View metadata, citation and similar papers at core.ac.uk

brought to you by CORE

provided by Scholarship@Western

Western Graduate&PostdoctoralStudies

Western University

Scholarship@Western

Electronic Thesis and Dissertation Repository

8-20-2013 12:00 AM

The Effect of Exercise on Cravings and Ad libitum Smoking Following Concurrent Stressors

Angela J. Fong
The University of Western Ontario

Supervisor
Dr. Harry Prapavessis
The University of Western Ontario

Graduate Program in Kinesiology
A thesis submitted in partial fulfillment of the requirements for the degree in Master of Arts
© Angela J. Fong 2013

Follow this and additional works at: https://ir.lib.uwo.ca/etd

 Part of the Applied Behavior Analysis Commons, Exercise Science Commons, Health Psychology Commons, and the Other Kinesiology Commons

Recommended Citation

Fong, Angela J., "The Effect of Exercise on Cravings and Ad libitum Smoking Following Concurrent Stressors" (2013). *Electronic Thesis and Dissertation Repository*. 1521.
https://ir.lib.uwo.ca/etd/1521

This Dissertation/Thesis is brought to you for free and open access by Scholarship@Western. It has been accepted for inclusion in Electronic Thesis and Dissertation Repository by an authorized administrator of Scholarship@Western. For more information, please contact wlswadmin@uwo.ca.

THE EFFECT OF EXERCISE ON CRAVINGS AND AD LIBITUM SMOKING FOLLOWING CONCURRENT STRESSORS

(Thesis format: Monograph)

by

Angela J. Fong

Graduate Program in Kinesiology

A thesis submitted in partial fulfillment
of the requirements for the degree of
Master of Arts

The School of Graduate and Postdoctoral Studies
The University of Western Ontario
London, Ontario, Canada

© Angela J. Fong 2013

Abstract

Quitting smoking itself is a stressor; it is likely that other stressors occur concurrently and deplete self-regulatory resources. Failure to cope leads to smoking relapse. Exercise has been shown to attenuate cravings and withdrawal symptoms in previous research and has yet to be examined following concurrent stressors. This study examined the effect of an acute bout of moderate intensity exercise on psychological withdrawal symptoms (PWS), cravings and ad lib smoking after concurrent stressors (i.e., temporary abstinence and depletion). Twenty-five smokers were randomized into exercise or passive conditions. Results showed PWS were significantly exacerbated after temporary abstinence and again after depletion for both conditions. A significant group x time interaction effect was found for cravings favouring exercise. Exercise had no effect on ad lib smoking. This is the first study to show craving reductions after exercise following concurrent stressors and represents a more ecologically valid lab-based scenario.

Keywords: smoking, temporary abstinence, self-regulation, acute exercise, concurrent stressors

Acknowledgements

It has been quite the journey for me to reach this point and it is because of those around me that I have reached my goals. To my supervisor, Harry Prapavessis, thank you for taking a chance on me, you always pushed me to strive for excellence and for that I am truly grateful. To my colleague Stefanie, thank you for being my friend and for always being in my corner, I am so humbled. Amy, thank you for always being an inspiration to me, I have a lot of live up to. Dr. Steven Bray, thank you for furthering my understanding of self-regulation literature, without you I would've been lost. To the EHPL: Lisa, Ally, Mia, Mariel, Lyndsay, Sandra, Anca, Terri and Nerissa, thank you for listening to my constant rambles and stories. I am so happy to have been part of this lab. To the love of my life, Dorrey, thank you for your unwavering love and support, even if you didn't always understand why I was so stressed. Finally, to my family, thank you for teaching me that hard work and perseverance will always pay off in the end.

Table of Contents

Abstract ii

Acknowledgements iii

List of Tables vi

List of Figures vii

List of Appendices viii

Chapter One: Literature Review 1

- **Introduction** 1
- **Smoking Addiction** 2
- **Stress During a Quit Attempt** 6
- **Stress Due to Environment and Cue-Related Smoking Stimuli** 8
- **Cue-elicited Craving Research** 12
- **Purpose and hypotheses** 15

Chapter Two: The Current Study 16

- **Methods** 16
- **Participants** 16
- **Design** 16
- **Manipulation (Fidelity) Check for Concurrent Stressors** 17
- **Primary Outcome Measures** 17
- **Secondary Outcome Measures** 17
- **Other Measures** 18
- **Intervention** 20
- **Procedure** 21
- **Sample Size Calculation** 24
- **Statistical Analyses** 25
- **Results** 28
- **Treatment of Data** 28
- **Group Equivalency at Baseline** 31
- **Manipulation Check** 31
- **Main Analyses** 32

Chapter Three: Discussion **39**

Effect of Concurrent Stressors on Psychological Withdrawal Symptoms 39

Effect of Exercise on Cravings 41

Effect of Exercise on Ad lib Smoking 44

Limitations 47

Conclusions 48

References **49**

Appendix A **63**

Appendix B **84**

Curriculum Vitae for Angela J. Fong **95**

List of Tables

Table 1: Criteria for nicotine addiction (USDHHS) 3

Table 2: Schedule of measures..... 27

Table 3: Baseline characteristics..... 34

Table 4: Manipulation check for psychological withdrawal symptoms 35

Table 5: Strength of desire to smoke across all data collection time points..... 36

Table 6: Correlations of key variables of interest 38

List of Figures

Figure 1: Flow diagram of study 30

Figure 2: The effect of exercise on strength of desire to smoke. 37

List of Appendices

Appendix A 63
Recruitment Advertisement 64
Ethics Approval 65
Letter of Information – Control Participants 66
Letter of Information – Experimental Participants 74
Ad lib Smoking Reminder Slip 83
Debriefing Letter 83
Appendix B 84
Shiffman – Jarvik Withdrawal Scale – Psychological Symptoms Subscale 85
Cravings 86
Demographic Questionnaire 87
Physical Activity Readiness Questionnaire (PARQ) 88
7-Day Physical Activity Recall Questionnaire 89
Fagerstrom Test for Cigarette Dependency 90
Smoking Ladder Questionnaire 91
Brief Self-Control Questionnaire 92
Coping Self-Efficacy Questionnaire 94

Chapter One: Literature Review

Introduction

Smoking is the most important cause of premature death in Canada (Makromaski-Illing & Kaiserman, 1999). Currently, 19.9% of those aged 12 and over smoke cigarettes daily or occasionally, resulting in approximately 5.8 million current smokers (Statistics Canada, 2011). Even though smoking prevalence has declined over the past decade, this pattern has now slowed (Reid, Hammond, Burkhalter, Rynard & Ahmed, 2013). Cigarette smoking is the cause of many chronic diseases such as lung and bladder cancers and is a risk factor for other diseases such as coronary heart disease and ischemic stroke (U.S. Department of Health and Human Services (USDHHS), 2004; 2010). Even low levels of exposure to cigarettes smoking (e.g., one puff of a cigarette or second-hand exposure) can lead to rapid and sharp declines in endothelial function and inflammation. These are risk factors for cardiovascular events and thrombosis (USDHHS, 2010). Yet individuals continue to smoke despite these detrimental health consequences. This is primarily due to smokers becoming dependent on cigarettes.

Smoking Addiction

In 2011, nearly half (45.4%) of smokers and recent quitters had quit in the past year (Statistics Canada, 2011). Of those who had quit, only 10.7% had stayed quit for one year (Reid et al., 2013). This quit rate is higher for those who seek pharmacological treatment (22%; Gonzales et al., 2006) and lower for those who try to quit on their own (4 – 7%; American Cancer Society, 2013). This modest smoking cessation success rate is a clear indicator that smoking is a powerful addiction, which is very difficult to quit for long periods of time. There are many factors that sustain smoking behaviour; it is likely that these factors also affect prolonged smoking abstinence.

Nicotine is the addictive agent in cigarettes. In addition to being highly addictive, nicotine is also a habit-forming substance (Pomerleau, Collins, Shiffman & Pomerleau, 1993). While there has yet to be consensus on criteria for nicotine addiction, USDHHS, *Diagnosis and Statistical Manual of Mental Disorder, 4th edition* (*DSM – IV*; American Psychological Association (APA), 2000) and *International Classification of Diseases, 10th revision* (World Health Organization, 1992) have agreed on some basic criteria (Table 1; USDHHS, 1988). Thus, outlining that smoking is a harmful and addictive habit. Furthermore, nicotine and smoking behaviour have various biological, psychobehavioural and environmental factors associated with it, which will be discussed in further detail in this section.

Table 1

Primary and additional criteria for nicotine addiction (USDHHS, 1988).

Primary Criteria	Additional Criteria

• Highly controlled or compulsive use
• Psychoactive effects
• Drug-reinforced behaviour
	• Addictive behaviour often involves
	  ○ Stereotypic pattern of use
	  ○ Use despite harmful effects
	  ○ Relapse following abstinence
	  ○ Recurrent drug cravings
	• Dependence-producing drugs often produce
	  ○ Tolerance
	  ○ Physical dependence
	  ○ Pleasant (euphoriant) effects

Biological factors. Nicotine is an agonist for nicotine acetylcholine receptors and has effects on the central and peripheral nervous systems (Holladay, Dart & Lynch, 1997). Nicotine binds to these receptors, which leads to dopamine release (McGehee and Role, 1996). This gives the smoker strong pleasant and rewarding feelings. Moreover, the receptors located in the ventral tegmental area of the brain (located near the brainstem and part of the reward circuit) are activated and have been linked to the reinforcement aspect of nicotine (USDHHS, 2010). These factors make smoking cessation very difficult to achieve, as the reward aspect of smoking is complex and challenging to reshape or break.

Genetics play an important role in the uniqueness of smoking behaviour. Variations, or polymorphisms, of the CYP2A6 gene contribute to different patterns of smoking behaviour and cessation rates. Those who are quicker to metabolize nicotine show an increase in smoking activity and decrease in smoking cessation activity compared to slower nicotine metabolizers (Munafo, Clark, Johnstone, Murphy & Walton, 2004). These polymorphisms can contribute to smoking cessation success rates, as quicker metabolizers are less likely to be successful (Munafo et al., 2004). In addition to biological effects, nicotine is a psychoactive substance, which alters normal behaviour (APA, 2000).

Psychobehavioural factors. As individuals continue to smoke, they become more tolerant of nicotine (Kalant, LeBlanc & Gibbins, 1971). Chronic tolerance decreases a smoker's responsiveness to nicotine, leading to an increase in number of cigarettes smoked (Kalant et al., 1971). A smoker is dependent on nicotine when they abstain from smoking and there is a significant increase in cravings and withdrawal symptoms (USDHHS, 2010). Cigarette cravings vary based on

dependence. Similarly, withdrawal symptoms also vary and include: affective disturbances (i.e., irritability, anger, anxiety and a depressed mood) and behavioural symptoms (i.e., restlessness, sleep disturbance and increased appetite) (APA, 2000). Moreover, cognitive disturbances are also common, including difficulty concentrating and perceived difficulty coping with daily life events (Hughes, 2007). Withdrawal symptoms have been tightly linked to pattern of use, time course, intensity and relationship with relapse (USDHHS, 2010).

Due to its role in the mesolimbic pathway, or reward system of the brain, nicotine is a reinforcing drug. A stimulus is defined as reinforcing if the behaviour or response to obtain the stimulus is increased. Drugs are reinforcing if self-administration of the drug is more than that of an inert substance (Everitt & Robbins, 2005). There are behavioural grounds for reinforcing smoking, some include changing negative affect (e.g., reducing restlessness, sadness or anxiety), suppressing appetite to maintain weight, increasing coping abilities in stressful situations and enhancing concentration during cognitively demanding tasks (Perkins, 1993; Heishman, Taylor & Henningfield, 1994; Kassel, Stroud & Paronius, 2004). Reinforcement of self-administration of nicotine (i.e., smoking) is clearly modulated by positive and negative factors that lead to learning and increased smoking behaviour (Tiffany, Conklin, Shiffman & Clayton, 2004). There are many cues that can spark this learning cycle, such as those found in a smoker's environment.

Environmental factors. Cues from the environment can have a large impact on smoking behaviour. Clinical studies use a cue-elicited smoking paradigm, whereby participants are exposed to various smoking-related (i.e., lit cigarette sitting in an ash tray) or environmental stimuli (i.e., cognitive interference via Stroop task)

(Carter & Tiffany, 1999; Munafo, Mogg, Roberts, Bradley & Murphy, 2003). Cues elicit physiological and psychobehavioural responses, such as increased heart rate, galvanic skin response and increased desire to smoke (Niaura, Abrams, Monti & Pedraza, 1989; Carter & Tiffany, 1999; Waters, Shiffman, Sayette, Paty, Gwaltney & Balabanis, 2004). According to Conklin & Tiffany (2002), smoking cessation treatments that can dampen a smoker's response (i.e., cravings) to environmental stimuli and related cues may increase the likelihood of prolonged smoking cessation.

In summary, smoking addiction/dependency is complex and involves the interplay of biological, psychobehavioral and environment factors. This interplay makes it easy to see how quitting smoking can be very difficult. In the next section, stress during a quit attempt and stress due to the environment and cue-related stimuli will be discussed with respect to effective treatments for reducing cravings and withdrawal symptoms.

Stress During a Quit Attempt

In a stressful situation (i.e., during a quit attempt) an individual must constantly monitor the stimulus and override the natural tendency to let one's attention wander (Matthews, Scheier, Bunson & Carducci, 1989). In order to successfully cope with a stressor, individuals must override or stop thoughts, urges and emotions in addition to regulating attention (Lazarus & Folkman, 1983; Pennebaker, 1988; Wegner & Pennebaker, 1993; Eisenber, Fabes & Guthrie, 1997). This change in behaviour leads to depletion of self-regulatory resources (Muraven & Baumeister, 2000). This cognitive breakdown may lead to an increase in the number of cigarettes smoked and likelihood of relapse (Carter & Tiffany, 1999;

Chassin, Presson, Sherman & Kim, 2002). Moreover, failure to cope with cigarette cravings and psychological withdrawal symptoms is associated with high relapse rates and accounts for the terrible quit smoking success rates (West, Hajek & Belcher, 1989; Killen & Formann, 1997; Piasecki, Naiura, Shadel, Fiore & Baker, 2000; Taylor & Katomeri, 2007). An examination of current treatments to alleviate cravings and withdrawal symptoms during a quit attempt is discussed below.

Pharmacological treatments. Oral (e.g., gum, spray, lozenge) nicotine replacement therapy (NRT) has been shown to have an acute effect on cigarette cravings (Ferguson & Shiffman, 2009). For instance, Niaura and colleagues (2005) showed that rapid-release nicotine gum showed a more rapid and meaningful relief of nicotine cravings compared to nicotine polacrilex gum. In addition, experimental research has shown transdermal NRT (patch) to reduce cravings and withdrawal symptoms best when combined with another therapy (Stead et al., 2012). Moreover, pharmacological aides such as varenacline (Champix®) and sustained-release bupropion (Zyban®) have been shown to be efficacious in clinical trials (Scharf & Shiffman, 2004; Jorenby et al., 2006). However, in cue-elicited situations, the effectiveness of these aides is inconsistent (Wilson, Sayette, Delgado & Fiez, 2005; Weinstein et al., 2009).

Non-pharmacological treatments. While it is acknowledged that there are various forms of non-pharmacological treatments (e.g., cognitive behavioural therapy and counselling from health professionals), this section will review literature on exercise, as it is the main treatment used in the present study. A single bout of light-to-moderate intensity exercise has been shown to significantly reduce cravings in temporarily abstinent smokers (Daniel, Cropley & Fife-Schaw, 2007; Everson,

Daly & Ussher, 2008; Janse Van Rensburg and Taylor 2008; Faulkner, Arbour-Nicitopoulos & Hsin, 2010; Elibero, Janse Van Rensburg & Drobes, 2011; Harper, 2011; Janse Van Rensburg, Taylor, Hodgson & Benattayallah, 2012). Two recent meta-analyses (Haasova et al., 2012; Roberts, Maddison, Simpson, Bullen, & Prapavessis, 2012) provide further empirical evidence for acute exercise having positive effect on cigarette cravings and withdrawal symptoms during abstinence. It has been shown that exercise is more than a distraction from cravings and withdrawal symptoms, as the benefits of exercise last after the bout of exercise is over (Daniel et al., 2006; Ussher, West, Doshi, & Sampuran, 2006). In addition, treatment expectations are unrelated to reductions in cravings and withdrawal following an acute bout of exercise (Daniel et al., 2007; Harper, Fitzgeorge, Tritter, & Prapavessis, 2013).

In order to further support acute exercise for managing cravings and withdrawal symptoms, it is crucial to examine cue-elicited smoking research to determine the value of exercise. Before this literature is reviewed, some background on stress due to environment and cue related smoking stimuli and on self-regulation is warranted.

Stress Due to Environment and Cue-Related Smoking Stimuli

As highlighted in the previous section, smoking is a patterned, habitual behaviour and a smoker, who wishes to quit, must exert self-regulation to resist smoking urges in addition to withdrawal symptoms such as negative affect, irritability and nausea (Tiffany, 1990; Brown, 1998; Carter & Tiffany, 1999). Coping with a quit attempt together with other environmental and cue related stressors is likely to vastly

deplete self-regulatory strength (Muraven & Baumeister, 2000). These situations may involve smoking stimuli, social pressures, negative emotional states and/or intense smoking urges (Brodbeck, Bachmann & Znoj, 2012). It is suggested that as negative affect increases in response to abstinence, smoking cues and other stressors cognitive pathways become biased and promote increased smoking behaviour (Shiffman & Waters, 2004). For instance, non-abstaining smokers smoke more cigarettes and experience increased urges to smoke when they have experienced more negative life events and perceive higher levels of stress (Todd, 2004). Also, a strong predictor of relapse (i.e., one-time event of smoking behaviour) is an inability to cope with stressful or high-risk situations, particularly those where individuals might reach for a cigarette (Chassin, Presson, Sherman, & Kim, 2002). In order to appreciate the effect of self-regulation during smoking cessation, it is imperative to examine the current body of literature.

