A TEST OF ELABORATED INTRUSION THEORY: MANIPULATING VIVIDNESS OF IMAGERY INTERVENTIONS ON CIGARETTE CRAVING

Shanna L. Murray

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Committee:
Harold Rosenberg, Ph.D., Advisor
Sharon Subreenduth, Ph.D., Graduate Faculty Representative
Robert Carels, Ph.D.
Steve Jex, Ph.D.
Smoking cigarettes is considered to be the single most preventable cause of disease and death in the United States. Craving has been identified as one factor that contributes to the maintenance of nicotine use and relapse. The most recently proposed model of craving is the Elaborated Intrusion (EI) Theory (May, Andrade, Panabokke, & Kavanagh, 2004). EI theory views craving as the outcome of intrusive mental images/thoughts that arise from internal (e.g., drop in blood nicotine level) and external factors (e.g., the smell of a cigarette). In addition, elaboration or mental embellishment of initial intrusive images/thoughts of smoking will result in craving if such thoughts are accompanied by anticipated pleasure or relief. EI theory suggests that interrupting the process of elaboration with competing imagery tasks may reduce craving. The main purpose of the present study was to test whether manipulating the vividness of competing, movie-theatre imagery would decrease craving. Sixty current and regular smokers were trained to engage in either high vivid or low vivid imagery set in a movie theatre, or were instructed to imagine staring at a blank, white wall (control condition). Results supported two predictions of EI theory: a) the more vividly one imagined and/or had thoughts of smoking cigarettes, the higher was one’s craving and b) the more vividly one imagined competing mental images (in the imagery conditions), the lower one’s craving. However, neither the high or low imagery interventions significantly decreased craving compared to the control group. Methodological limitations and future directions are discussed.
This dissertation is dedicated to my parents, John and Foong Ling Murray, and my brother, Thomas Murray.
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INTRODUCTION

Addiction has been defined as apparently uncontrollable, compulsive drug seeking and consumption, even in the face of negative health and social consequences (National Institute of Drug Abuse [NIDA], 2006). One of the most widely used addictive substances, tobacco, is considered to be the single most preventable cause of disease, disability, and death in the United States (Centers for Disease Control and Prevention, 2006). In fact, lung cancer is the most common cancer among men and women, and approximately 90% of lung cancer cases are caused by tobacco use (American Lung Association, 2006). In 2004, a study found that young adults aged 18 to 25 reported the highest rate of use of tobacco products compared to any other age group (NIDA, 2006). Because tobacco use is highly addictive, prevalent during the early adult years, and considered to be a preventable chronic health condition, research that examines psychological factors that maintain use, lead to relapse, and facilitate smoking cessation in this population is important.

A key feature of addiction is relapse – that is, a return to consumption following detoxification or a period of abstinence. Research demonstrates that the likelihood of a slip or relapse for smokers is high, with an estimated 60 to 90% of smokers who quit relapsing within one year (Garvey, Bliss, Hitchcock, Heinold, & Rosner, 1992). Clinicians and researchers have identified various factors that maintain use and lead to relapse, including the experience of negative affect (e.g., Killen & Fortmann, 1997), stress (e.g., Sinha, 2001), positive outcome expectancies (e.g., Marlatt, 1978), and craving (e.g., al’Absi, Hatsukami, Davis, & Wittmers, 2003). Craving is problematic because it may maintain use in current smokers and lead to relapse in ex-smokers. Therefore, I summarize below the literature on the relationship between craving and relapse.
CHAPTER I: RESEARCH ON CRAVING AND RELAPSE

Definitions and Measurements of Craving

Although the term craving is used in everyday language, there is no apparent consensus regarding the definition of craving in the professional literature (Anton, 1999; Franken, 2003). Investigators generally agree that craving is a feature of addiction and that craving potentially leads to relapse; however, its role and strength in predicting relapse, as well as its definition, continue to be explored. Nonetheless, craving is recognized as a key factor related to substance dependence. For example, the Diagnostic and Statistical Manual of mental disorders (DSM-IV) recognizes “persistent desire” as part of the core criteria for diagnosing substance dependence and the International Classification of Diseases (ICD-10) defines substance dependence as “behavioral, cognitive, and physiological phenomena…that typically include a strong desire to take the drug.”

