

A PILOT TEST OF AN INTERNET-BASED SMOKING CESSATION
INTERVENTION: OUTCOMES ACROSS CHRONIC PAIN AND PAIN-FREE
SAMPLES

A Thesis

Submitted to the Faculty of Graduate Studies and Research

In Partial Fulfillment of the Requirements

For the Degree of

Doctor of Philosophy

in

Clinical Psychology

University of Regina

By

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Regina, Saskatchewan

May, 2017

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UNIVERSITY OF REGINA
FACULTY OF GRADUATE STUDIES AND RESEARCH
SUPERVISORY AND EXAMINING COMMITTEE

Hollyanne Ellen Ruth Parkerson, candidate for the degree of Doctor of Philosophy in Clinical Psychology, has presented a thesis titled, ***A Pilot Test of an Internet-Based Smoking Cessation Intervention: Outcomes Across Chronic Pain and Pain-Free Samples***, in an oral examination held on April 28, 2017. The following committee members have found the thesis acceptable in form and content, and that the candidate demonstrated satisfactory knowledge of the subject material.

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Abstract

Background: Smoking and chronic pain are major public health concerns in Canada. Contemporary models of smoking and chronic pain suggest a reciprocal and self-perpetuating cycle, wherein smoking reduces pain in the short term but indirectly exacerbates pain in the long term. Population evidence indicates that a majority of Canadian smokers want to quit smoking; however, 90% of quit attempts are unsuccessful. Quitting may be even more difficult for those with chronic pain. Pain-related anxiety and expectancies that smoking will reduce pain have been suggested as additional cessation barriers faced by some individuals with chronic pain. Internet-based interventions have been suggested as a cost-effective medium for offering broad population level cessation support. Many Internet-based interventions have emerged but few clinical trials have been conducted to assess the efficacy and mechanisms of change associated with such interventions. Purpose: The proposed investigation was designed to achieve three objectives. The first objective was to pilot test an Internet-based smoking cessation intervention (StopAdvisor) in a Canadian sample by assessing user abstinence rates, engagement, and satisfaction. The second objective was to assess whether variance in smoking dependence would be accounted for by smoking expectancies for pain reduction and pain-related anxiety. The third objective was to assess whether successful smoking abstinence would positively impact pain and pain-related disability outcomes of individuals with acute and chronic pain. Methods: Participants comprised 168 daily smokers with acute pain ($n = 27$; 33.3% male), chronic pain ($n = 58$; 46.6% male), or no pain ($n = 73$; 55.6% male), who were willing to make a serious quit attempt using a cessation website that offers automated interactive tailored cessation support. Results: A total of 34 participants (21.5%) remained abstinent at 8-weeks post-enrolment, double

the rate observed among smokers making an unaided quit attempt. Participants who made a serious quit attempt using StopAdvisor viewed approximately 142 pages across 9 visits to the site. The majority of participants rated the program favourably across a variety of satisfaction indices. Analysis of covariance results indicated that pain-related anxiety, but not smoking expectancies for pain reduction, accounted for a significant proportion of the variance of smoking dependence scores of the total sample as indicated by a medium effect ($p = .03$, $\eta_p^2 = .06$). Results of a repeated measures analysis of variance demonstrated that individuals with acute or chronic pain who abstained from smoking experienced statistically and clinically meaningful decreases in pain and pain-related disability from pre- to post-intervention. Implications: The current investigation demonstrated that an automated tailored smoking cessation intervention improved the likelihood of short-term smoking abstinence in a Canadian sample. This type of administration format was acceptable to most participants. To our knowledge, current results are the first indicate that pain-related anxiety may be a risk factor for increased smoking dependence for all individuals regardless of pain status (i.e., chronic pain, acute pain, and pain-free groups). As such, pain-anxiety management may be a useful addition to existing smoking cessation and relapse prevention interventions for all smokers, and not just those with pain. The current investigation also provided novel evidence regarding the impact of sustained smoking abstinence on prospective pain outcomes. Such findings highlight an important role for incorporating smoking cessation interventions within pain treatment settings.

Acknowledgements

I wish to express my sincere thanks to my supervisor, Dr. Gordon Asmundson, for his support and guidance throughout the completion of this dissertation and my Doctoral degree. His knowledge and advice have contributed to my development as a researcher and professional. Within his lab, I have had the freedom to flex my intellectual curiosity by participating in research on a variety of topics. Under his mentorship, I learned to write academically, work efficiently, collaborate with other professionals, mentor junior researchers, and appreciate the value of a well-executed prank. I now feel prepared with the skills needed to move forward in my career as a competent researcher. For this I am truly thankful. I wish to thank Dr. Heather Hadjistavropoulos who has served as a committee member on my Master's and Doctoral theses, supervised my clinical work, and taught key clinical courses throughout my graduate education. She has dedicated herself to the professional development of the Clinical Psychology students, and I have personally reaped the benefits of her service. Her feedback on my research projects has helped me to think practically, be specific in my writing, and not to skip steps in planning. I am especially thankful for her role in helping me become a conscientious CBT clinician. I wish to acknowledge Dr. Nicholas Carleton who has also served as a committee member on my Master's and Doctoral theses, and been a co-supervisor of my lab. I will be ever thankful for his willingness to provide impromptu instruction on statistics, theoretical conceptualization, and professional development issues. He also provided invaluable mentorship as I learned to teach a course at the university level. I wish to thank my internal-external committee member, Dr. Ron Martin for his insightful comments on this project. Lastly, I acknowledge the CIHR RPP Doctoral Award, the University of Regina Faculty of Graduate Studies, and Dr. Asmundson for financially supporting this project.

Dedication

I dedicate this project to my husband, Micah Parkerson. Thank you for supporting my dream. Without your love, steadiness, and encouragement, it would not have been possible. I will never forget all that you sacrificed for me. I also dedicate this project to my parents, Teresa and James Hominuke. You have loved me fiercely, believed in me, and supported me in many many ways. I could never fully express the depth of my gratitude for all that you are and all that you do. Thank you. To my brothers (Joel, James), sisters-in-law (Tamara, Shelley, Shari), parents-in-laws (Nancy, Buford), and my dear friends. You have all played a role in who I am today and all my accomplishments are yours too. Thank you. I would also like to extend my gratitude to my cohort (Sam, Kim, Sarah) and each member of the Anxiety and Illness Behaviours Lab (past and present) for their advice, support, and friendship throughout this journey.

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1.0 Introduction

Smoking and chronic pain are major public health concerns in Canada. Approximately 4.5 million Canadians smoke daily (Reid, Hammond, Burkhalter, Rynard, & Ahmed, 2013) and treatment of smoking-related illnesses costs over \$17 billion each year in Canada alone (Rehm et al., 2006). A substantial number of Canadians want to quit smoking. Nearly half of smokers made a quit attempt in a 2010, but only one in ten remained abstinent (Reid et al., 2013). Likewise, almost 3 million Canadians live with chronic pain (Statistics Canada, 2009). The prevalence of smoking in chronic pain populations is double the rate found in the general population (Hooten, Shi, Gazelka, & Warner, 2011; Zvolensky, McMillan, Gonzalez, & Asmundson, 2009). Contemporary models of pain and smoking posit a cyclical relationship wherein individuals smoke to reduce pain in the short term; however, smoking to cope with pain indirectly exacerbates pain in the long term (Ditre & Brandon, 2008). Preliminary evidence suggests that smoking cessation can also be more difficult for individuals with chronic pain (Zale, Ditre, Dorfman, Heckman, & Brandon, 2014).

Empirically supported behavioural-based smoking cessation interventions include individual and group counselling (Lancaster & Stead, 2005); however, these types of interventions are not provided through the public health care system in Canada. Internet-based interventions have been suggested as a cost-effective medium for offering broad population-based cessation support (McClure et al., 2013). Many Internet-based smoking interventions have emerged, but relatively few randomized controlled trials have gauged the efficacy of such interventions (Civljak, Stead, Hartmann-Boyce, Sheikh, & Car, 2013) and most fail to describe the intervention content, making it difficult to determine

why some interventions demonstrate greater efficacy than others (Michie et al., 2012). Further testing is needed to clarify whether Internet-based interventions can be effective and which mechanisms contribute to successful behaviour change in samples of the general population as well as at-risk populations.

The current dissertation is structured as follows. Theoretical and empirical literature will be reviewed separately for tobacco use disorder (TUD) and pain. Thereafter, the co-occurrence of pain and smoking will be discussed. Transtheoretical models of behaviour change will be reviewed in terms of their application to smoking cessation. Internet-based smoking interventions will be introduced for their potential utility in supporting smoking cessation attempts at the population level and for at-risk populations, such as individuals with chronic pain. Finally, the purpose and hypotheses, methodology, analyses, and implications of the current investigation will be presented.

1.1 Tobacco Use Disorder

TUD is a substance-related disorder in the Diagnostic and Statistical Manual, fifth edition (DSM-5; American Psychiatric Association, 2013), characterized as a pattern of problematic tobacco use occurring within a 12-month period. Problematic tobacco use is identified by occurrence of two or more diagnostic criteria, which generally pertain to cravings, tolerance, withdrawal, interference with life obligations, and persistent use of tobacco despite its consequences for personal safety or health. Cigarette smoking represents over 90% of nicotine usage (American Psychological Association, 2013) and comprises the focus of the current investigation.

1.1.1 Prevalence. Smoking dependence is widespread in Canada. Approximately 13.8% of Canadians over aged 14 are daily smokers who, on average, smoke 14.4

cigarettes per day (Reid et al., 2013). Higher risk of smoking dependence is associated with demographic factors such as lower socioeconomic status and education (Pisinger et al., 2011) and psychological factors like anxiety and depression (Beesdo et al., 2009; Goodwin, Zvolensky, Keyes, & Hasin, 2012). Individuals with chronic pain are also at increased risk for smoking dependence (Hooten et al., 2011; Zvolensky et al., 2009, 2010).

1.1.2 How nicotine acts. Nicotine acts on the central nervous system (Balfour, 2004; Stolerman & Jarvis 1995) via stimulation of the nicotinic acetylcholine receptors (nAChRs; Benwell, Balfour, & Khadra, 1994), which indirectly causes the release of dopamine (Balfour, 2004) and the subjective experience of relaxation and pleasure (Nestler, 1999). Repeat use of nicotine causes growth or activation of millions of extra nAChRs, which results in desensitization and the development of tolerance. The result of tolerance is that larger doses or more frequent administration of nicotine are necessary to achieve the same level of stimulation and avoid withdrawal experiences (Watkins, Koob, & Markou, 2002). Several conceptual models of addictive behaviour have been proposed to explain nicotine dependence phenomena.

1.1.3 Biological model of nicotine addiction. According to the biological model, neuroadaptation associated with nicotine tolerance and subsequent withdrawal is the primary mechanism of smoking maintenance and relapse. The biological model also highlights the role of genetics in perpetuating addictive behaviours. For example, twin studies support heritability as a factor predicting smoking initiation and regular tobacco use (Maes et al., 2004). In addition, specific gene variants have been associated with the

propensity to smoke (Li et al., 2010, Saccone et al., 2009) and quantity of cigarettes smoked (Lips et al., 2010).

1.1.4 Behavioural model of nicotine addiction. The behavioural model of addiction focuses on principles of classical and operant conditioning. The effect of nicotine associated with smoking is an unconditioned stimulus and the physiological effect of nicotine is an unconditioned response (Bevins & Palmatier, 2004). Stimuli repeatedly paired with smoking become conditioned stimuli and elicit conditioned responses such as smoking urge or withdrawal symptoms (Berridge & Robinson, 2003; Childress, Ehrman, Rohsenow, Robbins, & O'Brien, 1992; Niaura, 2000). From an operant conditioning perspective, smoking is positively reinforced by pleasure and reward processes resulting from increased dopamine activity (Balfour, 2004). Likewise, nicotine abstinence is negatively reinforced by aversive withdrawal states (Eissenberg, 2004). From a behavioural perspective, the association between smoking and escape from withdrawal and negative affective states is a key factor in maintaining smoking addictions.

1.1.5 Cognitive social learning model of nicotine addiction. The cognitive social learning model highlights the role of the environment and cognitive processes in the development of nicotine dependence (Abrams & Niaura, 1987; Marlatt & Gordon, 1985; Shadel, Shiffman, Niaura, Nichter, & Abrams, 2000; Tiffany, 1990). Initially, a person may learn about the direct effects of a substance through observation. Beliefs about the physical and psychological effects of smoking can be developed through such observation, but also through communication, personal experience, or any other means by which a person receives information (Shadel & Mermelstein, 1993). Beliefs, or

expectancies, are fundamentally memories stored and retrieved for the purpose of preparing an organism for circumstances that are similar those previously experienced (Goldman, 1999). Existing research indicates that expectancies are powerful motivators of smoking behaviour that can be successfully altered through experimental manipulation (Harrell & Juliano, 2012; Tate et al., 1994).

1.2 Pain

Pain has been defined as “an unpleasant sensory and emotional experience associated with actual or potential tissue damage...” (International Association for the Study of Pain Subcommittee on Taxonomy [IASP], 1994, p. S212). The pain experience is complex and does not necessarily coincide with the extent of tissue damage; rather, it is influenced by sensory, affective, and cognitive components (Melzack & Wall, 1965; Turk & Melzack, 2001). The experience of pain has protective and adaptive functions. It signals potential tissue damage and motivates a person to remove oneself from danger, prevents a person from engaging in activity that could cause additional damage following injury, and facilitates learning regarding situations that could cause injury or tissue damage in the future (see reviews, Millan, 1999; Wieseler-Frank, Maier, & Watkins, 2004).

Chronic pain, defined as pain that persists beyond the time required to promote healing, is neither protective nor adaptive (IASP, 1994). Pain that persists beyond 3 months from time of onset is typically classified as chronic (IASP, 1994). Chronic pain is among the most common health conditions in Canada, impacting approximately 19% of the population (Schopflocher, Taenzer, & Jovey, 2011), and is associated with considerable social and occupational impairment (Asmundson & Katz, 2009), increased

medical service utilization (Blythe, March, Brnabic, & Cousins, 2004), and increased risk of developing psychiatric disorders (Asmundson & Katz, 2009; Fishbain, Cutler, Rosomoff, & Steele Rosomoff, 1998).

Several cognitive-behavioural models contribute to our conceptualization of how acute pain becomes chronic (for a review see Asmundson & Wright, 2004). The fear-avoidance model of pain (Asmundson, Norton, & Norton, 1999; Vlaeyen & Linton, 2000) is amongst the most popular theoretical models addressing the emotional aspects of pain and has guided a significant amount of research and clinical practice. The fear-avoidance model posits that, following injury, the normal healing process generally requires a progressive increase in activity to challenge soft tissue and regain function. Catastrophic interpretation of pain, however, can lead to fear of movement and avoidance of activities that might elicit further pain, but otherwise promote healing. Ultimately, avoidance of such activities is posited to contribute to further disuse, deconditioning, and chronic pain (Asmundson, Norton, & Vlaeyen, 2004; Vlaeyen & Linton, 2000). Individual differences in fear of pain (a response to an immediate pain-related threat) and pain-related anxiety (a response that occurs in anticipation of pain-related threat) have been linked to pain perception and have also been shown to play an important role in the complex transition from acute to chronic pain (Asmundson et al., 2004; McCracken, Gross, Aikens, & Carnrike, 1996).