Self-regulation. To begin, self-regulation is exertion of control over self by the self; more specifically it is when a person attempts to alter their normal way of thinking, feeling or behaving (Muraven & Baumeister, 2000). Self-regulation involves effort in inhibiting urges, behaviours, desires or emotions. The limited strength model of self-regulation (strength model) suggests that self-regulatory strength is needed to execute self-function (Baumeister, 1998). The model also has several key assumptions. First, self-regulatory strength is limited, such that a person has a finite capacity for self-regulation. Second, all self-regulatory behaviours draw from the same resource pool. Third, self-regulatory success or failure depends on an individual's amount of self-control strength. If strength is depleted, it may lead to a breakdown in self-regulatory behaviour; however, this decrease is not permanent.

Tasks that require more self-regulation are more affected by depletion than those that require less self-control. Finally, strength is used up in the process of self-regulation. Similar to other limited resource models such as attention, the strength model predicts that attempting to regulate multiple behaviours simultaneously, an inability to self-regulate, may lead to decreased overall self-regulation. The strength model has implications for health research, in particular, smoking cessation as it provides an applicable framework to develop and test hypotheses.

Compared to other self-regulation behaviours, such as dieting and alcohol consumption, smoking cessation has received little attention in terms of application of the strength model, as outlined in a review by Hagger, Wood, Stiff and Chatzisarantis (2009). The first study by O'Connell, Schwartz and Shiffman (2008) examined the effect of duration and frequency of resisted temptations to smoke on urges from two data sets using ecological momentary assessment. The authors predicted that self-regulatory resources would be depleted and result in an increased likelihood of relapse in smokers. Contrary to their predictions, increased frequency of resisted temptations actually decreased likelihood of relapse. Increased relapse duration had no effect. It is possible that the frequency of resisted urges may have increased smokers' ability to resist urges and thereby increased self-regulatory strength through training. While this study took place in a naturalistic setting, O'Connell et al. (2008) suggested that the strength model might not be appropriate in "real world" settings. It is also important to note that the authors did not measure trait self-regulation, which may have had a moderating effect on intensity of urges and quitting (Hagger et al., 2009).

Similarly, the strength model and smoking cessation have also been studied in a laboratory setting. Shmeuli and Prochaska (2009) examined the effect of self-regulation (cognitive) depletion on the likelihood of smoking. Participants were asked to either resist tempting sweets (depletion condition) or raw vegetables (control condition). Participants were given a 10-minute recess where their smoking behaviour was discretely observed; this was also biologically verified with breath carbon monoxide readings. Those who were randomized to depletion condition were more likely to smoke during the recess (53.2%) than those in control condition (34.0%). The authors suggest that this has implications for self-regulation strength as a factor for resisting the urge to smoke and further supports the notion that individuals who are attempting to quit smoking should delay dieting behaviours (Fiore et al., 2008).

Extending this research, Shmeuli and Prochaska (2012) looked into replenishing self-control strength through positive affect induction. Smokers were depleted in the same manner as the aforementioned study. Then, either positive or neutral affect was elicited through a writing or video condition, after which smoking behaviour was observed during a 10-minute recess. Those randomized to depletion and had a positive affect induction via video clips were least likely to smoke (10.5%) compared to those who were depleted, but in neutral video or writing conditions (65.5% and 85%, respectively). Interestingly, writing exercises were associated with smoking during recess regardless of whether they were positive or neutral. The authors suspect that participants may have written about tobacco-related activities, which may have led to smoking during recess. Limitations of this study include that self-control was manipulated, but not directly measured and potentially confounding

variables (e.g., arousal, distraction, etc.) were not addressed in this study. Also, smokers in this group reported a 4.1 (*SD* = 2.5) on the Fagerstrom Test for Cigarette Dependence indicating that they have low dependence on cigarettes and this may have further confounded results (Heatherton, Kozlowski, Frecker & Fagerstrom, 1991).

Limitations. While these studies provide a good foundation for examining self-regulation in smokers, there are a few limitations. The depletion tasks used are not applicable in a real world setting. For instance, dieting while abstinent may only apply to a sub-population of those who wish to quit smoking. Further, a depleting task should represent a more ecologically valid scenario so that it may represent any host of stressors, for instance those experienced in daily life. Another limitation is that smoking behaviour was generally modeled, or was observational. Using a quantifiable method, such as those employed in acute smoking study paradigms may afford a clearer picture of the effect of cognitive depletion on smoking behaviour. Finally, participants were in relatively calm states, which is not usually the case for an individual during a quit attempt. Thus, further examination of how self-regulation influences smoking behaviour during environmental related stress (e.g., resisting temptations) is required. In the next section, studies that have examined whether treatments like exercise attenuate increases in cue-elicited cravings during abstinence will be reviewed.

Cue-elicited Craving Research

Cue-reactivity research, or cue-elicited research is originally derived from classical conditioning framework (Tiffany, 1995a). In this paradigm, addicts are

exposed to cues related to their addiction (e.g., drug paraphernalia or drug-use situations) and psychological and/or physiological responses are measured. Cues can be presented in a variety of ways such as pictures, audio clips or *in vivo*. Generally, responses are measured through self-report using a measure of craving or desire for the drug. Other measures include heart rate, galvanic skin response and sweat gland activation (Carter & Tiffany, 1999). A meta-analysis conducted by Carter and Tiffany (1999) suggests that the cue-elicited research paradigm is useful for basic addiction research and robust for psychological responses. The authors also suggest that more insight is needed to determine the factors around cue-elicited responses.

Experimental studies have shown that nicotine replacement therapy (NRT) and naltrexone, an opioid antagonist; attenuate increases in cue-elicited cravings during smoking abstinence. Participants who received a 50mg dose of naltrexone and NRT had no increase in urge to smoke or negative affect compared to a placebo group (Hutchinson et al., 1999). Conversely, participants using the patch alone have produced mixed results. For instance, high dose patches (35mg) attenuate overall cravings, some withdrawal symptoms (i.e., concentration and negative affect), but have no effect on cue-provoked cravings (Shiffman et al., 2003; Waters et al., 2004). Similarly, lower dose patches (21mg) attenuate effects of abstinence, but have limited effect on cue-elicited cravings and urges (Tiffany, Cox & Elash, 2000; Morissette et al., 2005).

Using a non-pharmacological approach, Taylor and Katomeri (2007) showed that a single bout of exercise could moderate cue-elicited cravings and withdrawal symptoms during a temporary quit period. Following a 2-hour abstinence period,

participants were randomized to either a 15-minute brisk walk or passive condition. Both groups completed a set of tasks (i.e., stressors) following their respective treatment conditions. Exercise attenuated strength of desire to smoke, tension, poor concentration and stress in response to a lit cigarette, but had minimal effects on cravings and withdrawal symptoms in response to other stressors (i.e., Stoop task and speech task). Moreover, participants who exercised lit up a cigarette 57 minutes later than passive controls after leaving the laboratory.

While the study conducted by Taylor and Katomeri (2007) advances knowledge, it nevertheless has some limitations. First, a 2-hour abstinence period may not have been long enough to elicit intense cravings and withdrawal symptoms, which are more reflective of a true quit attempt. Next, the stressors were presented after the treatment condition, and although this was not the authors' main objective, a more ecological scenario would be to present the stressors immediately after the temporary abstinence. It is unknown whether a single bout of exercise is beneficial when a smoker is experiencing a temporary abstinence period (stress condition 1) followed by exposure to a cognitive depletion task and/or cue-elicited smoking stimuli (stress condition 2). This situation mirrors a real life situation where individuals often have to simultaneously deal with both types of stressors. The combined effects of both stressors may not be the same as those felt when an individual engages in a temporary quit attempt, only. In other words, the severity of the withdrawal symptoms, specifically the psychological symptoms, will likely be higher for those experiencing concurrent stressors. This in turn, makes it more challenging for treatments like exercise to work in reducing cravings.

Purpose and hypotheses

The purpose of this study is to examine the effect of a single bout of exercise on cigarette cravings, psychological withdrawal symptoms and ad libitum smoking following concurrent stressors (temporary smoking abstinence period and cognitive depletion/cue-elicited smoking stimuli).

Hypothesis 1 (manipulation check—concurrent stressors). All participants will experience higher psychological withdrawal symptoms following temporary abstinence and then again following cognitive depletion/cue-elicited smoking stimuli.

Hypothesis 2 (primary outcome—cravings). Compared to passive controls, those who perform an acute bout of moderate intensity exercise will experience lower cravings following temporary abstinence and cognitive depletion/cue-elicited smoking stimuli.

Hypothesis 3 (secondary outcome—ad libitum smoking). Compared to passive controls, those who perform an acute bout of moderate intensity exercise will take a longer time to light up their first cigarette following temporary abstinence and cognitive depletion/cue-elicited smoking stimuli.

Chapter Two: The Current Study

Methods

Participants

Healthy male and female smokers (N = 36) were recruited using advertisements in local newspapers and online classifieds at Western University, Fanshawe College and the London community (Appendix A). Inclusion criteria included: (a) aged 18 – 65 years; (b) smoked an average of 10 cigarettes or more per day for at least two years; and (c) no contraindications to physical activity. Exclusion criteria included: (a) for females, were pregnant or intending on becoming pregnant before completion of the study and (b) an inability to temporarily abstain from smoking for a minimum of 12 hours. Twenty-five participants (M_{age} = 37.4, SD = 14.8) who satisfied all criteria completed this study and were randomized into one of two conditions: moderate intensity exercise (experimental arm) or passive sitting (control arm). Participants included 14 females and 11 males.

Design

This research study used a stratified (age and sex), two-group randomized controlled trial design. A computer-generated numbers table accomplished randomization for age (18-30 years, 31-50 years, 51-65 years) and sex (male, female). Participants, but not researchers, were blinded to group allocation and were unapprised to the existence of a second condition. Refer to Figure 1 for participant study flow diagram.

Manipulation (Fidelity) Check for Concurrent Stressors

The Shiffman-Jarvik withdrawal scale is a 15-item questionnaire that assesses tobacco withdrawal symptoms in smokers attempting to quit smoking (Shiffman & Jarvik, 1976). Items are measured on a 7-point Likert scale anchored at 1 *definitely do not feel* and 7 *definitely feel*. The items are divided into subscales based on factor analysis: cravings (five items), psychological symptoms (five items), physical symptoms (three items), sedation (one item) and appetite (one item). For the purpose of this study, only the psychological subscale (see Appendix B) was administered to validate that participants' scores for psychological distress increased from baseline to post-abstinence (stress condition 1) and then again from post-abstinence to post-cognitive depletion/ cue-elicited smoking stimuli (stress condition 2). In the current study, this scale demonstrated acceptable reliability based on Cronbach's alpha (at baseline $\alpha = .73$; post-abstinence $\alpha = .82$; post-cognitive depletion/ cue-elicited smoking stimuli $\alpha = .80$; 2-minutes post-treatment $\alpha = .76$).

Primary Outcome Measures

Cigarette cravings. Cigarette cravings were measured using strength of desire to smoke (West, Hajek & Belcher, 1989). This scale was measured with a single item 'How strong is your desire to smoke right now?' scored on a 7-point Likert scale from 1 *not at all* to 4 *somewhat* and 7 *extremely*.

Secondary Outcome Measures

Ad libitum smoking was calculated as the difference in time from leaving the laboratory after post-abstinence assessments (Visit 2) to the time of their first

cigarette; this method is consistent with previous research in acute smoking (Taylor & Katomeri, 2007). Participants either emailed the study's purpose-built email address with the time and date of their first cigarette, or called and left a message on a secure phone line. Researchers then calculated the difference between the self-reported times and expressed this variable in minutes.

Other Measures

Demographic characteristics. Demographic information, including: age, gender, smoking status (i.e., number of cigarettes per day) and smoking history (i.e., number of years smoking regularly) were collected. Height (m) and weight (kg) were recorded and Body Mass Index (BMI; kg/m^2) was calculated.

Physical activity readiness questionnaire. This seven-item questionnaire was used to determine if an individual required medical clearance from a physician before engaging in physical activity (CSEP). Participants responded yes or no to items; if a participant responded yes to one or more items then they were excluded from the study. An example of an item is, "Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?"

Physical activity. The Seven Day Physical Activity Recall Questionnaire (7DR, Blair, 1985) was used to measure current levels of physical activity. This measure was used to screen individuals at baseline (Visit 1) to ensure that they were not already exceeding current physical activity guidelines of 150 minutes of moderate to vigorous physical activity per week (CSEP). This questionnaire prompts individuals to remember information about type, duration and intensity of

physical activity over the previous seven days. The 7DR has been used extensively in exercise and health research (Daniel, Cropley, Ussher & West, 2004).

Smoking dependency. Perceived dependency of cigarettes was measured with the Fagerstrom Test for Cigarette Dependency (FTCD; Heatherton, Koxlowski, Frecker & Fagerstrom, 1991). The FTCD is scored out of 10 points total where a score of zero to two indicates a very low dependence; a score of three to four is a low addiction; a score of five is a medium addiction; a score of six to seven is high addiction and a score of eight to ten is a considered a very high addiction. The FTCD has shown high internal consistency and adequate retest reliability (Pomerleau, Carton, Lutzke & Flessland, 1994). In this study, Cronbach's alpha was slightly below acceptable levels ($\alpha = .66$); however, inter-item correlation was adequate at .22 (Briggs & Cheek, 1986).

Readiness to quit smoking. Smoking ladder questionnaire determines the readiness of a participant to quit smoking. It is based on stages of change theory and separates smokers based on their readiness to quit (Prochaska & DiClemente, 1983). The categories are pre-contemplation (one and two on the ladder); contemplation (three and four); preparation (five and six); maintenance (seven and eight) and action (nine and ten). Participants are asked to only select one statement that best represents their thoughts as a smoker (Biener & Abrams, 1991).

Self-control. This 13-item measure (Tangney, Baumeister & Boone, 2004) assesses individual differences in self-control in various situations. Items are measured on a 5-point Likert scale, 1 *not at all* and 5 *very much*. An example of an item is, "I am good at resisting temptation." This scale has shown good internal

consistency and retest reliability (Tangney et al., 2004). In the current study, Cronbach's alpha was acceptable (α = .75).

Coping self-efficacy. A general coping measure, Coping Self-Efficacy Scale, was used to assess perceived self-efficacy for coping with challenges (Chesney, Neilands, Chambers, Taylor & Folkman, 2006). For the purpose of this study, only the emotion and thoughts subscales were used. This nine-item subscale prompts participants to think about their ability to perform behaviours important for adaptive coping. The 11-point scale is anchored by 0 *cannot do at all* and 10 *certainly can do*. An example of an item is, "When things aren't going well for you, or when you're having problems, how confident or certain are you that you can do the following: Make unpleasant thoughts go away." This measure has shown strong internal consistency and test-retest reliability (Chesney et al., 2006). In the current study, Cronbach's alpha was good (α = .82).

Intervention

Moderate intensity exercise. Participants randomized into this condition completed a single, 15-minute bout of moderate intensity exercise. Moderate intensity was defined as 45-68% of heart rate reserve (HRR; Karvonen, Kentala, & Mustala, 1957). HRR was calculated using the formula: maximum heart rate (HRmax; 220 – age) – resting heart rate (HRrest) (CSEP). Resting heart rate (RHR) was taken at baseline (Visit 1). Additionally, resting heart rate can drop by about 8.5 beats per minute after a temporary abstinence period (Perkins, Epstein, Stiller, Marks, & Jacob, 1989). Resting heart rate was taken before abstinence because it is an indicator of normal heart rate; however, if a participant indicated that they had

just smoked a cigarette before Visit 1 then a default resting heart rate of 75 beats per minute was used in place of RHR. Rationale for this decision is that smoking a cigarette would have elevated their RHR above their normal range. For moderate intensity exercise, the calculation for 45% HRR was: [(HRmax – HRrest) X .45] + HRrest. The calculation for 68% HRR was: [(HRmax – HRrest) X .68] + HRrest (CSEP). Heart rate was monitored using a Polar RS100 heart rate monitor.

The exercise condition consisted of a 2-minute warm up, followed by 10 minutes of walking at a rate, which allowed participants to reach 45% to 68% of their HRR and a 3-minute cool down on a treadmill (Woodway, Waukesha, WI). Researchers controlled the incline and speed of the treadmill, but participants indicated if the speed and incline were appropriate for their current level of fitness.

Passive sitting. Participants randomized to this condition were asked to sit in a quiet room for 15 minutes. They were not discouraged from reading.

Procedure

Conduct of this trial followed principles outlined in the Declaration of Helsinki (World Medical Association, 2008) and the World Health Organization Good Clinical Research Practice (World Health Organization, 2002). Conduct and reporting followed CONSORT principles (www.consort-statement.org). Ethical approval was obtained from Western University's Health Sciences Research Ethics Board (#103019; Appendix A) and participation was voluntary. All participants read the Letter of Information (Appendix A), had his/her questions answered and signed a Consent Form (Appendix A) prior to participation in this study.

