

AN INVESTIGATION OF THE ROLE OF MOTIVATION LEVEL  
IN PRODUCING PLACEBO EFFECTS IN SMOKERS

By

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Submitted to the

Faculty of the College of Arts and Sciences

of American University

in Partial Fulfillment of

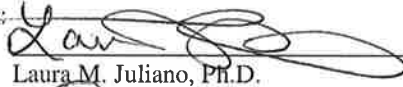
the Requirements for the Degree of


Doctor of Philosophy


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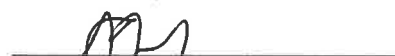
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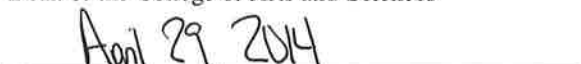
  
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2014

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ABSTRACT

It is believed that a variety of psychological mechanisms play a role in producing placebo effects including, but not limited to, expectations, conditioning, and motivation (Finnis et al., 2010). Most research to date has focused on classical conditioning and expectancy explanations, while very few studies have examined how different levels of motivation to respond to a placebo contribute to the placebo effect (Geers et al., 2005; Irmak et al., 2005, Jensen & Karoly, 1991). This study attempted to manipulate the motivation to response to a placebo, or denicotinized (DN), cigarette among regular smokers. Participants smoked a DN cigarette while being randomly assigned to an instructional set manipulation designed to induce low motivation to experience a PE (n=40) or high motivation to experience a PE (n=40). Urge to smoke, mood, nicotine withdrawal, and smoking satisfaction were assessed before and after the manipulation. Smokers in the high motivation group reported significantly greater urge and withdrawal reduction, and greater smoking satisfaction and reward than those in the low motivation group. These findings are among the first to empirically demonstrate that motivation may play a role in placebo responding, and should be explored in future studies.

## ACKNOWLEDGMENTS

I gratefully acknowledge my graduate advisor, Laura M. Juliano, Ph.D., for her invaluable guidance in the design, implementation, and assessment of this experiment, and my dissertation committee Maria Gomez, Ph.D., David Kearns, Ph.D., and Andrew Waters, Ph.D. for their review and evaluation of this project. Special thanks to Tessa Ratner for her assistance with preparing assessments, running participants, and data management. I recognize all of the former and current members of the Behavioral Pharmacology and Health Promotion Laboratory at American University for their assistance and support. This study was supported by Mellon funds and a Doctoral Dissertation Fellowship Award received from the American University College of Arts and Sciences.

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## CHAPTER 1

### INTRODUCTION

The Center for Disease Control (CDC) estimates that between 2000 and 2004, four hundred and forty-three thousand deaths per year in the United States were attributed to the effects of cigarette smoking (Annual Deaths Attributable, 2013). The health effects of smoking cigarettes have reportedly led to one hundred and ninety-three billion dollars in U.S. health care costs. The 2010 Surgeon General's report asserts that "There is no safe level of exposure to tobacco smoke. Any exposure to tobacco smoke – even an occasional cigarette or exposure to secondhand smoke – is harmful." (A Report of the Surgeon General, 2013, p. 1). Despite nicotine replacement therapies (gum, patch, sprays, inhalers, lozenges), medications such as Bupropion and Varenicline, and behavioral treatments, the National Institute on Drug Abuse (2010) estimates that over 62 million Americans over the age of twelve still smoke cigarettes (DrugFacts, 2012). A similar CDC report (2011) maintains that of the 52.4% of Americans who tried to quit smoking in the previous year, only 6.2% reported recent cessation (Quitting Smoking Among Adults, 2011).

It remains clear that additional efforts are needed to further develop effective treatments to reduce and potentially eliminate the harmful results of cigarette smoking. However, the nicotine contained in cigarettes remains both reinforcing and rewarding (Jaffe, 1979), making it difficult for cigarette smokers to reduce or stop their smoking behaviors despite negative health consequences. The denicotinized cigarette, also known as a placebo cigarette, has proved to be a valuable tool in studying the reinforcing and rewarding characteristics of cigarettes without the reinforcing factor of nicotine. Research evidence maintains that nicotine alone is not solely responsible for the maintenance of smoking behaviors in smokers, but that the behavioral and



sensorimotor aspects of smoking also play a role in producing smoking reward and reinforcement (Robinson et al., 2000). Amidst efforts to quit smoking, smokers who receive nicotine replacement therapy still have a difficult time staying abstinent, and often relapse (Kenford et al., 1994). Research with placebo cigarettes has shed light on the role that sensorimotor aspects play in the maintenance of smoking habits by providing the sensory and motor experiences of smoking in the absence of the direct pharmacological effects of nicotine (Becker, Rose, & Albino, 2008; Rose, 2003).

Recent findings from studies investigating the effects of placebo cigarettes in smokers provide support that they may even facilitate smoking cessation attempts. In one double-blind smoking cessation trial, smokers interested in quitting smoked 0.3 mg nicotine yield, 0.05 mg nicotine yield cigarettes, or used nicotine lozenges (4 mg nicotine) for six weeks (Hatsukami, et al., 2010). 0.05 mg nicotine yield cigarettes reduced withdrawal better than lozenge, produced a higher rate of cessation than 0.3 mg nicotine yield cigarettes, and were not associated with compensatory smoking behaviors. In a similar double-blind cessation trial (Becker et al., 2007), smokers who used denicotinized cigarettes plus nicotine replacement therapy (patch) for two weeks before a designated quit date, then for several weeks after, were more likely to remain abstinent for four weeks after the quit date than smokers who used either a nicotine patch or a placebo patch alone after quitting. Even cessation trials in which smokers knew they were smoking denicotinized cigarettes produced similar results; an open label trial comparing heavy smokers who used nicotine cigarettes alone or denicotinized cigarettes plus patch two weeks before a quit date found that the denicotinized cigarettes plus patch group experienced fewer and less intense cigarette cravings before and after the quite date (Rezaishiraz et al., 2007). When used as a quitting tool, denicotinized cigarettes promote abstinence by reducing cigarette craving

and nicotine withdrawal, thereby reducing the likelihood of relapse regardless of whether quitters know what type of cigarette they are smoking.

In addition to supporting their use in facilitating smoking cessation, recent investigations with placebo cigarettes have informed the area of smoking research literature about the acute subjective and behavioral effects of denicotinized cigarettes in smokers. A number of studies have compared smokers' immediate reactions to nicotine and placebo cigarettes. Such studies have shown that placebo cigarettes are capable of alleviating cravings and withdrawal among smokers (Rezaishiraz et al., 2007; Donny, Houtsmuller, & Stitzer, 2006; Buchhalter et al., 2005; Dallery et al., 2003; Gross, Lee, & Stitzer, 1997; Butschky et al., 1995) and improving poor mood (Juliano, Fucito, & Harrell, 2011). Placebo cigarettes have also been rated as more satisfying than nicotine inhalers, and delay the onset of smoking longer than nicotine inhalers (Barrett, 2010). Denicotinized cigarettes have also been found to be reinforcing; double-blind studies have shown that smokers will work to obtain placebo cigarettes, though they will work harder for nicotine cigarettes when they are concurrently available (Shahan et al., 1999). As a whole, research suggests that placebo cigarettes produce rewarding and reinforcing effects and are preferred over receiving nicotine in the absence of smoking (Rose et al., 2010). The rewarding effects of placebo cigarettes, although sometimes less than nicotine cigarettes, are generally not significantly different from rewarding effects of nicotine cigarettes (Robinson, Houtsumuller, Moolchan, & Pickworth, 2000; Rose & Behm, 1994b).