Although the involvement of fear- and anxiety-based constructs in pain chronicity has received much empirical support (Asmundson, Noel, Petter, & Parkerson, 2012; Asmundson, Parkerson, Petter, & Noel, 2012; Lucchetti, Oliveira, Mercante, & Peres, 2012; Vlaeyen & Linton, 2012), the fear-avoidance model itself has received several

criticisms. First, researchers have questioned the validity of the sequencing of psychological constructs as outlined in the fear-avoidance model. For example, results from two recent prospective studies indicated that early changes in pain catastrophizing were not associated with later changes in fear of pain/movement; rather, the constructs occurred concurrently (Bergbom, Boersma, & Linton, 2012; Wideman, Adams, Sullivan, 2009). Second, the fear-avoidance model has been criticized for suggesting that avoidance-disuse is the only or most common pathway to disability (Wideman et al, 2013). The avoidance-endurance model (Hasenbring, 2000) proposes empirically supported alternate pathways to disability, which involve endurance, overload, and overuse. Third, the fear-avoidance model has been criticized for focusing exclusively on factors that predict maladaptive responses to chronic pain (Wideman et al., 2013) while ignoring resiliency factors that predict successful adaptation to chronic pain (Pincus & McCracken, 2013). Psychological flexibility—a willingness to experience some level of pain and discomfort in pursuit of greater life goals or values— is thought to account for the experiences of many individuals who are well adjusted despite pain (Pincus & McCracken, 2013). Although there is not a dominant unifying theory guiding psychological research and treatment of pain chronicity, the three aforementioned approaches converge on the prominence each places on the interpretation of pain and its subsequent effect on emotion and coping behaviours. Accordingly, a cognitive-behavioural perspective of pain and pain chronicity will be utilized as a theoretical underpinning of the current investigation.

1.3 The Co-occurrence of Smoking and Pain

As previously mentioned, the risk of smoking dependence is two-fold for

individuals with chronic pain when compared with the general population (Hooten, et al., 2011; Zvolensky et al., 2009). An integrative model, first introduced by Ditre and Brandon (2008), suggested that smoking behavior and pain interact in the manner of a positive feedback loop, resulting in greater pain and smoking dependence (Ditre, Brandon, Zale, & Meagher, 2011). A revised integrative reciprocal model adapted from Ditre and Brandon (2008) and Ditre, Heckman, Brandon, and Butts (2010) highlights psychological factors that may act as mechanisms in the integrative reciprocal cycle of pain and smoking (see Figure 1; Parkerson, Zvolensky, & Asmundson, 2013).

A well-established literature links smoking, along with other factors, to the development and maintenance of many chronic pain conditions, such as musculoskeletal pain (Tian & Qi, 2010), knee pain, (Amin et al., 2007), oral pain (Millar & Locker, 2007), cluster headaches (Rozen, 2010), rheumatoid arthritis (Di Giuseppe, Orsini, Alfredsson, Askling, & Wolk, 2013), and temporomandibular disorder (Melis et al., 2010; see review by Parkerson et al., 2013). Likewise, pain may reinforce smoking behaviour through a number of mechanisms. For example, smoking has been identified as an analgesic (Miyazaki, Wang, Inui, Domino, & Kakigi, 2010) which may be used to reduce the pain itself. Smoking is also used to reduce negative affect induced by pain (Ditre & Brandon, 2008) and as a distraction from pain (Hooten et al., 2011). Smoking expectancies for pain reduction have been associated with greater smoking urge and behaviour following experimental pain induction (Parkerson & Asmundson, 2016). Furthermore, a recent experimental investigation demonstrated that challenging smoking expectancies for pain coping/relief through educational videos resulted in significantly less smoking urge following cold pressor pain manipulation (Ditre et al., 2010).

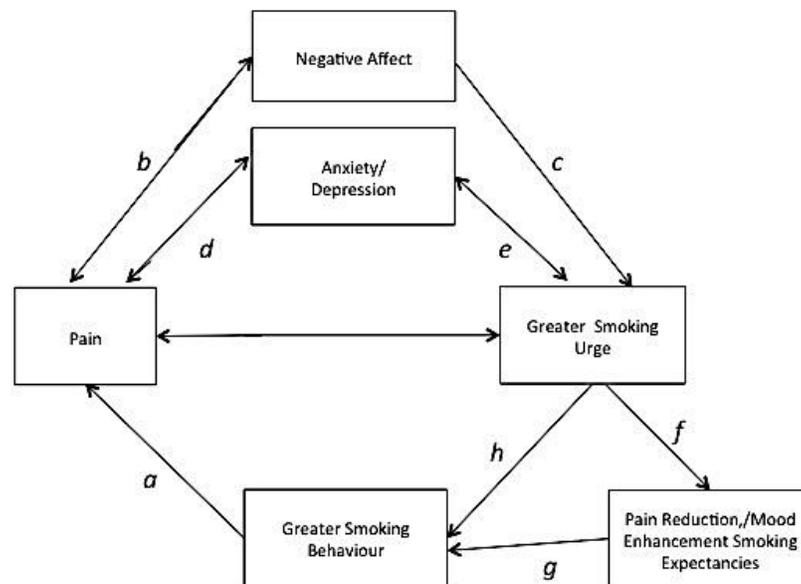


Figure 1. Integrative reciprocal model of pain and smoking from Parkerson, Zvolensky, and Asmundson (2013). Adapted from Ditre and Brandon (2008) and Ditre, Heckman, Butts, and Brandon (2010). This figure has been reproduced with permission from the Taylor & Francis.

Research investigating how pain impacts quit attempts is only beginning to emerge. Existing evidence indicates that smokers with pain may have less confidence in their ability to quit smoking when compared with their pain-free counterparts (Zale et al., 2014). Chronic pain may act as a barrier to smoking cessation for individuals who use smoking as a coping strategy to mitigate pain and pain-related emotional distress (Hooten et al., 2011). Pain-related anxiety has been associated with smoking motives related to physical dependence (cravings, tolerance, automaticity) as well as situational motivators (mood regulation, weight control) in individuals with chronic pain (Ditre, Zale, Kosiba, & Zvolensky, 2013). To date, no trials have assessed how quit attempts are impacted by individual differences in pain-related anxiety and smoking expectancies for pain reduction. Such knowledge may provide targets for future intervention adaptations suitable for the general population, as pain-related anxiety and expectancies related to smoking also occur in individuals without chronic pain. Furthermore, it is currently unclear whether breaking the cycle of pain and smoking through successful smoking abstinence would positively impact pain and pain-related disability outcomes.

2.0 Models of Behaviour Change

2.1 The Transtheoretical Model

Models of behaviour change have been developed to provide a framework for understanding why behaviours change and how behaviour change can be facilitated. Transtheoretical models integrate key factors from multiple models of addiction in order to address barriers and facilitators of behaviour change at many different conceptual levels. The Transtheoretical Model (TTM), also known as the Stages of Change model (DiClemente & Prochaska, 1982), has guided a significant amount of research as well as

clinical practice. TTM has been described as a biopsychosocial model that focuses heavily on changing behaviour by means of rational decision-making processes (Velicer, Prochaska, Fava, Norman, & Redding, 1998). The TTM has gained popularity for guiding behaviour change associated with many problem behaviours, including smoking (Prochaska, Redding, & Evers, 2008).

Main components of the TTM include the *stages of change* and the *processes of change*. A key proposition of the TTM is that change is not all-or-nothing; rather, change occurs on a continuum and over time (DiClemente & Prochaska, 1982). The TTM categorizes this continuum into conceptual stages of change. The stages, as applied to smoking cessation, are precontemplation (no intention to quit within 6 months), contemplation (intention to quit within the next 6 months), preparation (intention to quit in the next 30 days), action (having quit for 1 day to 6 months), and maintenance (having quit for longer than 6 months; Prochaska, DiClemente, & Norcross, 1992). A supposition of the TTM model is that smokers progress and regress through these stages many times on their journey to smoking cessation and that different processes of change are involved at each stage (Prochaska et al., 2008).

The TTM processes of change are behavioural activities and cognitive experiences used when changing behaviour (e.g., consciousness raising, contingency management, helping relationships; Prochaska et al., 2008). The processes of change were initially identified through a comparative analysis of leading psychotherapy systems of behaviour change (Prochaska, 1979). Principal components analysis supported 12 overarching processes of change from the more than 130 techniques identified (Prochaska, 1988). Cross-sectional analyses were used to identify which processes of change were most

likely to be utilized at the different stages of change (for a review see Prochaska et al., 1992), knowledge of which can supposedly direct tailored interventions to help move people along the continuum of change.

In recent years, TTM has received several criticisms (see Etter, 2005; Herzog, 2005; Sutton, 2005; West, 2005, 2006). A primary criticism pertains to the arbitrary parameters of the stages of change (West, 2005), as clients typically have differential involvement in many or all of the stages (Little & Girvin, 2002). As such, stage assignment generated by TTM algorithms may be artificial (Little & Girvin, 2002). Another criticism involves the premise that people necessarily progress and regress sequentially through a series of stages. Longitudinal evidence has reported over 400 patterns of movement through the stages (Norman, Velicer, Fava, & Prochaska, 1998) and yet sequential progression through an entire stage sequence has not been reported (Little & Girvin, 2002). In addition, the TTM has been criticized for the assumption that cognitive change necessarily precedes behaviour change (Little & Girvin, 2002), as up to half of quit attempts are undertaken with no planning at all (Larabie, 2005) and intention-to-quit often changes spontaneously over short periods of time (Etter & Perneger, 1999).

2.2 PRIME (Plans, Responses, Impulses, Motives, Evaluations) Theory of Motivation

The PRIME theory of motivation is a relatively new transtheoretical model of behaviour change, which was developed to address deficiencies of other transtheoretical models (West, 2006; West & Brown, 2013). The PRIME theory proposes a model of human motivation with four interacting sub-levels (*impulses, motivations, evaluations,*

plans), which differentially influence behavioural *responses* (see Figure 2). Addiction is approached as a moment-by-moment motivational and self-regulatory concern affected by a wide range of motivational processes (impulses, habits, drives, feelings, desires), rationale decision-making processes (cost-benefit analyses), as well as plans and self-imposed rules for behaviour (West, 2006, 2009; West & Brown, 2013). The four sublevels are described below in hierarchical order, starting with the most primitive and progressing to the most complex.

The impulse system represents our basic appetitive-inhibitory system that helps ensure survival (West, 2006; West & Brown, 2013). The impulse system can be stimulated directly by internal stimuli such as drives and emotions (e.g., impulse to eat when hungry or cry when sad) or indirectly through external stimuli that influence drives or emotions. The impulse system is the only level of the motivational system that has a direct effect on behavioural response by way of starting, stopping, or modifying behaviour. Neuroadaptation processes such as nicotine tolerance and subsequent withdrawal are incorporated at this level of the model.

Motives, representing the second level of human motivation in the PRIME model, are tied to our capacity to form mental representations of images, objects, and future events (West, 2006; West & Brown, 2013). Such representations, when associated with a level of attraction or repulsion, create feelings of want or aversion that form the basis of goal directed behaviour. Motives work to influence behaviour by triggering the impulse-inhibitory system. Principles of classical and operant conditioning are accounted for at this level of the multi-level motivational system.

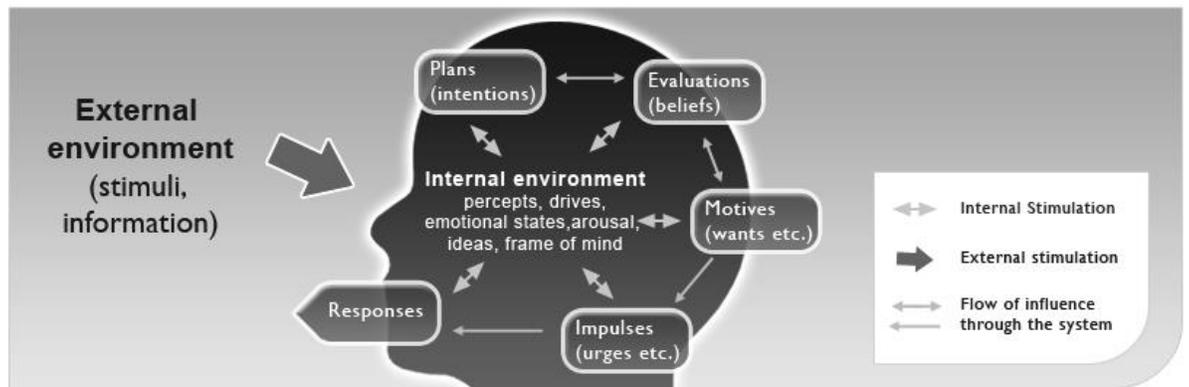


Figure 2. Pictorial representation of the human motivation system according to PRIME (plans, responses, impulses, motives, evaluations) theory from www.primetheory.com.
 Reproduced with permission from Dr. Robert West.

The third level of the motivational system, evaluations, involves our capacity to make appraisals and form beliefs (e.g., right/wrong, true/false, pleasing/displeasing; West, 2006; West & Brown, 2013). Evaluation can influence behaviour only by generating motives, which trigger impulses. In other words, beliefs drive behaviour by means of feelings. A logical or rational evaluation may fail to produce motive if it does not trigger an emotional state or if it is attached to a negative emotional state. For example, although the costs of smoking outweigh the benefits, the idea of quitting may create feelings of anxiety. The need to relieve anxiety may override the decision to quit smoking, especially if a person believes that smoking can reduce anxiety. People often hold multiple evaluations regarding the same target. Evaluations of the same valence will reinforce each other, whereas co-occurrence of both positive and negative evaluations will create internal conflict. Such conflict can be relieved seemingly effortlessly through suppression, modification, or addition of beliefs, but may also require more effortful analytic processes like cost-benefit analyses. Cognitive principles regarding expectancies are included in this level of the model.

The planning system is the highest level of the motivational system proposed by PRIME (West, 2006; West & Brown, 2013). Plans arise from the human ability to anticipate future possibilities and form mental representations of the actions necessary to attain a given outcome. Because the motivation system favours input from the more primitive levels, the planning system encounters the greatest challenge in influencing behaviour. In order to succeed, plans must be recalled at the appropriate time and must activate motives with sufficient strength to compete with other demands occurring throughout the motivational system.

PRIME theory is a relatively new behavioural change theory; however, its conceptualization of addiction has advantages over the dominant TTM. As mentioned, TTM has been criticized for utilizing arbitrary stages of change and for assuming that cognitive change precedes behavioural change. In contrast to this linear perspective, PRIME theory conceptualizes addiction as a dynamic motivation and self-regulatory concern which differentially effect cognition, emotion, and, ultimately, behaviour. PRIME theory benefits from a set of principles structured in a manner that allows for systematic evaluation and refinement. Accordingly, PRIME theory will be used to guide the proposed investigation instead of the dominant TTM.