Participants were initially screened for eligibility criteria by telephone or e-mail. After initial screening, eligible and interested participants were asked to come in for a baseline assessment (Visit 1) to further confirm initial screening. Screening questions included smoking status (i.e., number of cigarettes smoked per day), smoking history (i.e., number of years as a regular smoker), current physical health and PAR-Q. If a participant answered, "yes" to any question on the PAR-Q they were ineligible to participate. This study involved completing two assessments baseline and post-abstinence (Visit 1 and Visit 2) at the Exercise and Health Psychology Laboratory (EHPL; www.ehpl.uwo.ca) at Western University in London, Ontario, Canada (see Figure 1).

Baseline assessments (Visit 1) included verification of smoking status using the piCO+^{TM} Smokerlyzer® carbon monoxide (CO) monitor (Bedfont Scientific Ltd., Kent, England). A breath CO reading of greater than 10 parts per million (ppm) was the threshold of inclusion as used in previous research (Daniel et al., 2007). CO monitors were calibrated on a daily basis to ensure accurate readings. Resting heart rate was recorded for all participants. After, participants completed a demographic information sheet. Participants then completed the following: (1) 7DR (Blair, 1985); (2) FTCD (Heatherton et al., 1991); (3) strength of desire to smoke (West et al., 1989); (4) Shiffman-Jarvik withdrawal scale – psychological subscale (Shiffman & Jarvik, 1976); (5) smoking ladder (Beiner & Abrams, 1991); (6) Coping Self-Efficacy Scale (Chesney et al., 2006) and (7) Brief Self-Control Efficacy Questionnaire (Tangey et al., 2004). Questionnaires can be found in Appendix B. A schedule of measures can be found in Table 2. Visit 1 took about one hour to complete.

Post-abstinence assessment (Visit 2) was scheduled 4-7 days after baseline (Visit 1). Prior to the second assessment, participants were required to abstain from smoking for 18 hours (stress condition 1). In addition, participants were also asked to abstain from common forms of substance dependency (i.e., caffeine and alcohol) to ensure clean or unenhanced psychological responses to questionnaires and Stroop task at the second visit. This is consistent with other temporary abstinence studies (Taylor & Katomeri, 2007). Temporary abstinence was verified using expired CO; a reading of less than 10ppm validated temporary abstinence. Next, participants completed a questionnaire packet containing strength of desire to smoke (West et al., 1989) and psychological withdrawal subscale (Shiffman & Jarvik, 1976) (Table 2).

Regardless of randomization, participants underwent depletion via a modified, augmented computerized Stroop task and cue-elicited smoking stimuli (stress condition 2). The Stroop task is a direct measure of depletion that incongruently matches words and colours, whereby participants are required to say aloud the colour of the printed ink and not the word (Williams et al., 1996). For example, *blue* could be presented in green ink and participant would be required to say *green*. However, when participants came across words in red ink they were required to override the first rule and say the actual word and not *red*. As an indirect measure of depletion, researchers asked participants to place a cigarette of their preferred brand on the desk in plain sight (cue-elicited smoking stimulus) before completing the Stroop task. They were informed that for every error made, a dollar would be subtracted from their total compensation (augmentation). Then, participants performed this task for 5 minutes and error rate and progress (i.e., number of

prompts completed) was recorded. After depletion, participants completed a manipulation check. This was to ensure that the task did in fact deplete the participant rather than energize them, or have no effect.

During treatment conditions (either moderate intensity exercise or passive sitting), participants' cigarette cravings were assessed at 5-minute intervals. Two minutes after participants completed their treatment conditions they completed a final, post-treatment questionnaire packet (see Table 2).

Upon questionnaire completion, participants were asked to report the time of their first cigarette after leaving the lab. Participants were given an envelope that contained the debriefing letter (Appendix A) and their full compensation. A reminder slip with their participant number and laboratory and study information was attached to the envelope (Appendix A). Researchers reiterated the importance of calling or e-mailing prior to opening the envelope. Also, a reminder sticker was placed across the seal to further encourage participant compliancy. Participants reported their participant number and time of first cigarette to either a purpose-made e-mail account, or left a voicemail on a secure line at the EHPL. Researchers contacted participants if they did not respond within three hours. Visit 2 took about 1 hour to complete.

Sample Size Calculation

Manipulation check (concurrent stressors). Previous research has shown Shiffman-Jarvik withdrawal symptoms psychological subscale scores of 2.55 at baseline increases to 3.72 (standard deviations not reported by authors) after a 13-16 hour period of temporary abstinence (Canamar & London, 2012). Moreover, no

previous research exists to inform power analysis for psychological symptoms after temporary abstinence and depletion (concurrent stressors). It is anticipated that the additional stressor of depletion will likely elevate psychological symptoms from 3.72 to 4.2 (*SD* = 1.0). Hence, in order to be adequately powered (power = .82) to detect this difference, a sample size of 25 smokers is needed with the alpha set at 0.05 (SamplePower 3, IBM-SPSS).

Post-treatment. It is anticipated that post-treatment differences in strength of desire after temporary abstinence and depletion will be larger [treatment mean = 3.67 (*SD* = 1.96) vs. control mean = 6.3 (*SD* = 1.0)] than differences in strength of desire after temporary abstinence only [treatment mean = 2.81 (*SD* = 1.96) vs. control mean = 5.48 (*SD* = 1.18); Taylor & Katomeri, 2007]. Hence, a sample size of 10 for each arm is needed to be powered at 0.92 with an alpha of 0.05 to detect these differences (SamplePower 3, IBM-SPSS).

Statistical Analyses

Group equivalency. One-way ANOVAs were used to determine group equivalency at baseline for (a) key demographic, smoking status and psychological variables (i.e., age, gender, cigarettes smoked per day, smoking history, physical activity levels, self-control and coping self-efficacy); and (b) the primary and secondary outcome variables (i.e., strength of desire and psychological symptoms).

Manipulation check (exercise). A paired t-test was used to determine if those randomized to moderate intensity exercise had increased their heart rates from baseline to post-exercise.

Manipulation check (concurrent stressors). Repeated measures analysis of variance (ANOVA) and follow-up *post-hoc* paired t-tests were used to determine if psychological symptoms increased from baseline to post-abstinence (stress condition 1) and then again from post-abstinence to post-depletion (stress condition 2) (hypothesis 1).

Primary and secondary outcome analyses. For the primary outcome, a group (moderate intensity exercise or passive control) by time (baseline, post-abstinence, post-depletion, 5 minutes, 10 minutes, 15 minutes into treatment and immediately post-treatment) repeated measures ANOVA was used to determine an interaction effect for cravings (hypothesis 2). Planned *post-hoc* t-tests followed a significant interaction. For the secondary outcome, an independent t-test was conducted for ad lib smoking comparing means between treatment groups (hypothesis 3). Finally, bivariate correlation was used to establish linear relations between key variables of interest (age, years smoked, cigarettes smoked per day, baseline expired CO, FTCD, smoking ladder, brief self-control and coping self efficacy scores), post-depletion psychological withdrawal, post-treatment cravings and ad lib smoking scores.

The level of significance was accepted at $p < .05$ for all tests (Tabachnick & Fidell, 1996). For t-tests, all *p*-values are two-tailed. Effect sizes (η^2) accompany all reported findings. In accordance with Cohen (1988), 0.01 is a small effect size, 0.06 is a moderate effect size, and 0.14 is a large effect size. Data were analyzed using IBM SPSS Statistics (Version 21).

Table 2

Schedule of measures.

Variable	Baseline	Post-abstinence	Post-depletion *(manipulation check)*	During Treatment – 5 min	During Treatment – 10 min	During Treatment – 15 min	Post-treatment
PAR-Q	x						
Expired CO	x	x					
Demographics and smoking history	x						
Physical activity recall	x						
FTCD	x						
Psychological withdrawal symptoms	x	x	x				
Smoking ladder	x						
Strength of desire to smoke	x	x	x	x	x	x	x
Self-control	x						
Coping self-efficacy	x						
Ad libitum smoking							x

Note. FTCD = Fagerstrom Test for Cigarette Dependency. Treatment conditions are either moderate intensity exercise or passive sitting.

Results

Treatment of Data

Missing data. Data from participants who did not complete an outcome measure during testing (baseline and post-abstinence assessments) were omitted from that measure. This occurred three times at baseline (Visit 1) for 7-day Physical Activity Recall Questionnaire, only. No data were missing at post-abstinence assessment (Visit 2). Participants who missed Visit 2 were omitted from the data set.

Outliers. Outliers were identified using a boxplot; if a datum point was more than 1.5 box-lengths from the edge of the box it was considered an outlier. Outliers and extreme outliers were removed from the final data set. At Visit 2, fourteen outliers were discovered. Three outliers for hours abstained from smoking (2 experimental and 1 control), six for ad lib smoking (2 experimental, 4 control), two for modified Stroop task errors (1 experimental and 1 control) and three for days in between assessments (Visit 1 and Visit 2). No outliers were found at Visit 1.

Assumptions of statistical techniques. Assessment of normality was accomplished through skewness and kurtosis values and checking histogram shapes for distribution. Finally, Kolmogorov-Smirnov statistic was used to further assess normality. Assumptions of normality were not violated.

Repeated measures analysis of variance (ANOVAs) and one-way ANOVAs were assessed for assumptions of homogeneity of variances with Levene's test for equality of variances. Assumptions were violated for hours abstained from smoking (p = .04). Repeated measures were also checked for homogeneity of inter-

correlations using Box's M statistic. Assumptions were not violated.

Repeated measures ANOVAs were assessed for sphericity using Mauchly's Test of Sphericity statistic. Upon inspection, assumptions were violated for cravings and thus, test within-subjects Greenhouse-Geisser statistics are reported.

Finally, bivariate correlations were checked for assumptions of linearity and homoscedasticity by examining the distribution of data points on a scatterplot. Assumptions for homoscedasticity were not violated.

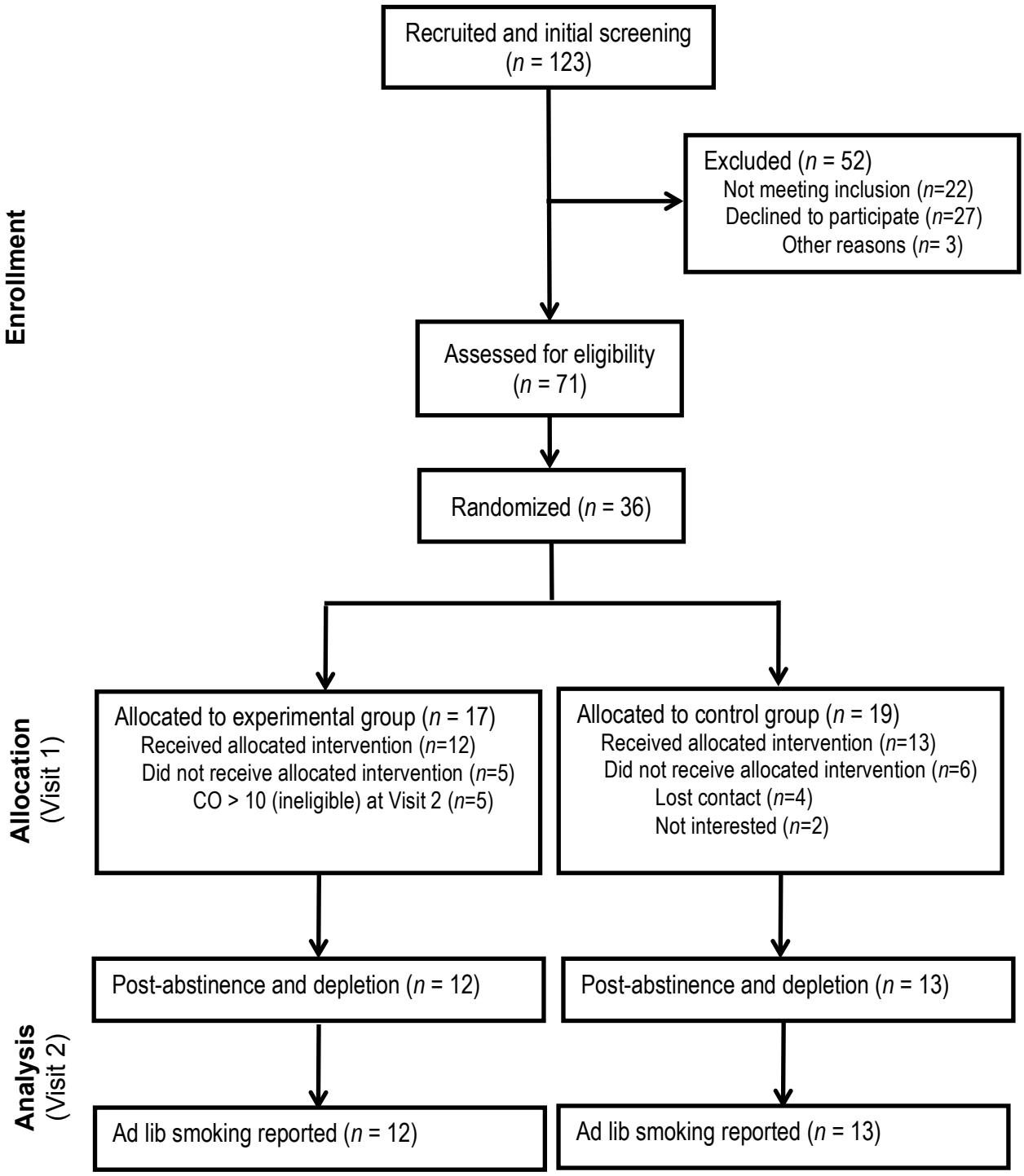


Figure 1. Flow diagram of participants moving through the study.

Group Equivalency at Baseline

Baseline characteristics and one-way ANOVAs for moderate intensity exercise vs. passive control groups are shown in Table 3. There were no significant differences between groups for baseline characteristics or strength of desire to smoke (cravings) and psychological withdrawal symptoms. There also were no significant differences between groups on any of the demographic, smoking status or psychological constructs (i.e., self-control and coping self-efficacy). Hence, there was no need to use any of these variables as potential covariates for the main repeated measures ANOVA analysis for cravings.

Manipulation Check

Exercise. A paired t-test showed that there was significant increase in heart rate for those who exercised at a moderate intensity from baseline to post-exercise, $t(11) = -7.28$, $p < .0001$, $\eta^2 = .84$.

Concurrent stressors (psychological withdrawal symptoms). Repeated measures ANOVA for psychological withdrawal symptoms showed a significant time (baseline to post-abstinence to post-depletion) effect, $F(2, 23) = 24.3$, $p < .0001$, $\eta^2 = .50$. *Post-hoc* paired t-tests showed an increase in psychological symptoms from baseline to post-abstinence (stress condition 1; $M_{difference} = -1.23$, $SD = 1.46$), $t(24) = -4.23$, $p < .0001$, $\eta^2 = .43$ and from post-abstinence to post-depletion (stress condition 2; $M_{difference} = -.576$, $SD = 1.08$), $t(24) = -2.65$, $p = .01$, $\eta^2 = .23$. The means and standard deviations are presented in Table 4.

Main Analyses

Cravings. For strength of desire to smoke, repeated measures ANOVAs revealed a significant group (moderate intensity exercise and passive control) by time (baseline, post-abstinence, post-depletion, 5-, 10- and 15-minutes into treatment and immediately post-treatment) interaction effect, F (6, 18) = 13.4, p < .0001, η^2 = .82, for strength of desire (see Table 5 and Figure 2). *Post-hoc* t-tests showed that the exercise group reported significantly lower craving scores at all post concurrent stressor time points compared to their passive control counterparts (see Figure 2).

Ad lib smoking. Independent t-test revealed no significant difference for ad lib smoking for moderate intensity exercise (M = 12.7, SD = 9.52) and passive control (M = 14.1, SD = 12.6), t (17) = -.262, p = .80, η^2= .003.

Relationships among the variables. There was no significant correlation between strength of desire to smoke (cravings) measured post-treatment and ad lib smoking (see Table 6). However, when groups were separated, there was a non-significant, medium correlation for those who exercised at a moderate intensity (r = -.463, p = .178) compared to a weak, non-significant correlation for passive controls (r = -.147, p = .71) between ad lib smoking and strength of desire to smoke. No significant correlations were found between ad lib smoking and demographic variables, smoking status, psychological constructs and post-depletion psychological withdrawal symptoms (Table 6).

In relation to other main variables, psychological withdrawal symptoms measured post-depletion were positively and significantly correlated with cigarettes smoked per day (Table 6). Moreover, psychological withdrawal symptoms were not

significantly correlated with cravings measured post-treatment. Cravings were not related to self-control or coping self-efficacy (SE). Similarly, psychological withdrawal symptoms were not related to self-control or coping SE (Table 6).

With respect to the relationship between demographic variables, smoking status, psychological constructs, post-depletion psychological withdrawal symptoms and post-treatment cravings, significant and positive correlations were found between years smoked and the following: cigarettes smoked per day, age and self-control. There were significant, positive correlations for cigarettes smoked per day and both expired CO score (baseline) and psychological withdrawal symptoms. Negative, significant correlations were revealed for FTCD and cigarettes smoked per day. Expired CO and FTCD scores were positively correlated. Finally, self-control and coping SE scores were significantly correlated (Table 6).

While non-significant, there was a medium, positive correlation for years smoked and coping, in addition to a medium, negative correlation for years smoked and cravings. Self-control and coping SE both displayed medium, positive, non-significant correlations with age as well. Cravings and coping SE scores showed a medium, negative correlation that was also not significant.