The fact that placebo cigarettes can effectively reduce cigarette craving and withdrawal in addition to generating rewarding effects in smokers begs the question of how denicotinized cigarettes produce placebo effect in smokers. Drug literature poses three major explanations for how inert drugs can produce placebo effects in active drug users (Geers et al., 2005): classical

conditioning, expectancies, and motivation. In addressing the effects of placebo cigarettes in smokers, the Classical Conditioning Theory (Pavlov, 1927) conjectures that the nonpharmacological and environmental factors involved in the smoking experience repeatedly become paired with the pharmacological effects of nicotine. Over time, these non-drug (sensorimotor) aspects of smoking such as the taste and smell of a cigarette, and the sensation of smoke in the throat and lungs, become conditioned stimuli. Conditioned placebo responses have been demonstrated in several classic animal studies showing that rats experience placebo effects from injected saline resulting from associations between injections and the effects of morphine or amphetamines (Pihl & Altman, 1971; Ross & Schnitzer, 1963; Herrnstein, 1962). Studies with human subjects have also established that classical conditioning plays a role in producing placebo effects (Foltin & Haney, 2000; Blumenthal & Flaten., 1999; Ader., 1993).

Even in the absence of nicotine, conditioned sensorimotor stimuli can produce conditioned responses in smokers similar to responses typically attributed to exposure to the unconditioned stimulus (nicotine), including reduced cigarette craving, reduced nicotine withdrawal, and improved mood. The classical conditioning explanation of placebo effects that result from smoking denicotinized cigarettes is supported by data showing that pepper spray, which stimulates the throat much like cigarettes, reduces cigarette craving and withdrawal in smokers (Rose & Behm, 1994a; Rose, Behm, & Levin, 1993). In addition, the finding that smokers prefer smoking placebo cigarettes to receiving nicotine that is delivered in naturalistic doses (IV) in the absence of the sensory aspects of smoking (Rose et al., 2010), also strengthens the argument that classical conditioning plays a role in how smokers respond to placebo cigarettes.

However, limitations exist in explaining placebo effects exclusively through behavioral conditioning. Not all individuals who have repeatedly used a drug show increased placebo effects (Geers et al., 2005). While classical conditioning does explain how smokers can develop an association between the non-drug and nicotine factors involved in smoking, it also explains how smokers develop associations between the cigarettes which they smoke and the effects they expect to feel from them. Smoking cigarettes over time with repeated experiences can lead to the development of expectancies about the effects of smoking cigarettes. Smokers might expect their cigarettes to contain nicotine, and expect that smoking a cigarette will produce certain physiological and behavioral effects. When describing the mechanisms behind placebo effects, drug literature, particularly in the area of placebo responses, distinguishes expectancies from classical conditioning while still acknowledging the relationship between the two theories (Stewart-Williams & Podd, 2004). Renowned placebo researcher Irving Kirsch clarifies, “Rather than being viewed as an alternative to expectancy, classical conditioning can be understood as one method by which expectancies are formed.” (Kirsch, 1985). It has also been argued that expectancies developed from verbal information about a drug may mediate placebo effects developed through other mechanisms such as classical conditioning (Stewart-Williams & Podd, 2004; Kirsch & Weixel, 1988). In other words, it is believed that conditioning can produce expectancies (Montgomery & Kirsch, 1997).

The idea that expectancies themselves can serve as a mechanism leading to placebo effects has been widely studied. Expectancy Theory (see Brandon, Juliano, & Copeland, 1999) postulates that individuals react to information given to them about a drug, and information about the drug leads them to possess expectancies about the content of the drug or the effects of consuming the drug (see Perkins et al., 2003). Drug expectancies are generally studied as a

mechanism independent of any associations formed as a result of classical conditioning, and usually result from information received about the drug from the environment. Perkins et al. (2003) describe two ways in which expectancies about placebos can be formed from the environment: a. Instructional Set- verbal information given to drug users about the content of the drug, and b. Cues- non-verbal information about a substance. In addition, two types of expectancies have been distinguished: a *stimulus expectancy* refers to a subject's belief about drug content while a *response expectancy* refers to the subject's belief about the drug's effects (Perkins et al., 2003). According to the Expectancy Theory, smokers are most likely to experience placebo effects, such as reduction in urge from a denicotinized cigarette, if they possess a stimulus expectancy that the cigarette which they are smoking contains nicotine, and a response expectancy that nicotine reduces urge to smoke (Juliano, Fucito, & Harrell, 2011).

Investigations that have manipulated smokers' expectations about the type of cigarette they smoked reveal that reactions to nicotine and placebo cigarettes depend in part on what type of cigarette the smoker thinks he is smoking. Results from studies which manipulate participants' response expectancies about a placebo demonstrate that expectancies sufficiently influence subjective outcomes of smoking, and can be manipulated. These studies facilitate the use of the Balanced Placebo Design (BPD), a 2 x 2 between-subjects research design that allows researchers to distinguish the main effects and interaction effects of response expectancies and drug content in producing placebo effects. The design involves the randomization of study participants into four distinct conditions: 1. told drug/given drug, 2. told drug/given placebo, 3. told placebo/given drug, and 4. told placebo/given placebo. As an example, Perkins et al., (2004) used the balanced placebo design to find that smokers who were told they would smoke a nicotine cigarette, regardless of nicotine dose, reported higher ratings of the cigarette, greater

liking and satisfaction of the cigarette, and worked harder to earn puffs of the cigarette than those told they would smoke a denicotinized cigarette, regardless of nicotine dose.

Additional findings using the BPD reveal that smokers who expect to smoke a nicotine cigarette report greater reduction in urge to smoke (Juliano & Brandon, 2002; Juliano, Fucito, & Harrell, 2011) and show improved cognitive performance (Juliano, Fucito, & Harrell, 2011) after smoking than those expecting a placebo cigarette. Among participants who smoke a placebo cigarette, those told they will smoke a nicotine cigarette report greater reduction in urge to smoke (Juliano and Brandon, 2002), liking the cigarette more, find the cigarette more satisfying (Perkins et al., 2008), report better mood (Juliano, Fucito & Harrell, 2011), and self-administer more cigarette puffs (Darredeau et al., 2013) than those told they will smoke a placebo cigarette. Gender differences have also been found; women appear less sensitive to nicotine but more sensitive to dose instructions than men in increasing reward and reinforcement (Perkins et al., 2006). In a 2012 study (Harrell & Juliano), participants' expectancies were manipulated by telling them that smoking a cigarette would enhance or impair cognitive and motor performance. Those in the "enhance" condition reported greater psychological reward, motivation to perform well on a cognitive task, and enjoyment of the physical sensations of the cigarette, as well as reduced craving compared to the "impair" condition (Harrell & Juliano, 2012).

In addition to classical conditioning and expectancies, the motivations behind why individuals use a drug have also been used to explain the placebo effect (Finniss et al., 2010; Price, Finniss, & Benedetti, 2008). Motivation to use a drug or to experience particular symptoms from a drug can come from many places (see Jensen & Karoly, 1991), including the desire to fulfill societal expectations, social affirmation, experiment demand characteristics (Orne, 1962), or internal individual needs (Baker, Brandon, and Chassin, 2004). Examples of

internal needs that may need to be fulfilled include stress/anxiety reduction (Price & Fields, 1997), reduced withdrawal symptoms, pleasurable feelings, anticipated reward (see Robinson & Berridge, 1993), and cognitive enhancement.

While the current research investigating how classical conditioning and expectancies contribute to the placebo effect appears well-explored, the number of studies investigating the belief that an individual's motivation influences his or her response to a placebo drug remains small. Nonetheless, a contribution of motivational factors in producing placebo effects has been established. In a study conducted by Jensen and Karoly (1991), high and low motivation to use a sedative pill were induced in participants by asking them to read scripts about people who typically respond to this pill. Participants in the high motivation condition read about pill users who possess positive personality characteristics, while participants in the low motivation condition read about pill users who possess negative personality characteristics. Participants were also given a rationale to establish a relationship between the personalities of pill users and how those users typically respond to the sedative pill. Specifically, they were told that pill users with positive personalities respond more to the pill than pill users with negative personalities. The researchers defined motivation as the desire to feel the sedative effects of the pill, and anticipated that participants in the high motivation group would have a greater desire to feel the effects of the pill. In addition to manipulating motivation, the researchers also manipulated expectancies about the drug (told high dose vs. low dose), and found that regardless of dose expectancy, participants in the high motivation condition reported greater sedative effects from the pill.