3.0 Internet-Based Smoking Cessation Interventions

Over the past decade, many Internet-based smoking interventions have emerged, likely due to advantages such as potentially broad reach, cost-effective dissemination, and the ability to standardize delivery of content tailored for the needs of the individual (McClure et al., 2013). Nonetheless, relatively few randomized clinical trials have gauged the efficacy of such interventions (Civljak et al., 2013). A recent study assessed the efficacy of an automated tailored Internet-based cessation intervention (Smit, De Vries, & Hoving, 2012). A total of 1123 Dutch participants were recruited through newspaper, television, radio, social media sites, and smoking cessation forums in the Netherlands. Participants were randomly assigned to a control or tailored Internet-based cessation intervention group. Participants in the intervention condition received tailored feedback letters on three occasions, which covered the following topics: smoking behaviour and intentions for smoking cessation, attitudes toward smoking and quitting, perceived social influences regarding smoking, self-efficacy, making action plans, and

coping with difficult situations. Six-week and six-month response rates were 40% and 25.9%, respectively, with participants lost to follow-up considered non-abstainers. The intervention group had significantly increased abstinence rates at six-weeks follow-up (11% vs. 6%; OR 1.85; 95% CI 1.30 to 2.65; $p < .05$) compared with participants in the control group. The intervention effects dissipated at six months follow-up. The authors suggested that attrition rates might have resulted in an underestimation of the intervention effectiveness.

Elfeddali Bolman, Candel, Wiers, and De Vries (2012) assessed the efficacy of an automated tailored Internet-based cessation intervention in a Dutch sample ($N = 2031$). Participants were randomly assigned to one of two intervention groups or a control group. The first intervention group (action plan; AP) included one automated tailored feedback letter and six assignments focused on planning for and overcoming cessation difficulties. The second intervention group (action plan plus; AP+) condition was the same as the AP group but included automated tailored feedback at 11 time points instead of one. The third condition was a control condition, which provided no intervention. The 12-month response rates were 27.2% (AP), 25% (AP+), and 31% (control). Significant differences in abstinence were observed between the intervention conditions and the control group when using the most liberal estimates (including only participants with follow-up data, excluding participants who did not adhere to at least one treatment component) but not when using intent-to-treat principles (Little & Kang, 2013).

A study by Haug, Meyer, and John (2011) assessed the efficacy of an automated tailored Internet-based intervention with inpatients ($N = 477$) from German rehabilitation centers. The cessation intervention offered the following resources over the course of six

months: up to seven automated tailored counselling sessions, links to online resources, and a message board where participants could read about and discuss personal cessation experiences. Retention was high (intervention = 88%, control = 92%). Abstinence was measured in terms of 4-week point prevalence estimates at 6-months follow-up (i.e., abstinence for 4 weeks prior to follow-up). Significantly more participants in the intervention group had been abstinent for 4-weeks prior to follow-up than the control group (22.7% vs. 11.1%; OR 2.0; 95% CI 1.1 to 3.7; $p = .03$).

A recent Cochrane review (Civljak et al., 2013) identified only 23 randomized or quasi-randomized controlled trials for Internet-based smoking cessation interventions, revealing mixed findings in terms of efficacy. Pooled results demonstrated statistically significantly greater benefits of interactive tailored Internet-based interventions when compared with self-help or usual care (RR 1.41; 95% CI 1.11 to 1.78), whereas non-tailored Internet-based interventions did not demonstrate benefits greater than self-help or usual care (RR .87; 95% CI 0.63 to 1.20). Studies comparing interactive tailored Internet-based interventions to static websites also did not demonstrate a significant difference between conditions (RR 1.12; 95% CI .95 to 1.32). Civljak et al. (2013) stated that it was unclear why some interventions were more effective than others and, based on the current state of the evidence, conclusions could not be drawn as to whether Internet-based programs can help people stop smoking. Other researchers (Michie et al., 2012) have suggested that the lack of transparency and insufficient descriptions of intervention content have made understanding differences in efficacy between interventions difficult.

To facilitate refinement and advancement of Internet-based smoking cessation interventions and encourage future collaborative efforts across research groups, Michie

and colleagues (2012) developed a smoking intervention on an open-source web development platform. The intervention—StopAdvisor—was developed from principles of PRIME theory as well as empirically-supported behavioural change techniques (Michie, Hyder, Walia, & West, 2011). A total of 19 theoretical principles were selected: eight addressing motivation; three addressing self-regulation skills; one addressing utilization of medication as an adjuvant to treatment; and seven promoting engagement with the intervention (Michie et al., 2012; see Table 1). Empirical evidence guided the selection of 21 behavioural change techniques (see Table 2), which were linked together into intervention components in a manner consistent with evidenced-based treatment used in the United Kingdom National Health Service Stop Smoking Services. A clear description of StopAdvisor content and methodology was published to allow for ongoing empirical assessment of the PRIME theory principles as well as the behavioural change techniques utilized in the intervention (Michie et al., 2012). Functionally, the StopAdvisor intervention was designed to simulate personal contact by offering individualized information and a structured quit plan on an interactive website format (Michie et al., 2012). Users have up to 2 weeks to obtain medication and an additional 2 weeks in which they can set a quit date. Support is provided from pre-quit preparation through to 4 weeks post-quit date. As such, the duration of the program from enrolment to completion can range from 4 to 9 weeks. Pre-quit preparation addresses reasons for quitting, medication use, setting a quit date, minimizing smoking urges by making changes in routine, developing expectations about difficulties that might be encountered, and coping strategies for managing difficulties. On quit day, StopAdvisor users are encouraged to adopt a *non-smoker* identity, which includes adherence to a basic rule regarding abrupt

Table 1

PRIME Theory principles underlying intervention design

- Directly address motivation
- 1 Establish a very clear mental image of the goal of becoming an ex-smoker and how to get to it with the help of the quit plan.
 - 2 Construct the personal rule such that it will generate strong resolve whenever needed (clear boundaries: ‘not even a puff’, achievable: ‘day at a time if necessary’, applicable to every relevant situation: ‘no matter what’).
 - 3 Associate adhering to the rule with things to which the smoker has strong emotional attachment/central aspects of their identity (e.g. good role model for others, protecting loved ones).
 - 4 Develop new sources of desire not to smoke and maximise the impact of existing sources of desire (e.g. wanting to keep the achievement to date).
 - 5 Change aspects of identity that promote smoking (e.g. an ‘unhealthy’ person) and foster aspects of identity that promote not smoking (e.g. a healthy persona), in a way that supports rather than conflicts with other core aspects of identity (e.g. a rebel).
 - 6 Change beliefs that generate a desire to smoke (e.g. that smoking helps with stress) in such a way that negative images of the results of smoking are generated.
 - 7 Maximise the experience of reward they obtain from moving towards their goal of becoming an ex-smoker (e.g. by helping them visualise their achievement).
 - 8 When describing what to expect ensure that it is phrased positively but realistically.
- Maximise self-regulatory capacity and skills
- 9 Avoid cues that will trigger strong urges to smoke (e.g. through social or environmental restructuring).
 - 10 Develop effective ways of distracting attention from smoking cues in the environment and from urges to smoke when they occur (e.g. by developing as routine activity).
 - 11 Maximise levels of mental energy available to exercise self-control (e.g. by teaching ways of avoiding or reducing stress).
- Make effective use of adjuvant activities
- 12 Make most effective use of medications that reduce the urges to smoke (e.g. by making sure that they choose the best medication, have appropriate expectations, use it properly and for long enough, and are not put off by side effects).
- Promoting engagement
- 13 Establish a ‘rapport’ between the smoker and personification of the website (e.g. by creating a visual sense of the team behind the website who want the smoker to succeed) and use language that expresses shared understandings and empathy. Give feedback to the user to show that the program ‘understands’ his or her situation.
 - 14 Set up clear expectations concerning how the site will be used early on.
 - 15 Keep demands on the smoker to a minimum (e.g. for every question asked of the smoker calculate the cost in terms of making the site unattractive versus the benefit in terms of helping to tailor the website).
 - 16 Make use of the site as habitual as possible in terms of the location of different elements, consistent forms of interaction and clear associations between goals that smokers may have and actions needed to achieve these.
 - 17 Keep main pages as simple and visually appealing as possible but encourage and make it easy for smokers to explore the site to find out more information.
 - 18 Always provide users with a rewarding experience when they visit the website. Each interaction must provide pleasure, satisfaction and/or relief, combat a tendency to habituate to website materials, and establish strong anticipated pleasure, satisfaction or relief for the next session. Do not require users to enter more than a few responses on a page without immediately rewarding them with answers to concerns, advice that is perceived as useful and information about themselves that they find interesting.
 - 19 From the user’s perspective the website must provide desired information and advice and not be an overt attempt to motivate.

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Table 2

StopAdvisor components: Description and rationale

<u>Intervention component</u>	<u>PRIME Theory principles</u>	<u>Behavioural change techniques</u>
1 Text encouraging users to repeat to themselves: 'Smoking is not an option'. Explain and introduce a motto: 'Not a puff — no matter what' and an image to accompany this.	Construct personal rule to generate strong resolve.	BM6: Prompt commitment from the client there and then BM8: Strengthen exsmoker identity BM10: Explain importance of abrupt cessation.
2 Text encourages users to spend some time thinking about who they want to be in the future. They are asked to consider positive identities they might wish to take on once they have successfully completed their quit attempt	Associate non-smoking to central aspects of identity.	BM8: Strengthen ex-smoker identity.
3 Text offers reassurance and suggests high craving are a normal part of quitting smoking.	Develop new, and maximise impact of existing, sources of desire not to smoke.	BM5: Provide normative information about others' behaviour and experiences RC1: Build general rapport RC6: Provide information on withdrawal symptoms RC10: Provide reassurance.
4 Users are required to identify reasons for wanting to stop smoking. Importantly, they are given space to engage with these elements.	Develop new, and maximise impact of existing, sources of desire not to smoke.	BM9: Identify reasons for wanting and not wanting to smoke.
5 Users are presented with key facts regarding how the body starts repairing itself immediately, as soon as the smoker stops.	Develop new, and maximise impact of existing, sources of desire not to smoke.	BM1: Provide information on consequences of smoking and smoking cessation.
6 It will be suggested that users visualise, in some detail, being told they have a serious illness.	Develop new, and maximise impact of existing, sources of desire not to smoke/ Change aspects of identity that promote smoking.	BM1: Provide information on consequences of smoking and smoking cessation BM8: Strengthen exsmoker identity
7 When users get to a certain point without smoking a cigarette (8–10 days or more) they will be asked to reflect on this positive progress and use it to build confidence and continue with the quit attempt.	Develop new, and maximise impact of existing, sources of desire not to smoke.	BM2: Boost motivation and self efficacy BM4: Provide rewards contingent on successfully stopping smoking RC1: Build general rapport.
8 Users are encouraged to think about how well they are doing, and how they need to remember to reward themselves, by doing something they like — that does not remind them of smoking. They are provided with examples.	Develop new, and maximise impact of existing, sources of desire not to smoke/Maximise experience of reward from moving towards goal.	BM2: Boost motivation and self efficacy BM7: Provide rewards contingent on effort or progress BS10: Advise on conserving mental resources.
9 Users are encouraged to visualise an image of smoking as a battle. They are to think of themselves as winning the battle. A catching image will be provided.	Maximise experience of reward from moving towards goal.	BM2: Boost motivation and self efficacy.

10	A section will focus on the use of ‘buddies’ — teaming up with someone who is also trying to quit. Another will advise users on the potential benefits of telling family friends and colleagues.	Avoid cues that trigger urges to smoke.	BS3: Facilitate action planning BS11: Advise on avoiding social cues for smoking A2: Advise on/facilitate use of social support.
11	Users will be advised that there are some daily routines that can trigger cravings, and suggested changes to those routines will be recommended.	Avoid cues that trigger urges to smoke.	BS7: Advise on changing routines.
12	Users are asked to identify situations where they think they might smoke. Then, generate their own way of dealing with it.	Avoid cues that trigger urges to smoke.	BS1: Facilitate barrier identification and problem solving BS2: Facilitate relapse prevention and coping.
13	Users are asked to note down activities they might use to keep themselves busy, when they feel the urge to smoke.	Develop effective ways of distracting attention.	BS2: Facilitate relapse prevention and coping.
14	Users are encouraged to use brisk exercise when they experience a craving.	Develop effective ways of distracting attention.	BS2: Facilitate relapse prevention and coping.
15	A section will explain the potential benefits of using glucose tablets to suppress cravings.	Develop effective ways of distracting attention.	BS2: Facilitate relapse prevention and coping.
16	Users will be provided with advice and instructions about how tensing and relaxing areas of the body can reduce cravings. Audio will be used here.	Develop effective ways of distracting attention.	BS2: Facilitate relapse prevention and coping BS10: Advise on conserving mental resources.
17	Users are advised to conserve their mental energy. Depletion of resources and cravings are described.	Maximise levels of mental energy.	BS10: Advise on conserving mental resources RC6: Provide information on withdrawal symptoms.
18	Users are encouraged to attend to small things in their daily routine that may support their quit attempt. One such message is to try going to bed earlier than usual.	Maximise levels of mental energy/Avoid cues that trigger urges to smoke.	BS7: Advise on changing routines BS10: Advise on conserving mental resources.
19	Users will learn relaxation techniques. These will be presented through audio.	Maximise levels of mental energy/Develop effective ways of distracting attention.	BS2: Facilitate relapse prevention and coping BS10: Advise on conserving mental resources.
20	There will be a detailed fully tailored section on medication advice, for those using medication with the website.	Make most effective use of medication.	BS2: Facilitate relapse prevention and coping BS3: Facilitate action planning A1: Advise on stop-smoking medication A3: Adopt local procedures to enable users to obtain free medication.
21	Users will be provided with supportive messages of encouragement throughout the intervention.	Establish a rapport with website/Always provide rewarding experience.	BM2: Boost motivation and self efficacy RC1: Build general rapport.

Note. BM = specific focus on behaviour and addressing motivation, BS = specific focus on behaviour and maximising self-regulatory capacity, RC = general aspects of interaction focusing on general communication, A = promote adjuvant activities. This table has been reproduced with permission from Springer Science.

cessation (*smoking is not an option, not even one puff*). Post-quit date support is tailored to needs of the users at each login as determined by their reports of abstinence, smoking urge, confidence in ability to remain abstinent, medication adherence, and anticipated frequency of stressful and social events.

Three studies using StopAdvisor have been published. An uncontrolled pilot test of StopAdvisor was conducted by Brown and colleagues (2012), which assessed participant satisfaction as well as abstinence at 8-weeks post-enrolment. Participants included 204 residents of the United Kingdom ($M_{age} = 37.9$, $SD = 11.8$; 57% female) who smoked an average of 20.8 ($SD = 12.1$) cigarettes daily, recruited through a smoking cessation portal hosted by the UK Department of Health. Follow-up measures were completed by 83% of participants. Those lost to follow-up were treated as non-abstainers. Overall, the program was rated favourably on indices of helpfulness, personal relevance, recommendation to others, and future use. In terms of the efficacy, 20% of participants were abstinent at 8-weeks post-enrolment, which is twice the rate reported for serious unassisted cessation attempts (West & Stapleton, 2008).

StopAdvisor has also been adapted for use with pregnant women (i.e., *MumsQuit*; Herbec, Brown, Tombor, Michie, & West, 2014). A randomized pilot test of the MumsQuit program was conducted with residents of the United Kingdom ($N = 200$; $M_{age} = 27.8$, $SD = 5.9$) who smoked an average of 17.7 ($SD = 6.6$) cigarettes daily. Approximately 34% of participants were lost to follow-up and were treated as non-abstainers. Results demonstrated higher 4-week abstinence rates for MumsQuit users (28.3%) compared with participants randomly assigned to use a static website offering brief cessation advice (20.8%); however, the values were not statistically significantly

different (OR 1.5; 95% CI 0.8 to 2.9; $p = .22$). The authors indicated that sample size was a limitation of the investigation.