Table 3

Mean and standard deviations for baseline (Visit 1) characteristics.

Characteristics	Experimental (*n* = 12)	Control (*n* = 13)	*F*	η^2	*p*
Demographics					
Age (years)	35.7 (14.9)	39.1 (15.2)	.320	.01	.57
Female gender, number (percent)	7 (58.3)	7 (53.8)	.047	.002	.83
BMI (kg/m^2)	27.6 (6.49)	24.2 (4.83)	2.36	.09	.14
Moderate/ vigorous intensity activity in the past week (hours)	2.71 (1.65)	2.31 (1.57)	.717	.01	.58
Resting heart rate (bpm)	87.0 (13.9)	83.5 (8.98)	.556	.02	.46
Smoking Status					
Years smoked	17.8 (13.3)	21.2 (14.7)	.366	.02	.55
Cigarettes per day	13.0 (5.95)	15.2 (6.08)	.796	.03	.38
FTCD	3.58 (2.07)	4.08 (2.66)	.265	.01	.61
Expired CO (ppm)	17.0 (7.04)	22.2 (9.67)	2.35	.09	.14
Smoking ladder	5.66 (1.07)	6.11 (1.53)	.709	.03	.41
Strength of desire	3.75 (1.49)	2.85 (1.86)	1.78	.07	.20
Psychological withdrawal symptoms	2.96 (.893)	2.69 (1.13)	.449	.02	.51
Length of smoking abstinence (hours)	18.1 (.370)	17.8 (1.19)	.569	.03	.46
Days between visits	6.40 (1.83)	6.92 (1.44)	.546	.03	.47
Self-Control	2.98 (.352)	2.97 (.741)	.001	.0001	.98
Coping Self-Efficacy	59.0 (13.4)	59.8 (15.6)	.017	.0007	.90

Note. FTCD = Fagerstrom Test for Cigarette Dependence; CO = carbon monoxide.

Table 4

Means and standard deviations (SD) for psychological withdrawal symptoms at three time points (manipulation check).

Time	*N*	Mean	SD
Baseline	25	2.82	1.01
Post-abstinence	25	4.05	1.34
Post depletion	25	4.63	1.28

Table 5

Mean and standard deviations (SD) for strength of desire to smoke at all data collection time points.

Time	Experimental (*n* = 12)	Control (*n* = 13)
Baseline	3.75 (1.49)	2.85 (1.86)
Post-abstinence	5.08 (1.50)	5.38 (1.61)
Post-depletion	5.58 (1.73)	5.31 (1.75)
During treatment – 5 minutes	2.83 (1.85)	5.23 (1.79)
During treatment – 10 minutes	2.92 (1.93)	5.23 (1.69)
During treatment – 15 minutes	3.00 (2.05)	5.38 (1.61)
Immediately post-treatment	3.50 (2.15)	5.31 (1.55)

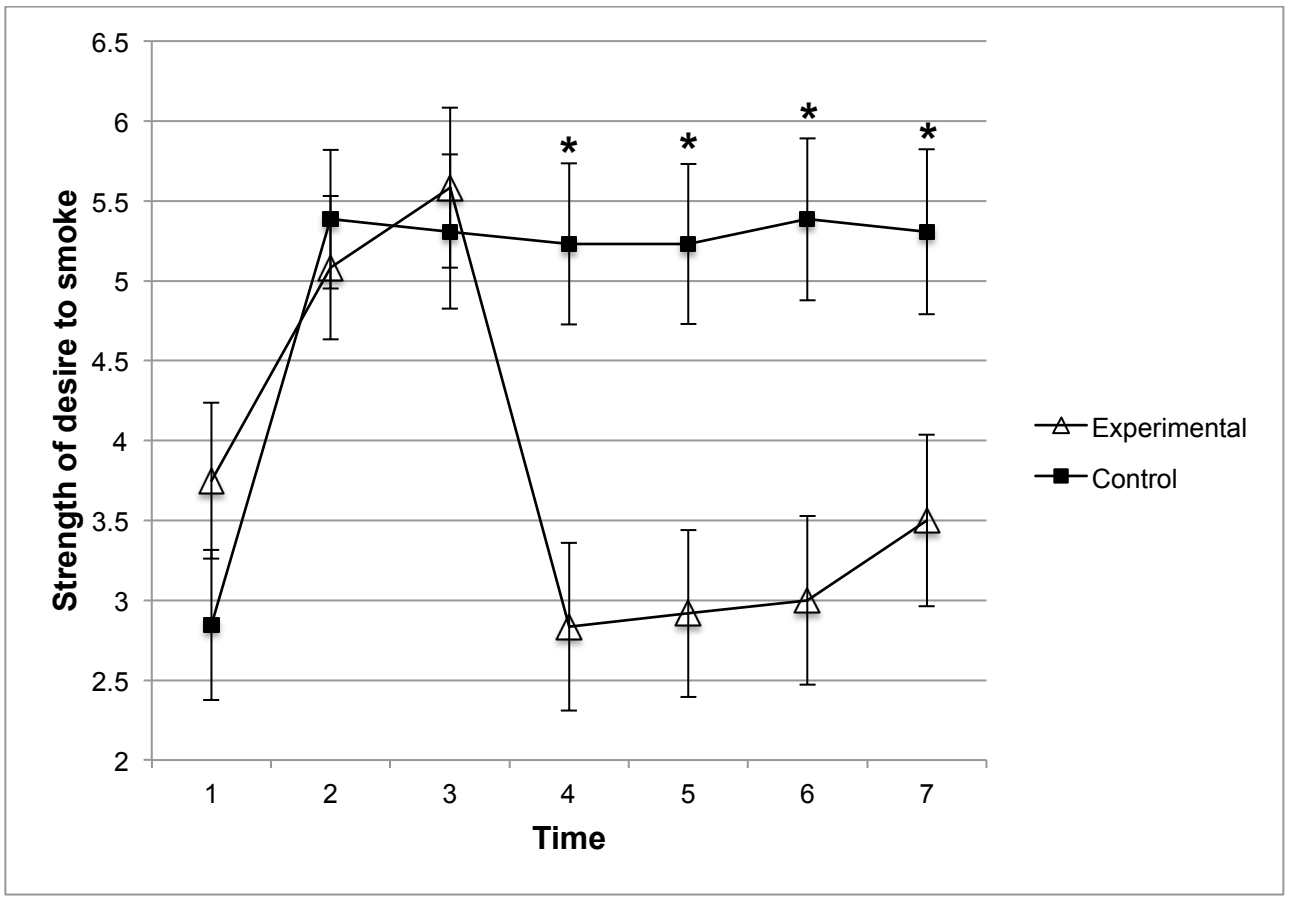


Figure 2. The effect of exercise on strength of desire to smoke compared to passive control (mean and standard error). Time points are baseline (1); post-abstinence (2); post-depletion (3); during treatment – 5 minutes (4); during treatment – 10 minutes (5); end of treatment – 15 minutes (6) and immediately post-treatment (7). Asterisks indicate significant differences between groups at specific time points ($p < .05$).

Table 6

Correlations between ad lib smoking and key demographic variables and smoking status, post-depletion psychological withdrawal symptoms and post-treatment strength of desire to smoke (cravings).

Variable	1	2	3	4	5	6	7	8	9	10	11
1. Ad lib	—	-.040	.021	.214	.055	-.01	-.273	-.274	-.242	.083	-.062
2. Age	—	—	.956*	.504	.297	.314	.045	.292	-.273	.338	.357
3. Years Smoked	—	—	—	.438*	.280	.258	.060	.292	-.388	.397*	.344
4. CPD	—	—	—	—	.444*	-.773*	.030	.415*	.139	-.050	-.117
5. CO	—	—	—	—	—	631*	.281	.244	.207	.251	.097
6.FTCD	—	—	—	—	—	—	.048	.318	.301	.052	.098
7. SL	—	—	—	—	—	—	—	-.003	.022	.158	.105
8. PWS	—	—	—	—	—	—	—	—	.132	.095	-.194
9. SoD	—	—	—	—	—	—	—	—	—	-.238	-.334
10. SC	—	—	—	—	—	—	—	—	—	—	.457*
11. Coping SE	—	—	—	—	—	—	—	—	—	—	—

Note. CPD = cigarettes smoked per day, CO = carbon monoxide, FTCD = Fagerstrom Test for Cigarette Dependence, SL = smoking ladder, PWS = psychological withdrawal symptoms, SC = self-control, SE = self-efficacy, SoD = strength of desire to smoke (cravings). Asterisk indicates significant relationship ($p < .05$).

Chapter Three: Discussion

The present study aimed to examine the acute effect of a single bout of exercise on strength of desire to smoke (cravings) and ad lib smoking following concurrent stressors. Results showed that following concurrent stressors (i.e., temporary abstinence and depletion), significant reductions in cravings were seen for those in the moderate intensity exercise condition, but not for those in the passive control condition; however the treatment had no effect on ad lib smoking. Beyond these general findings, the following specific issues warrant commentary.

Effect of Concurrent Stressors on Psychological Withdrawal Symptoms

Concurrent stressors represent a more realistic setting for a smoker when they attempt to quit. Sources of stress often unfold unexpectedly, leaving individuals in a heightened state of arousal. For individuals engaging in a quit attempt, added stressors can exacerbate an already challenging process and increase the chances of relapse (Carter & Tiffany, 1999). Intervening at this point of heightened stress is therefore important.

In the present study, psychological withdrawal symptoms were selected as the manipulation check as they were salient to both stressor conditions (i.e., temporary abstinence and depletion) and likely to change in response to each condition. The manipulation check supported a significant increase in psychological withdrawal symptoms following temporary abstinence (stress condition 1) and again following depletion (stress condition 2).

Self-regulation is exertion of control over self by the self. It is a crucial construct for successful human functioning, as it helps regulate one's thoughts, emotions and behaviours in a stressful situation. Self-regulation failure is reasoned to be the culprit behind substance abuse, criminal behaviour and obesity (Muraven & Baumeister, 2000). Using Muraven and Baumeister's limited strength model of self-regulation as a framework, the present study was able to provide insight into one's self-regulatory resources. Specifically, participants' psychological withdrawal symptoms increasing through their experience of concurrent stressors (i.e., temporary abstinence followed by depletion and cue-elicited smoking stimuli), provides indirect evidence that self-regulatory strength was likely being depleted. Unfortunately, the study design makes it impossible to distinguish the individual contribution that cognitive depletion vs. cue-elicited smoking stimuli made to increases in psychological withdrawal.

Future research is encouraged to further examine self-regulation and smoking abstinence. For instance, does exercise replenish self-regulatory resources and if so, how does it do this? Replenished self-regulatory resources counteract the negative effects of depletion by moderating tendencies to resort back to automatic behaviours (i.e., smoking) according to the limited strength model (Shmeuli & Prochaska, 2012). Previous research has shown that positive affect induction through watching humorous video clips is able to replenish some self-regulatory strength in smokers who were not abstaining and postponed smoking behaviour (Shmeuli & Prochaska, 2012). Moreover, research also suggests that exercise increases positive affect in smokers during temporary abstinence (Everson et al., 2008). Based on the evidence from the present study, it is possible that exercise

had a replenishing effect on psychological withdrawal (i.e., psychological withdrawal scores returned to baseline values) and through extension positively influenced strength of desire (cravings) scores. While the primary focus of the present study was self-regulation depletion and not replenishment, a *post-hoc* analysis revealed that exercise did have a renewing effect on psychological withdrawal symptoms compared to passive controls. It would be novel to explore the replenishing aspect of self-regulation through exercise in a population of smokers wishing to quit smoking.

Similarly, measurement of self-regulation should be further evaluated. In previous research, self-regulation depletion and replenishment have been measured by task performance, for example improvement of grip strength, or on a Stroop task (Bray, Graham, Martin Ginis & Hicks, 2012). Surrogates for self-regulation such as motivation and stress tolerance have also been suggested (Brown, Lejuez, Kahler, & Strong, 2002; Muraven & Slessareva, 2003). Future research is needed to develop self-regulation measures that are less subjective and easier to quantify. For instance, previous literature has suggested examining glucose use in the brain to determine the severity of depletion (Gailliot et al., 2007). Moreover, fMRI could be employed to determine activation in certain areas of the brain to determine if an individual has been depleted (Janse Van Rensburg & Taylor, 2008).

Effect of Exercise on Cravings

This is the first time that exercise has been shown to decrease cravings following concurrent stressors compared to passive controls. This finding is important as concurrent stressors represent a more ecologically valid setting since

stressors often occur simultaneously when an individual is attempting to quit smoking (e.g., stress from quitting smoking and daily life stressors). Following concurrent stressors, participants who exercised at a moderate intensity experienced sustained, reduced cravings during their treatment, while passive control participants experienced sustained, heightened cravings. The heightened and sustained cravings support that concurrent stressors had an impact on cigarette cravings. This finding, again, speaks to the ecological validity of the study, as increased and sustained cigarette cravings eventually lead to smoking relapse during a serious quit attempt (Carter & Tiffany, 1999).

Insofar as craving reduction is concerned, there was a 2.58 (46%) to 2.75 (49%) reduction in strength of desire to smoke from concurrent stressor to during exercise treatment (i.e., 5, 10 and 15 minutes). This is in line with other studies, which have reported 1.4 to 4.1-point reductions in strength of desire to smoke from pre-abstinence to during moderate intensity exercise (Taylor, Katomeri & Ussher, 2005; Daniel et al., 2007; Everson et al., 2008; Janse Van Rensburg et al., 2012; Roberts et al., 2012). The point reduction of exercise on strength of desire from concurrent stressor to immediately post treatment was 2.08 (37%), which again is in line with the research cited above. The extremely large group by time interaction effect (η^2 = .82) found indicates that exercise accounted for most of the decrease in cravings. Overall these data provide strong evidence that exercise is a viable non-pharmacological treatment for decreasing cravings in abstaining smokers.

While the mechanisms behind this phenomenon are not clear, there are some explanations, which may shed light on the effect of exercise on cigarette cravings. First, research has suggested that changes in dopamine may mediate exercise and

affective responses (Acevedo & Ekkekakis, 2006). An increase in dopamine activity, for example through exercise, has been shown to mediate the rewarding effects of drugs, including nicotine (Koob & Le Moal, 2001). Future research is encouraged to examine changes in dopamine and other opioids, and cortisol both during and following exercise to further examine the relationship (Taylor & Katomeri, 2007).

Second, changes in affective responses due to exercise may have ameliorated cravings in participants who exercised. Negative affect is associated with increased desire to smoke (Shiffman & Waters, 2004). Moreover, positive affect induction has been shown to decrease likelihood of smoking (Shmeuli and Prochaska, 2012). Smokers who watched a humorous video clip were least likely to smoke compared to those who watched a neutral video clip. Although affect was not measured during exercise in the current study, it is likely that exercise increased positive affect, which decreased cigarette cravings. Research should examine the effect of exercise on cigarette cravings and affective responses following concurrent stressors.

Third, shifts in attention and arousal have also been supported as possible explanations behind this phenomenon. Janse Van Rensburg and colleagues (2012) suggest that a single bout of exercise may attenuate attentional shifts away from smoking-related cues. fMRI scans showed no activation in the brain to smoking images compared to neutral images in participants who were temporarily abstaining from smoking and had exercised prior to scanning. The authors suggest that the brain is overloaded with maintaining homeostasis during exercise (i.e., temperature regulation, heart rate regulation) that higher cognitive functioning (i.e., regulating emotions and behaviours in response to smoking cues and stressors) is temporarily

sacrificed. However, this explanation warrants further research as it is still in its infancy.

Effect of Exercise on Ad lib Smoking

Delayed ad lib smoking may reduce the number of cigarettes smoked and harm inflicted on the smoker (deRuiter & Faulkner, 2006). In addition, decreased cigarette consumption also decreases carcinogen exposure (USDHHS, 2010). The current study found that exercise had no effect on ad lib smoking. This finding is inconsistent with the current body of literature.

For instance, Taylor & Katomeri (2007) examined the effects of exercise on ad lib smoking and found that those who exercised waited an average of 57 minutes before lighting up their next cigarette. It is important to note that subjects abstained for 2-hours vs. 18 hours in the current study. It is possible that an 18-hour abstinence period was too long for participants in the present study and a ceiling effect may have incurred for smoking outcomes (ad lib time). Regardless of randomization, both groups may have been pushed to the limit and lit up a cigarette after leaving the laboratory. Participants in the Taylor and Katomeri study were also younger [M_{age} = 27.1 (experimental) and M_{age} = 30.1 (control)] than the sample in the current study [(M_{age} = 35.7 (14.9) (moderate intensity exercise) and M_{age} = 39.1 (15.2) (control)]. Based on age, it is likely that smokers in the current study had been smoking for a longer time [M_{age} = 17.8 years (moderate intensity exercise) and M_{age} = 21.2 years (control)] compared to those in Taylor and Katomeri study; and thus went back to smoking sooner due to force of habit (Conklin & Tiffany, 2002).

The correlations between ad lib time to first cigarette and strength of desire measured immediately post-treatment were stronger for participants who exercised at a moderate intensity (r = -.463, p = .178) than correlations reported by Taylor and Katomeri (2007) (r = -0.29, p < .05) even if they were not significant. This suggests that while exercise did attenuate cravings during treatment, the residual effects from concurrent stressors may have been too difficult for participants to overcome without using smoking as a coping mechanism.