Taking a different route, Geers et al. (2005) argued that individuals are motivated when they self-regulate themselves to achieve unconscious goals. Believing that situational

cues/expectations can automatically activate these unconscious goals, and that the desire to achieve unconscious goals moderates placebo effects, the authors predicted that people with placebo-compatible goals were most likely to feel placebo effects. After conducting five studies in which participants were primed or not primed to possess an unconscious goal of cooperation, participants were exposed to one of several types of placebos (positive music, sleep therapy, negative writing task, caffeine capsules, and music therapy) and were given expectations about how these placebos might make them feel. The experimenters concluded that primed cooperation goals did enhance placebo responding for all types of placebos, but that longer/stronger placebos could also produce placebo responding in the absence of the primed cooperation goals. This limited research supports the theory that motivational factors, whether defined as the desire to possess positive characteristic traits or desire to maintain a goal that is compatible with feeling placebo effects, can influence response to a placebo.

A third study conducted by Irmak and colleagues (2005) demonstrates the importance of motivation in producing the desire to experience the purported benefits of a marketed product, in this case, an energy drink. Participants were randomized to drink one New York Minute brand of energy drink, one diet decaffeinated beverage, or one glass of water. Before consuming their drinks, participants completed baseline measures. Participants in all conditions read an excerpt about New York Minute energy drinks, then answered questions about their motivation level and expectations about their drink. Participants finished their drinks, and then completed a twenty-five minute task to ensure time for the drinks to be absorbed. Arousal, physical reflex, and alertness were also measured. As with Jensen and Karoly (1991), researchers in this study defined motivation as the desire to feel the effects of the product. However, a median split was used with this data to distinguish high motivation drinkers (energy drink condition) from low



motivation drinkers (two placebo drink conditions). The placebo energy drink increased blood pressure, physical reflexes, enhanced mental alertness, and raised self-reported arousal, but only in high motivation drinkers.

Of the three explanations for placebo effects, motivation remains the least studied. This is likely due to the fact that the mechanisms behind its role in producing placebo effects are not well-understood. Regardless, research findings do establish that motivation plays a role in producing placebo effects. Importantly, the role of motivation in producing placebo responses in smokers remains completely unexplored. The aim of the current study is to further develop knowledge about how varied levels of motivation in individual smokers contribute to their subjective and behavioral responses to smoking a placebo cigarette. In this study, participants were randomized to feel high motivation (HM) or low motivation (LM) to smoke a denicotinized cigarette. Based on the Jensen and Karoly study (1991), high and low motivation were induced by reading scripts to participants which described people who smoked placebo cigarettes as having either positive (high motivation) or negative (low motivation) character traits. Participants were not given positive or negative information about the denicotinized cigarettes themselves in order to distinguish motivation to smoke the cigarette from expectancies about the cigarette. Participants in these two groups (HM and LM) were told that they would smoke a placebo cigarette (open label). In addition to manipulating motivation through scripts, a manipulation check was used to ensure that high motivation smokers showed greater motivation to smoke the denicotinized cigarette and feel its effects than low motivation smokers; two questions measuring participants' motivation and desire to smoke the cigarette they were given were included in the post-smoking assessment battery. Change in urge to smoke, withdrawal symptoms, total mood disturbance, and carbon monoxide level were be measured from before to

after smoking, as well as differences between groups in smoking satisfaction, number of puffs, and time spent smoking. Differences in mean response to each of the two motivation questions were calculated between the two conditions.

The researchers in this study hypothesized that participants in the HM group would display greater placebo effects from smoking the denicotinized cigarette compared to participants in the LM group. Specifically, it was predicted that participants in the HM condition would show a greater reduction in urge to smoke, withdrawal symptoms, and mood disturbance, and would report greater smoking satisfaction than participants in the LM condition. The rationale behind this prediction is that smokers in the HM group would feel more motivated to smoke the denicotinized cigarette and more motivated to feel the effects of the denicotinized cigarette than smokers in the LM group. When measuring differences between the two conditions, social desirability was assessed using the Crowne Marlowe Social Desirability Scale (Leite & Beretvas, 2005; Beretvas, Meyers, & Leite, 2002; Crowne & Marlowe, 1960) to control for the possible demand effects that could arise as a result of the experimental manipulation (Orne, 1962). Social Desirability is defined as “the desire for individuals to project favorable images of themselves during social interaction” (Johnson, Fendrich, & Hubbell, 2002), and has been known to lead to distortion in self-reported research responses (van de Mortel, 2008; Crowne & Marlowe, 1960).

## CHAPTER 2

### METHOD

#### **Participants**

Eighty cigarette smokers were recruited from the campus of American University and the local Washington D.C. area to participate in this experiment. Prior to participation, participants were screened for eligibility by phone. Eligible respondents were required to be at least 18 years old and smoke at least 5 cigarettes per day (cpd), every day, for the last year. Participants were permitted to choose either \$25.00 or extra credit points towards an undergraduate psychology course as compensation for study completion.

#### **Procedure**

During the phone screening process, participants provided their contact information and scheduled a study appointment. They were asked not to smoke for two hours prior to their appointment to control for recent cigarette exposure, and to ensure that participants were not satiated or experiencing severe withdrawal at the time of the study.

This study was designed to be a between-subjects, open-label placebo cigarette trial. Participants attended one laboratory session at American University which lasted approximately one hour and involved the completion of informed consent, questionnaires on a computer, behavioral measures, and smoking one denicotinized (DN) cigarette, also known as a placebo cigarette.

During the study session, participants first completed the informed consent process, then provided a baseline breath sample to measure carbon monoxide level, an indicator of smoking. They then completed a preliminary battery of self-report measures including questions about demographics, smoking history, the Fagerström Test for Nicotine Dependence (FTND), the Urge

Rating Scale, a modified version of the Positive and Negative Affect Schedule (PANAS-X), the Minnesota Nicotine Withdrawal Scale (MNWS), and the Crowne Marlowe Social Desirability Scale. All questionnaires were administered on a computer using the Inquisit software program.

Prior to taking part in the study, each participant was randomly assigned a participant ID number. Upon completion of the preliminary questionnaires, participants in Condition 1 (LM) were read aloud a written script designed to induce low motivation to smoke a placebo cigarette, were told they were being given a placebo cigarette, and then smoked a placebo cigarette. Participants in Condition 2 (HM) were read a script designed to induce high motivation to smoke a placebo cigarette, were told they were being given a placebo cigarette, then smoked a placebo cigarette.

#### Motivation script for Condition 1:

During this part of the study, you are going to rate and smoke a cigarette. The cigarette you are about to smoke is a denicotinized cigarette, also called a placebo cigarette. A placebo cigarette contains no nicotine. Placebo cigarettes are not very popular in the United States. Research shows that people who smoke them are less health conscious, less financially responsible, and less environmentally aware than people who smoke nicotine cigarettes. People who smoke placebo cigarettes tend to be less agreeable, more anxious, and less open to new experiences than people who smoke nicotine cigarettes. It is expected that sales of denicotinized cigarettes will decrease in the future. We would really appreciate if you could smoke one of these cigarettes and let us know what you think of it. We believe these cigarettes may still hold some promise for future use.

#### Motivation script for Condition 2:

During this part of the study, you are going to rate and smoke a cigarette. The cigarette you are about to smoke is a denicotinized cigarette, also called a placebo cigarette. A placebo cigarette contains no nicotine. Placebo cigarettes have become very popular in the United States. Research shows that people who smoke them are more health conscious, more financially responsible, and more environmentally aware than people who smoke nicotine cigarettes. People who smoke placebo cigarettes also tend to be more agreeable, more conscientious, and more open to new experiences than people who smoke nicotine cigarettes. It is expected that sales of denicotinized cigarettes will increase in the future. We would really appreciate if you could smoke one of these cigarettes and let us know what you think of it. We believe these cigarettes may hold some promise for future use.

All participants smoked one placebo (DN) cigarette ad lib. Because this study was an open-label trial for Conditions 1 and 2, both the experimenter and participants in those two conditions knew that the cigarette was denicotinized. Instructions for Conditions 1 and 2:

You are now going to smoke a placebo cigarette. Smoke the cigarette as you normally would. A lighter and ashtray are located in this box for you to use. Please wait one full minute after I leave, then light and smoke your cigarette. You may take as long as you need to finish smoking.