In general, two types of craving have been proposed in the literature – “non-symbolic” and “symbolic” craving (Isbell, 1955). Non-symbolic craving is the physical experience of desire that occurs during physical withdrawal and is experienced by those who are physically dependent on nicotine, alcohol, or other substances. Symbolic craving is the psychological experience of desire that occurs after a period of abstinence and can not be explained by physical withdrawal. Craving as a possible antecedent to relapse has been examined empirically for several decades, during which many definitions of “symbolic” or “non-symbolic” craving have emerged. Examples of definitions include craving being described as an extreme desire (Kozlowski & Wilkinson, 1987), a motivational state associated with a variety of addictive behaviors (Merikle, 1999), a desire to use any abused substance at any time (Bauer, 1992), an overpowering desire (Jellineck, 1960), an irresistible urge that compels drug-seeking behavior
Halikas, Kuhn, Crosby, Carlson, & Crea, 1991), and a conscious experience of a desire to take a drug (Drummond, 2001), among other definitions. The ICD-10 defines craving as a strong desire or sense of compulsion to consume a substance. Other terms similar to craving include the experiences of an urge, desire, or preoccupation with a drug.

Also, there is no consensus about how to measure craving. To assess craving, researchers have employed measures of physiological reactivity to drug or alcohol cues (e.g., salivation, skin conductance level), cognitive processing (e.g., reaction time), behavior (e.g., speed of consumption), and single or multi item self-report questionnaires that typically examine both cognitive and behavioral aspects of subjective craving. Carter and Tiffany (1999) conducted a meta-analysis on 41 studies of alcohol, cigarette, cocaine, and heroin abusers who were exposed to drug and alcohol-related stimuli meant to provoke craving versus neutral stimuli while their physiological and/or subjective craving responses were monitored. Across the substance groups, larger effect sizes were found for self-reported subjective craving when exposed to drug-related stimuli than for physiological measures (e.g., heart rate, skin temperature, and skin conductance). Although the relationship of the experience of craving and physiological measures is unclear, it may be that physiological measures of craving are less reliable and valid compared with subjective measures of craving.

Relapse is defined as the re-initiation of use by one who has abused or been dependent on a psychoactive substance or alcohol, but measurement of cigarette relapse often varies by investigation. For instance, Killen, Fortmann, Kraemer, Varady, and Newman (1992) defined relapse as at least seven consecutive days of smoking, and Shiffman et al. (1996) defined relapse as smoking at least five cigarettes per day for three consecutive days. Relapse has been typically measured through retrospective patient self-report of drug or alcohol use. Positive urine drug
screens, carbon monoxide readings for cigarettes, interviewing of significant others to verify use, or dropping out from a treatment program have also been used to indicate use or relapse.

Concepts related to relapse include “slip” or “lapse,” which are used to indicate short-term consumption and are considered to be different experiences from relapse (Marlatt, 1985; Shiffman et al., 1996). For example, a slip has been defined as one or several episodes of drinking, drug taking, or cigarette smoking during which one consumes some amount of drug or alcohol on one or more than one occasion, but has not yet returned to a pattern of problem use. Some define a “lapse” as any occasion of smoking, even if a “puff” (Shiffman et al., 1996), but without resumption of problem use. Therefore, if consumption stops and the person returns to abstinence or moderate use, then the consumption episode(s) may not be considered a “relapse.”

The Relationship between Cigarette Craving and Relapse

Given the difficulties of defining and measuring craving and relapse, studies of the relationship between craving and relapse have typically yielded mixed findings. Three types of methodology have been used to examine the relationship of craving and relapse – retrospective, concurrent, and prospective methods. Retrospective studies assess craving by having participants recall via interviews or questionnaires what led to their lapse or relapse. In concurrent studies, craving and relapse are measured at the same time, or close to the same time, often using Ecological Momentary Assessments (EMA). Prospective studies assess craving at one point to predict future lapse, relapse, or another outcome variable related to relapse (e.g., percent abstinent days). Some studies have employed more than one methodology (e.g., used both prospective and retrospective methods) to assess the relationship of craving and relapse. Because the experience of craving may be attenuated by anti-craving medication, I reviewed only those studies in which anti-craving medication was not used.
Although some of the studies yielded mixed results, several retrospective studies have demonstrated a relationship between cigarette craving and relapse. For example, Baer, Karmarck, Lichenstein, and Ransom’s (1989) study used both retrospective and prospective methods to evaluate craving and use in heavy smokers enrolled in a smoking cessation program. Results indicated that at Month 1, 67% of participants reported urges/cravings just prior to a smoking episode. At Month 3, 38% of participants had urges/cravings associated with a smoking episode. Baer et al. (1989) also found that 10 of the 15 participants who reported having urges/cravings associated with a lapse at Month 1 were still smoking at Month 2. This indication of the relationship between craving and smoking is tempered, however, by other findings reported in this study. For example, urges/cravings associated with a lapse at Month 2 were not predictive of relapse at Month 3 and those who did not report urges/cravings at Month 3 were significantly more likely to relapse at Month 6 (38% of the participants who reported urges relapsed in comparison to 82% of the participants who did not report urges relapsed).