Also, correlations between ad lib time and key demographic, smoking status, and psychological characteristics, and ad lib time and post-depletion psychological withdrawal symptoms were generally small and non-significant. For instance, there was a small negative relationship found between ad lib smoking and post-depletion psychological withdrawal symptoms, suggesting that these constructs are mildly related. This finding further strengthens the notion that those who are stressed will likely light up a cigarette sooner (Carter & Tiffany, 1999). In addition, there was a small negative correlation between ad lib smoking and smoking ladder scores. For individuals who are higher on the smoking ladder, perhaps entering the planning or action stages, it is possible that they would have waited before lighting their first cigarette.

While the present study produced a null result for exercise on ad lib smoking, the finding that those who exercised showed a much larger correlation between cravings measured immediately post-treatment and ad lib smoking when compared to correlation found for the controls is encouraging. It is therefore recommended that this study be replicated, perhaps with a shorter period of abstinence and a larger sample size to account for changes in ad lib smoking. Moreover,

implementing technology such as ecological momentary assessment and smoking topography devices to measure changes in desire and smoking behaviour in real time and in natural surroundings would allow findings to be generalizable outside of a laboratory setting.

Interestingly, cravings measured post-treatment and psychological withdrawal symptoms measured post-depletion were not correlated. This may seem like a contradiction; however, it should be noted that the time points from which the constructs are measured are not the same. Cravings were measured at the end of treatment, where individuals had completed their respective conditions (moderate intensity exercise or passive sitting). As mentioned previously, cravings had been attenuated for those who had exercised at a moderate intensity compared to those were in the passive condition. Whereas, psychological withdrawal symptoms were measured when participants had been concurrently stressed (i.e., temporarily abstaining from cigarettes and depletion), but had yet to experience their respective conditions. Due to the different time points and conditions of measurement, it seems appropriate that the constructs should not be correlated. Conversely, if correlations were completed for the constructs at the same time points (i.e., post-depletion or post-treatment) higher correlations would be expected.

Next, cravings were negatively, yet non-significantly, correlated with self-control and coping self-efficacy (SE). This relationship was expected as it is well documented that smokers use cigarettes as a coping mechanism (Taylor, 2000). However, psychological withdrawal symptoms were not related with self-control or coping SE. This relationship was somewhat expected as psychological withdrawal

symptoms represent manifestations related to stress. Stress is the antithesis to self-control and coping SE and should therefore show little to no correlation.

An unexpected, significant negative relationship was found for FTCD scores and cigarettes smoked per day. Smokers who smoke more per day are deemed less dependent on cigarettes. One plausible explanation for this counterintuitive relationship is that the smokers in this study were not hardened smokers as reflected by their FTCD scores (three to four out of ten). For instance, smokers were less likely to smoke upon waking and might not smoke while sick in bed. Future research should further investigate all relationships using more statistically robust methods to give deeper insight on causation of relationships.

Limitations

This study is not without limitations. For instance, findings can only be generalized to individuals who were able to temporarily abstain from smoking for 17 – 18 hours. Researchers did not examine the lasting effects of exercise on cravings post-treatment and this has been examined in previous studies (e.g., Ussher et al., 2006). Next, the study was conducted in a laboratory, under controlled conditions. Inferences drawn from the study cannot be applied to a more naturalistic setting. Also, the effects of the depletion task cannot be teased apart as it is unknown whether the Stroop task, or cue-elicited smoking stimulus contributed more to depleting participants. In addition, the replenishing effects of exercise were not assessed. Finally, this study relied on self-report measure for ad lib smoking. Researchers were unable to validate the accuracy of reporting.

Conclusions

Overall, this is the first study to examine the effect of a single bout of moderate intensity exercise on cigarette cravings in smokers who had been concurrently stressed by temporary abstinence and cognitive depletion/ cue-elicited smoking stimuli. This study represents a more ecologically valid lab-based scenario than previous research. Findings from this study support exercise as an effective strategy for ameliorating strength of desire to smoke. The effect of exercise on ad lib smoking cannot be supported by the present study. Future work is now needed where momentary assessment is used in participants' natural environment to examine changes over time in cigarette cravings following acute bouts of exercise.

References

Acevedo, E. O. & Ekkekakis, P. (Eds.). (2006). *Psycho-Biology of Physical Activity*. Champaign, IL: Human Kinetics.

American Cancer Society. (2013). *Guide to quitting smoking*. Retrieved from http://www.cancer.org/acs/groups/cid/documents/webcontent/002971-pdf.pdf

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed., text version). Washington, DC: Author.

Baumeister, R. F. (1998). The self. In D. Gilbert, S. T. Fiske & G. Lindzey (Eds.), *Handbook of social psychology* (4th ed.) (pp. 680-740). Boston: McGraw-Hill.

Biener, L. & Abrams, D. B. (1991). The contemplation ladder: Validation of a measure of readiness to consider smoking cessation. *Health Psychology,10*, 360–365.

Blair, S. N., Haskel, W. L., Ho, P., Paffenberger, P., Vranizan, K., Farquhan, J. W., & Wood, P. D. (1985). Assessment of habitual physical activity by seven-day recall in a community survey and non control experiments. *American Journal of Epidemiology, 122*, 794–804.

Bray, S. R., Graham, J. D., Martin Ginis, K. A., Hicks, A. L. (2012). Cognitive task performance causes impaired maximum force production in human hand flexor muscles. *Biological Psychology, 89*, 195-200.

Briggs, S. R. & Cheek, J. M. (1986). The role of factor analysis in the development and evaluation of personality scales. *Journal of Personality, 54*, 106 – 148. doi: 10.1111/j.1467-6494.1986.tb00391.x.

Brodbeck, J., Bachmann, M. S. & Znoj, H. (2013). Distinct coping strategies differentially predicting urge levels and lapses in a smoking cessation attempt. *Addictive Behaviours, 38*, 2224–2229.

Brown, J. M. (Ed.). (1998). *Self-regulation and the addictive behaviours*. New York: Plenum.

Brown, R. A., Lejuez, C. W., Kahler, C. W. & Strong, D. R. (2002). Distress tolerance and duration of past smoking cessation attempts. *Journal of Abnormal Psychology, 111,* 180–185.

Canadian Society for Exercise Physiology (CSEP) Retrieved from: http://www.csep.ca.

Canamar, C. P. & London, E. (2012). Acute cigarette smoking reduces latencies on a smoking stroop test. *Addictive Behaviours, 37,* 627-631.

Carter, B. L. & Tiffany, S. T. (1999). Meta-analysis of cue-reactivity in addiction research. *Addiction, 94*, 327– 340.

Chassin, L., Presson, C. C., Sherman, S. J. & Kim, K. (2002). Long-term psychological sequelae of smoking cessation and relapse. *Health Psychology, 21*, 438-443.

Chesney, M. A., Neilands, T. B., Chambers, D. B., Taylor, J. M. & Folkman, S. (2006). A validity and reliability study of the coping self-efficacy scale*. Journal of Health Psychology, 11,* 421-437.

Cohen, J. W. (1988). *Statistical power analysis for the behavioural sciences* (2nd ed.). Hillsdale: Lawrence Erlbaum Associates.

Conklin, C. A. & Tiffany, S. T. (2002). Cue-exposure treatment: time for change [letter]. *Addiction, 97,*1219–1221.

Daniel, J., Cropley, M., Ussher, M., & West, R. (2004). Acute effects of a short bout of moderate versus light intensity exercise versus inactivity on tobacco withdrawal symptoms in sedentary smokers. *Psychopharmacology, 174*, 320-326. doi: 10.1007/s00213-003-1762-x.

Daniel, J. Z., Cropley, M., & Fife-Schaw, C. (2006). The effect of exercise in reducing desire to smoke and cigarette withdrawal symptoms is not caused by distraction. *Addiction, 101*, 1187-1192. doi: 10.1111/j.1360-0443.2006.01457.

Daniel, J. Z., Cropley, M. & Fife-Schaw, C. (2007). Acute exercise effects on smoking withdrawal symptoms and desire to smoke are not related to expectation. *Psychopharmacology, 195*, 125–129.

deRuiter, W., & Faulkner, G. (2006). Tobacco harm reduction strategies: The case for physical activity. *Nicotine & Tobacco Research, 8*, 157–168.

Eisenberg, N., Fabes, R. A. & Guthrie, I. K. (1997). Coping with stress: The roles of regulation and development. In S. A. Wolchik & I. N. Sandler (Eds.), *Handbook of children's coping: Linking theory and intervention* (pp. 41-70). New York: Plenum.

Elibero, A., Janse Van Rensburg, K. & Drobes, D. J. (2011). Acute effects of aerobic exercise and hatha yoga on craving to smoke. *Nicotine & Tobacco Research 13,* 1140–1148.

Everitt, B.J. & Robbins, T.W. (2005). Neural systems of reinforcement for drug addiction: from actions to habits to compulsion. *Nature Neuroscience, 8*, 1481–1289.

Everson, E. S., Daley, A. J. & Ussher, M. (2008). The effects of moderate and vigorous exercise on desire to smoke, withdrawal symptoms and mood in abstaining young adult smokers. *Mental Health and Physical Activity, 1*, 26–31.

Faulkner, G. E., Arbour-Nicitopoulos, K. P. & Hsin, A. (2010). Cutting down one puff at a time: the acute effects of exercise on smoking behaviour. *Journal of Smoking Cessation, 5,* 130–135.

Ferguson, S.G. & Shiffman, S. (2009). The relevance and treatment of cue-induced cravings in tobacco dependence. *Journal of Substance Abuse Treatment, 36*, 235-243.

Fiore, M. C., Jae´n, C. R., Baker, T. B., Bailey, W. C., Benowitz, N. L., Curry, S. J., . . . Wewers, M. E. (2008). *Treating Tobacco Use and Dependence: 2008 Update.* Rockville, MD: U.S. Department of Health and Human Services, Public Health Service.

Gailliot, M. T., Baumeister, R. F., DeWall, C. N., Maner, J. K., Plant, E. A., Tice, D. M., ... Schneichel, B. J. (2007). Self-control relies on glucose as a limited energy source: willpower is more than metaphor. *Journal of Personality and Social Psychology, 92*, 325-336.

Gonzales, D., Rennard, S. I., Nides, M., Oncken, C., Azoulay, S., Billing, C. B., Watsky, E. J., Gong, J., Williams, K. E. & Reeves, K. R. (2006). Verenicline, an alpha4beta2 nicotinic acetylcholine receptor partial agonist, vs sustained-release bupropion and placebo for smoking cessation: a randomized controlled trial. *Journal of the American Medical Association, 296,* 47 – 55.

Haasova, M., Warren, F. C., Ussher, M., Janse Van Rensburg, K., Faulkner, G., Cropley, M., … Taylor, A. H. (2012). The acute effects of physical activity on cigarette cravings: systematic review and meta-analysis with individual participant data. *Addiction, 108,* 26-37. doi: 10.1111/j.1360-0443.2012.04034.x.

Hagger, M. S., Wood, C., Stiff, C. & Chatzisarantis, N. L. D. (2009). The strength model of self-regulation failure and health-related behaviour. *Health Psychology Review, 3,* 208-238.

Harper, T. M. (2011). *Mechanisms behind the success of exercise as an adjunct quit smoking aid* (Doctoral dissertation). Retrieved from Electronic Thesis and Dissertation Repository. Retrieved from http://ir.lib.uwo.ca/etd/198.

Harper, T., Fitzgeorge, L., Tritter, A., & Prapavessis, H**.** (2013). Are treatment expectations related to reductions in craving and withdrawal symptoms following an acute bout of exercise? *Mental Health and Physical Activity, 6,* 83-86.

Heatherton, T. F., Kozlowski, L. T., Frecker, R. C., & Fagerstrom, K. O. (1991). The Fagerstrom Test for Nicotine Dependence: A revision of the Fagerstrom Tolerance Questionnaire. *British Journal of Addictions, 86,* 119-1127.

Heishman, S. J., Taylor, R. C. & Henningfield, J. E. (1994). Nicotine and smoking: a review of effects on human performance. *Experimental and Clinical Psychopharmacology, 2,* 345–95.

Holladay, M.W., Dart, M.J. & Lynch, J.K. (1997). Neuronal nicotinic acetylcholine receptors as targets for drug discovery. *Journal of Medicinal Chemistry, 40,* 4169–4194.

Hughes, J.R. (2007). Effects of abstinence from tobacco: valid symptoms and time course. *Nicotine & Tobacco Research, 9*, 315–327.

Hutchinson, K. E., Monti, P. M., Rohsenow, D. J., Swift, R. M., Colby, S. M., Gnys, M., … Sirota, A. D. (1999). Effects of naltrexone with nicotine replacement on smoking cue reactivity: preliminary results. *Psychopharmacology, 142,* 139-143.

Janse Van Rensburg, K. & Taylor, A. H. (2008). The effects of acute exercise on cognitive functioning and cigarette cravings during temporary abstinence from smoking. *Human Psychopharmacology: Clinical and Experimental, 23,* 193–199.

Janse Van Rensburg, K., Taylor, A. H., Hodgson, T. & Benattayallah, A. (2012). The effects of exercise on cigarette cravings and brain activation in response to smoking-related images. *Psychopharmacology, 221,* 659-666. doi:10.1007/s00213-011-2610-z.

Jorenby, D. E., Hays, J. T., Rigotti, N. A., Azoulay, S., Watsky, E. J., Williams, K. E., … Reeves, K. R. (2006). Efficacy of varenicline, an α4β2 nicotinic acetylcholine receptor partial agonist, vs. placebo or austained-release bupropion for smoking cessation: a randomized controlled trial. *Journal of the American Medical Association, 296*, 56-64.

Kalant, H., LeBlanc, A.E. & Gibbins, R.J. (1971). Tolerance to, and dependence on, some non-opiate psychotropic drugs. *Pharmacological Reviews, 23*,135–191.

Karvonen, M.J., Kentala, E. & Mustala, O. (1957). The effects of training on heart rate; a longitudinal study. *Annales Medicinae Experimentalis et Biologiae Fenniae*, *35*, 307-315.

Kassel, J.D., Stroud, L.R., Paronis, C.A. (2003). Smoking, stress, and negative affect: correlation, causation, and context across stages of smoking. *Psychological Bulletin, 129*, 270–304.

Killen, J. E., & Fortmann, S. P. (1997). Craving is associated with smoking relapse: Findings from three prospective studies. *Experimental and Clinical Psychophannacology, 5,* 137-142.

Koob, G. F. & LeMoal, M. (2001). Drug addiction, dysregulation of reward, and allostasis. *Neuropsychopharmacology, 24*, 97–129.

Lazarus, R. S. & Folkman, S. (1984). *Stress, appraisal and coping*. New York: Springer.

Makomaski-Illing E. M. & Kaiserman, M. G. (2004). Morality attributable to tobacco use in Canada and its region 1998. *Canadian Journal of Public Health, 95*, 38-44.

Matthews, K. A., Scheier, M. F., Bunson, B. I. & Carducci, B. (1989). Why do unpredictable events lead to reports of physical symptoms? In T. W. Miller (Ed.), *Stressful life events* (pp. 91-100). Madison, CT: Internal Universities Press.

McGehee, D. S. & Role, L. W. (1996). Presynaptic ionotropic receptors. *Current Opinion in Neurobiology, 6*, 342–349.

Morissette, S. B., Palfai, T. P., Gullliver, S. B., Spiegel, D. A. & Barlow, D. H. (2005). Effects of transdermal nicotine during imaginal exposure to anxiety and smoking cues in college smokers. *Psychology of Addictive Behaviours, 19,* 192-198.

Munafo, M., Mogg, K., Roberts, S., Bradley, B. P. & Murphy, M. (2003). Selective processing of smoking-related cues in cur- rent smokers, ex-smokers and never-smokers on the modified Stroop task. *Journal of Psychopharmacology*, *17*, 310–316.

Munafo, M. R., Clark, T. G., Johnstone, E. C., Murphy, M. F. G. & Walton, R. T. (2004). The genetic basis for smoking behavior: a systematic review and meta-analysis. *Nicotine & Tobacco Research, 6,* 583–598.

Muraven, M. & Baumeister, R. F. (2000). Self-regulation and depletion of limited resources: does self-control resemble a muscle? *Psychological Bulletin, 126*, 247-259.

Muraven, M. & Slessareva, E. (2003). Mechanisms of self-control failure: Motivation and limited resources. *Personality and Social Psychology Bulletin, 29*, 894–906.

Niaura, R., Abrams, D.B., Monti, P. M. & Pedraza, M. (1989). Reactivity to high-risk situations and smoking cessation outcome. *Journal of Substance Abuse, 1*, 393–405. *Addiction, 100*, 1720-1730.

Niaura, R., Sayette, M., Shiffman, S., Glover, E. D., Nides, M., Shelanski, M. … Sorrentino, J. (2005). Comparative efficacy of rapid-release nicotine gum versus nicotine polacrilex gum in relieving smoking cue-provoked craving. *Addiction, 100*, 1720–1730.

O'Connell, K. A., Schwartz, J. E., & Shiffman, S. (2008). Do resisted temptations during smoking cessation deplete or augment self-control resources? *Psychology of Addictive Behaviors, 22,* 486-495.

Pennebaker, J. W. (1988). Confession, inhibition, and disease. In L. Berkowitz (Ed.), *Advances in experimental social psychology Vol. 22* (pp. 211-242). Orlando, FL: Academic Press.

Perkins, K.A. (1993). Weight gain following smoking cessation. *Journal of Consulting and Clinical Psychology*, *61*, 768–77.

Perkins, K. A., Epstein, L. H., Stiller, R. L., Marks, B. L., & Jacob, R. G. (1989). Chronic and acute tolerance to the heart rate effects of nicotine. Psychopharmacology, *97*, 529-534. doi: 10.1007/BF00439559.