While the participant smoked, the experimenter observed the participant via a one way mirrored window and recorded the number of puffs and amount of time spent smoking. After the participant completed smoking, each cigarette butt was collected and weighed to measure how much of the cigarette had been smoked. Upon completion of the smoking task, all participants completed the urge, mood, and withdrawal measures a second time, in addition to two questions about motivation and the Cigarette Evaluation Scale (CES). At this point, participants provided their second breath sample. The study design is summarized in Figure 1.

### **Materials/Measures**

**Cigarettes.** All participants in this experiment smoked a *Quest 3* brand “nicotine free” cigarette (.05 mg. nicotine, 10 mg tar). Participants who reported smoking menthol cigarettes during their phone screen prior to participation were given menthol cigarettes to smoke during the study, and participants who reported smoking non-menthol cigarettes were given non-menthol cigarettes during the experiment. Length of time spent smoking and the weight of cigarette remains were recorded for each participant.

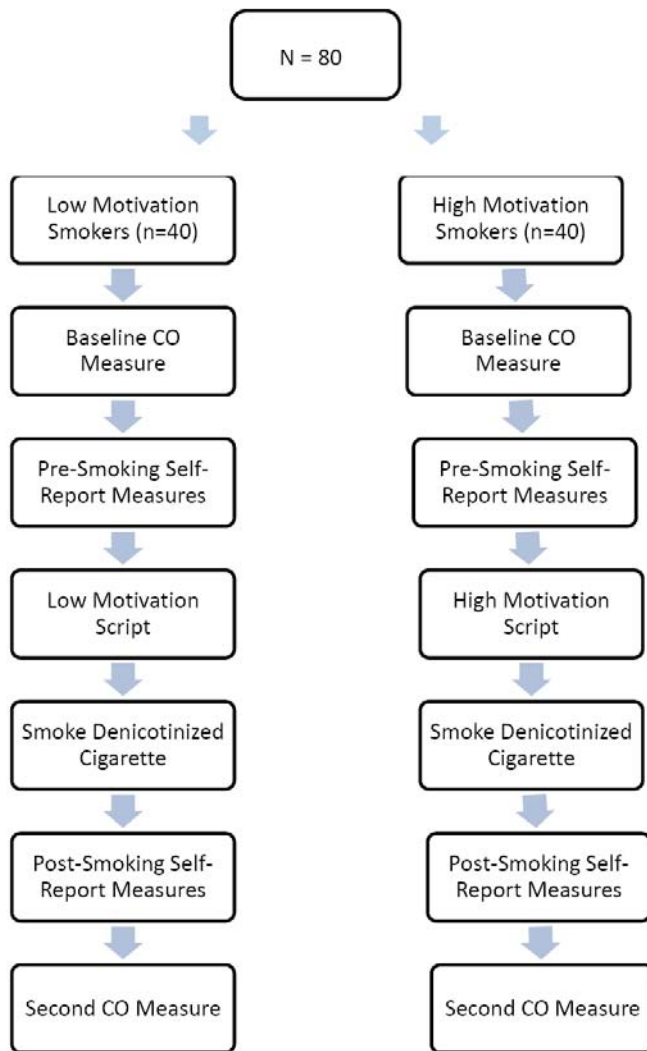


Figure 1. Study Flowchart

**Carbon Monoxide Testing.** Breath samples provided by participants were analyzed for volume of carbon monoxide using a portable Smokerlyzer (Bedfont Scientific Ltd., Medford, NJ).

**Smoking History.** Smoking behavior and history was assessed using a 21-item measure, including 6 items from the *Fagerström Test for Nicotine Dependence (FTND)* (Heatherton,

Kozlowski, Frecker, & Fagerström, 1991), a widely used measure of nicotine dependence, and questions about participant demographics.

**Urge Rating Scale.** Respondents rated their urge to smoke on three items (1. *I have a desire for a cigarette right now.*, 2. *I do want to smoke now.*, and 3. *I crave a cigarette right now.*) on a seven point scale ranging from *strongly disagree* (1) to *strongly agree* (7). This scale has demonstrated adequate reliability and validity in assessing urge to smoke (Kozlowski, Pillitteri, Sweeney, Whitfield & Graham, 1996).

**Positive and Negative Affect Schedule (PANAS-X)** This 40-item version of the original PANAS-X (60 items) measures positive and negative affect as dominant dimensions of the emotional experience, as well as 9 out of the 11 original PANAS-X specific affects: Fear (4 items), Sadness (3 items), Guilt (4 items), Hostility (4 items), Fatigue, Joviality, Self-Assurance, Attentiveness, and Serenity. Respondents are asked to rate how much they feel each feeling or emotion *right now* on a scale ranging from *Very Slightly or Not at All* (1) to *Extremely* (5). Reliability and validity on this measure have been established (Watson & Clark, 1994). In this study, Cronbach Alphas for the General Positive Factor (10 items) and General Negative Factor (10 items) pre-smoking were 0.885 and 0.893. Cronbach Alphas for the General Positive and General Negative Factors post-smoking were 0.930 and .999.

**Modified version of the Minnesota Nicotine Withdrawal Scale (MNWS).** This self-report measure asked respondents to rate how much they were feeling various symptoms of nicotine withdrawal “RIGHT NOW” on a scale ranging from *None* (0) to *Severe* (4). Our modified version of the MNWS contained 11 items: Angry, Irritable, Frustrated, Anxious, Nervous, Depressed mood/sad, Desire or craving to smoke, Difficulty concentrating, Increased appetite/hungry, Restless, and Impatient (Insomnia was not included due to its lack of relevance

to nicotine withdrawal). Reliability and validity on this measure have been established (Hughes & Hatsukami, 1986; Etter & Hughes, 2006). Total withdrawal was calculated at pre-smoking and post-smoking by calculating the sum of the Negative Affect and Restlessness factor means at each time point. Cronbach Alphas for the Negative Affect (7 items) and Restlessness (2 items) factors of this measure at pre-smoking were 0.881 and 0.744. Cronbach Alphas for the Negative Affect and Restlessness factors at post-smoking were 0.898 and 0.815. Items of craving, increased appetite, and insomnia are often included on this measure, but were not included in the Total Withdrawal score. Craving was not included to keep the craving construct separate from other symptoms of withdrawal. Appetite and Insomnia were not included because we would not expect to see changes on these two items over the course of a short experimental session.

**The Crowne Marlowe Social Desirability Scale.** This thirty-three item questionnaire asked respondents to mark whether or not they believed each statement about attitudes and traits was true or false as it pertained to them. Example items include “Before voting I thoroughly investigated the qualifications of all the candidates.” and “I have never deliberately said something that hurt someone’s feelings.” High internal consistency has been established for this measure, as well as high correlations with other measures of social desirability including the Edwards Social Desirability Scale and several scales of the Minnesota Multiphasic Personality Inventory (Leite & Beretvas, 2005; Beretvas, Meyers, & Leite, 2002; Crowne & Marlowe, 1960).

**The Life Orientation Test Revised (LOT-R).** This questionnaire is a self-report measure that was used to determine individual differences in respondents' optimism and pessimism about the future. Using a scale ranging from “I agree a lot” to “I DISagree a lot”, respondents are asked to rate whether or not they agree with ten statements that describe how



they might respond to a situation (6 scored items, 4 fillers). Example items include “In uncertain times, I usually expect the best.” and “I rarely count on good things happening to me.” This measure was used to determine if pre-existing differences in optimism/pessimism existed at baseline between our two conditions. Good predictive validity and the validity of dispositional optimism as a theoretical construct were established for the original Life Orientation Test (Schier & Carver, 1985). High internal consistency and test-retest reliability have also been established for the LOT-R (Scheier, Carver, & Bridges, 1994). In this study, the Cronbach’s alpha value for all scored items on this measure equals 0.841.