In another study that used retrospective and prospective methods, Norregaard, Tonnesen, and Petersen (1993) found that craving was endorsed as a precipitant of relapse at a significantly higher rate as compared to other possible relapse statements. Specifically, in the “early and late relapse” groups (not defined), 44% of the late relapse and 61% of the early relapse participants endorsed the option that “craving for cigarettes was too much.” In addition, Norregaard et al. (1993) used a prospective methodology and found that craving assessed during the first week using the single-item Visual Analog Scale (VAS) was significantly higher in relapsers at the end of the first week of smoking cessation as compared to complete abstainers, but craving was not significantly associated with a “slip.”

Further evidence for the apparent relationship of cigarette craving and relapse was
provided in a retrospective study by Shiffman, Read, and Jarvik (1985). Participants were asked to provide answers to an interview that was designed to examine what factors (e.g., craving, affect, stress) may be related to near-relapse or relapse episodes. A cluster analysis based upon the answers revealed that craving was spontaneously reported by 9 of 53 participants. This study demonstrated that craving was still reported by participants as being associated with relapse even when craving was not specifically asked about during the interview.

Concurrent studies have evaluated the relationship between urges and smoking using methodology in which craving and consumption are measured simultaneously. For example, an EMA study by Shiffman et al. (2002) examined urges from smoking and non-smoking observations that were collected prior to quitting and evaluated how urges were related to ongoing smoking over a one week period. The results indicated that higher urges to smoke occurred more often immediately before smoking as compared to non-smoking observations conducted at random times when the participants were not smoking. Therefore, this study provided evidence that urges play a role in maintaining cigarette use.

Shiffman and Jarvik (1976) examined craving (using items from the Gritz-Jarvik questionnaire) and subsequent use concurrently over a two-week period. Results indicated that the partially abstinent group reported higher craving scores compared to the totally abstinent group. In another study, Hughes (1992) assessed cigarette craving and consumption/abstinence concurrently at specified follow-up days (Day 2, Week 1, Week 2, Month 1, Month 3, and Month 6) after quitting and evaluated group differences between the “abstinence” and “relapse” groups. Results indicated that a single-item self-rating of craving on a 0-100 scale predicted abstinence (≤ 1 cigarette per day) or relapse (defined as >1 cigarette per day) across some of the follow-up assessments (follow-up times not specified).
Prospective studies have also found a relationship between craving and relapse. For example, Swan, Ward, and Jack (1996) found that higher craving scores (using the Shiffman-Jarvik Withdrawal Symptom subscale of craving) were significantly associated with a shorter time to relapse over a four-week period. Covey, Glassman, and Stetner (1990) found that higher VAS craving during the first week after quit day was significantly associated with the “failure” group (those who reported smoking or had a cotinine measurement over a certain cut-off level) but not the “success” group. Using the Questionnaire of Smoking Urges (QSU), al’Absi et al. (2003) found that early relapsers (those who had at least one cigarette during the first week after the quit date) had higher craving scores than the group that maintained abstinence over the one week period.

Additionally, Killen et al.’s (1992) study yielded mixed results in that the higher a smoker’s craving immediately after quitting, the lower the likelihood of not relapsing at Year 1, but baseline craving did not predict relapse at Year 2. Gunn’s (1986) study also yielded mixed results. Using the Impact of Events Scale (IES) as a measure of craving, results indicated that higher scores on the subscale measuring intrusive thoughts about smoking were significantly related to relapse (defined as a return to smoking) by the end of the cessation program and at three months following treatment; however, the results applied only to female participants. On the other hand, the IES subscale measuring avoidance was not significantly associated with relapse at the end of the cessation program or three months following treatment.