Piasecki, T. M., Niaura, R., Shadel, W. G., Fiore, M. C. & Baker T. B. (2000). Smoking withdrawal dynamics in unaided quitters. *Journal of Abnormal Psychology, 109,* 74–86.

Pomerleau, C. S., Carton, S. M., Lutzke, M. L., & Flessland, K. A. (1994). Reliability of the Fagerstrom Tolerance Questionnaire and the Fagerstrom Test for Nicotine Dependence. *Addictive Behaviors, 19*, 33- 39.

Pomerleau, O. F., Collins, A. C., Shiffman, S. & Pomerleau, C. S. (1993). Why some people smoke and others do not: new perspectives. *Journal of Consulting and Clinical Psychology, 61,* 723-731.

Prochaska, J. O., & DiClemente, C. C. (1983). Stages and processes of self-change of smoking: Toward an integrative model of change *Journal of Consulting and Clinical Psychology 51,(3),* 390-395.

Reid, J. L., Hammond, D., Burkhalter, R., Rynard, V. L. & Ahmed, R. (2013). *Tobacco Use in Canada: Patterns and Trends, 2013 Edition*. Waterloo, ON: Propel Centre for Population Health Impact, University of Waterloo.

Roberts, V., Maddison, R., Simpson, C., Bullen, C. & Prapavessis, H., (2012). The acute effects of exercise on cigarette cravings, withdrawal symptoms, affect, and smoking behaviour: systematic review update and meta-analysis. *Psycholopharmacology, 176,* 1-15. doi: 10.1007/s00213-012-2731-z.

Scharf, D. & Shiffman, S. (2004). Are there gender differences in smoking cessation, with and without bupropion? Pooled- and meta-analyses of clinical trials of Bupropion SR. *Addiction, 99*, 1462-1469.

Shiffman, S. M., & Jarvik, M. E. (1976). Smoking withdrawal symptoms in two weeks of abstinence. *Psychopharmacology, 50*, 35-39.

Shiffman, S., Shadel, W. G., Niaura, R., Khayrallah, M. A., Jorenby, D. E., Ryan, C. F. & Ferguson, C. L. (2003). Efficacy of acute administration of nicotine gum in relief of cue-provoked cigarette craving. *Psychopharmacology, 166,* 343-350.

Shiffman, S. & Waters, A. J. (2004). Negative affect and smoking lapses: a prospective analysis. *Journal of Consulting and Clinical Psychology, 72,* 192–201.

Shmeuli, D. & Prochaska, J. J. (2009). Resisting temping foods and smoking behaviour: implications from a self-control theory perspective. *Health Psychology, 28*, 300-306.

Shmeuli, D. & Prochaska, J. J. (2012). A test of positive affect induction for countering self-control depletion in cigarette smokers. *Psychology of Addictive Behaviours, 26,* 157-161. doi: 10.1037/a0023706.

Statistics Canada. (2011). *Canadian community health survey*. Ottawa: CANSIM.

Stead, L.F, Perera, R., Bullen, C., Mant, D., Hartmann-Boyce, J., Cahill, K. & Lancaster, T. (2012). Nicotine replacement therapy for smoking cessation (review). *Cochrane Database of Systematic Reviews 2012*, Issue 11. Art. No.: CD000146. doi: 10.1002/14651858.CD000146.pub4.

Tabachnick, B., & Fidell, L. (1996). *Using multivariate statistics* (3rd ed.). New York: Harper Collins.

Tangney, J. P., Boone, A. L. & Baumeister, R. F. (2004). High self- control predicts good adjustment, less pathology, better grades, and interpersonal success. *Journal of Personality, 72*, 271-324.

Taylor, A. H. & Katomeri, M. (2007). Walking reduces cue-elicited cigarette cravings and withdrawal symptoms, and delays ad libitum smoking. *Nicotine and Tobacco Research, 11*, 1183-1190.

Taylor, A. H., Katomeri, M. & Ussher, M. (2005). Acute effects of self-paced walking on urges to smoke during temporary smoking abstinence. *Psychopharmacology, 181*, 1-7.

Tiffany, S. T. (1990). A cognitive model of drug urges and drug-use behavior: Role of automatic and nonautomatic processes. *Psychological Review, 97*, 147–16.

Tiffany, S. T. (1995a) Potential functions of classical conditioning in drug addiction, in: Drummond, D. C., Tiffany, S. T., Glautier, S. & Remington, B. (Eds.), *Addictive Behaviour: cue exposure theory and practice* (pp. 47-71). Chichester: John Wiley & Sons.

Tiffany, S.T., Conklin, C.A., Shiffman, S., Clayton, R.R. (2004). What can dependence theories tell us about assessing the emergence of tobacco dependence? *Addiction, Suppl 1*(99)*,* 78–86.

Tiffany, S. T., Cox, L. S., Elash, C. A. (2000). Effects of transdermal nicotine patches on abstinence-induced and cue-elicited craving in cigarette smokers. *Journal of Consulting and Clinical Psychology, 68,* 233-240.

Todd, M. (2004). Daily processes in stress and smoking: effects of negative events, nicotine dependence, and gender. *Psychology of Addictive Behaviors, 18,* 31–39.

U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, Center for Health Promotion and Education, (1988). *The health consequences of smoking: nicotine addiction: a report of the surgeon general.* Retrieved from http://profiles.nlm.nih.gov/ps/access/NNBBZD.pdf.

U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, (2004). *The health consequences of smoking: what is means to you.* Retrieved from http://www.cdc.gov/tobacco/data_statistics/sgr/2004/pdfs/whatitmeanstoyou.pdf.

U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, (2010). *How tobacco smoke causes disease: the biology and behavioural basis for smoking- attributed disease: a report of the surgeon general.* Retrieved from http://www.surgeongeneral.gov/library/reports/tobaccosmoke/executivesummary.pdf.

Ussher, M., West, R., Doshi, R., Sampuran, A. K. (2006). Acute effect of isometric exercise on desire to smoke and tobacco withdrawal symptoms. *Human Psychopharmacolology: Clinical and Experimental, 21,* 39–46.

Waters, A.J., Shiffman, S., Sayette, M.A., Paty, J.A., Gwaltney, C., & Balabanis, M. (2004). Cue-provoked craving and nicotine replacement therapy in smoking cessation. *Journal of Consulting and Clinical Psychology, 72,* 1136–1143.

Wegner, D. M. & Pennebaker, J. W. (1993). Changing our minds: An introduction to mental control. In D. M. Wegner & J. W. Pennebaker (Eds.), *Handbook of mental control (*pp. 1-12). Englewood Cliffs, NJ: Prentice Hall.

Weinstein, A., Greif, J., Yemini, Z., Lerman, H., Weizman, A. & Even-Sapir, E. (2010). Attenuation of cue-induced smoking urges and brain reward activity in smokers treated successfully with bupropion. *Journal of Psychopharmacology, 24*, 829-838. doi: 10.1177/0269881109105456

West, R., Hajek, P., & Belcher, M. (1989). Severity of withdrawal symptoms as a predictor of outcome of an attempt to quit smoking. *Psychology and Medicine, 19,* 981–985.

Wilson, S. J., Sayette, M. A., Delgado, M. R. & Fiez, J. A. (2005). Instructed smoking expectancy modulates cue-elicited neural activity: A preliminary study. *Nictoine & Tobacco Research, 7*, 637-645.

World Health Organization. (1992). International Statistical Classification of Diseases and Related Health Problems, Tenth Revision. Geneva: World Health Organization.

World Health Organization. (2002). Handbook for Good Clinical Research Practice (GCP): Guidance for Implementation. Geneva: World Health Organization.

World Medical Association (2008). Proceedings from the 59th General Assembly: World medical association declaration of Helsinki Ethical principles for medical research involving human subjects. Seoul, Retrieved from http://www.wma.net/en/30publications/10policies/b3/index.html

Appendix A

Recruitment Advertisement

Smoking Participants Needed!

Smoking Research Study

The Exercise and Health Psychology Lab is looking for male and female adult smokers to participate in a short term quit smoking study. Compensation is available.

To be eligible you must:

- Be between 18-64 years of age
- Smoke at least 10 cigarettes per day for the past 2 years
- Not have another substance dependency problem, or mental or physical disorder(s)
- For females only, not be pregnant or considering becoming pregnant

If interested please contact Angela.

Western
UNIVERSITY · CANADA

Ethics Approval

Re-Issued

Western

Research Ethics

Use of Human Participants - Ethics Approval Notice

Principal Investigator: Prof. Harry Prapavessis
File Number:103019
Review Level: Delegated
Approved Local Adult Participants:40
Approved Local Minor Participants:0
Protocol Title: The effect of exercise on cravings, withdrawal and ad libitum smoking following concurrent stressors
Department & Institution: Health Sciences\Kinesiology,Western University
Sponsor:
Ethics Approval Date: November 08, 2012 **Expiry Date:**December 31, 2013
Documents Reviewed & Approved & Documents Received for Information:

Document Name	Comments	Version Date
Advertisement	Recruitment materials (mass email, phone script, and ad)	2012/08/23
Western University Protocol		
Other	Location of requested revisions.	2012/11/06
Revised Letter of Information & Consent	Letter of information for control participants with requested changes double underlined.	2012/10/25
Revised Letter of Information & Consent	Letter of information for exercise participants with requested changes double underlined.	2012/10/25
Amendment	Protocol amendment for the addition of a computerized reaction time task on the first lab visit.	2012/11/06

This is to notify you that The University of Western Ontario Research Ethics Board for Health Sciences Research Involving Human Subjects (HSREB) which is organized and operates according to the Tri-Council Policy Statement: Ethical Conduct of Research Involving Humans and the Health Canada/ICH Good Clinical Practice Practices: Consolidated Guidelines; and the applicable laws and regulations of Ontario has reviewed and granted approval to the above referenced revision(s) or amendment(s) on the approval date noted above. The membership of this REB also complies with the membership requirements for REB's as defined in Division 5 of the Food and Drug Regulations.

The ethics approval for this study shall remain valid until the expiry date noted above assuming timely and acceptable responses to the HSREB's periodic requests for surveillance and monitoring information. If you require an updated approval notice prior to that time you must request it using the University of Western Ontario Updated Approval Request Form.

Members of the HSREB who are named as investigators in research studies, or declare a conflict of interest, do not participate in discussion related to, nor vote on, such studies when they are presented to the HSREB.

The Chair of the HSREB is Dr. Joseph Gilbert. The HSREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000940.

[redacted]

Ethics Officer to Contact for Further Information

[redacted]

This is an official document. Please retain the original in your files.

Western University, Support Services Bldg Rm. 5150 London, ON, Canada N6A 3K7
t. 519.661.3036 f. 519.850.2466 www.uwo.ca/research/ethics

Letter of Information – Control Participants

LETTER OF INFORMATION

Study Title: The effect of exercise on cravings, withdrawal and *ad libitum* smoking following concurrent stressors.

Principal Study Investigator:
Harry Prapavessis, Ph.D. (School of Kinesiology, The University of Western Ontario)

Co-Investigator:
Angela Fong, B.A. (School of Kinesiology, The University of Western Ontario)

Stefanie De Jesus, PhD. Candidate (School of Kinesiology, The University of Western Ontario)

You are being invited to participate in a research study looking at the effects of a short period of exercise on smoking behavior. This is a randomized control trial (a type of research study), which includes eligible volunteers who choose to take part. Please take your time to make a decision, and discuss this proposal with your personal doctor, family members and friends, as you feel inclined. The purpose of this letter is to provide you with the information you require to make an informed decision on participating in this research. This letter contains information to help you decide whether or not to participate in this research study. It is important for you to know why the study is being conducted and what it will involve. Please take the time to read this carefully and feel free to ask questions if anything is unclear or there are words or phrases you do not understand. We are asking you to take part because you are an adult between 18 and 64 years of age who smokes.

Purpose of the study
Exercise has been shown to help with traditional quit smoking strategies. A single bout of low to moderate intensity exercise can help regulate cravings and withdrawal symptoms.

The primary objective of this study is to examine the effects of an acute bout of moderate intensity exercise on smoking cravings and withdrawal symptoms following a psychological stress test (i.e. word-colour interference test) during a period of smoking abstinence. The second purpose of this study is to assess the effect of an exercise bout on smoking behaviour after concurrent stressors.

Participants
Forty participants will be asked to take part in this research. To be eligible to participate, you must meet the following criteria: 18 and 64 years of age, smoke 10 or more cigarettes per day for more than 2 years, have not engaged in a serious quit attempt in the last six months, must not be suffering from an illness (e.g. cold) that would affect your typical smoking behavior, do not have a medical condition that

prevents you from exercising, not be pregnant or intending on becoming pregnant. You must also be able to read and write in English and provide a telephone or e-mail account to the investigators so that the investigators can contact you.

Research Procedure

If you choose to take part in this study, you will be asked to complete three study components:

A) first laboratory session, B) temporarily abstain from smoking, C) second laboratory session.

The laboratory sessions will be held at the Exercise and Health Psychology Laboratory (EHPL) at Western University. The EHPL is located in Room 408 of the Labatt Health Sciences Building. Each laboratory session will take approximately 60 minutes.

A) First laboratory session

During your first laboratory session, you will complete a questionnaire package (see Item 1) and the following information will be collected: weight, height, breath carbon monoxide levels (see Item 3) and saliva samples (see Item 4) for nicotine metabolism analysis. You will also complete a computerized time reaction test to measure your executive function (see Item 1a). Executive function is an ability that allows you to select a response or make a decision.We are looking at an executive function called inhibition, which is your ability to stop unwanted actions and unwanted responding. One example of inhibition in your everyday life is, when you think something but then stop yourself from saying your thoughts. You are inhibiting (or stopping) your thoughts from being verbalized.At the end of your first laboratory session, we will schedule your second laboratory session within seven days of your first laboratory session.It is within your rights to refuse to answer any questionnaire items and we will honour your rights. You will receive half your compensation at this time.

B) Abstain from smoking

You will be asked to abstain from smoking for at least 18 hours prior to your laboratory visit (see Item 7). We will confirm that you have not smoked in the last 18 hours by asking you to complete a carbon monoxide test (Item 3).

C) Second laboratory session

During your secondlaboratory session, smoking abstinence will be confirmed by breath carbon monoxide levels (Item 3). If the carbon monoxide value shows that you are not smoke-free at this time, we will reschedule your appointment.If at that time you again are unable to abstain, you will be ineligible to continue with the study. After, you will complete a psychological stress test (see Item 5). After the test, you will complete a questionnaire package that addresses cigarette cravings, withdrawal symptoms and coping items (Item 6). Upon completing the questionnaire package, you will you will be asked to sit passively for 15 minutes. During this time, you will be asked to complete the cigarette craving questionnaire at 5 and 10 minutes (found in Items 1, 2 and 6).Following sitting, you will be asked to fill out the cigarette

cravings and withdrawal symptoms questionnaires again. It is within your rights to refuse to answer any questionnaire items and we will honour your rights.

Upon completion of the cigarette cravings and withdrawal symptoms questionnaire package, you will be asked to report the time of your first cigarette after you leave the lab by phone (leaving a message on a secure line) or email. You will be given a reminder slip that contains our contact information (telephone number and email address). The remainder of your compensation will be given to you at this time.

Experimental description (items 1-8)

Item 1: Pre-screening questionnaire package (first lab visit)
Time Involvement: 20 minutes
The questionnaire package will include: PAR-Q, coping questionnaire, cigarette cravings questionnaire and withdrawal symptoms questionnaire.

Item 1a: Computerized Time Reaction Test
Time Involvement: 20 minutes
We will measure your reaction time on a button press computer task. Reaction time is the time it takes you to respond (press a key on keyboard) to a prompt (flash) on the computer screen.

Item 2: Baseline questionnaire package (second lab visit)
Time Involvement: 30 minutes
The questionnaire package will include: demographics information sheet, smoking history questionnaire, seven-day physical activity recall questionnaire, nicotine dependence questionnaire, coping questionnaire, cigarette cravings questionnaire and withdrawal symptoms questionnaire.

Item 3: Carbon monoxide assessments
Time Involvement: 15 seconds
We will ask you to breathe into a machine called the Bedfont Smokerlyzer. This machine measures the amount of carbon monoxide (CO) as you breathe out. It does not cause any harm or discomfort to you. This Smokerlyzer measures how much you have smoked in the past several hours. A CO value of less than 6 parts per million will confirm that you have temporarily stopped smoking.

Item 4: Provide saliva sample on cotton swab
Time Involvement: 2 minutes
From this saliva sample we will measure the 3-hyrdroxycotinine and cotinine within your body to determine a 3-hyrdroxycotinine/cotinine ratio. This ratio tells us about the rate at which your body metabolizes (breaks down) nicotine.

Item 5: Psychological stress test
Time Involvement: 2 minutes and 45 seconds.
You will be asked to complete a psychological test called the Stroop task. This task involves colour words (e.g./ red, green, blue and yellow) presented in mismatched ink colours (e.g./ the word blue might be printed in green ink). You will be asked to say aloud the colour that the word is printed in and not the actual word itself. For example, if the word blue is presented in green ink you would say "green." Some words will be presented in red ink, for these words you must say the actual word itself and not the colour of the printed ink. For example if the word yellow is presented in red ink you would say "yellow." These words will be presented to you on a computer screen.

Item 6: Post-test questionnaire package
Time Involvement: 15 minutes
The questionnaire package will include: coping questionnaire, self-control questionnaire, cigarette cravings questionnaire and withdrawal symptoms questionnaire.