**Motivation Questions.** Two simple motivation questions were created by the investigators of this current study to serve as a manipulation check to ensure that the motivation scripts written for this study actually did increase or decrease participants' motivation to smoke a placebo cigarette. Participants were asked to rate on a scale of 1 (Not at all motivated) to 5 (Extremely motivated) “How motivated did you feel to smoke the cigarette that was given to you today?”, and on a scale of 1 (Not at all) to 5 (Extremely) “How much did you want to smoke the cigarette that was given to you today?” The two questions were administered after participants smoked to prevent the action of reading or answering the questions themselves from affecting participants’ motivation to smoke the placebo cigarette or from affecting their smoking behaviors. The question “How motivated were you to feel the effects of the cigarette which you smoked today?” was not asked to participants in order to keep the purpose of the study hidden until debriefing.

**Modified version of the Cigarette Evaluation Scale (Rose, Behm & Westman, 2001; Westman, Levin, & Rose, 1992).** This 14-item questionnaire (Rose, Behm, & Westman, 2001) assessed participants’ immediate reactions to the experimental cigarettes using a 7-point scale

ranging from *not at all* (1) to *extremely* (7). In reference to the cigarette that they smoked during the study, participants were asked questions such as: Was it satisfying?, Did it taste good?, and Did you enjoy the sensations of smoke in your throat and chest? In addition to the 10 original items described by Rose et al. (2001), the following four items were also included: (a) Did it immediately reduce your cravings for cigarettes?, (b) Did it taste different than your usual brand?, (c) Did it make you feel more alert? and (d) Did it make you feel less anxious? This questionnaire was administered to participants in all three conditions to assess their immediate reactions to the experimental cigarettes. Cronbach Alphas for the Smoking Satisfaction (2 items), Psychological Reward (5 items), and Aversion (2 items) factors for this measure were 0.857, 0.878, and 0.857. Enjoyment of Respiratory Tract Sensations and Craving Reduction factors also exist for items on this measure, but only contain one item each.

## CHAPTER 3

### RESULTS

#### **Baseline Data**

**Self-Report Measures (FTND).** A series of analyses of variance (ANOVAs) were conducted to rule out baseline differences between the High Motivation and Low Motivation conditions on self-reported characteristics. As shown in Table 1, there were no baseline differences between conditions on any of the relevant baseline demographic variables (e.g. smoking history, age), including optimism as measured by the LOT-R and Social Desirability as measured by the Crowne Marlowe Social Desirability Scale (See Table 1).

#### **Main Outcome Data**

A series of analysis of covariance (ANCOVA's) were conducted to compare smokers who were induced with Low Motivation versus High Motivation on subjective and behavioral smoking outcomes, controlling for social desirability. (See Tables 2, 3, and 4) The score on the Crowne-Marlowe Social Desirability measure was included as a covariate.

**Smoking Exposure (CO).** An ANCOVA conducted to compare Low Motivation smokers versus High Motivation smokers on change in carbon monoxide level from pre-smoking to post-smoking (CO boost), controlling for Social Desirability, found no significant difference between the Low Motivation ( $M\ change = +3.30, SD = 3.37$ ) and High Motivation ( $M\ change = +3.60, SD = 4.24$ ) conditions,  $F(1,77) = 0.189, p = 0.665$  (See Figure 2).

Table 1

*Baseline Differences: Low Motivation vs. High Motivation*

	<u>Low Motivation (n=40)</u>	<u>High Motivation (n=40)</u>	<u>Total (N=80)</u>		
Demographics	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>F</i>	<i>p</i>
Age	36.88 (16.06)	32.68 (13.34)	34.78 (14.82)	1.618	0.207
Cigarettes Per Day	12.35 (7.11)	10.98 (7.25)	11.66 (7.17)	0.734	0.394
Years Smoked Daily	15.01(13.85)	12.05 (9.16)	13.53 (11.76)	1.273	0.263
Desire to Quit	4.30 (1.64)	3.98 (1.56)	4.14 (1.60)	0.826	0.366
# Quit Attempts	2.98 (3.81)	4.33 (8.11)	3.65 (6.33)	0.908	0.343
FTND Score	3.63 (2.15)	2.98 (2.35)	3.30 (2.26)	1.671	0.200
Hrs. since last cig.	3.850 (3.51)	3.40 (1.61)	3.63 (2.73)	0.542	0.464
Baseline CO	13.80 (7.94)	11.88 (7.57)	12.84 (7.77)	1.232	0.270
LOT-R (optimism)	14.13 (5.86)	13.45 (5.01)	13.79 (5.43)	0.307	0.581
Social Desirability	16.38 (5.02)	14.83 (5.93)	15.60 (5.51)	1.594	0.211

	<u>Low Motivation</u>	<u>High Motivation</u>	<u>Total</u>
	<i># (% of Total)</i>	<i># (% of Total)</i>	<i># (% of Total)</i>
Sex			
Male	26 (32.5%)	28 (35%)	54 (67.5%)
Female	14 (17.5%)	12 (15%)	26 (32.5%)
Race			
White	24 (30%)	21 (26.3%)	45 (56.3%)
Black/AA	12 (15%)	18 (22.5%)	30 (37.5%)
Hispanic	2 (2.5%)	0	2 (2.5%)
Asian	1 (1.3%)	1 (1.3%)	2 (2.5%)
Arab	1 (1.3%)	0	1 (1.3%)
Employment			
Unemployed	22 (55%)	21 (53%)	43 (53.8%)
Full-Time	7 (17.5%)	5 (12.5%)	12 (15%)
Part-Time	10 (25%)	10 (25%)	20 (25%)
Disabled	0	3 (7.5%)	3 (3.8%)
Retired	1 (2.5%)	1 (2.5%)	2 (2.5%)
Highest Education			
High School/GED	15 (18.8%)	15 (18.8%)	30 (37.5%)
No HS Degree	0	1 (1.3%)	1 (1.3%)
Some College	12 (15%)	13 (16.3%)	25 (31.3%)
Associate's degree	2 (2.5%)	2 (2.5%)	4 (5%)
Bachelor's degree	8 (10%)	5 (6.3%)	13 (16.3%)
Some Grad School	2 (2.5%)	2 (2.5%)	4 (5%)
Graduate Degree	1 (1.3%)	2 (2.5%)	3 (3.8%)
Student Status			
Not a Student	26 (32%)	24 (30%)	50 (62.5%)
Full-Time Student	14 (17.5%)	12 (15%)	26 (32.5%)
Part-Time Student	0	4 (5%)	4 (5%)
Marital Status			
Single	32 (40%)	32 (40%)	64 (80%)
Married	2 (2.5%)	2 (2.5%)	4 (5%)
Separated	1 (1.3%)	0	1 (1.3%)
Divorced	3 (3.8%)	5 (6.3%)	8 (10%)
Widowed	2 (2.5%)	1 (1.3%)	3 (3.8%)
Menthol			
Yes	9 (22.5%)	11 (27.5%)	20 (25%)
No	31 (77.5%)	29 (72.5%)	60 (75%)

*Note:* ANOVA analyses revealed no significant differences between conditions at baseline on any of the variables above.

Table 2

*Change in Main Outcome Measures: Low Motivation vs. High Motivation*

Measure	Pre-Smoking <i>M (SD)</i>	Post-Smoking <i>M (SD)</i>	Post-Smoking minus Pre-Smoking <i>M (SD)</i>	ANCOVA <i>F (1, 77)</i>	<i>p</i>
Urge to Smoke					
Low Motivation	5.03 (2.47)	3.36 (2.87)	- 1.67 (2.93)	4.227	0.043*
High Motivation	5.72 (2.46)	2.92 (2.65)	- 2.80 (3.00)		
General Positive Factor					
Mood Rating (PANAS-X)					
Low Motivation	2.72 (0.77)	2.45 (0.94)	- 0.27 (0.56)	0.574	0.451
High Motivation	2.66 (0.70)	2.48 (0.93)	- 0.18 (0.66)		
General Negative Factor					
Mood Rating (PANAS-X)					
Low Motivation	1.53 (0.79)	1.47 (0.65)	-0.06 (0.44)	0.436	0.511
High Motivation	1.55 (0.63)	1.43 (0.55)	-0.12 (0.40)		
Total Withdrawal Rating (MNWS)					
Low Motivation	10.40 (8.63)	9.75 (8.50)	-0.65 (5.83)	6.712	0.011*
High Motivation	11.58 (8.57)	7.63 (6.82)	-3.95 (6.24)		
CO Smoke Exposure (ppm)					
Low Motivation	13.80 (7.94)	17.10 (7.64)	+3.30 (3.37)	0.189	0.665
High Motivation	11.88 (7.57)	15.48 (9.17)	+3.60 (4.24)		

*Note:* ANCOVA results are reported with Social Desirability as a covariate. \*Values below the .05 level are considered significant.