West, Hajek, and Belcher (1989) also conducted a study that yielded mixed findings. Results indicated that more time experiencing an urge during Week 1 predicted smoking during Week 2. However, more time experiencing an urge during Week 2 did not predict smoking at Week 3. Additionally, the intensity of urge at Week 1 did not predict smoking at Week 2 and
intensity of urge at Week 2 did not predict smoking at Week 3. Furthermore, neither the time experiencing an urge or intensity of urge at Week 3 predicted smoking at Week 4.

A prospective study by Shiffman et al. (1997) found that the average duration of “temptation” episodes (a rise in urge to smoke or being on the brink of smoking) on one’s quit day and the daily waking urge on the day of one’s lapse significantly predicted subsequent lapse over a 26-day period. However, randomly assessed urges, peak temptation urges, temptation rates, and number of temptations did not significantly predict relapse. Another study by Shiffman et al. (1996) found that urge before the initial lapse significantly predicted rapid progression toward relapse (defined as smoking at least five cigarettes per day for three consecutive days) over a three month period. However, participants who reported higher peak urges at the first smoking lapse did not reliably experience a second lapse or relapse.

In summary, several studies have demonstrated that craving is associated with subsequent smoking lapse or relapse, but others have yielded mixed results. Given the apparent relationship of craving, consumption and relapse, several theories have been proposed to explain the etiology of craving and its impact on relapse. These theories include conditioning and learning theory (e.g., Ludwig & Wikler, 1974), cognitive-behavioral theory (e.g., Marlatt & Gordon, 1985), an automaticity model of drug urges and drug use behavior (Tiffany, 1990), incentive sensitization theory (Robinson & Berridge, 2001) and, most recently, the Elaborated Intrusion theory (May, Andrade, Panabokke, & Kavanagh, 2004).
CHAPTER II: ELABORATED INTRUSION (EI) THEORY

The most recently proposed cognitive theory of craving is the Elaborated Intrusion Theory (May et al., 2004). I chose to examine craving based on EI theory because there is little research testing predictions based on this theory and because of my interest in evaluating the cognitive processes underlying the craving experience. EI theory proposes that craving may occur following elaboration of intrusive mental images and/or thoughts about regularly used substances. Intrusive thoughts arise from factors such as becoming aware of not having the substance (e.g., drop in blood nicotine or alcohol level), anticipatory responses (e.g., salivation for the substance), negative affect (e.g., depression or anxiety), thoughts associated with the substance (e.g., expecting a pleasurable experience), or external cues (e.g., seeing someone smoking a cigarette). These antecedents may initiate thoughts about the substance, trigger other associations with the substance, and result in elaborated thoughts about the substance.

Elaboration is defined by Kavanagh, Andrade, and May (2005) as mentally embellishing the initial stimulus or antecedent. Once an antecedent results in an intrusive thought (e.g., “I need a cigarette”), elaboration of the intrusive thought may take place. Elaboration is a search for drug-related information in short-term or long-term memory. Examples of elaborated thoughts include imagining the context in which the substance is taken, recalling the last time the substance was used, and thinking about whether there is enough money available to purchase the substance. Elaborated cognitions produce and maintain images associated with the craved substance. EI theory posits that elaboration requires effortful mental processing that places a load on working memory. In other words, the cognitive processing of intrusive thoughts competes for the limited resources of working memory.

Kavanagh et al. (2005) defined craving or desire as an affectively or emotionally charged
cognitive event in which an object or activity that is associated with pleasure, relief, or discomfort is the focus of attention. EI theory proposes that intrusive thoughts and/or imagery about the substance are initially rewarding because positive sensations of relief are elicited as if the drug were actually being used (a conditioned response to the drug) and provide a strong sense of reward. These pleasurable sensations encourage more cognitive associations about the drug, resulting in elaboration of drug-related thoughts and a strong desire or craving for the drug. However, once the person is aware of not having the substance or is unable to take the substance, elaborated thoughts may lead to negative affect. Therefore, EI theory views drug abuse as a maladaptive pattern in which a person encounters a situation and does not have or is unable to take the substance. Craving becomes a motivational state brought about by elaborated imagery of the substance. This motivational state of craving is believed to sustain addiction.