Item 7: Abstain from smoking for 18-24 hours
We ask that prior to your second laboratory session you abstain from smoking for at least 18 hours (18-24hours).

Item 8: *Ad libitum* smoking behavior
When you have completed the laboratory session, you will be asked to report the time of your first cigarette after you leave the EHPL. You be provided with a reminder slip that will contain two different ways you can contact us (phone, or email). If you forget to contact us, we will call or email you as a reminder.

Risks
While in the study, you may experience side effects. Known side effects are listed below, but other effects may occur that we cannot predict. If you are or become pregnant you must notify the investigator as smoking involves risks to the foetus.

Temporary Smoking Abstinence**:** You may experience withdrawal symptoms during the time you are abstaining from cigarettes. Such symptoms may include feeling edgy and nervous, dizzy, sweaty, having trouble concentrating, headaches, insomnia, increased appetite and weight gain, muscular pain, constipation, fatigue, or having an upset stomach. All of these symptoms are common for those who have temporarilyquit smoking so you should not be alarmed, as these symptoms will go away within a few days. Moderate intensity exercise has been shown to reduce smoking withdrawal symptoms, so it could be that those in the moderate intensity exercise treatment condition experience relief from some of these symptoms. Another common side effect of temporarily quitting smoking is that your "smoker's cough" gets worse for the first few days after you temporary quit. This is your body's way of attempting to rid the lungs of excess toxins. Your smoker's cough will improve largely if you have become smoke-free for a number of days.

Benefits
Your participation may help you and us get knowledge to shape the development of future exercise and smoking cessation programs.

Participation
Participation in this study is voluntary. You may refuse to participate, refuse to answer any questions or withdraw from the study at any time with no effect on your academic or employment status. If you decide to take part you will be given this Letter of Information to keep and be asked to sign the consent form. If you withdraw from the study, you maintain the right to request that any data collected from you not be used in the study. If you make such a request, all of the data collected from you will be destroyed. Please contact the study coordinator, Angela Fong, if you wish to withdraw from the study. If you are participating in another study at this time, please inform the study researchers right away to determine if it is appropriate for you to participate in this study.

Biological Specimens
The sample we are asking of you during the course of this study is saliva. This saliva sample will be used for the current study only. The saliva sample will be frozen in our laboratory freezer, then shipped and analyzed at the University of Toronto in Canada for an indication of how quickly you metabolize (break down) nicotine in your body (3-hydroxycotinine: cotinine ratio). Bar codes will be used to label your saliva samples, so the laboratory technicians analyzing your saliva will have no information as to who provided the saliva sample. The samples will be stored for a minimum of 3 years. Usage and potential research value will be reviewed annually thereafter. It is typical to keep the samples collected from a research study for 6 years after the study has been conducted. Once the research value is deemed lower than sufficient to justify storage costs, the samples will be destroyed by standard disposal of biohazardous waste laboratory policies and procedures. If we would like to use your saliva for a different study or for a different purpose in this study, we will send you a new letter of information and ask your permission.

Any specimen(s) obtained for the purposes of this study will become the property of the study researchers and once you have provided the specimens you will not have access to them. The specimen(s) will be discarded or destroyed once they have been used for the purposes described in the protocol. The specimen(s) will be used for research and such use may result in inventions or discoveries that could become the basis for new products or diagnostic or therapeutic agents. In some instances, these inventions and discoveries may be of potential commercial value and may be patented and licensed by the researcher. It is not the purpose of this study to use specimens for any inventions or patents, so it is very unlikely that this will occur as an outcome of a sample you provide us with. You will not receive any money or other benefits derived from any commercial or other products that may be developed from use of the specimens.

New Findings
If, during the course of this study, new information becomes available that may relate to your willingness to continue to participate, this information will be provided to you by the investigator (for instance, if a new quit-smoking aid becomes available).

Confidentiality
We will be collecting information from 40 participants for this study. All the information you provide to the researcher will be kept in the strictest confidence. You will be assigned an identification number and all data collected from you will be recorded and stored under this number only. All data will be stored in coded form on computers accessible only to research staff in a secure office. You will not be identified in any documents relating to the research. No information obtained during the study will be discussed with anyone outside of the research team. If the results of the study are published, your name will not be used.

Representatives of the University of Western Ontario Health Sciences Research Ethics Board and regulatory bodies (Health Canada) may contact you or require access to your study-related records to monitor the conduct of the research. If we find information we are required by law to disclose, we cannot guarantee confidentiality. We will strive to ensure the confidentiality of your research- related records. Absolute confidentiality cannot be guaranteed, as we may have to disclose certain information under certain laws.

Compensation
Free parking will be provided for your visits to the laboratory. If public transportation is required for participation in this study you will be reimbursed to a maximum of $15.00 (half distributed at the first lab visit and the remainder given out at the second lab visit).

If you have private medical or life insurance, you should check with your insurance company before you agree to take part in the study to confirm your participation in this study will not affect your insurance coverage and/or access to benefits.

This study is covered by Western University's insurance policy and if during the course of the study, any injury should occur to you, not due to your fault or negligence, all medical expenses necessary to treat such injury will be paid provided: a) you comply at all times with the study researcher's instructions b) you promptly report any such injury to the study researchers conducting the study, and c) the expenses are not otherwise covered by your provincial health care. Financial compensation for such things as lost wages, disability or discomfort due to this type of injury is not routinely available.You do not waive any legal rights by signing the consent form.

Alternative treatments
If you decide not to participate or if you withdraw from the study before it is completed, the alternative course of treatment could be to see your family physician

for advice on how to quit smoking. Another alternative to the procedures described above is not to participate in the study and continue on just as you do now.

Contact person(s)
If you have any questions about your rights as a research participant or the conduct of the study you may contact Dr. David Hill, Scientific Director, Lawson Health Research Institute. If you have any questions about the study, please contact the study coordinator, Angela Fong, or Stefanie De Jesus, or Dr. Harry Prapavessis.

This letter is for you to keep. You will be given a copy of this letter of information and consent form once it has been signed. If you have any concerns, please feel free to contact one of the researchers below. You may request the general findings of this research study from the researchers after the study is complete. You do not waive any legal rights by singing the consent form.

INFORMED CONSENT

Study Title: The effect of exercise on cravings, withdrawal and *ad libitum* smoking following concurrent stressors.

I have read the Letter of Information, have had the nature of the study explained to me and I agree to participate. All questions have been answered to my satisfaction.

Please send me the overall conclusions from this trial: Yes □ No □

I consent for my study related data to be used in future research studies:
Yes □ No □

I would like to be contacted for other research studies: Yes □ No □

Consenting Signature:

Participant: _____
Please Print Name

Participant: _____
Please Sign Name

Date: _____

Researcher Signature:

Person obtaining informed consent:

_____
Please Print Name

Person obtaining informed consent:

_____
Please Sign Name

Date: _____

Letter of Information – Experimental Participants

LETTER OF INFORMATION

Study Title: The effect of exercise on cravings, withdrawal and *ad libitum* smoking following concurrent stressors.

Principal Study Investigator:
Harry Prapavessis, Ph.D. (School of Kinesiology, The University of Western Ontario)

Co-Investigators:
Angela Fong, B.A. (School of Kinesiology, The University of Western Ontario)

Stefanie De Jesus, PhD. Candidate (School of Kinesiology, The University of Western Ontario)

You are being invited to participate in a research study looking at the effects of a short period of exercise on smoking behavior. This is a randomized control trial (a type of research study), which includes eligible volunteers who choose to take part. Please take your time to make a decision, and discuss this proposal with your personal doctor, family members and friends, as you feel inclined. The purpose of this letter is to provide you with the information you require to make an informed decision on participating in this research. This letter contains information to help you decide whether or not to participate in this research study. It is important for you to know why the study is being conducted and what it will involve. Please take the time to read this carefully and feel free to ask questions if anything is unclear or there are words or phrases you do not understand. We are asking you to take part because you are an adult between 18 and 64 years of age who smokes.

Purpose of the study
Exercise has been shown to help with traditional quit smoking strategies. A single bout of exercise, low to moderate in intensity, can help regulate cravings and withdrawal symptoms.

The primary objective of this study is to examine the effects of an acute bout of moderate intensity exercise on smoking cravings and withdrawal symptoms after concurrent stressors (i.e., temporary abstinence and a psychological test) following a period of smoking abstinence. The second purpose of this study is to assess the effect of exercise on smoking behaviour after concurrent stressors.

Participants
Forty participants will be asked to take part in this research. To be eligible to participate, you must meet the following criteria: 18 and 64 years of age, smoke 10 or more cigarettes per day for more than 2 years, have not been engaged in a serious quit attempt in the last six months, must not be suffering from an illness (e.g.

cold) that would affect your typical smoking behavior, do not have a medical condition that prevents you from exercising, not be pregnant or intending on becoming pregnant. You must also be able to read and write in English and have a telephone or e-mail account that the investigators can contact you at.

Research Procedure
If you choose to take part in this study, you will be asked to complete three study components:
A) first laboratory session, B) abstain from smoking, C) secondlaboratory session. The laboratory sessions will be held at the Exercise and Health Psychology Laboratory (EHPL) at Western University. The EHPL is located in Room 408 of the Labatt Health Sciences Building. Each laboratory session will take approximately 60 minutes.

A) First laboratory session
During your first laboratory session, you will complete a questionnaire package (see Item 1) and the following information will be collected: weight, height, breath carbon monoxide levels (see Item 3) and saliva samples (see Item 4) for nicotine metabolism analysis. You will also complete a computerized time reaction test to measure your executive function (see Item 1a). Executive function is an ability that allows you to select a response or make a decision. We are looking at an executive function called inhibition, which is your ability to stop unwanted actions and unwanted responding. One example of inhibition in your everyday life is, when you think something but then stop yourself from saying your thoughts. You are inhibiting (or stopping) your thoughts from being verbalized.At the end of your first laboratory session, we will schedule your second laboratory session within seven days of your first laboratory session. It is within your rights to refuse to answer any questionnaire items and we will honour your rights. You will receive half your compensation at this time.

B) Abstain from smoking
You will be asked to abstain from smoking for at least 18 hours prior to your laboratory visit (see Item 7). We will confirm that you have not smoked in the last 18 hours by asking you to complete a carbon monoxide test (see Item 3).

C) Second laboratory session
During your second laboratory session, smoking abstinence will be confirmed by breath carbon monoxide levels (Item 3). If the carbon monoxide value shows that you are not smoke-free at this time, we will reschedule your appointment. If at that time you again are unable to abstain, you will be ineligible to continue with the study. After, you will complete a psychological test (see Item 5). After the test, you will complete a questionnaire package asking questions about cigarette cravings, withdrawal symptoms and coping (see Item 6). Upon completing the questionnaire package, you will you will be asked to exercise at a moderate intensity on a treadmill for 15 minutes. Approximately 5 minutes into exercising, you will complete the cravings questionnaire, only (found in Items 1, 2 and 6). You will be asked complete the cravings questionnaire again after 10 minutes and 15 minutes of exercising. The

questions will be asked to you verbally and you will look at a copy of the scale on laminated card. You will give your answer verbally to the exercise supervisor. In addition, you will be asked how hard you are working every 2 minutes. A rate of perceived exertion scale will be presented to you on a laminated card. Again, you will give your answer verbally.

When 15 minutes has passed, you be asked to fill out a questionnaire package asking about cigarette cravings and withdrawal symptoms. It is within your rights to refuse to answer any questionnaire items and we will honour your rights. Upon completion of the cigarette cravings and withdrawal symptoms questionnaire package, you will be asked to report the time of your first cigarette after you leave the lab by phone (leaving a message on a secure line)or email. You will be given a reminder slip that contains our contact information (telephone number and email address). The remainder of your compensation will be given to you at this time.

Experimental description (items 1-8)

Item 1: Pre-screening questionnaire package (first lab visit)
Time Involvement: 20 minutes
The questionnaire package will include: PAR-Q, coping questionnaire, cigarette cravings questionnaire and withdrawal symptoms questionnaire.

Item 1a: Computerized Time Reaction Test
Time Involvement: 20 minutes
We will measure your reaction time on a button press computer task. Reaction time is the time it takes you to respond (press a key on keyboard) to a prompt (flash) on the computer screen.

Item 2: Baseline questionnaire package (second lab visit)
Time Involvement: 30 minutes
The questionnaire package will include: demographics information sheet, smoking history questionnaire, seven-day physical activity recall questionnaire, nicotine dependence questionnaire, coping questionnaire, cigarette cravings questionnaire and withdrawal symptoms questionnaire.

Item 3: Carbon monoxide assessments
Time Involvement: 15 seconds
We will ask you to breathe into a machine called the Bedfont Smokerlyzer. This machine measures the amount of carbon monoxide (CO) as you breathe out. It does not cause any harm or discomfort to you. This Smokerlyzer measures how much you have smoked in the past several hours. A CO value of less than 6 parts per million will confirm that you have temporarily stopped smoking.

Item 4: Provide saliva sample on cotton swab
Time Involvement: 2 minutes
From this saliva sample we will measure the 3-hyrdroxycotinine and cotinine within your body to determine a 3-hyrdroxycotinine/cotinine ratio. This ratio tells us about the rate at which your body metabolizes (breaks down) nicotine.

Item 5: Psychological stress test
Time Involvement: 2 minutes and 45 seconds.
You will be asked to complete a psychological test called the Stroop task. This task involves colour words (e.g./ red, green, blue and yellow) presented in mismatched ink colours (e.g./ the word blue might be printed in green ink). You will be asked to say aloud the colour that the word is printed in and not the actual word itself. For example, if the word blue is presented in green ink you would say "green." Some words will be presented in red ink, for these words you must say the actual word itself and not the colour of the printed ink. For example if the word yellow is presented in red ink you would say "yellow." These words will be presented to you on a computer screen.

Item 6: Post-test questionnaire package
Time Involvement: 15 minutes
The questionnaire package will include: coping questionnaire, self-control questionnaire, cigarette cravings questionnaire and withdrawal symptoms questionnaire.

Item 7: Abstain from smoking for 18-24 hours
We ask that prior to your second laboratory session you abstain from smoking for at least 18 hours (18-24hours).

Item 8: *Ad libitum* smoking behavior
When you have completed the laboratory session, you will be asked to report the time of your first cigarette after you leave the EHPL. You be provided with a reminder slip that will contain two different ways you can contact us (phone, or email). If you forget to contact us, we will call or email you as a reminder.

Risks
While in the study, you may experience side effects. Known side effects are listed below, but other effects may occur that we cannot predict. If you are or become pregnant you must notify the investigator as smoking involves risks to the foetus.

Exercise: There are some inherent risks of injury associated with exercise participation, particularly among people who are not used to exercising. You may, for example, feel mild muscle "tightness" or soreness that lasts for a couple of days. The possible benefits associated with exercise may outweigh the potential minor discomfort of beginning a supervised, laboratory-based exercise program. To minimize the physical risks of exercise, proper warm-up/cool-down and stretching protocols will be performed by a trained exercise counsellor. Additionally, the exercise program delivered will be tailored to your individual fitness level, and

modified according to your comfort level. Furthermore, you will only be allowed to participate in this exercise program if you complete the PAR-Q (Physical Activity Readiness Questionnaire) forms to ensure that it is safe for you to begin an exercise program. The exercise facilitator will be both CPR and First Aid trained, and experienced in working with previously inactive populations.If any physical or mental risks arise during treatment, The Student Emergency Response Team (SERT) will be available to provide immediate assistance. SERT will assist the exercise supervisor until the 911 emergency services arrive. Should you have a minor injury, for instance sore knees, or cramped muscles (e.g./ a "Charlie horse"), while exercising you will receive first aid onsite as required. A first aid kit and ice packs will be available for minor injuries.

Temporary Smoking Abstinence**:** You may experience withdrawal symptoms during the time you are abstaining from cigarettes. Such symptoms may include feeling edgy and nervous, dizzy, sweaty, having trouble concentrating, headaches, insomnia, increased appetite and weight gain, muscular pain, constipation, fatigue, or having an upset stomach. All of these symptoms are common for those who have temporarily quit smoking so you should not be alarmed, as these symptoms will go away within a few days. Moderate intensity exercise has been shown to reduce smoking withdrawal symptoms, so it could be that those in the moderate intensity exercise treatment condition experience relief from some of these symptoms. Another common side effect of temporarily quitting smoking is that your "smoker's cough" gets worse for the first few days after you temporary quit. This is your body's way of attempting to rid the lungs of excess toxins. Your smoker's cough will improve largely if you have become smoke-free for a number of days.

Benefits
Your participation may help you and us gain knowledge to shape the development of future exercise and smoking cessation programs.

Participation
Participation in this study is voluntary. You may refuse to participate, refuse to answer any questions or withdraw from the study at any time with no effect on your academic or employment status. If you decide to take part you will be given this Letter of Information to keep and be asked to sign the consent form. If you withdraw from the study, you maintain the right to request that any data collected from you not be used in the study. If you make such a request, all of the data collected from you will be destroyed. Please contact the study coordinator, Angela Fong, if you wish to withdraw from the study. If you are participating in another study at this time, please inform the study researchers right away to determine if it is appropriate for you to participate in this study.