A recent randomized controlled trial assessed the efficacy of the StopAdvisor program compared to a static information-only website (Brown et al., 2014). The 6-month biochemically verified abstinence rates did not differ between conditions (10%; RR 1.06; 95% CI 0.89 to 1.27; $p = 0.49$). Nonetheless, an intervention effect was observed across subsamples of low and high socioeconomic status. In individuals of low socioeconomic status, StopAdvisor was helpful compared to an intervention-only website (8% vs. 6% respectively; RR 1.36; 95% CI 1.00 to 1.86; $p = 0.049$). A similar effect was not observed for individuals of a high socioeconomic status. Results were deemed clinically significant, as low socioeconomic status is a risk factor for smoking dependence and automated interventions are cost-effective and easily implemented.

To date, all trials utilizing the StopAdvisor intervention have taken place in England. Empirical assessment of the tenets of PRIME theory and the utility of its application as an Internet-based smoking cessation intervention is in its infancy. Nonetheless, StopAdvisor, as an application of PRIME theory, offers a promising conceptualization of addiction by which to guide research and treatment of smoking dependency for general and chronic pain populations.

4.0 Current Investigation

The current investigation was designed to achieve three objectives. The first objective was to pilot test the StopAdvisor smoking cessation intervention in a Canadian sample by assessing user abstinence rates, engagement, and satisfaction. The second objective was to assess whether variance in smoking dependence was accounted for by

smoking expectancies for pain reduction and pain-related anxiety. The third objective was to assess whether successful smoking abstinence would positively impact pain and pain-related disability outcomes of individuals with acute and chronic pain. Accordingly, the proposed investigation had five main hypotheses:

1. Abstinence outcomes were expected to be similar to those reported by Brown et al., (2012; 20%) at 8-weeks post-enrolment.
2. User engagement was expected to be in line with results from Brown et al. (2012), which reported participants on average viewed 133.5 website pages ($SD = 124.3$; median = 71.5) across 6.4 logins ($SD = 6.8$; median = 3).
3. Consistent with Brown et al. (2012), it was expected that the majority (~75%) of participants would rate the program satisfactorily on indices of website helpfulness, personal relevance, likelihood of recommending the program to a friend, and use in the future.
4. Post-intervention smoking dependence scores were expected to be significantly lower than pre-intervention smoking dependence scores. Reduction in smoking dependence was expected to be accounted for by smoking expectancies for pain reduction (Ditre et al., 2010) and pain-related anxiety (Ditre et al., 2013).
5. The reciprocal model of pain and smoking (Ditre & Brandon, 2008) posits that smoking leads to increased pain. The current investigation tested whether breaking the cycle through successful smoking abstinence would positively impact pain and pain-related disability outcomes. To that end, successful abstainers with acute or chronic pain were expected to have decreased pain intensity and functional pain interference ratings from pre-intervention to post-intervention follow-up, whereas

pain intensity and functional pain interference ratings were expected to remain unchanged in individuals whose cessation attempt was unsuccessful.

5.0 Method

5.1 Participant Recruitment

Ethical approval was obtained through the University of Regina Ethics Board. Participants were recruited from across Canada through community notices (e.g., posters, flyers), online advertisements (e.g., Facebook, Kijiji, Craigslist), and through press releases sent to different media outlets. Recruitment materials described the study as an Internet-based smoking cessation intervention efficacy trial that would not involve any face-to-face contact. Eligible participants were daily smokers, 18 years of age or older, located in Canada, and willing to make a serious quit attempt using a stop-smoking website that sends email reminders. Compensation was not provided to participants. Power analyses using G*Power were conducted to ensure adequate power for comparative analyses. Using $f = .20$ effect size (alpha = 5%, beta = 20%; Cohen, 1988), a sample of 66 participants would be necessary to detect whether variance in pre- to post- smoking dependence was accounted for by smoking expectancies for pain reduction and pain-related anxiety. A conservative small-medium effect size was selected based on previous experimental research demonstrating a small-medium effect of smoking expectancies for pain reduction on smoking latency ($f = .20$), time spent smoking ($f = .21$), and urge to smoke ($f = .43$; Ditre et al., 2010), as well as cross-sectional research indicating pain-related anxiety accounted for significant variance in smoking motives ($f = .48$; Ditre et al., 2013). Previous estimates were not available to guide a power analysis assessing whether smoking abstinence would result in reductions

of pre- to post-intervention pain and pain-related disability. Using a conservative $f = .20$ ($\alpha = 5\%$, $\beta = 20\%$) effect size, a sample of 60 participants would be necessary to detect such differences between abstainers and non-abstainers.

5.2 Measures

5.2.1 Primary outcome measures.

Abstinence. Successful smoking abstinence was defined as having had no cigarettes (not even a puff) for at least 28 days. Because participants have up to 4 weeks to obtain medication and set a quit date, completion of the program can take up to 8 weeks. For this reason, smoking abstinence was queried at 8-weeks post-enrolment and was determined by self-report (Brown et al., 2012). All participants who completed baseline measures, consented to participation, and logged in to the StopAdvisor system at least once on or after their self-determined quit date were included in abstinence analyses. Abstinence was used as a primary outcome measure.

Cigarette Dependence Scale (CDS-12; Etter, Le Houezec, & Perneger, 2003).

The CDS-12 is a 12-item measure designed to assess a unitary construct of cigarette dependence. Item content was derived from qualitative interviews and reflects DSM-IV criteria of dependence, with the exception of tolerance. Response options on most items of the CDS-12 range from 1 (*totally disagree*) to 5 (*fully agree*). The unitary factor structure of the CDS-12 has been replicated across samples, which represents the high association of dependence symptoms (Etter, 2005; Etter et al., 2003). The CDS-12 has demonstrated strong test-retest reliability ($r \geq 0.83$; Etter et al., 2003) and internal consistency (α ranged from .84 to .91; Etter, 2005; Etter et al., 2003). Further, CDS-12 scores are more strongly associated with saliva cotinine levels than other commonly used

measures of smoking dependence (Okuyemi et al., 2007). Alpha reliability of the CDS-12 in the current sample was .88.

To our knowledge, no smoking dependence measures have been updated and validated for DSM-5 and the CDS-12 is no exception. The DSM-5 criteria for TUD were derived from DSM-IV nicotine dependence and nicotine abuse criteria. TUD has a list of 11 potential diagnostic criteria, whereas DSM IV nicotine dependence has only 7. It is unclear whether merging the new DSM-5 diagnostic criteria with the CDS-12 would affect subsequent dependence severity ratings. However, a number of brief measures assess smoking dependence severity without querying all relevant DSM criteria (e.g., Cigarette Dependence Scale-5, Fagerstrom Test for Nicotine Dependence), as dependence criteria are highly correlated. As such, the CDS-12 was used as the primary metric of smoking dependence for the proposed investigation, which was assessed at baseline and 8-weeks post-enrolment.

User engagement and satisfaction. User engagement was measured by the number of logins and pages viewed by each participant at 8-weeks post-enrolment (Brown et al., 2012). User satisfaction, also assessed at 8-weeks post enrolment, was measured using a series of questions (*Did you find the website helpful?*, *Did you find the website personally relevant?*, *Would you recommend the website to others?*, [Brown et al., 2012], *Was participation worth your time?*). Users responded to the questions on a rating scale ranging from 0 (*not at all helpful*) to 5 (*extremely helpful*). User engagement and satisfaction were used as primary outcome measures. Alpha reliability for the user engagement and satisfaction items was .91.

McGill Pain Questionnaire, Short Form (SF-MPQ; Melzack, 1987). The SF-MPQ is a self-report measure of present pain experience. The two-factor SF-MPQ is comprised of a sensory-pain and an affective-pain factor. Participants are asked to complete a checklist of 15 adjectives commonly used to describe aspects of pain. Checklist items are rated on a 4-point scale ranging from 0 (*none*) to 3 (*severe*). The SF-MPQ has demonstrated strong correlations with the original MPQ (Melzack & Katz, 2001) and good factorial validity (Wright, Asmundson, & McCreary, 2001). The SF-MPQ was administered at baseline and 8-week post-enrolment, and used as a primary outcome measure. Alpha for the MPQ-SF in the current sample was .91.

Pain Disability Index (PDI; Pollard, 1984). The PDI is a 7-item self-report measure designed to assess pain-related disability across different life domains including family/home responsibilities, recreation, social activity, occupation, sexual behaviour, self-care, and life support activities. Items are responded to on an 11-point rating scale ranging from 0 (*no disability*) to 10 (*worst disability*). The PDI has been shown to discriminate between low and high levels of disability (Pollard, 1984; Tait, Pollard, Margolis, Duckro, & Krause, 1987) and is highly correlated with the Oswestry Disability Scale (Gronblad et al., 1993). The PDI was administered at baseline and 8-week post-enrolment and used as a primary outcome measure. Alpha for the PDI in the current sample was .91.

Pain Anxiety Symptoms Scale-20 (PASS-20; McCracken & Dhingra, 2002). The PASS-20 is a 20-item self-report measure designed to assess pain-related anxiety across four subscales: escape and avoidance, cognitive anxiety, pain-related fear, and physiological anxiety. Items are responded to on a 6-point scale ranging from 0 (*never*)

to 5 (*always*). The PASS-20 total and subscale scores have demonstrated factorial validity in both clinical (e.g., Coons, Hadjistavropoulos, & Asmundson, 2004) and non-clinical (Abrams, Carleton, & Asmundson, 2007) samples, as well as strong internal consistency and construct validity (McCracken & Dhingra, 2002). The PASS-20 was assessed at baseline and used as covariate within the primary analyses. Alpha for the PASS-20 in the current sample was .94.

Pain and Smoking Expectancies Scale (PSE; Ditre & Brandon, 2008). The PSE is a unitary 6-item scale designed to assess expectancies that smoking will help cope with pain. Items are responded to on a rating scale with options ranging from 0 (*completely unlikely*) to 9 (*completely likely*). This measure has demonstrated excellent internal consistency ($\alpha = .95$; Ditre & Brandon, 2008). The PSE was assessed at baseline and used as covariate within the primary analyses. Alpha for the PSE in the current sample was .95.

5.2.2 Other measures.

Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977). The CES-D is a 20-item self-report measure designed to assess depressive symptomatology. The CES-D has four factors, including depressed affect, anhedonia, interpersonal concerns, and somatic concerns. Participants rate each item based on their experience from the previous week. Items are responded to on a 4-point rating scale ranging from 0 (*rarely or none of the time*) to 3 (*most or all of the time*). The CES-D has high internal consistency ($\alpha = .91$), acceptable test-retest reliability over 4 to 8 weeks (ranging from $r = .49$ to $.67$; Radloff, 1977), and acceptable convergent validity with other measures of depressive symptoms (e.g., Hamilton Rating Scale for Depression; Devins & Orme,

1985). Additionally, the CES-D has demonstrated good predictive validity among chronic pain patients (Geisser, Roth, & Robinson, 1997). The CES-D was used as a baseline measure. Alpha for the CES-D in the current sample was .91.

GAD-7 (Spitzer, Kroenke, Williams, & Lowe, 2006). The GAD-7 is a brief 7-item self-report measure designed to assess generalized anxiety disorder (GAD) symptoms. Participants rate how much they have been bothered by specific symptoms in the last 2 weeks on 4-point rating scale ranging from 0 (*not at all*) to 3 (*nearly every day*). The GAD-7 has demonstrated strong internal consistency ($\alpha = 0.92$) and 1-week test-retest reliability ($r = .83$; Spitzer et al., 2006). The GAD-7 has also demonstrated good criterion (Spitzer et al., 2006), construct (Ware & Sherbourne, 1992), and convergent validity (Kroenke et al., 2006). The GAD-7 was employed as a baseline measure. Alpha for the GAD-7 in the current sample was .91.

Demographic, smoking history, and pain history questionnaire. Participants provided brief demographic, smoking history, and pain history details. Demographic queries included age, sex, ethnicity, education, employment, income, and relationship status. Smoking history queries included age of first cigarette, years since becoming a daily smoker, age of first quit attempt, number of serious quit attempts, duration of quit attempts, and family smoking history. Pain history queries included nature of pain sensations, duration of pain, percentage of each day pain is experienced, and perceived pain coping. Demographic, smoking history, and pain history questions were administered at baseline and used to characterize the samples.

5.3 Procedure

Interested persons accessed a StopAdvisor information page where they could read about the study, create a username and password, provide consent for participation, and complete baseline measures. The StopAdvisor program is hosted on a server at the University of Southampton, which was designed for creating and running Internet-based interventions. The system uses security standards implemented by Java's Spring Security and is behind the firewall of the Department of Electronics and Computer Science at the University of Southampton. All contact with participants including consent, completion of measures, and tailored feedback were automated through the StopAdvisor program. Following completion of the measures, study participation comprised five components: (1) welcome-information and medication prompting, (2) quit date selection and preparation, (3) week 1, (4) weeks 2 to 4, and (5) 8-week post-enrolment questionnaires. A graphical representation of the study protocol and structure of post-quit sessions are summarized in Figures 3 and 4, respectively. To follow is a brief description of the five treatment components.

5.3.1 Welcome-information and medication prompting. Once participants completed consent and baseline measures, they were directed to a welcome page where they could learn more about the website, the structure of the intervention, and the benefits of using a behavioural support program (see example StopAdvisor screen shots in Figures 5 and 6). Participants were asked about their reasons for quitting smoking, information was provided regarding the science behind smoking cravings and withdrawal states, and participants were introduced to a basic StopAdvisor rule of *smoking is not an option, not even one puff*. Information about smoking cessation medications was provided and participants were encouraged to speak to their physician

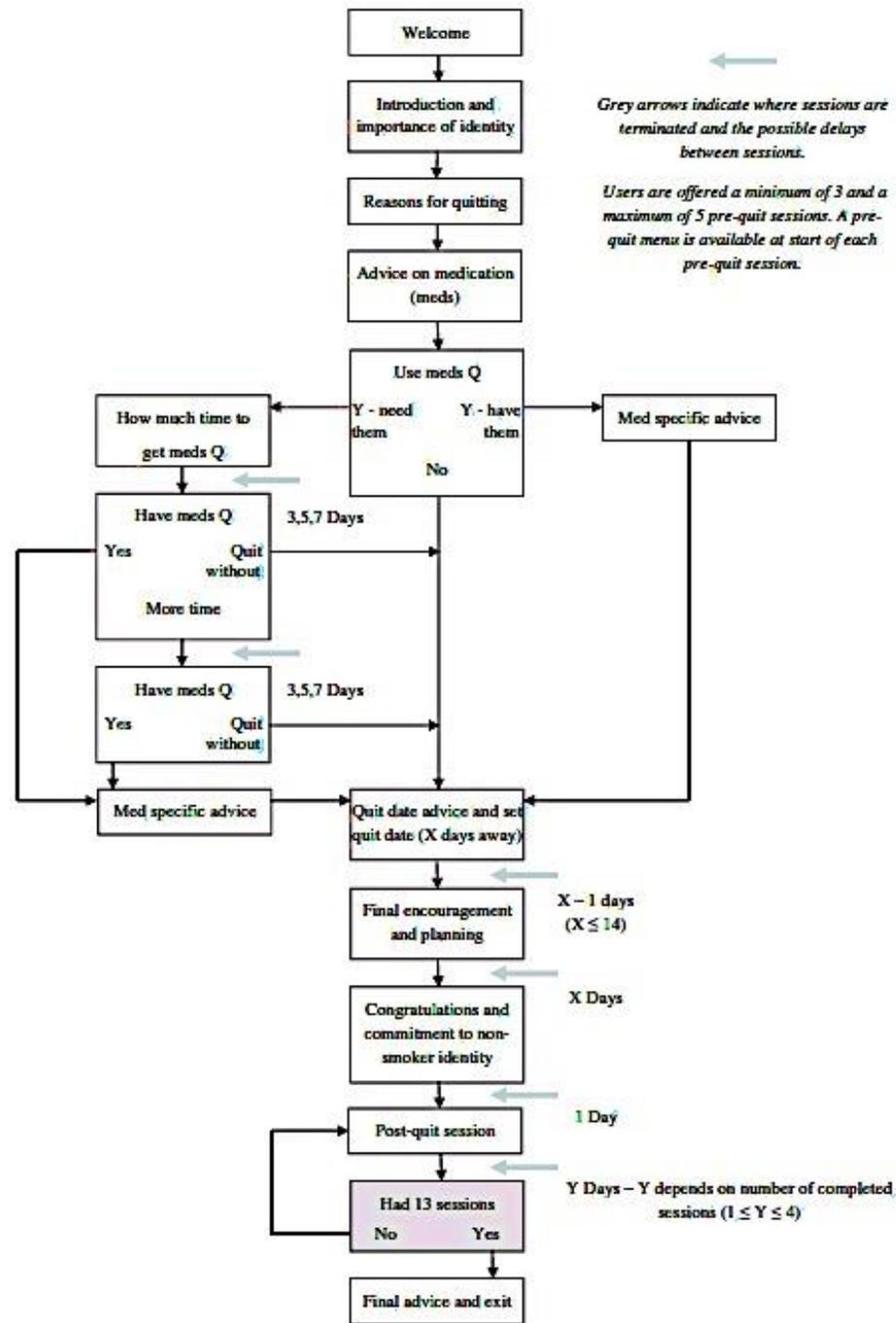


Figure 3. Flow chart of StopAdvisor protocol. This figure has been reproduced with permission from Springer Science.

