dark colours, wanting to see more colour	
		Looks did not affect quitting experience	
		Finding it easy to move around the app	
		Finding the app to be cluttered and difficult to find features	
	Messaging in the app	Was understandable and simple	
		Feeling that it was written for young adults	
		Keeps encouragement going with positive language	
		Bland	
		Writing is mature – more jokes or simplicity is needed	
		Childish encouragement at times	
	Personalizing the app	The feature was not used	Not knowing about customization options
		The feature was used	Inputting your personal quit reason
			Inputting personal photos
			Making your own quit plan

Tree	Branch	Twig	Leaf
		Feelings on personalization	Reminding yourself of quit reasons
			Feeling in control
			Other thoughts
	Encountering technological challenges	Always needing data or Wi-Fi connections	
		Experiencing slow speed & buttons not working	
		Not reconnecting to your account with a new smart device	
		Assumes you haven't smoked if no data inputted	
		Not making an immediate quit plan	

Tree	Branch	Twig	Leaf
Crush The Crave Features	Home Page with smoke & crave trackers, money saved, days-smoke free, & daily allowance information	How was this used?	Logging smokes and craves
			Seeing amount of money saved
			Not using the crave tracker
			Knowing how long it has been through days smoke-free
			Following the daily allowance limits
			Knowing you need to input tracking info
			Forgetting to input data into trackers
			Only using crave tracker for all activities
		How did this affect the quit experience?	Seeing your own progress
			Keeping tracking of the numbers for you
			Feeling motivated to keep to keep trying & pushing forward
			Frustrating to log the info ➢ (bud) Inputting all cravings is unrealistic
			Having an idea of smoking habits
			Info pop-ups were interesting and helpful
			Providing guidance & realistic targets with daily allowance
			Reminded of quit reasons
			Someone is cheering you on
			Knowing days smoke-free not as important as the consequence based info
			Admitting to self (negative reinforcement)
			Feeling in control with the allowances
	My Progress with graphs & health calculators	How was this used?	Looking at the graphed information
			Checking the health calculators
			Not using the progress page
			Not using the health calculators
		How did this affect the quit experience?	Informing yourself on progress & feeling

Tree	Branch	Twig	Leaf
			good about it
			Feeling encouraged to keep going
			Understanding your own behaviour
			Knowing things were under your control
			Seeing slips & smokes made motivation waver
			Knowing info wasn't true as you couldn't input all info
	Quit Help pages	How was this used?	Looking through the quit help info
			Not using the quit help function
			Not using the Crave Community (CTC's Facebook page)
			Seeing info that is already known or available online
			Not interested in looking at quit help info
		How did this affect the quit experience?	Learning info, tips, & tricks to help
			Reading info gave something to do instead of smoking
			Info keeping you aware of what to expect
			Info was organized well & not sole purpose of app
	Distractions	How was this used?	Playing game, listening to music, and/or watching videos
			Not texting a quit buddy ➢ (bud) Not wanting to contact someone all the time ➢ (bud) Not having a support system
			Not using distractions
			Texting a 'quit buddy'
		How did this affect the quit experience?	Getting distracted in the moment & forgetting to smoke

Tree	Branch	Twig	Leaf
			Having to look for games, install, and then play
			Not needing the app for these type of distractions
			Wanting to see all aspects contained in the app
			Feeling good about the support system
			Wanting to smoke more with the music
	Awards page	How was this used?	Checking for awards received and those upcoming
			Not viewing the awards ➢ (bud) Feeling motivated by other app components ➢ (bud) Noticing health changes by yourself instead
		How did this affect the quit experience?	'shocking' to see how much money was saved
			Feeling more confident to keep trying
			Seeing your progress through awards
			Understanding how quitting improves your health
			Having smaller, more manageable goals
			Receiving info along with awards
			Using awards as a game to compare between friends
			Only showing end achievement, not the steps taken in between
			Tracking money by oneself so not useful to have app track
	My Map & Leaderboards	Encouraging to see other users anonymously	
		Map feature is tracking inaccurately	