EI theory points out that even though the substance user may experience frequent passing thoughts of the substance, the state of craving only emerges once the intrusive thoughts or images have been elaborated and are brought into conscious awareness. Because craving results from drug-related images and thoughts, Kavanagh et al. (2004) suggested having the person engage in tasks that compete for cognitive resources as one way to reduce elaborated imagery and thoughts.

Support for EI theory comes from research findings demonstrating that imagery was reported as accompanying a craving episode (May et al., 2004), that imagery interventions meant to compete for cognitive resources impacted craving (Kemps, Tiggemann, Woods, & Soekov, 2004; McClelland, Kemps, & Tiggemann, 2006; Versland & Rosenberg, 2007), and that the experimental manipulation of vividness (a presumed indication of elaboration) of visual imagery impacted craving (Baylen, unpublished dissertation).
For example, May et al. (2004) demonstrated that imagery was part of the craving experience by examining the nature of everyday cravings and triggers of craving episodes. Questionnaires were mailed to a non-clinical sample of university students asking about their craving experience once they found themselves “craving something.” Specifically, participants rated the strength of their craving for the substance on a 10-point scale (“very slight” to “overwhelming”). In addition, 12 potential triggers of craving were provided on the questionnaire (items represented negative and positive affect, imagining the sound/smell/taste of the substance) and participants rated them on a 5-point scale (“not at all” to “definitely”). Ten statements were also listed as descriptions of the craving episode and participants were asked to endorse the items that applied to their craving experience (e.g., “trying to resist having it,” “hearing myself having it,” “I am visualizing it,” amongst other items) and rate them on a 5-point scale.

Of the 361 participants (24% response rate) who responded to the questionnaire, participants most often reported craving food (n=219), followed by tobacco (n=60), soft drinks/non-alcoholic drinks (n=59), and alcoholic drinks (n=23). Craving ratings that were completed at the time when the person reported the craving episode did not differ significantly across the substances. An examination of craving triggers revealed the highest ratings across the substances were for the statements that the person “suddenly thought about it,” “felt hungry/thirst/tired/physical discomfort,” “imagined the taste/smell of it,”” and “pictured myself having it.” Chi-square analysis found that tobacco cravings were triggered less often by “imagining the smell/taste of it” (olfactory/gustatory senses) and “felt hungry/thirst/tired/physical discomfort” (somatovisceral senses) as compared to the other substances.
Across all substances, the highest rated statements when describing the craving episode were for the items stating “I want it because I am hungry/thirsty/tired/in physical discomfort,” “having it would feel very comforting right now,” “I am thinking of how much better I will feel after I have had it,” “I am imaging the taste of it,” and “I would feel more relaxed if I had it.” The authors noted that most of these items represented some aspect of a physiological relief or reward component to craving, providing evidence for their EI theory. Results also indicated that 65% of respondents rated ≥3 on a 5-point scale for the statement of “imaging the taste,” 61% rated ≥3 for the statement of “visualizing it,” and only 9% of participants rated ≥3 for the statement about “hearing it.” Furthermore, chi-square analyses revealed that somatovisceral senses (e.g., “I want it because I am hungry/thirsty/tired/in physical discomfort) were not rated as high when describing the craving episode for tobacco and alcohol cravings as compared to the other substances. Therefore, across substances, the results demonstrated that visual and gustatory imagery were mainly involved in the craving experience, whereas auditory and somatovisceral senses were less often a part of the craving experience.

Other studies have examined whether imagery was part of the craving experience and whether interventions were effective at interrupting or reducing craving. Research on food cravings has evaluated whether vividness is related to craving and whether interventions using different “anti-elaboration” tasks are effective at reducing craving. These food craving studies examined tenets based on EI theory, but also evaluated the working memory model to examine whether food cravings were selectively engaging the visuospatial sketchpad of working memory.