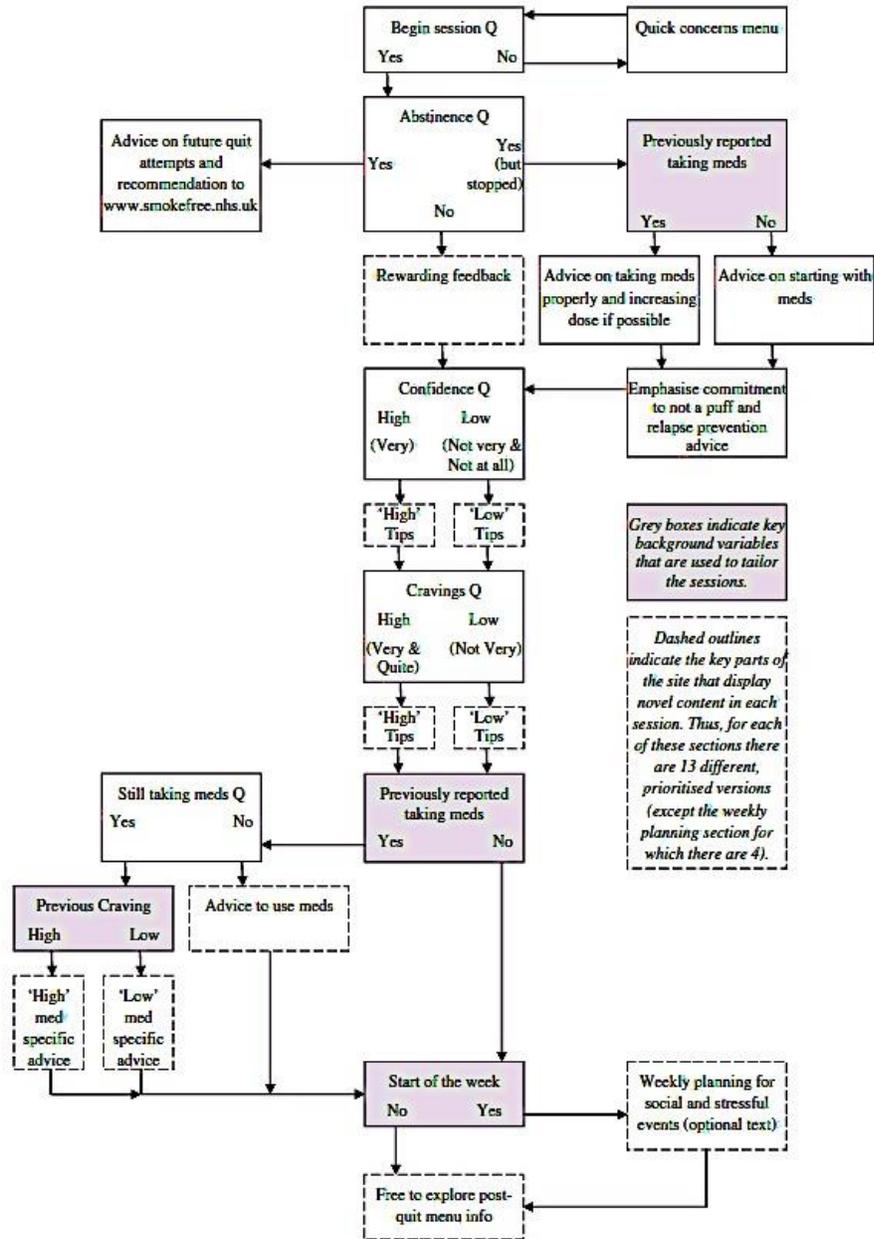


Figure 4. Flow chart of structure of all post-quit StopAdvisor sessions. This figure has been reproduced with permission from Springer Science.

StopAdvisor .COM

Personalised *expert advice* on
Stopping Smoking

More about StopAdvisor

To find out more about StopAdvisor, please click on the links below. Otherwise, click 'next page' to start your first session.

- Why stop smoking now?
- What's it like to use StopAdvisor?
- The team behind StopAdvisor
- Why is StopAdvisor special?
- What will happen when I stop smoking?
- What is the secret to success in stopping smoking?

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Figure 5. Screenshot of a StopAdvisor pre-quit information page. Reproduced with permission by Dr. Jamie Brown.

StopAdvisor .com



Personalised *expert advice* on
Stopping Smoking

Science of cravings

Why overcoming cravings is the key to quitting:

- Smoking releases **chemicals in your brain** that make you want to smoke.
- When you stop smoking your brain goes back to its **natural state**, and you slowly **stop getting urges to smoke**.
- If you have **just one puff** whilst you are giving up, this will **make you want to smoke more**.
- **All your hard work can be undone by just one cigarette.**



next page >

Figure 6. Screenshot of a StopAdvisor welcome page. Reproduced with permission by Dr. Jamie Brown.

about using smoking cessation medication as an adjuvant to treatment. Participants who indicated they wanted to use medication were given a 2- to 14-day window to obtain medication. If participants already had medication or chose not use medication, they moved forward to the next treatment component.

5.3.2 Quit date selection and preparation. Participants selected a quit date within a 2-day to 2-week time frame. Participants received an automated email the day before and on the day of their quit date inviting them to log into the system to read pre-quit information. Pre-quit information provided to participants included tips for managing withdrawal symptoms and expectations, planning to avoid potential smoking triggers, avoiding high-risk situations, and planning to use social support, as well as encouragement to plan the time of their last cigarette. Quit-day support focused on helping participants adopt a non-smoker identity.

5.3.3 Week 1. Participants received automated emails every day during the first week of their quit attempt, inviting them back to the site. Every visit to the site followed the same format. Upon logging in, participants encountered a menu where they could read common concerns about smoking cessation (eating, health, mood, medicine, general). Participants were asked to report on their engagement in smoking behaviour since their last visit. Those who had not smoked received encouraging feedback. Those who had smoked a couple times but attempted to remain abstinent were directed to information regarding the importance of abrupt abstinence. Participants were directed to have a break from their smoking cessation attempt and encouraged to speak to their physician about additional resources when they are ready to try again. During each session, participants were asked about their confidence in continuing their cessation

attempt, the intensity of cravings, and medication adherence (for those who chose to use medication). Participants were also asked to report on cessation difficulties they had experienced as well as potential upcoming risky situations, for which they also received automated tailored advice. Once a module had been completed, participants had access to a personalized interactive menu that provided a progress report (days since quit date, money saved, likely health benefits) as well as video and written testimonials of other ex-smokers' experiences.

5.3.4 Weeks 2 to 4. The structure of the sessions for weeks 2 to 4 follow the same format as described for week 1, albeit the sessions were offered less frequently (three sessions in week 2, two sessions in week 3, and one session in week 4). Automated individualized advice continued to be provided based on problems or concerns endorsed by the participants. Different advice was offered in each session, even if the same concern was repeatedly endorsed.

5.3.5 Follow-up questionnaires. An automated email reminder with a link to the final questionnaires was sent to participants at 8-weeks post-enrolment to assess abstinence, user satisfaction, smoking dependence, current pain, and pain related disability. The 8-week time frame was set to allow participants a 4-week window to obtain medication and set a quit date, and receive four weeks of post-quit date support.

5.4 Data Analytic Plan

5.4.1 Preliminary analyses. Analyses for the proposed study were conducted using SPSS version 22.0. Descriptive statistics were calculated and reported for demographic, smoking history, and pain history variables, as well as baseline measures (CDS, PSE, PASS-20, GAD-7, CES-D). An analysis of variance (ANOVA) was used to

assess for differences between chronic pain, acute pain, and pain-free groups on demographic and smoking history variables and baseline measures.

5.4.2 Primary analyses. The main hypotheses were tested as follows:

1. Abstinence rates were calculated with data from all participants who provided consent, completed baseline measures, and logged into the StopAdvisor system at least once on or after their self-determined quit date. Participants lost to follow-up were treated as non-abstainers. Consistent with Brown and colleagues (2012), an attrition rate of approximately 20% was expected.
2. User engagement was calculated for indices of pages viewed and number of logins with data from participants who provided consent, completed baseline measures, and logged into the StopAdvisor system at least once on or after their self-determined quit date. A one-way ANOVA was used to assess potential differences between pain groups on the user engagement indices.
3. User satisfaction was calculated with data from participants completing 8-week post-enrolment measures on indices of website helpfulness, personal relevance, likelihood of recommending the program to a friend, and whether the program was worth their time. A series of ANOVAs were used to assess potential differences between the pain groups regarding the degree to which the user satisfaction indices were endorsed.
4. A repeated measures analysis of covariance (ANCOVA) was used to assess whether potential smoking dependence reductions (pre- and post-intervention CDS scores) were accounted for by smoking expectancies for pain reduction (PSE) and pain-related anxiety (PASS-20).

5. Repeated measures ANOVAs were used to assess potential changes in pain ratings (Δ SF-MPQ) and pain interference ratings (Δ PDI) from enrolment to 8-weeks post-enrolment across successful abstainers and non-abstainers with acute or chronic pain.

6.0 Results

6.1 Preliminary Analyses

A total of 699 participants provided consent for participation and started completing baseline measures. Of these participants, 458 failed to complete the measures and set a quit date, and 75 participants who completed baseline measures did not log into the system on or after their self-determined quit date. A total of 166 participants completed baseline measures and logged into the system on or after their quit date, 93 of whom completed 8-week follow-up measures. A total of eight cases from the pain-free group were identified as outliers. Outliers were comprised of cases wherein participants reported being pain-free and yet a) frequently experiencing pain measured as 19 or higher (out of a possible 45) on the MPQ, or b) experiencing regular pain-related disability measured as 16 or higher (out of a possible 70) on the PDI. As the nature and duration of pain for such cases were indeterminable, they were removed from subsequent analyses. Descriptive statistics for the revised pain groups are presented in Table 3.

As a whole, the sample ($n = 158$) was comprised of 74 male (46.8%) and 84 female (53.2%) Canadians with a mean age of 43.77 years ($SD = 11.069$; range = 18-72), the majority of whom self-identified as White Caucasian (93.7%). Remaining participants identified as Latino (6%), First Nations (1.9%), Asian (1.3%), African (0.6%), and 1.9% abstained from disclosing their ethnicity. Self-reported education

Table 3

Descriptive statistics by pain group

	<u>No Pain (n = 73)</u>			<u>Acute Pain (n = 27)</u>			<u>Chronic Pain (n = 58)</u>		
	Mean	Range	SD	Mean	Range	SD	Mean	Range	SD
Age	42.59	18-72	11.56	40.26	18-57	10.42	46.90	29-68	10.09
Years smoked	24.25	1-60	12.12	22.22	1-45	11.52	30.12	6-72	10.95
Cessation Confidence	4.82	2-7	1.37	5.00	1-7	1.84	4.57	2-7	1.35
Previous Quit Attempts	6.08	1-99	12.07	3.70	1-13	2.95	5.19	1-20	4.69
CDS-12	46.49	15-59	9.59	50.26	32-59	7.10	49.05	27-59	7.13
CESD	19.88	1-54	12.36	24.04	2-54	13.62	21.69	2-49	11.94
GAD7	7.67	0-21	5.67	9.11	0-20	6.02	8.67	0-21	5.94
PASS-20	17.75	0-80	18.83	29.74	0-67	18.87	33.31	2-86	19.55
PSE	8.73	0-45	13.37	11.96	0-45	14.86	11.38	0-45	13.62
SF-MPQ	2.56	0-13	3.42	11.00	1-34	8.73	15.93	2-14	8.24
PDI	2.62	0-16	4.14	17.11	0-66	17.43	23.60	0-62	15.08

Note. CDS-12 refers to the Cigarette Dependence Scale; CESD refers to the Center for Epidemiologic Studies Depression Scale; GAD7 refers to the Generalized Anxiety Disorder 7-item scale; PASS-20 refers to the Pain Anxiety Symptoms Scale; PSE refers to the Pain and Smoking Expectancies Scale; SF-MPQ refers to the McGill Pain Questionnaire, Short Form; PDI refers to the Pain Disability Inventory.

levels included an incomplete high school education (11.9%), graduated from high school (18.4%), partial college or university education (18.4%), completion of a college or university program (41.8%), and completion of a post-graduate program (9.5%). Self-reported employment status of participants included full time (54.4%) or part time (13.3%) employment, unemployed (8.2%), retired (5.7%), student (4.4%), medical leave (3.2%), or other (10.8%). Annual household income levels of participants were: under \$20,000 (9.5%), \$20,000 to \$34,999 (18.4%), \$35,000 to \$59,999 (18.4%), \$60,000 to \$84,999 (16.5%), over \$85,000 (24.7%), and prefer not to say (12.7%). Respectively, 20%, 26%, and 19% of pain-free, acute pain, and chronic pain participants elected to use medication during their quit attempt. Chi-square results indicated that pain groups did not differ by categorical demographic features (see Table 4). Statistically significant differences were observed between pain groups on age, $F(2,155) = 4.256$, $p = .016$, $\eta_p^2 = .052$, and years smoked, $F(2,155) = 5.922$, $p = .003$, $\eta_p^2 = .071$. Tukey post hoc tests indicated that the chronic pain group was older than the acute pain group ($p = .026$), and had smoked longer than the no pain ($p = .013$) and acute pain ($p = .011$) groups. The pain groups did not differ on number of quit attempts, $F(2,155) = .737$, $p = .480$, $\eta_p^2 = .009$, or cessation confidence, $F(2,155) = .937$, $p = .394$, $\eta_p^2 = .012$.