Biological Specimens
The sample we are asking of you during the course of this study is saliva. This saliva sample will be used for the current study only. The saliva sample will be frozen in our laboratory freezer, then shipped and analyzed at the University of Toronto in Canada for an indication of how quickly you metabolize (break down)

nicotine in your body (3-hydroxycotinine: cotinine ratio). Bar codes will be used to label your saliva samples, so the laboratory technicians analyzing your saliva will have no information as to who provided the saliva sample. The samples will be stored for a minimum of 3 years. Usage and potential research value will be reviewed annually thereafter. It is typical to keep the samples collected from a research study for 6 years after the study has been conducted. Once the research value is deemed lower than sufficient to justify storage costs, the samples will be destroyed by standard disposal of biohazardous waste laboratory policies and procedures. If we would like to use your saliva for a different study or for a different purpose in this study, we will send you a new letter of information and ask your permission.

Any specimen(s) obtained for the purposes of this study will become the property of the study researchers and once you have provided the specimens you will not have access to them. The specimen(s) will be discarded or destroyed once they have been used for the purposes described in the protocol. The specimen(s) will be used for research and such use may result in inventions or discoveries that could become the basis for new products or diagnostic or therapeutic agents. In some instances, these inventions and discoveries may be of potential commercial value and may be patented and licensed by the researcher. It is not the purpose of this study to use specimens for any inventions or patents, so it is very unlikely that this will occur as an outcome of a sample you provide us with. You will not receive any money or other benefits derived from any commercial or other products that may be developed from use of the specimens.

New Findings
If, during the course of this study, new information becomes available that may relate to your willingness to continue to participate, this information will be provided to you by the investigator (for instance, if a new quit-smoking aid becomes available).

Confidentiality
We will be collecting information from 40 participants for this study. All the information you provide to the researcher will be kept in the strictest confidence. You will be assigned an identification number and all data collected from you will be recorded and stored under this number only. All data will be stored in coded form on computers accessible only to research staff in a secure office. You will not be identified in any documents relating to the research. No information obtained during the study will be discussed with anyone outside of the research team. If the results of the study are published, your name will not be used.

Representatives of the University of Western Ontario Health Sciences Research Ethics Board and regulatory bodies (Health Canada) may contact you or require access to your study-related records to monitor the conduct of the research. If we find information we are required by law to disclose, we cannot guarantee confidentiality. We will strive to ensure the confidentiality of your research- related

records. Absolute confidentiality cannot be guaranteed, as we may have to disclose certain information under certain laws.

Compensation
Free parking will be provided for your visits to the laboratory. If public transportation is required for participation in this study you will be reimbursed to a maximum of $15.00(half distributed at the first lab visit and the remainder given out at the second lab visit).

If you have private medical or life insurance, you should check with your insurance company before you agree to take part in the study to confirm your participation in this study will not affect your insurance coverage and/or access to benefits.

This study is covered by Western University's insurance policy and if during the course of the study, any injury should occur to you, not due to your fault or negligence, all medical expenses necessary to treat such injury will be paid provided: a) you comply at all times with the study researcher's instructions b) you promptly report any such injury to the study researchers conducting the study, and c) the expenses are not otherwise covered by your provincial health care. Financial compensation for such things as lost wages, disability or discomfort due to this type of injury is not routinely available. You do not waive any legal rights by signing the consent form.

Alternative treatments
If you decide not to participate or if you withdraw from the study before it is completed, the alternative course of treatment could be to see your family physician for advice on how to quit smoking. Another alternative to the procedures described above is not to participate in the study and continue on just as you do now.

Contact person(s)
If you have any questions about your rights as a research participant or the conduct of the study you may contact Dr. David Hill, Scientific Director, Lawson Health Research Institute. If you have any questions about the study, please, Angela Fong, or Stefanie De Jesus, or Dr. Harry Prapavessis.

This letter is for you to keep. You will be given a copy of this letter of information and consent form once it has been signed. If you have any concerns, please feel free to contact one of the researchers below. You may request the general findings of this research study from the researchers after the study is complete. You do not waive any legal rights by singing the consent form.

INFORMED CONSENT

Study Title: The effect of exercise on cravings, withdrawal and *ad libitum* smoking following concurrent stressors.

I have read the Letter of Information, have had the nature of the study explained to me and I agree to participate. All questions have been answered to my satisfaction.

Please send me the overall conclusions from this trial: Yes □ No □

I consent for my study related data to be used in future research studies:
Yes □ No □

I would like to be contacted for other research studies: Yes □ No □

Consenting Signature:

Participant: _____
Please Print Name

Participant: _____
Please Sign Name

Date: _____

Researcher Signature:

Person obtaining informed consent:

_____
Please Print Name

Person obtaining informed consent:

_____
Please Sign Name

Date: _____

Ad lib Smoking Reminder Slip

REMINDER!!

Thank you for participating in this temporary quit smoking study. Please remember to email or leave a message with the following information:

ID# _____ and TIME of **first cigarette**

Please remember to be as accurate as you can with the time and do not leave your name so that your information remains confidential. Thank you!

Debriefing Letter

Western HealthSciences

REMINDER AND DEBRIEFING LETTER

Study Title: The effect of exercise on cravings, withdrawal and *ad libitum* smoking following concurrent stressors.

Principal Study Investigator:
Harry Prapavessis, Ph.D. (School of Kinesiology, The University of Western Ontario)

Co-Investigator:
Angela Fong, B.A. (School of Kinesiology, The University of Western Ontario)

Stefanie De Jesus, PhD. Candidate (School of Kinesiology, The University of Western Ontario)

Thank you for participating in my study.

Before you completed the Stroop task (word-colour association or "intelligence" test), you were told that this test is a reflection of your intelligence, but that was a trick to stress you out. Also, you were told that for every error on your Stroop task you would look $1.00 of your compensation, but that was a trick to stress you out even more. You have received your full compensation ($15.00 total) and this test was not a reflection of your intelligence. This task is designed to demand your attention to make you mentally tired.

Please remember to email or call with the time and date of your first cigarette after leaving the laboratory. Please remember to only leave your identification number (3-digit number) and the time and date of your cigarette. For confidentiality purposes do not leave your name.

If you have any questions about the study, please contact the study coordinator, Angela Fong, or Stefanie De Jesus, or Dr. Harry Prapavessis

Angela Fong
Graduate Student
School of Kinesiology,
Western University

Stefanie De Jesus
Graduate Student
School of Kinesiology,
Western University

Dr. Harry Prapavessis
Professor
School of Kinesiology,
Western University

Appendix B

Shiffman – Jarvik Withdrawal Scale – Psychological Symptoms Subscale

INSTRUCTIONS: Please CIRCLE the number to the right of each question that most accurately reflects how you feel at this moment.

	Definitely Do Not Feel						Definitely Feel
1. Do you feel more calm than usual?	1	2	3	4	5	6	7
2. Are you able to concentrate as well as usual?	1	2	3	4	5	6	7
3. Do you feel content?	1	2	3	4	5	6	7
4. Do you feel more tense than usual?	1	2	3	4	5	6	7
5. Are you feeling irritable?	1	2	3	4	5	6	7

Cravings

INSTRUCTIONS: Please CIRCLE the number on the line below for each question that most accurately reflects how you feel at this moment.

1. How strong is your desire to smoke right now?

Not at all			Somewhat			Extremely
1	**2**	**3**	**4**	**5**	**6**	**7**

Demographic Questionnaire

First Name:_____ Last Name:_____

Address:_____
STREET ADDRESS, CITY, POSTAL CODE

Home Phone: _____- _____-_____

Email Address:
_____@_____

Date of Birth: _____/_____/_____ Age: _____

Gender: ☐ Male ☐Female

Height: _____ Weight: _____ BMI: _____

SMOKING STATUS AND HISTORY

Please indicate the length of time you have smoked: _____

On average, how many cigarettes do you smoke per day? : _____

Do you currently smoke any other substance besides cigarettes? ☐ Yes ☐ No

If yes, please specify (e.g. marijuana, cigar, pipe, cigarello, waterpipe tobacco/hookah):

_____

Have you ever smoked any other substance besides cigarettes? ☐ Yes ☐ No

If yes, please specify (e.g. marijuana, cigar, pipe, cigarello, waterpipe tobacco/hookah):

_____

Does anyone in your household currently smoke? ☐ Yes ☐ No

Do you drink Alcohol? ☐ Yes ☐ No

If yes, number of drinks per week? _____

What is the approximate date and time of the last cigarette you have smoked?

Date: _____ Time: _____

Physical Activity Readiness Questionnaire (PARQ)

1. Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?

a. [ ] Yes
b. [ ] No

2. Do you feel pain in your chest when you do physical activity?

a. [ ] Yes
b. [ ] No

3. In the past month, have you had chest pain when you were not doing physical activity?

a. [ ] Yes
b. [ ] No

4. Do you lose your balance because of dizziness or do you ever lose consciousness?

a. [ ] Yes
b. [ ] No

5. Do you have a bone or joint problem that could be made worse by a change in your physical activity?

a. [ ] Yes
b. [ ] No

6. Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart?

a. [ ] Yes
b. [ ] No

7. Do you know of any other reason why you should not do physical activity?

a. [ ] Yes
b. [ ] No

_____

Name

_____

Signature

_____

Date

7-Day Physical Activity Recall Questionnaire

INSTRUCTIONS: Please complete the chart below with information regarding any work, household or leisure activities that are at a level of intensity that makes you breathe slightly harder than normal, makes your heart beat faster than normal and lasts for at least 5 minutes. We'd like to know about any of this type of physical activity, which you have done in the last week, starting with yesterday and working backward.

Moderate activity is activity, which feels similar to a brisk walk.
Hard activity is activity, which feels harder than a brisk walk.
Very hard activity is activity, which feels similar to running or jogging.

1. Please complete the following chart with specific activities that you've done this week.

DAY	MORNING	AFTERNOON	EVENING	Minutes of Activity
1 (yesterday)				
2				
3				
4				
5				
6				
7				

W: Walk, **Exh**: Sructured home exercise, **Exf**: Structured exercise facility, **H**: Housework,
Sw: Swimming, **DIY**: Do it yourself, **Cyc**: Cycling, **G**: Gardening, **D**: Dancing,
Spi: Sport/individual, **Spt**: Sport Team , **Occ**: Occupational, **O**: Other *(please state).*

2. Number of minutes spent last week doing **moderate activity**: _____.
3. Number of minutes spent last week doing **hard activity**: _____.
4. Number of minutes spent last week doing **very hard activity:** _____.
5. Number of days with 30 minutes or more of **hard or very hard activity:**_____ _____.
6. Number of days with 30 minutes or more of **moderate, hard or very hard activity**: __
7. How much physical activity did you do last week compared to the previous 3 months? (*Circle one box only*)

Much less	Less	About the same	More	Much more

Fagerstrom Test for Cigarette Dependency

1. How many cigarettes per day do you usually smoke? *(Circle the number that best represents your cigarette consumption)*

    a. 10 or less

    b. 11 to 20

    c. 21 to 30

    d. 31 or more

2. How soon after you wake up do you smoke your first cigarette? *(Circle one response)*

    a. Within 5 minutes

    b. 6 to 30 minutes

    c. 31 or more

3. Do you find it difficult to refrain from smoking in places where it is forbidden (e.g. in church, at the library, in the cinema)? *(Circle one response)*

    a. No

    b. Yes

4. Which cigarette would you most hate to give up? (*Circle one response*)

    a. The first of the morning

    b. Other

5. Do you smoke more frequently in the first hours after waking than during the rest of the day? *(Circle one)*

    a. No

    b. Yes

6. Do you smoke if you are so ill that you are in bed most of the day? *(Circle one response)*
    a. No

    b. Yes

Smoking Ladder Questionnaire

Below are some thoughts that smokers have about quitting. On this ladder, circle the one number that shows what you think about quitting. Please read each sentence carefully before deciding.

10	I have quit smoking and I will never smoke again.
9	I have quit smoking, but I still worry about slipping back, so I need to keep working on living smoke free.
8	I still smoke, but I have begun to change, like cutting back on the number of cigarettes I smoke. I am ready to set a quit date.
7	I definitely plan to quit smoking with the next 30 days.
6	I definitely plan to quit smoking in the next 6 months.
5	I often think about quitting smoking, but I have no plans to quit.
4	I sometimes think about quitting smoking, but I have no plans to quit.
3	I rarely think about quitting smoking, and I have no plans to quit.
2	I never think about quitting smoking, and I have no plans to quit.
1	I enjoy smoking and have decided not to quit smoking for my lifetime. I have no interest in quitting.

Brief Self-Control Questionnaire

INSTRUCTIONS: Using the scale provided, please indicate how much each of the following statements reflects how you typically are.

1. I am good at resisting temptation.

Not at all				Very much
1	2	3	4	5

2. I have a hard time breaking bad habits.

Not at all				Very much
1	2	3	4	5

3. I am lazy.

Not at all				Very much
1	2	3	4	5

4. I say inappropriate things.

Not at all				Very much
1	2	3	4	5

5. I do certain things that are bad for me, if they are fun.

Not at all				Very much
1	2	3	4	5

6. I refuse things that are bad for me.

Not at all				Very much
1	2	3	4	5

7. I wish I had more self-discipline.

Not at all				Very much
1	2	3	4	5

8. People would say that I have iron self-discipline.

Not at all				Very much
1	2	3	4	5

9. Pleasure and fun sometimes keep me from getting work done.

Not at all				Very much
1	2	3	4	5

10. I have trouble concentrating.

Not at all				Very much
1	2	3	4	5

11. I am able to work effectively toward long-term goals.

Not at all				Very much
1	2	3	4	5

12. Sometimes I can't stop myself from doing something, even if I know it is wrong.

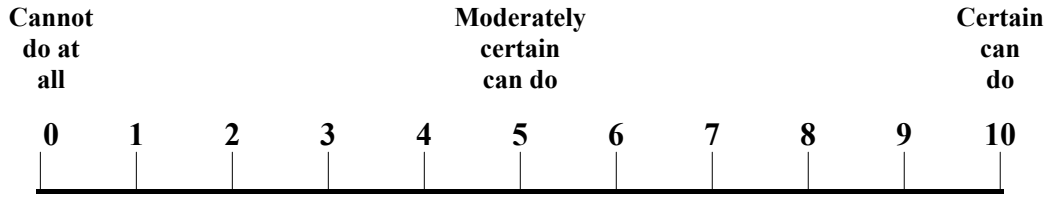
Not at all				Very much
1	2	3	4	5

13. I often act without thinking through all the alternatives.

Not at all				Very much
1	2	3	4	5

Coping Self-Efficacy Questionnaire

INSTRUCTIONS: Using the scale below write a number from 0 to 10 for the following items.



When things aren't going well for you, or when you're having problems, how confident or certain are you that you can do the following:

1. Make unpleasant thoughts go away. _____
2. Take your mind off unpleasant thoughts. _____
3. Stop yourself from being upset by unpleasant thoughts. _____
4. Keep from feeling sad. _____
5. Keep from getting down in the dumps. _____
6. Look for something good in a negative situation. _____
7. Keep yourself from feeling lonely. _____
8. Visualize a pleasant activity or place. _____
9. Pray or meditate. _____

Curriculum Vitae for Angela J. Fong

ACADEMIC HISTORY

Masters of Arts, Kinesiology – Exercise Psychology **2012 – 2013**
University of Western Ontario, London, ON, Canada

Bachelors of Arts, Kinesiology **2006 –2010**
University of Western Ontario, London, ON, Canada

RESEARCH EXPERIENCE

Research Assistant – Exercise at Western **May 2013 – Aug 2013**
Dr. C. R. Hall, The University of Western Ontario, London, ON
Dr. W. Rodgers, Dr. T. Berry, University of Alberta, Edmonton, AB

Research Assistant – Go Girls! Research Project **Dec 2012 – May 2013**
A. Justine Wilson (PhD. candidate) and Dr. M. R. Beauchamp, University of British Columbia, Vancouver, BC

Physical Activity Coordinator (PAC) – CO.21 Trials **May 2012 – Present**
Dr. K. S. Courneya, University of Alberta, Edmonton, AB

Research Coordinator – Getting Physical on Cigarettes Trial **Sept 2010 – Present**
Dr. H. Prapavessis, The University of Western Ontario, London, ON

Volunteer Research Assistant **May 2009 – Sept 2010**
Dr. H. Prapavessis, The University of Western Ontario, London, ON

PUBLICATIONS

Fong, A. J., De Jesus, S., Fitzgeorge, L. & Prapavessis, H. (in preparation). Implications of weight concerns on anthropometric changes in the Getting Physical on Cigarettes trial.

Presentations
Fong, A. J., De Jesus, S., Tritter, A., Fitzgeorge, L. & Prapavessis, H. Implications of Weight Concern on Anthropometric Measures in Women Attempting to Quit Smoking. Poster presentation at the 34th Annual Meeting & Scientific Sessions of the Society of Behavioral Medicine, March 20-23, 2013.

Invitations
Fong, Angela J. (February, 2013) Implications of weight concern on anthropometric measures in women attempting to quit smoking. Journal Club at Western University. London, Ontario Canada.

Fong, Angela J. (March 2013) Exercise as an aid for smoking cessation: a primer and future directions. Retiring with Strong Minds Seminar Series. London, Ontario, Canada.

SCHOLARSHIPS AND ACADEMIC HONOURS

School of Kinesiology Travel Award – Winter 2013 $684	**May 2013**
Faculty of Health Sciences Travel Award – Winter 2013 $500	**Apr 2013**
Western Graduate Research Scholarship $10, 500 per year	**Sept 2012**

TEACHING EXPERIENCE

Graduate Teaching Assistant for Kinesiology 1088A	**Fall Semester 2012**
Graduate Teaching Assistant for Kinesiology 3476G	**Winter Semester 2013**