Table 3

*Subjective Ratings of Cigarettes: Low Motivation vs. High Motivation*

Measure	<i>M (SD)</i>	ANCOVA <i>F (1, 77)</i>	<i>p</i>
CES Smoking Satisfaction Factor			
Low Motivation	2.88 (2.12)	2.915	0.092
High Motivation	3.74 (3.04)		
CES Psychological Reward Factor			
Low Motivation	1.86 (1.50)	7.377	0.008*
High Motivation	3.15 (2.66)		
CES Aversion Factor			
Low Motivation	0.93 (2.14)	0.008	0.929
High Motivation	0.94 (1.61)		
CES Enjoyment of Sensations Factor			
Low Motivation	2.68 (2.49)	2.509	0.117
High Motivation	3.58 (3.22)		
CES Craving Reduction Factor			
Low Motivation	2.78 (2.75)	2.577	0.112
High Motivation	3.80 (3.35)		

*Note:* ANCOVA results are reported with Social Desirability as a covariate. \*Values below the .05 level are considered significant.

Table 4

*Behavioral Smoking Measures: Low Motivation vs. High Motivation*

Measure	<i>M (SD)</i>	ANCOVA <i>F (1, 77)</i>	<i>p</i>
Number of Puffs			
Low Motivation	11.03 (3.37)	0.524	0.471
High Motivation	10.85 (3.24)		
Time Spent Smoking (mins)			
Low Motivation	3.67 (0.91)	2.105	0.151
High Motivation	3.95 (1.06)		
Cigarette Butt Weight (grams)			
Low Motivation	0.378 (0.07)	0.054	0.816
High Motivation	0.374 (0.08)		

*Note:* ANCOVA results are reported with Social Desirability as a covariate. \*Values below the .05 level are considered significant.

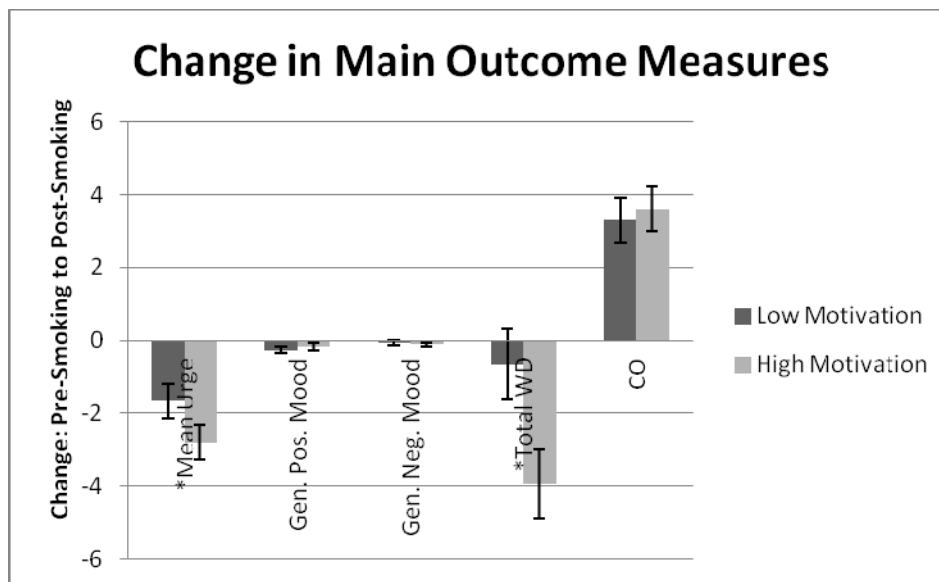
**Urge (3 Item Urge Questionnaire).** An ANCOVA conducted on change in urge to smoke from pre-smoking to post-smoking, controlling for Social Desirability, revealed a significant difference between the two conditions,  $F(1,77) = 4.227$ ,  $p = 0.043$ . High Motivation smokers had a significantly greater reduction in urge ( $M \text{ change} = -2.80$ ,  $SD = 3.002$ ) than Low Motivation smokers ( $M \text{ change} = -1.67$ ,  $SD = 2.932$ ) (See Figure 2).

**Mood (PANAS-X).** An ANCOVA conducted to compare Low Motivation smokers with High Motivation smokers on change in the mean General Positive Mood Factor of the PANAS-X from pre-smoking to post-smoking, controlling for Social Desirability, revealed no significant differences between the two groups,  $F(1,77) = 0.574$ ,  $p = 0.451$ . A similar analysis comparing Low Motivation and High Motivation smokers on change in the mean General Negative Mood Factor also revealed no significant differences between the conditions,  $F(1,77) = 0.436$ ,  $p = 0.511$  (See Figure 2).

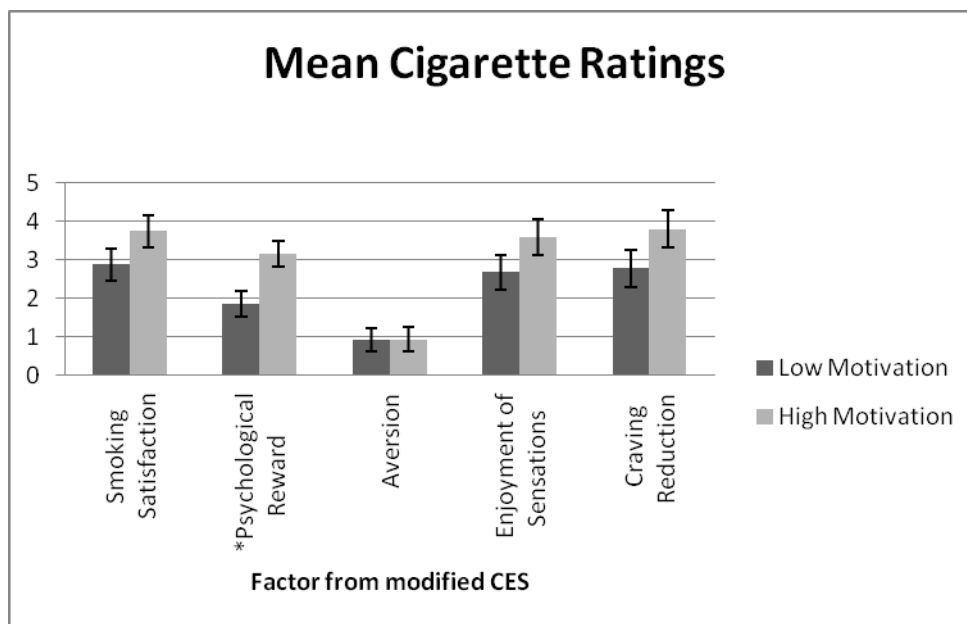
**Withdrawal (MNWS).** An ANCOVA conducted to compare Low Motivation smokers with High Motivation smokers on change in total withdrawal symptoms from pre-smoking to post-smoking, controlling for Social Desirability, showed a difference for Total Withdrawal,  $F(1,77) = 6.712, p = 0.011$ . High Motivation smokers ( $M \text{ change} = -3.95, SD = 6.243$ ) had greater reductions in withdrawal than Low Motivation smokers ( $M \text{ change} = -0.65, SD = 5.825$ ) from pre-smoking to post-smoking (See Figure 2).