6.2 Primary Analyses

6.2.1 Hypothesis 1. As predicted, and in line with Brown et al. (2012), a total of 34 participants (21.5%) reported abstaining from smoking at the 8-week follow-up. A total of 55 participants (34.8%) reported a failure to abstain and 89 participants (56.3%) were lost to follow-up and, therefore, categorized as non-abstainers. Abstinence rates by pain group were as follows: 15 abstainers (20.5%) in the pain free-group, 7 abstainers

Table 4

Chi-square results of demographic features between pain groups.

	<i>X²</i>	<i>DF</i>	<i>p</i>	Cramer's V
Sex	2.777	2	0.249	0.133
Ethnicity	15.368	10	0.119	0.221
Employment Status	14.483	12	0.271	0.214
Income	9.825	10	0.456	0.176
Medication Use	0.55	2	0.76	0.059

(25.9%) in the acute pain group, and 12 abstainers (20.7%) in the chronic pain group. Medication use of abstainers by pain group was as follows: 2 medication users in pain-free abstainers (13.3%), 2 medication users in the acute pain group (28.6%), and 4 medication users in the chronic pain abstainers (33.3%).

6.2.2 Hypothesis 2. As predicted, and in line with Brown et al. (2012), participants who made a serious quit attempt with StopAdvisor viewed an average of 142.45 pages ($SD = 116.59$, median = 103) and logged into the system 8.99 times ($SD = 6.70$, median = 6). Approximately two thirds of participants rated the program favourably on indices of website helpfulness (68%), personal relevance (65.3%), likelihood of recommending the program to a friend (68%), and worth your time (70.3%). ANOVA results indicated that user satisfaction and engagement indices did not differ between pain groups (see Table 4).

6.2.3 Hypothesis 3. A repeated measures ANCOVA was used to assess whether potential smoking dependence reductions (pre- and post-intervention CDS scores) were accounted for by smoking expectancies for pain reduction (PSE scores) and pain-related anxiety (PASS-20 scores). Results indicated that post-intervention smoking dependence scores ($M_{CDS2} = 33.46$, $SD = 15.71$) were significantly lower than pre-intervention smoking dependence scores ($M_{CDS1} = 47.05$, $SD = 8.05$), $F(1,83) = 37.282$, $p < .001$, $\eta_p^2 = .310$. Pain-related anxiety ($M_{PASS-20} = 24.39$, $SD = 20.695$, range = 0-86) was a significant covariate with a medium effect, $F(1,83) = 4.882$, $p = .030$, $\eta_p^2 = .056$, indicating that pain-related anxiety was a risk factor for increased smoking dependence in this sample. Smoking expectancies for pain reduction was not a significant covariate ($M_{PSE} = 8.23$, $SD = 11.51$, range = 0-45), $F(1,83) = .565$, $p = .454$, $\eta_p^2 = .007$.

Table 5

User engagement and satisfaction across pain groups

	<u>No Pain</u>			<u>Acute Pain</u>			<u>Chronic Pain</u>			ANOVA Results
	Mean	Range	SD	Mean	Range	SD	Mean	Range	SD	
Pages viewed	146.00	23-659	116.89	143.30	13-468	119.48	137.22	17-428	116.73	$F(2,155) = .097, p = .907, \eta p^2 = .001$
Logins	9.16	2-29	6.51	9.11	2-23	6.58	8.72	2-30	7.11	$F(2,155) = .074, p = .929, \eta p^2 = .001$
Helpfulness	3.05	2.57-3.53	1.49	2.91	1.78-4.05	1.70	3.04	2.68-3.38	1.52	$F(2,72) = .038, p = .963, \eta p^2 = .001$
Relevance	2.74	2.30-3.19	1.37	2.91	1.94-3.89	1.45	3.32	2.63-4.01	1.68	$F(2,72) = 1.149, p = .323, \eta p^2 = .031$
Recommend	3.05	2.55-3.65	1.57	2.82	1.55-4.09	1.89	3.16	2.49-3.83	1.63	$F(2,72) = .167, p = .847, \eta p^2 = .005$
Worth time	3.21	2.63-3.78	1.78	3.64	2.28-4.99	2.01	3.48	2.95-3.77	1.71	$F(2,72) = .333, p = .718, \eta p^2 = .009$

6.2.4 Hypothesis 4. A repeated measures ANOVA was used to measure changes in pain ratings (MPQ scores) from enrolment to 8-weeks post-enrolment across successful abstainers and non-abstainers in the pain group. Results demonstrated a significant effect of abstinence on pre- and post-intervention pain $F(1,35) = 6.453, p = .016, \eta_p^2 = .156$, such that individuals with acute or chronic pain who successfully abstained from smoking experienced significant reductions in pain (see Figure 7). Mean MPQ pain scores of abstainers reduced from 14.13 ($SD = 6.85$, range = 1-24) to 5.53/45 ($SD = 5.52$, range = 0-16), whereas scores increased nominally for non-abstainers from 13.81 ($SD = 8.27$, range 2-38) at pre-intervention to 14.86 ($SD = 12.22$, range = 0-37) at post-intervention.

6.2.5 Hypothesis 5. A repeated measures ANOVA was also used to measure changes in pain interference ratings (PDI scores) from enrolment to 8-weeks post-enrolment across successful abstainers and non-abstainers in the pain group. Results of a repeated measures ANOVA demonstrated a significant effect of abstinence on pre- and post-intervention pain-related disability $F(1,32) = 5.780, p = .022, \eta_p^2 = .153$, such that individuals with acute or chronic pain who successfully abstained from smoking reported significant reductions in pain-related disability (see Figure 8). Mean PDI pain scores of abstainers reduced from 25.71 ($SD = 16.64$, range = 0-66) to 13.35/70 ($SD = 11.61$, range = 0-35), whereas scores increased nominally for the non-abstainers from 21.50 ($SD = 18.54$, range 1-62) at pre-intervention to 22.95 ($SD = 20.47$, range = 0-64) at post-intervention.

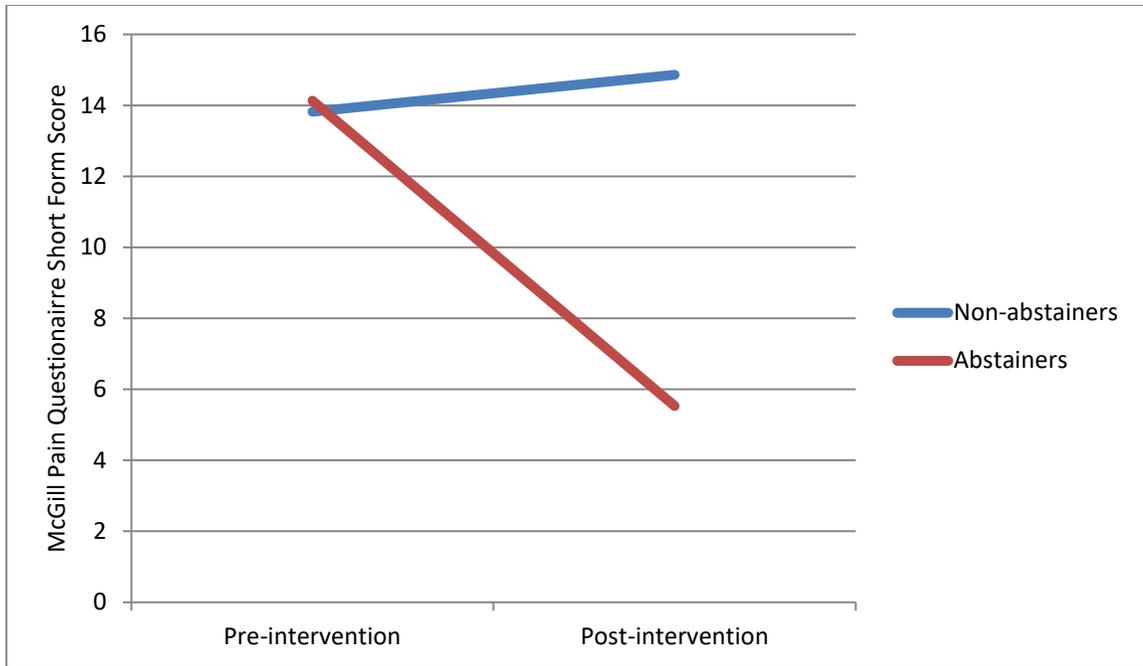


Figure 7. Line graph demonstrating the effect of smoking abstinence on pre- and post-intervention pain.

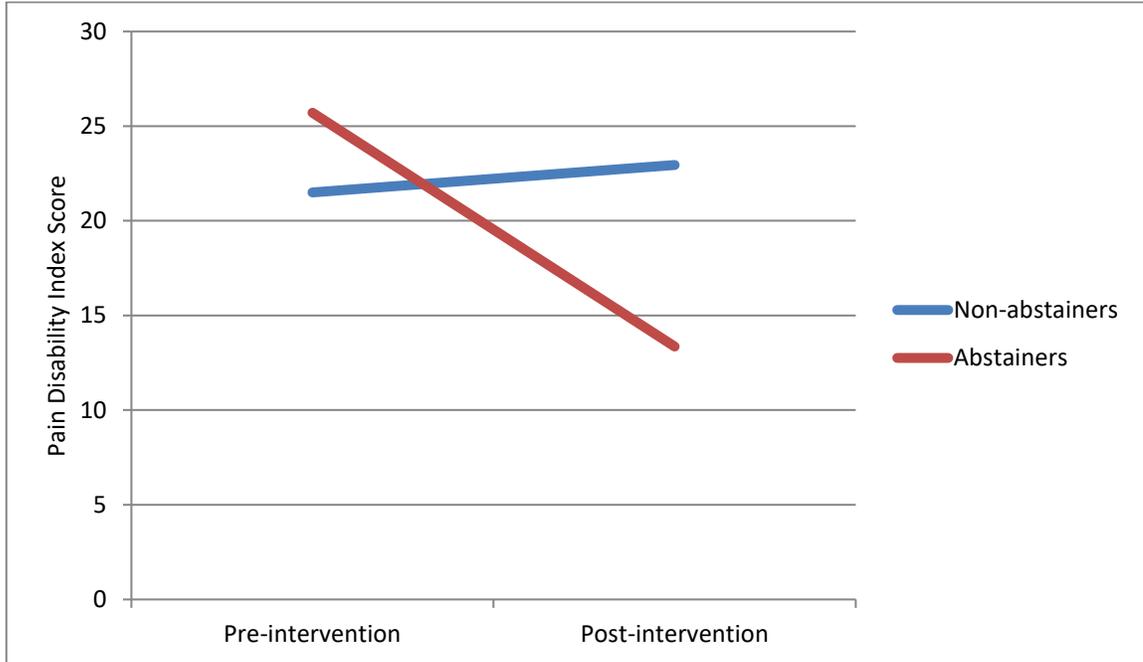


Figure 8. Line graph demonstrating the effect of smoking abstinence on pre- and post-intervention pain-related disability.

6.3. Post Hoc Analyses

A large number of participants ($n = 75$) who completed baseline measures and set a quit date also failed to login to the system on or after their quit date (nonstarters). Post hoc analyses were used to explore potential differences between the nonstarters and those who followed through with a quit attempt using StopAdvisor (starters). A series of chi-square test results identified no statistically significant differences between groups on demographic characteristics such as sex, $X^2(1, n = 233) = 1.866, p < .172$, Cramer's $V = .072$, ethnic identification, $X^2(5, n = 233) = 7.236, p < .204, p < .46$, Cramer's $V = .217$, education level, $X^2(4, n = 233) = 6.632, p < .157$, Cramer's $V = .169$, or employment status, $X^2(6, n = 233) = 5.253, p < .512$, Cramer's $V = .512$.

Post hoc analyses were also used to explore differences between starters and nonstarters on baseline smoking, pain, and psychological characteristics. Results of a one-way ANOVA indicated that the starters were approximately 5 years older ($M_{\text{age}} = 43.77$, range = 18-72) than the nonstarters ($M_{\text{age}} = 37.96$, range = 21-66), $F(1, 231) = 13.899, p < .001, \eta_p^2 = .057$, and had been smoking for approximately 5 years longer ($M_{\text{years}} = 26.06$, range = 1-60) than the nonstarters ($M_{\text{years}} = 20.91$, range = 2-46), $F(1, 231) = 10.172, p = .002, \eta_p^2 = .042$. Smoking dependence scores of the groups were statistically equivalent (starters $M_{\text{CDS}} = 48.08/60$, range = 15-59; nonstarters $M_{\text{CDS}} = 47.95/60$, range = 22-59), $F(1, 231) = .012, p = .913, \eta_p^2 < .001$; however, cessation confidence of the starters ($M_{\text{confidence}} = 4.76/5$, range = 1-7) was statistically greater than the nonstarters ($M_{\text{confidence}} = 4.16/5$, range = 1-7), $F(1, 231) = 7.893, p = .005, \eta_p^2 = .033$. Pain scores of the groups did not differ for starters ($M_{\text{MPQ}} = 8.91/45$, range = 0-42) and

nonstarters ($M_{MPQ} = 10/45$, range 0-39), $F(1,231) = 2.249$, $p = .135$, $\eta_p^2 = .010$, but the pain disability scores of the nonstarters ($M_{PDI} = 17.92/70$, range 0-70) was significantly higher than the starters ($M_{PDI} = 12.80/70$, range 0-66), $F(1,231) = 4.985$, $p = .027$, $\eta_p^2 = .021$. The nonstarters also had significantly higher scores on anxiety ($M_{GAD} = 10.56/21$, range 0-21) and depression ($M_{CES-D} = 26.17/54$, range 0-54) than the starters ($M_{GAD} = 8.29/21$, range 0-21; $M_{CES-D} = 21.25/54$, range 1-54), $F_{GAD}(1,231) = 7.027$, $p = .009$, $\eta_p^2 = .030$ and $F_{CES-D}(1,231) = 7.038$, $p = .009$, $\eta_p^2 = .030$, respectively. Pain related anxiety did not differ for starters ($M_{PASS-20} = 25.51/86$, range 0-100) and nonstarters ($M_{PASS-20} = 29.19/100$, range 0-100), $F(1,231) = 1.353$, $p = .246$, $\eta_p^2 = .006$.

7.0 Discussion

Smoking and chronic pain are frequently co-occurring major public health concerns in Canada (see review by Parkerson et al., 2013). Contemporary models of pain and smoking highlight a cyclical relationship wherein individuals smoke to reduce pain in the short term; however, smoking to cope with pain indirectly exacerbates pain in the long term (Ditre & Brandon, 2008, Ditre et al., 2011; Parkerson et al., 2013). Internet-based interventions may provide a cost-effective medium for offering broad population-based cessation support (McClure et al., 2013) but relatively few randomized controlled trials have gauged the efficacy of such interventions (Civljak et al., 2013). The current investigation assessed the efficacy of a fully automated cognitive-behavioural based online stop smoking intervention in a sample of Canadian adults and evaluated whether specific smoking risk factors (i.e., smoking expectancies for pain reduction and pain-

related anxiety) acted as barriers to cessation. Furthermore, the current investigation assessed whether breaking the cycle of smoking and pain through successful smoking abstinence positively impacted pain and pain-related disability outcomes for individuals with acute and chronic pain.