Tree	Branch	Twig	Leaf
Social Media, Social Support, & Sharing the App	Social Media Connectivity	Not wanting to connect to social media	Believing that it is a good option if you need & have support from others
			Not wanting to share as it is a private, personal journey
			Would rather speak to people directly who care
			Not using Facebook often or in this manner
			Involves broadcasting failures to everyone
			Depending on progress, would only share with select individuals
			Believing it's great that it's your choice to connect, not automatic
			Could be unmotivating if others are not supportive
		Connecting the app to Facebook	Easy option for connecting (no ID or password needed)
			Not knowing about sharing progress steps
			Others were supportive on Facebook
			Letting & willing to tell others about quit journey
	Getting support	Through family & friends	
		Not getting support as others don't care or are negative	
		Supporting yourself through art	
		Through counsellors	
	Sharing app experience in other ways	Telling friends face-to-face, verbally, or through text about your experience with the app	
		Not telling others about using the app	
		Suggesting or going to suggest the app to others who may benefit	

Tree	Branch	Twig	Leaf
Experience with Using Other Quit Aids	Quit line was not used	Desiring more info before considering this option	
	Pharmacotherapy (NRT and Medication)	Not using medication	
		Not using NRT	
		Reasons for not using pharmacotherapy	Not wanting to put more chemicals in body
			Lacking confidence in pharmacotherapy being successful
			Not having money for pharmacotherapy
			Not knowing how medication works
			Lack of confidentiality between health professionals if medication used
		Using NRT	Experiencing negative effects from using NRT
			NRT was available for free
			Patch helped cut craving, but not the habit
		Using medication	Experiencing negative effects from medication
			Knowing it worked for other smokers
			Getting rid of urge to smoke
			Medication was expensive
	Interacting with health professionals	Not accessing health professionals for support	They only provided a prescription upon request (no support)
			Already knowing smoking is bad for you
			Not desiring to get a prescription
			Would access a health professional if a prescription was not needed
		Speaking to health professionals	Providing prescriptions & immunizations
	Trying E-cigarettes or vaporizers	Not as satisfying and not cutting cravings	
		Replacing one habit with another and creating another trend	
		They were too expensive	

Tree	Branch	Twig	Leaf
		Working initially to cut cravings	
	Using other quit smoking apps	None used	
		Using other apps	Other apps were very gamed based, pre-planned, rushed, full of ad's, and used poor sources
			CTC provided a clear focus, gave you control to plan, and had no ad's
			CTC was free which was important
			CTC similar to other apps, but having more substance
	Online resources	Not using online resources	
		Not helpful info as it is already known or comes from non-smokers	
	Other aids	Contests	
		Program at school	
		Laser therapy	
		Alan Carr book	
	Not using other quit aids	Preferring to quit by yourself	
		Other strategies – reading, chewing regular gum, & using natural remedies	
		Not all tools are reasonable for the age group	
		Not feeling like any other support was needed	
		Needing to find something that works	
		Making your own app like resource	
	Was CTC different & how?	Keeping track of progress through app features & visuals	
		Feeling that it was always accessible, personal, and you are in control	
		Doesn't involve taking in chemicals	

Tree	Branch	Twig	Leaf
		Has resources that are local	
Did the app contribute to the quitting experience?	Yes	Seeing your own progress & steps towards goal	
		Tracking is done for you	
		Providing a good middle ground (on your own with some support)	
		Displaying your personal info & your own plan	
		Always being there and available	
		Getting helpful information	
		Believing it's a good idea and beneficial if used	
		No need to use after quitting	
		Feeling good & motivated to continue	
		Looking at phone reinforces decision	
		Comparing results with friends	
	No	But nothing really worked	
		Made by non-smokers & unrealistic to stick with the app	
		Not giving a full effort	
		Needing internet at all times	

Appendix L

List of Pseudonyms

Interviewee Number	Pseudonym
01	John
02	Charlie
03	Susan
04	Heather
05	Edward
06	Brittany
07	Daniel
08	Kevin
09	Patricia
10	Vincent
11	Christina
12	Rachel
13	Jennifer
14	Robert
15	Brian

Appendix M

Project Expenditures

Item	Quantity	Amount (CDN)
Qualitative Software for analysis (NVivo 10 – $85/year)	1	$85
Incentive for participation ($50/participant)	15	$750
Transcription of interviews (~$175 per 60 minute interview) Cost includes the download of the digital recording from Arkadin and transcription by third party.	15	$2491.41
Knowledge transfer costs (e.g. fees associated with submitting papers to academic journals, abstracts to conferences, and presenting at conferences)	n/a	($4000 – future costs)
TOTAL		**$3326.41** + $4000 (anticipated)