**Subjective Ratings of Cigarettes (CES).** A series of ANCOVAs conducted with Social Desirability as a covariate revealed significant differences between Low and High motivation smokers on the Psychological Reward factor of the Cigarette Evaluation Scale,  $F(1,77) = 7.377, p = .008$ , but not on the Smoking Satisfaction  $F(1,77) = 2.915, p = 0.092$ , Aversion  $F(1,77) = 0.008, p = .929$ , Enjoyment of Sensations  $F(1,77) = 2.509, p = 0.117$ , or Craving Reduction  $F(1,77) = 2.577, p = 0.112$ , factors. Smokers in the High Motivation condition ( $M = 3.15, SD = 2.655$ ) reported greater Psychological Reward from smoking a denicotinized cigarette than Smokers in the Low Motivation condition ( $M = 1.86, SD = 1.500$ ) (See Figure 3).

**Behavioral Smoking Measures.** A series of ANCOVAs conducted to compare Low and High Motivation smokers on behavioral smoking measures, with Social Desirability as a covariate, revealed no significant differences between groups in number of puffs  $F(1,77) = 0.524, p = 0.471$ , time spent smoking,  $F(1,77) = 2.105, p = 0.151$ , or cigarette butt weight,  $F(1,77) = 0.054, p = 0.816$  (See Figure 4).

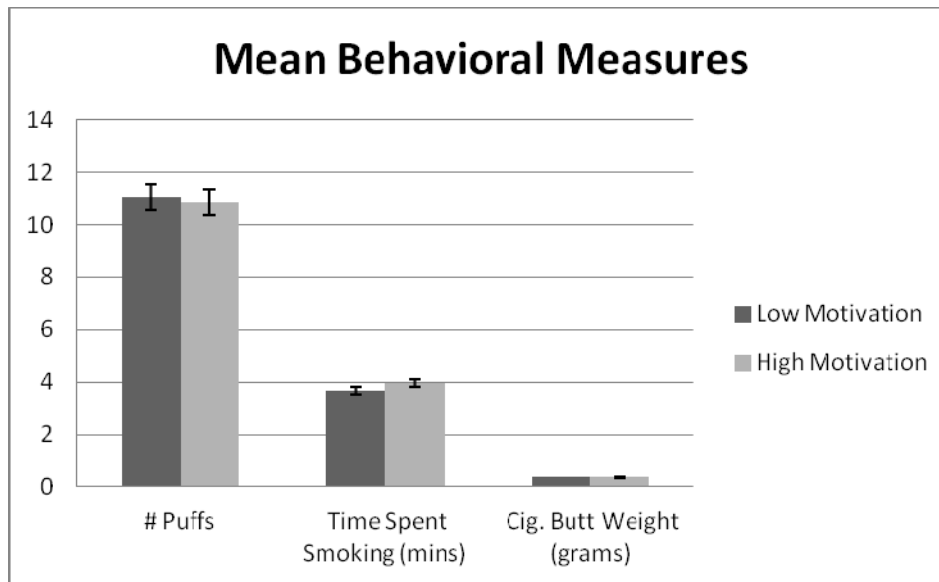


*Figure 2.* Main Outcome Measures: Change from Pre-Smoking to Post-Smoking by Condition. \* indicates significant difference at the .05 level.



*Figure 3.* Differences in Subjective Ratings of Cigarettes by Condition. \* indicates significant difference at the .05 level.





*Figure 4.* Differences in Behavioral Smoking Measures by Condition. No significant differences found between conditions.

**Motivation Questions.** An independent samples t-test was conducted to reveal any significant differences between High Motivation and Low Motivation smokers on their mean ratings of the two motivation questions. No significant differences were found between Low Motivation smokers ( $M = 2.80$ ) and High Motivation smokers ( $M = 3.05$ ) in the way that they responded to the question “How motivated did you feel to smoke the cigarette that was given to you today?” ( $t(78) = -0.924$ ). Nor were significant differences found between Low Motivation ( $M = 2.88$ ) smokers and High Motivation ( $M = 3.13$ ) smokers in the way that they responded to the question “How much did you want to smoke the cigarette that was given to you today?” ( $t(78) = -0.984$ ). It should be noted, however, that even though the mean ratings reported by Low and High Motivation smokers were not significantly different from each other on either of these questions, mean ratings on both questions were higher for smokers in the High Motivation condition.

## CHAPTER 4

### DISCUSSION

This study is the first to evaluate how manipulated levels of motivation affect smokers who respond to smoking a denicotinized cigarette. Previous studies have investigated the roles that classical conditioning and expectancies play in producing placebo effects in smokers, but few studies have investigated how motivation affects the way in which individuals experience placebo effects (Irmak et al., 2005; Geers et al., 2005; Jensen & Karoly, 1991). None have examined how manipulated levels of motivation may influence how smokers respond to cigarettes.

Denicotinized cigarettes serve as a valuable tool for researchers to study the effects of nicotine, sensorimotor effects of cigarettes, expectancies, and interactions between these factors on smokers' physiological, behavioral, and subjective responses to cigarettes. Research findings reveal that these placebo cigarettes reduce craving, mood disturbance, and symptoms of withdrawal, improve smoking reward, and are found to be reinforcing in smokers (see Introduction). While their usefulness as a potential treatment tool has initially been demonstrated (Hatsukami et al., 2010; Becker et al., 2007; Rezaishiraz et al., 2007), further understanding of the mechanisms which contribute to the placebo effects of denicotinized cigarettes may allow researchers to improve their treatment efficacy. The level of motivation that smokers feel to smoke a cigarette could be an important factor that influences how they respond to a denicotinized cigarette. Motivation level might also serve as a predictor in whether some smokers would benefit from using denicotinized cigarettes as a treatment tool.

In the present study, participants were randomly assigned to feel low motivation to smoke a denicotinized cigarette or high motivation to smoke a denicotinized cigarette. Motivation level was induced by reading scripts to participants before they smoked the cigarette. Smokers in the High Motivation group read a script containing positive information associated with people who smoke denicotinized cigarettes, while smokers in the Low Motivation condition read a script containing negative information associated with people who smoke denicotinized cigarettes. Main outcome measures included changes in urge to smoke, mood, withdrawal, and smoking exposure (CO) from pre-smoking to post-smoking. Cigarette ratings, number of puffs, and time spent smoking were also compared between the two groups.

It was predicted that participants in the High Motivation condition would show a greater reduction in urge to smoke, withdrawal symptoms, and mood disturbance from pre-smoking to post-smoking, and would report higher ratings of cigarettes than participants in the Low Motivation condition. As hypothesized, the experimental manipulation of motivation level did affect smokers' subjective self-reports of change in urge to smoke and withdrawal symptoms from pre-smoking to post-smoking. High Motivation smokers showed greater reductions in urge and withdrawal from pre-smoking to post-smoking compared to Low Motivation smokers. Manipulated motivation levels also affected smokers' reports of psychological reward (a measure of smoking satisfaction) from smoking a denicotinized cigarette; High Motivation smokers reported greater psychological reward than Low Motivation smokers. However, differences between the two groups were not found in any other subjective ratings of cigarettes. No differences were found between the two groups in CO boost or on any smoking behavior measures.

Results from this study provide significant information about the role that motivation level plays in producing placebo effects in smokers. In line with previous research, this study confirms that denicotinized cigarettes reduce subjective reports of urge to smoke and nicotine withdrawal in dependent smokers. Results from this study also reveal that motivation level can be manipulated in smokers, and that these manipulations affect smokers' responses to denicotinized cigarettes: smokers in the High Motivation condition showed greater reductions in urge to smoke and total withdrawal symptoms from pre-smoking to post-smoking than those in the Low Motivation condition, and smokers in the High Motivation condition also reported greater psychological reward from smoking a denicotinized cigarette than those in the Low Motivation condition. Findings from this study support the conclusion that inducing high levels of motivation to smoke a denicotinized cigarette increases the likelihood that smokers will feel placebo effects from the cigarette such as reduction in urge to smoke and in symptoms of withdrawal, plus increased psychological reward (such as calm feelings, concentration, wakefulness, hunger reduction, and reduction in irritability). And, such a supposition implies that creating ways to increase smokers' motivation to smoke a denicotinized cigarette may improve the likelihood of successful cessation attempts in High Motivation smokers who use denicotinized cigarettes as a treatment tool. Denicotinized cigarettes have been found to facilitate smoking cessation attempts better than the nicotine patch or nicotine lozenge alone, particularly in combination with the patch. Based on findings from Rezaishiraz et al. (2007), supplementing nicotine patches with denicotinized cigarettes as a cessation plan for High Motivation smokers who want to quit smoking may also prove to be particularly efficacious.