7.1 Summary of Outcomes

7.1.1. An evaluation of efficacy: Abstinence, engagement, and user satisfaction. Based on efficacy estimates of the StopAdvisor program in the U.K. (Brown et al., 2012), it was expected that approximately 20% of users who made a serious quit attempt using StopAdvisor would remain abstinent at the 8-week follow-up (West & Stapleton, 2008). Indeed, 21.5% of our sample reported remaining abstinent at 8-weeks follow-up. An abstinence rate of 20% is two times greater than that of individuals making unaided quit attempts in the Canadian population (Reid et al., 2013) and, therefore, considered a successful outcome target for automated online smoking cessation programs (Brown et al., 2012).

In terms of user engagement, participants who made a serious quit attempt using StopAdvisor viewed approximately 142 pages across 9 visits to the site. Such results are similar to those reported by Brown et al. (2012), in which participants viewed 135 pages across 6 logins. Approximately two thirds of participants who completed follow-up measures rated the program favourably on indices of website helpfulness (68%), personal relevance (65%), likelihood of recommending the program to a friend (68%), and whether the program was worth their time (70.3%). The satisfaction ratings were slightly lower than those reported by Brown et al. (2012) in which 75% of participants rated the program as helpful, 67% rated the program as personally relevant, and 75%

indicated they were likely to recommend the program to others. Satisfaction rates reported in the current study were also slightly lower than the range of values reported for other internet-delivered CBT-based interventions for anxiety and depression. In a meta-analysis of 22 controlled studies comparing Internet-delivered CBT for anxiety and depression to a waitlist condition (Andrews, Cuijpers, Craske, McEvoy, & Titov, 2010), a total of 10 studies reported user satisfaction indices. Satisfaction rates reported ranged from 70-100%. As the user experience is likely a key factor in participant retention and program effectiveness, qualitative exploration with regards to user experiences of StopAdvisor and other Internet-delivered stop smoking interventions may provide important clues for improving program effectiveness.

Taken together, the aforementioned results suggest that StopAdvisor may improve the likelihood by two-fold that a person will successfully quit smoking for the first 28-days following a serious quit attempt. The volume of website pages accessed by participants and the high number of repeat visits to the site suggest that many participants found StopAdvisor to be engaging and worthwhile. Furthermore, the majority of participants were satisfied with the program offerings. Current findings are encouraging, as they suggest that an online and automated smoking cessation intervention may be an effective, cost-effective, and broad-reaching format for administering much needed cessation support to Canadians. Indeed, at the population level, abstinence increases of 10% would represent a significant number of Canadians and could contribute to improved health and life expectancy. As such, a randomized control trial is warranted in order to test the efficacy of the StopAdvisor program

compared with other treatments (i.e., drug therapy alone, other psychosocial interventions) and no-treatment in a Canadian sample.

Current conclusions should be tempered by results of a recent randomized controlled trial conducted in the UK (Brown et al., 2014), which compared outcomes of StopAdvisor users to outcomes of those assigned to a static information-only website control condition. At 6-month follow-up, both groups had only a 10% biochemically verified abstinence rate. Such results suggest that individuals who have quit smoking using a 28-day cessation program may require additional support to prevent relapse over the long term. Indeed, the type of support that is helpful during the first month following a quit attempt is qualitatively different than the cognitive and behavioural strategies needed to remain abstinent in the months and years to follow (Hajek et al., 2013). Further, commonly administered relapse prevention strategies have not received consistent empirical support (Hajek et al., 2013). Future research will be necessary to assess what type of support is needed to prevent relapse after the first month of abstinence, as well as cost-effective population level administration methods.

Current results related to efficacy, engagement, and satisfaction were based on responses of participants who both completed baseline measures and logged in to the StopAdvisor site at least once on or after their quit date. Not included in the analyses were 166 non-starters—participants who completed baseline measures but failed to visit the site on or after their quit date. Non-starters likely had some interest in smoking cessation; however, there is no way to know why nonstarters did not follow through with a quit attempt using StopAdvisor. A discussion of potential psychosocial cessation barriers faced at the pre-quit date phase can be found in section 6.1.4.

7.1.2. Pain-related anxiety and smoking expectancies for pain reduction: Do smoking risk factors act as barriers to cessation during a serious quit attempt?

Previous research has demonstrated that pain-related anxiety is significantly associated with smoking motives related to physical dependence (e.g., cravings, tolerance, automaticity) as well as situational motivators (e.g., mood regulation, weight control) in individuals with chronic pain (Ditre et al., 2013). As pain-related anxiety occurs in the general population and not strictly in pain populations (Carleton, Abrams, Asmundson, Antony, & McCabe, 2009), the current investigation assessed the relative contribution of pain-related anxiety in pre- to post-intervention dependence scores in all participants regardless of their pain status. Pain-related anxiety accounted for a significant proportion of the variance as indicated by a medium effect ($p = .03$, $\eta_p^2 = .06$). Such results corroborate existing evidence indicating that pain-related anxiety is also a risk factor for increased smoking dependence in individuals with comorbid pain (Ditre et al., 2013). To our knowledge, however, current results are the first to indicate that pain-related anxiety may also be a risk factor for increased smoking dependence for pain-free smokers. Findings imply that pain-anxiety management strategies may be a useful addition to existing smoking cessation and relapse prevention interventions for the general population, not just those with acute or chronic pain.

In contrast to the hypotheses of the current investigation, smoking expectancies for pain reduction did not account for significant variance in smoking dependence pre- to post-intervention. The result was surprising given recent experimental research demonstrating positive associations between pain and smoking expectancies (as measured by the PSE) with smoking urge and behaviour in an experimental pain context

(Parkerson & Asmundson, 2016), as well as results demonstrating that challenging of PSE resulted in lower smoking urge following experimental pain (Ditre et al., 2010). As discussed below, individuals with pre-intervention acute or chronic pain who abstained from smoking experienced reduced pain and pain-related disability at follow-up. As pain reduced, smoking expectancies for pain reduction may have been activated less often and, therefore, resulted in an inconsistent effect on smoking outcomes. Such speculation warrants future empirical inquiry. Insufficient power may be responsible for the absence of statistically significant results. A power analysis indicated that sufficient power was attained to detect a small to medium effect of smoking expectancies change in pre- to post-intervention smoking dependence; however, very small effects may not have been detected in the current sample. Replication with a larger sample is warranted.

7.1.3. Breaking the cycle of pain and smoking: Does smoking abstinence improve pain outcomes? A third purpose of the current investigation was to assess whether successful smoking abstinence would positively impact pain and pain-related disability outcomes for individuals with acute and chronic pain. Indeed, pain intensity and pain-related disability for such individuals reduced by 8 and 12 points, respectively. Such differences were not observed for participants with acute or chronic pain who continued to smoke. Changes of 5 points or greater on the MPQ-SF were representative of clinically meaningful change in a Norwegian sample with musculoskeletal pain (Strand, Ljunggren, Bogen, & Johnsen, 2008). Likewise, changes of 9.5 on the PDI have been indicative of clinically meaningful change in individuals with chronic low back pain (Soer, Reneman, Vroomen, Stegeman, & Coppes, 2012). By such standards, observed changes in pre- to post-intervention MPQ-SF and PDI scores of abstainers with

pain represented statistically and clinically meaningful decreases in pain and pain-related disability. Although smoking is consistently associated with greater pain intensity and functional interference in treatment seeking chronic pain patients (Weingarten, Iverson, et al., 2009; Weingarten, Podduturu, et al., 2009), the current study is the first to provide evidence that pain and pain-interference outcomes may improve as a result of smoking cessation. Future research is necessary to assess whether pain management and rehabilitation treatment outcomes may be improved by including cessation support for patients who smoke.

7.1.4 Failing to start quitting: A post hoc exploration of why some participants signed-up but failed to make a serious quit attempt with StopAdvisor. A total of 75 participants were not included in the primary analyses because they failed to log-in to the system on or after their self-determined quit date. Exploratory post hoc analyses were conducted to evaluate whether starters and non-starters differed on baseline demographic, smoking, pain, and psychological constructs.

Starters and nonstarters did not differ on demographic characteristics such as sex, ethnic identification, education level, or employment status. As such, we cannot infer that demographic variables created a barrier with regards to quit attempt follow through. In terms of smoking variables, the groups did not differ on average age of onset; however, the starters were approximately 5 years older and had been smoking approximately 5 years longer than nonstarters. Numerous studies have reported similar findings wherein older age has been predictive of quit attempt follow through (e.g., Hyland et al., 2004; Jardin & Carpenter, 2012); however, the opposite relationship has also been reported (Hyland et al., 2006). The mixed findings suggest that the issue is

more complex; age may reflect a series of factors that differentially influence cessation attempts (e.g., age of onset, years smoked, current smoking dependency, current consequences of smoking).

Smoking dependency scores of starters and nonstarters were nearly equivalent, but a small statistical difference was observed between groups in cessation confidence ($\eta_p^2 = .03$). The size of the difference was a half point on a 7-point scale. A recent meta-analysis (Vangeli, Stapleton, Smit, Borland, & West, 2011) highlighted mixed findings with regards to the impact of cessation confidence on cessation attempts; confidence in cessation predicted quit attempts in three East Asian samples (Hagimoto, Nakamura, Morita, Masui, & Oshima, 2010; Li et al., 2010; Li et al., 2011) but not in Western samples (Hellman, Cummings, Haughey, Zielezny, & O'Shea, 1991; Herd, Borland, & Hyland, 2009). Authors highlighted cultural factors and a more recent history of tobacco control as potential moderating variables. As the current sample was comprised primarily of Caucasian individuals in Canada, the same cultural factors would not be implicated in this case. However, the aforementioned findings were derived from prospective population surveys, which are subject to the limitations of self-report with lengthy follow-up contact. Experimental investigations may be better suited to detect subtle effects of cessation confidence on quit attempts. Additional experimental investigation regarding the real time impact of cessation confidence on quit attempts is warranted.

Starters and nonstarters did not differ on their baseline pain ratings, but did differ on their ratings of pain-related interference. Specifically, pain disability scores were higher for nonstarters than starters (18/70 vs. 13/70 points, respectively; $\eta_p^2 = .02$). Previous research utilizing self-report data has demonstrated positive associations

between pain status and both cessation confidence and difficulty quitting (Zale et al., 2014). To our knowledge, this association had not been assessed experimentally. Current experimental findings align with findings reported by Zale et al. The extent to which pain interferes in an individual's ability to function in important aspects of life may be more important in understanding why individuals fail to engage in a quit attempt, rather than pain status alone. Further exploration in this regard is needed.

In the current sample, nonstarters reported statistically and clinically significant baseline anxiety ($\eta_p^2 = .03$) and depression ($\eta_p^2 = .03$), but not pain-related anxiety. Starters reported mean GAD-7 scores of 8.29/21, which is considered in the mild range of anxiety symptomatology; whereas the nonstarters reported mean scores of 10.56/21, which is considered in the moderate range. Likewise, starters reported mean CES-D scores of 21.25, which is within the Mild range of depressive symptomatology; whereas nonstarters reported mean scores of 26.17/54, which is in the Moderate range. In a sample of treatment seeking smokers, smokers ever diagnosed with GAD had higher pre-quit levels of cravings, negative affect, withdrawal symptoms leading up to quit day, when compared with individuals without a GAD diagnosis (Piper, Cook, Schlam, Jorenby, & Baker, 2010). Considering results reported by Piper and colleagues, nonstarters in the current study may have experienced similar barriers in commencing their quit attempts. To our knowledge, the pre-quit day experience of smokers with depression has not been reported in the extant literature. However, evidence indicates that depression is powerful predictor of smoking early in a quit attempt (Japuntich et al., 2007). Such findings have important implications for technology-delivered smoking interventions. Tailored pre-quit support should be provided specific to individuals with

anxiety or depression explaining what may be expected in terms of pre-quit craving, negative affect, and withdrawal symptoms. Likewise, future research should explore whether smoking cessation interventions are more successful for certain individuals when paired with modules designed to treat underlying anxiety and depressive symptomatology as a precursor to smoking cessation.

7.2 Theoretical Implications

The reciprocal model of smoking and pain, first introduced by Ditte and Brandon (2008), suggested that smoking behavior and pain interact in the manner of a positive feedback loop, resulting in greater pain and smoking dependence (Ditte, Brandon, Zale, & Meagher, 2011). A revised integrative reciprocal model highlights psychological factors that may act as mechanisms in the integrative reciprocal cycle of pain and smoking (See Figure 1; Parkerson et al., 2013). Findings from the current investigation corroborate several pathways outlined in the model, and extend our understanding of how the components in the model interact within a real time quit attempt.

Extensive empirical evidence supports pathway E in the cycle of pain and smoking. Reduction of anxiety and depression is a key smoking motive, and individuals experience a greater smoking urge in response to increased anxiety and depression (for a review, see Parkerson et al., 2013). Nonstarters in the current study had significantly higher anxiety and depression scores than starters, which suggests that higher levels of anxiety and depression may have been a barrier to commencing a quit attempt. In order to design Internet-delivered cessation interventions that are sensitive and responsive to the varied needs of the users, it will be necessary to gain a better understanding of how anxiety and depression impact quit attempt follow through.

In the revised reciprocal model of pain and smoking, pain-related anxiety is also accounted for in pathway E. Existing evidence suggests that pain-related anxiety is a risk factor for increased smoking dependence in individuals with comorbid pain, independent of generalized anxiety symptoms (Ditre et al., 2013). In the current investigation, pain-related anxiety was predictive of higher smoking dependence scores following a 28-day quit attempt in participants with and without chronic/persistent pain. This novel finding expands our conceptualization of how pain-related anxiety is involved in the cycle of pain and smoking. Indeed, pain is a ubiquitous human experience, and individuals with and without chronic/persistent pain will inevitably have normal and adaptive pain experiences that signal when a given activity may lead to insult or injury (IASP, 1994). Individuals with pain-related anxiety may be hypervigilant to these normal and adaptive pain experiences and interpret them as dangerous or intolerable (Asmundson et al., 2004; Vlaeyen & Linton, 2000). Such individuals may also be more likely to develop maladaptive coping strategies, like smoking, to mitigate their pain-induced anxiety and fear (Gonzalez et al., 2010; Zvolensky et al., 2009), which would contribute to increased smoking dependence. The potential involvement of pain-related anxiety in the transition from acute to chronic pain warrants further investigation.

Pathway A of the revised reciprocal model of pain and smoking suggests that greater smoking behaviour contributes to greater pain intensity. The current investigation evaluated whether pathway A could be broken through a successful quit attempt (i.e., does a successful quit attempt reduce pain in individuals with chronic or persistent pain?). Indeed, statistically and clinically significant reductions in pain and pain-related interference were observed for individuals with chronic or persistent pain who had been

abstinent during their quit attempt. Such findings are novel and need to be replicated, and yet represent a hopeful possibility for pain relief and increased functionality following a relatively short duration of abstinence for smokers with pain.

7.3 Limitations and Directions for Future Research

Limitations of the current investigation highlight important areas for future research that may continue to refine our understanding of the reciprocal interactions between smoking and pain and lead to improved smoking cessation and pain reduction outcomes. Attrition (i.e., participants lost to follow-up) was high for the current investigation (56%) as compared with the 20% attrition reported by Brown and colleagues (2012). Such high rates of attrition at follow-up are not uncommon for automated online smoking interventions. For example, Smit et al. (2012) reported 60% attrition at a 6-week follow-up. Nonetheless, generalizability of the current results may be negatively impacted by low response rates. User satisfaction, assessment of how quit attempts are impacted by pain-related anxiety and smoking expectancies for pain reduction, and assessment of how smoking abstinence impacts pain and pain-related disability outcomes were based on responses by only 44% of participants. Efficacy rates would not have been inflated by the high attrition. As participants lost to follow-up were considered non-abstainers, it is possible that the intervention may have been more effective than current results portrayed. As such, replication of the current study is needed.

Reasons for the high attrition in the current study are unknown; nevertheless, there are many possible explanations. First, some individuals may have been curious about the process or content provided by StopAdvisor but not committed to a serious quit attempt.

Likewise, some individuals may have made a serious quit attempt using StopAdvisor but not been committed to providing feedback about their experience. Indeed, the automated nature of the program may reduce overall accountability for completing the follow-up measures. A second possibility is that individuals who lost interest in receiving support or stopped using the program after an unsuccessful quit attempt may have also lost interest in providing program feedback. A third possibility is that automated reminders to complete the follow-up measures were filtered to participants' *spam* or *junkmail* folders. Continued refinement and improvement of such interventions will be dependent on high participant response rates. Therefore, future research should be directed at delineating reasons for attrition, as well as factors that could improve overall response rates.

The current investigation assessed whether successful cessation positively impacted pain and pain-related disability outcomes. As chronic pain is not static, improvements in pain may have improved participants' ability to quit smoking. Future research will be necessary to more closely assess the directionality of the observed pain-smoking relationship. Likewise, the current investigation used self-report abstinence, pain status, and pain-related disability outcomes. Future investigations should corroborate abstinence with saliva cotinine or expired breath carbon monoxide levels. Similarly, researchers may want to consider working in conjunction with physicians, physiotherapists, and other pain practitioners to recruit participants and provide a secondary assessment of pain status and interference.

A strength of the StopAdvisor program is its transparency with regards to describing module content, underlying theory, and behavioural change principles. As previously mentioned, StopAdvisor content is based on theoretical principles addressing

motivation, self-regulatory capacity and skills, utilization of medication as an adjuvant to treatment, and promoting engagement with the intervention (see Table 1). A total of 21 behavioural change techniques were constructed based on the theoretical principles (see Table 2). The transparency and accessibility of content was intentional in the development of the StopAdvisor program in order to allow researchers to assess the contribution of specific program content and related behavioural change principles. To date, no investigation has assessed the contributions of specific StopAdvisor content with respect to successful behaviour change outcomes. Future research in this regard may help identify areas of refinement to improve the efficacy of StopAdvisor and, ultimately, support individuals in making life saving behaviour change.

7.4 Conclusions

Smoking is a major public health concern that is associated with illness (U.S. Department of Health and Human Services, 1999) and early death (Baliunas, 2007). Up to 90% of smokers who attempt to quit smoking are unsuccessful (Reid et al., 2013) and quitting may be even harder for individuals with chronic pain (Zale et al., 2014). Likewise, chronic pain is a common and costly health condition associated with personal suffering, functional limitations, and hundreds of billions of dollars in health care costs annually in North America alone (Gaskin & Richard, 2012). The prevalence of smoking in chronic pain populations is double the rate found in the general population (Hooten, et al., 2011; Zvolensky et al., 2009). Evidence suggests that smokers seeking treatment for chronic pain experience greater pain severity, emotional distress, and functional impairment compared with non-smokers (Hooten, Townsend, Bruce, & Warner, 2009;

Weingarten, et al., 2008). Population level cessation support for Canadian smokers is long overdue and development and testing of such interventions is still needed.

Results of the current investigation indicated that an automated, tailored Internet-delivered smoking cessation intervention improves the likelihood of short-term smoking abstinence in a Canadian sample. Likewise, this type of administration format was acceptable to most participants. The StopAdvisor program and similar formats may provide a cost-effective means to increase the success of cessation attempts at the population level. The current investigation also provided clarity regarding how quit attempts are impacted by pain-related anxiety. Higher pain-related anxiety was associated with higher smoking dependence at follow-up. To our knowledge, current results are the first to indicate that pain-related anxiety may be a risk factor for increased smoking dependence for all individuals regardless of pain status (i.e., chronic pain, acute pain, and pain-free groups). As such, pain-related anxiety management may be a useful addition to existing smoking cessation and relapse prevention interventions for all smokers and not just those with pain. Lastly, the current investigation provided novel evidence regarding the impact of sustained smoking abstinence on prospective pain outcomes. Individuals with acute or chronic pain who abstained from smoking experienced statistically and clinically significant reductions in pain and pain-related disability at follow-up. The same was not observed for individuals who continued to smoke. Such findings highlight an important role for incorporating smoking cessation interventions within pain treatment settings.

8.0 References

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Appendix A

University of Regina, Research Ethics Board, Ethics Approval

PRINCIPAL INVESTIGATOR Holly Parkerson	DEPARTMENT Psychology	REB# 2015-062
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SUPERVISOR
Dr. Gordon Asmundson

FUNDER(S)
CIHR RPP Doctoral Award

TITLE
A pilot test of an internet-based smoking cessation intervention: Outcomes across chronic pain and pain-free samples

APPROVAL OF Application for Behavioural Research Ethics Review Appendix A – Recruitment Message Appendix B – Consent Form Appendix C - Questionnaire	APPROVED ON May 28, 2015	RENEWAL DATE May 28, 2016
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Full Board Meeting
Delegated Review

CERTIFICATION

The University of Regina Research Ethics Board has reviewed the above-named research project. The proposal was found to be acceptable on ethical grounds. The principal investigator has the responsibility for any other administrative or regulatory approvals that may pertain to this research project, and for ensuring that the authorized research is carried out according to the conditions outlined in the original protocol submitted for ethics review. This Certificate of Approval is valid for the above time period provided there is no change in experimental protocol, consent process or documents.

Any significant changes to your proposed method, or your consent and recruitment procedures should be reported to the Chair for Research Ethics Board consideration in advance of its implementation.

ONGOING REVIEW REQUIREMENTS

In order to receive annual renewal, a status report must be submitted to the REB Chair for Board consideration within one month of the current expiry date each year the study remains open, and upon study completion. Please refer to the following website for further instructions: <http://www.uregina.ca/research/REB/main.shtm!>



Dr. Larena Hoeber, Chair
University of Regina
Research Ethics Board

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Appendix B
Cigarette Dependence Scale

Cigarette Dependence Scale (CDS-12; Etter, Le Houezec, & Perneger, 2003)

1. Please rate your addiction to cigarettes on a scale of 0 (I am NOT addicted to cigarettes at all) to 100 (I am extremely addicted to cigarettes)
2. On average how many cigarettes do you smoker per day?
3. Usually, how soon after waking up do you smoke your first cigarette? (Minutes)
4. For you, quitting smoking for good would be:
 - Impossible = 5
 - Very difficult = 4
 - Fairly difficult = 3
 - Fairly easy = 2
 - Very easy = 1

Please indicate whether you agree with each of the following statements

Totally disagree = 1

Somewhat disagree = 2

Neither agree nor disagree = 3

Somewhat agree = 4

Fully agree = 5

5. After a few hours without smoking, I feel an irresistible urge to smoke
6. The idea of not having any cigarettes causes me stress
7. Before going out, I always make sure that I have cigarettes with me
8. I am a prisoner of cigarettes
9. I smoke to much
10. Sometimes I drop everything to go out and buy cigarettes
11. I smoke all the time
12. I smoke despite the risks to my health

Appendix C

McGill Pain Questionnaire, Short Form

McGill Pain Questionnaire, Short Form (Melzack, 1987)

Please place a check mark ✓ in the blank space underneath the word that best describes the intensity of each adjective you currently or frequently experience.

	<u>NONE</u>	<u>MILD</u>	<u>MODERATE</u>	<u>SEVERE</u>
THROBBING	0) _____	1) _____	2) _____	3) _____
SHOOTING	0) _____	1) _____	2) _____	3) _____
STABBING	0) _____	1) _____	2) _____	3) _____
SHARP	0) _____	1) _____	2) _____	3) _____
CRAMPING	0) _____	1) _____	2) _____	3) _____
GNAWING	0) _____	1) _____	2) _____	3) _____
HOT-BURNING	0) _____	1) _____	2) _____	3) _____
ACHING	0) _____	1) _____	2) _____	3) _____
HEAVY	0) _____	1) _____	2) _____	3) _____
TENDER	0) _____	1) _____	2) _____	3) _____
SPLITTING	0) _____	1) _____	2) _____	3) _____
TIRING-EXHAUSTING	0) _____	1) _____	2) _____	3) _____
SICKENING	0) _____	1) _____	2) _____	3) _____
FEARFUL	0) _____	1) _____	2) _____	3) _____
PUNISHING-CRUEL	0) _____	1) _____	2) _____	3) _____

Please rate your present level of pain by drawing a vertical | line on the following scale:

NO PAIN |-----| WORST POSSIBLE PAIN

Please rate your present level of pain by placing a check mark ✓ in the blank space beside the appropriate adjective:

- 0 NO PAIN _____
- 1 MILD _____
- 2 DISCOMFORTING _____
- 3 DISTRESSING _____
- 4 HORRIBLE _____
- 5 EXCRUCIATING _____

Appendix D

Pain Disability Index

Pain Disability Index (Pollard, 1984)

Please circle the number on the scale that describes the level of disability you typically experience **from pain interference**.

Family/Home Responsibilities: daily chores or personal duties.

No Disability 0__ . 1__ . 2__ . 3__ . 4__ . 5__ . 6__ . 7__ . 8__ . 9__ . 10__ . Worst Disability

Recreation: hobbies, sports, and other leisure activities.

No Disability 0__ . 1__ . 2__ . 3__ . 4__ . 5__ . 6__ . 7__ . 8__ . 9__ . 10__ . Worst Disability

Social Activity: participation with friends, acquaintances other than family members.

No Disability 0__ . 1__ . 2__ . 3__ . 4__ . 5__ . 6__ . 7__ . 8__ . 9__ . 10__ . Worst Disability

Occupation: activities related to one's job including non-paying jobs.

No Disability 0__ . 1__ . 2__ . 3__ . 4__ . 5__ . 6__ . 7__ . 8__ . 9__ . 10__ . Worst Disability

Sexual Behavior: frequency and quality of one's sex life.

No Disability 0__ . 1__ . 2__ . 3__ . 4__ . 5__ . 6__ . 7__ . 8__ . 9__ . 10__ . Worst Disability

Self Care: personal maintenance and independent daily living.

No Disability 0__ . 1__ . 2__ . 3__ . 4__ . 5__ . 6__ . 7__ . 8__ . 9__ . 10__ . Worst Disability

Life-Support Activities: basic life supporting behaviors like eating, sleeping, breathing.

No Disability 0__ . 1__ . 2__ . 3__ . 4__ . 5__ . 6__ . 7__ . 8__ . 9__ . 10__ . Worst Disability

Appendix E

Pain Anxiety Symptoms Scale

Pain Anxiety Symptoms Scale-20 (McCracken & Dhingra, 2002)

Please use the following scale to rate how often you engage in each of the following thoughts or activities. Circle the number beside the statement to indicate your rating.

	Never					Always						
1. I can't think straight when in pain	0	1	2	3	4	5						
2. During painful episodes it is difficult for me to think of anything besides the pain	0	1	2	3	4	5						
3. When I hurt I think about pain constantly	0	1	2	3	4	5						
4. I find it hard to concentrate when I hurt	0	1	2	3	4	5						
5. I worry when I am in pain	0	1	2	3	4	5						
6. I go immediately to bed when I feel severe pain	0	1	2	3	4	5						
7. I will stop any activity as soon as I sense pain coming on	0	1	2	3	4	5						
8. As soon as pain comes on I take medication to reduce it	0	1	2	3	4	5						
9. I avoid important activities when I hurt	0	1	2	3	4	5						
10. I try to avoid activities that cause pain	0	1	2	3	4	5						
11. I think that if my pain gets too severe it will never decrease	0	1	2	3	4	5						
12. When I feel pain I am afraid that something terrible will happen	0	1	2	3	4	5						
13. When I feel pain I think I might be seriously ill	0	1	2	3	4	5						
14. Pain sensations are terrifying	0	1	2	3	4	5						
15. When pain comes on strong I think that I might become paralysed or more disabled	0	1	2	3	4	5						
16. I begin trembling when engaged in an activity that causes pain	0	1	2	3	4	5						
17. Pain seems to cause my head to pound or race	0	1	2	3	4	5						
18. When I sense pain I feel dizzy or faint	0	1	2	3	4	5						
19. Pain makes me nauseous	0	1	2	3	4	5						
20. I find it difficult to calm my body down after periods of pain	0	1	2	3	4	5						

Appendix F

Pain and Smoking Expectancies Scale

Pain and Smoking Expectancies Scale (Ditre & Brandon, 2008)

Please rate the following items from 0 (completely unlikely) to 10 (completely likely)

1. Smoking would ease my pain if I were hurting. 0 1 2 3 4 5 6 7 8 9
2. If I were to experience pain, a cigarette would help reduce it. 0 1 2 3 4 5 6 7 8 9
3. If I hurt myself, I would feel less pain if I could smoke. 0 1 2 3 4 5 6 7 8 9
4. When I feel pain, a cigarette can really help. 0 1 2 3 4 5 6 7 8 9
5. I feel like smoking would help me cope with pain. 0 1 2 3 4 5 6 7 8 9

Appendix G

Center for Epidemiologic Studies Depression Scale

Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977).

For each statement, please circle the number in the column that best describes how you have been feeling *in the past week*.

	Rarely or none of the time (less than 1 day)	Some or a little of the time (1-2 days)	Occasionally or a moderate amount of the time (3-4 days)	Most or all of the time (5-7 days)
1. I was bothered by things that usually don't bother me.	0	1	2	3
2. I did not feel like eating; my appetite was poor.	0	1	2	3
3. I felt that I could not shake off the blues, even with the help from family or friends.	0	1	2	3
4. I felt that I was just as good as other people.	0	1	2	3
5. I had trouble keeping my mind on what I was doing.	0	1	2	3
6. I felt depressed.	0	1	2	3
7. I felt that everything I did was an effort.	0	1	2	3
8. I felt hopeful about the future.	0	1	2	3
9. I thought my life had been a failure.	0	1	2	3
10. I felt fearful.	0	1	2	3
11. My sleep was restless.	0	1	2	3
12. I was happy.	0	1	2	3
13. I talked less than usual.	0	1	2	3
14. I felt lonely.	0	1	2	3
15. People were unfriendly.	0	1	2	3
16. I enjoyed life.	0	1	2	3
17. I had crying spells.	0	1	2	3
18. I felt sad.	0	1	2	3
19. I felt that people dislike me.	0	1	2	3
20. I could not get "going".	0	1	2	3

Appendix H

GAD-7

GAD-7 (Spitzer, Kroenke, Williams, & Lowe, 2006)

Over the last 2 weeks, how often have you been bothered by the following problems?

	Not at all	Several days	Over half the days	Nearly every day
1. Feeling nervous, anxious, or on edge	0	1	2	3
2. Not being able to stop or control worrying	0	1	2	3
3. Worrying too much about different things	0	1	2	3
4. Trouble relaxing	0	1	2	3
5. Being so restless that it's hard to sit still	0	1	2	3
6. Becoming easily annoyed or irritable	0	1	2	3
7. Feeling afraid as if something awful might happen	0	1	2	3