There are several limitations to the study that should be noted. First, this study was designed to be an open-label examination such that all participants were informed that they

would smoke a denicotinized cigarette just before being presented with the cigarette which they smoked. The only information participants were given about the denicotinized cigarettes was that they contained no nicotine. However, at the time of smoking, participants were also presented with a cigarette box (Quest brand; both cigarette and box were matched to menthol or non-menthol depending on each smoker's smoking preference) along with a lighter and ashtray to validate that they were indeed smoking a denicotinized cigarette. The boxes did contain standard cigarette health warnings and minimal information about the contents of the cigarette, but it is unknown how this information affected participants.

Second, since participants did not smoke their own cigarettes during this study, ratings on the Cigarette Evaluation Scale were particularly important. In addition to completing the Cigarette Evaluation Scale questions, each participant also completed an experiment evaluation form after completing the study. Even though participants were asked on this form "Do you think there is more to this study than meets the eye?" and "Is there anything about the study that you disliked?", it is unknown what smokers actually believed about the cigarette which they smoked. A number of participants reported that they disliked the taste of the cigarettes, and that it tasted different than their usual brand, but it is unknown how much this affected participants' subjective reports of and behavioral responses to the denicotinized cigarette which they smoked.

Third, the method of this investigation involved researchers directly providing participants with a cigarette to smoke, information about the cigarette, and minimal instructions regarding how to smoke and rate the cigarette. Such close interaction between the researcher and participant may encourage demand characteristics in participants. In other words, participants may respond to the cigarette or to questions about their smoking experience in a way that they may believe (consciously or unconsciously) the researcher would expect them to respond,

creating bias in the results. The Crowne Marlowe Social Desirability Scale was included as a measure in this study to statistically control for possible demand effects that may have influenced the results. In this investigation, Social Desirability was controlled for when measuring differences between High Motivation and Low Motivation smokers on all of the main outcome measures by running several ANCOVA tests with Total Social Desirability Score as a covariate. Mixed reviews exist about the procedure of correcting data by covarying Social Desirability to control for response distortion in self-report data (Ones, Viswesvaran, & Reiss, 1996; Christiansen et al., 1994; McCrae & Costa 1983). Using this method has been shown to be effective with aggregate data, but less effective with individual data (Ellingson, Sackett, & Hough, 1999). A more recent data review of fourteen thousand studies in the health research field reports that nearly half of those studies were affected by social desirability responding, mostly in response to questions about competency and particularly sensitive topics. Only in sixteen percent of those studies were attempts made to correct for it (van de Mortel, 2008). Although correcting for demand characteristics caused by social desirability remains controversial, as a conservative measure, the researchers chose to control for social desirability in this study by measuring the total score on the Crowne Marlowe Social Desirability Scale as a covariate.

Fourth, participants in this study were told to smoke as they normally would on the day of the experiment, but to abstain from nicotine products for two hours before they took part in the study. These instructions were given in order to control for recent cigarette exposure that may lead participants to feel satiated while answering questions about their subjective state, such as how much they felt an urge to smoke or symptoms of nicotine withdrawal. The instructions also ensured that participants did not participate in the study while experiencing extreme withdrawal. This study investigated how motivation level affected smokers' responses to placebo cigarettes

while participants were in a normal state. However, it is important to note that many smokers attempting to quit, relapse during a period of withdrawal when they are possibly most vulnerable to giving in to smoking another cigarette. A number of studies have investigated how smokers respond to subjective and objective measures after a prolonged period of smoking abstinence (Shiffman et al., 1990; West & Russell, 1987). Given this consideration, some questions for future investigations include: How do smokers who have abstained from nicotine for a significant period of time differ from the participants in this study, in their response to a denicotinized cigarette (i.e., placebo effects) after manipulating their level of motivation to smoke a cigarette?, and How do dependent and nondependent smokers differ in their response to placebo cigarettes after manipulating motivation level?

Fifth, the researchers in this study developed and administered a manipulation check of two post-smoking motivation-related questions intended to ensure that the scripts used to manipulate smokers' motivation levels did in fact alter participants' motivation to smoke or feel the effects of the denicotinized cigarette. Results from this study show that High Motivation smokers did score higher (though, not significantly higher) than Low Motivation smokers on both questions. However, an important limitation of this study is that the questions "How motivated did you feel to smoke the cigarette that was given to you today?" and "How much did you want to smoke the cigarette that was given to you today?" have not been validated as measures of categorical levels of motivation or of change in motivation. Additionally, it is possible that the motivation manipulation used in this study lacked enough sensitivity to affect smoker's responses. The researchers in this study were unable to directly ask participants how motivated they felt to feel the effects of the cigarette without prematurely revealing the true

purpose of the study. Future research should address valid ways to measure smokers' desire to smoke and feel the effects of a denicotinized cigarette.

Finally, despite efforts to prevent participants in this study from developing expectancies about the content and effects of denicotinized cigarettes, conditioned responses from previous smoking experiences may have led smokers to possess expectancies about the denicotinized cigarette which they smoked. It is unknown how the additive effect of manipulated motivation plus possible expectancies may have influenced participants' responses to denicotinized cigarettes in this study. Subsequent studies investigating the effects of motivation on smokers' responses to cigarettes may benefit from administering a self-report expectancy questionnaire before and after participants smoke in order to identify if expectancies may have also contributed to changes in outcome measures or differences between conditions. It is also possible that additional external factors may have affected participants' desire to smoke or feel effects from the denicotinized cigarette.

In the present investigation, high motivation was defined as the desire to smoke a placebo cigarette and low motivation defined as the desire not to smoke a placebo cigarette (based on Jensen & Karoly, 1991). Further investigation is warranted to study how motivation level can be operationalized in various ways other than the desire to use a placebo that is associated with positive user characteristics versus negative user characteristics. Furthermore, the addition of a control group in which motivation is not manipulated, but participants smoke either a nicotine or a placebo cigarette, would strengthen the design of this study by providing a comparison of how much the manipulated motivation (versus unmanipulated motivation) level affects smokers' responses to cigarettes. Future research should also compare how high and low motivation smokers respond to denicotinized versus nicotine cigarettes; the Balanced Placebo Design may



serve as a beneficial tool in determining if interaction effects exist between dose instructions (expectancies about effects of the cigarette) and actual nicotine content among smokers induced to feel high motivation or low motivation to smoke a cigarette. Outcomes from such an examination may reveal evidence that the magnitude by which induced motivation level affects how smokers respond to denicotinized cigarettes may differ from how it affects the way smokers respond to nicotine cigarettes.

The results of this study offer an introduction to the role that motivation level plays in producing placebo effects in smokers. Findings from this study provide evidence that manipulated levels of motivation do affect ratings of urge, withdrawal, and psychological reward produced by the behavioral and sensorimotor aspects of smoking in the absence of direct nicotine effects. Specifically, high motivation smokers report greater reductions in urge to smoke, symptoms of smoking withdrawal, and larger increases psychological reward than low motivation smokers. These findings support the potential use of placebo (denicotinized) cigarettes as a cessation tool, particularly in smokers who gain satisfaction from the sensorimotor aspects of smoking and who possess high motivation to smoke a denicotinized cigarette. Along with classical conditioning and expectancies, the role that motivation and motivation levels play in producing placebo effects should be studied further to enhance our current understanding of the mechanisms by which individuals experience placebo effects, and to validate new systems that may effectively augment current treatment methods. Inducing high levels of motivation in patients may prove to be a useful enhancement to traditional treatment methods in reducing the likelihood of relapse in recovering substance users, and improving the efficacy of medications, such as painkillers, that are used to treat conditions which have shown sensitivity to placebo-based improvement.

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