For example, Harvey, Kemps, and Tiggeman (2005) recruited female undergraduate students who self-identified as dieters or non-dieters. First, participants completed a baseline measure of craving using a VAS 100-mm scale. Second, participants were asked to close their
eyes and imagine either a food or holiday scenario (“imagine you are eating your favorite food” or “imagine you are on your favorite holiday”). After the food or holiday scenario induction, participants completed a VAS 100-mm vividness rating scale of the food/holiday scenario (VAS scale from “no image at all” to “image perfectly clear – as vivid as normal vision/hearing”).

Next, participants were randomly assigned to imagine either visual (e.g., “imagine the appearance of a rainbow”) or auditory (e.g., “imagine the sound of a telephone ringing”) cues as ways to reduce food craving. Participants rated the vividness of each imagined visual or auditory cue and completed a current rating of food craving after the imagery task was completed.

Results revealed no pre-existing differences on imaging ability between the dieting and non-dieting groups and both the food and holiday scenarios were rated as equally vivid. Therefore, findings from later analyses could not be attributed to differences in general imaging ability or the vividness with which participants imagined the scenarios. After the food scenario, both the dieters and non-dieters had significantly higher craving ratings from baseline as compared to the holiday scenario. As expected, dieters had significantly higher food craving levels after the food scenario than non-dieters. The authors concluded that imagery was part of the experience of craving because the craving ratings increased after imagining the food, but not the holiday scenario. Analysis also indicated that there was a significant and positive correlation between vividness ratings of the food scenario and craving ratings, but not for the holiday scenario. These results are consistent with EI theory because higher levels of food craving were associated with more vivid images of the food scenario. Additionally, both tasks significantly lowered craving ratings as compared to the baseline craving ratings.

Kemps, Tiggemann, and Hart (2005) used a between-subjects design to investigate whether a visual task was more effective than an auditory task at reducing chocolate cravings.
Forty-eight female undergraduate student participants (24 self-identified chocolate cravers and 24 non-chocolate cravers) were shown seven pictures of chocolate images from magazines (e.g., chocolate cake), and were asked to retain each image for eight seconds while concurrently engaging in a visual task (watching a matrix of black and white squares), an auditory task (listening to a female reading a Dutch newspaper), or a control condition task (looking at a blank computer screen). After retaining each image and engaging in one of the concurrent tasks, participants completed a current VAS 100mm measure of craving (“no desire or urge to eat chocolate” to “extremely strong desire or urge to eat chocolate”) and vividness of their chocolate image (options ranged from “no image at all” to “image perfectly clear - as vivid as normal vision”). Each participant completed the assigned visual, auditory, or control condition task seven times – one time for each of the seven pictures of chocolate items. All participants were asked to abstain from eating and drinking (except for water) prior to participating in the study so that participants were in similar hunger states. Participants rated their hunger on a VAS measure using a scale ranging from “not at all hungry” to “extremely hungry.” General imaging ability was also assessed to confirm that everyone had similar imaging abilities.

The chocolate and non-chocolate craving groups did not differ in imaging ability. For craving ratings, regardless of craving group, craving was significantly lower in both experimental conditions as compared to the control condition and craving was significantly lower in the visual task condition. There was a significant and positive correlation between vividness of the chocolate images and chocolate craving in both concurrent task conditions, but only for the chocolate cravers group. This result supports the EI theory assertion that the more vivid an image is for a highly used substance, the higher the craving.

McClelland, Kemps, and Tiggemann (2006) compared the efficacy of four visuospatial
intervention tasks (eye movement task, visual noise task, spatial tapping task, and forehead tracking task) and a control condition (looking at a blank computer screen) for reducing food craving. Fifty female undergraduate student participants were asked to abstain from eating and drinking for at least two hours prior to the experiment. At baseline, participants were asked to form images of each of their five favorite foods and rate the vividness of the food image and craving intensity. Using a within-subjects design, participants were instructed to think of each food image while concurrently performing several trials of each of the tasks with one type of food image in mind. After each condition, participants rated the vividness of the food image and craving level.

At baseline, craving ratings did not differ by experimental group and results indicated that craving significantly decreased in all visuospatial task conditions as compared to the control condition. Further analyses indicated that the eye movement, dynamic visual noise, and forehead tracking conditions were more effective at reducing vividness ratings of the food image than the spatial tapping task. Moreover, a significant and positive correlation was found between vividness ratings of food images and craving ratings in the control and experimental conditions. This correlation provides support for EI theory in that a decrease in vividness of a craved image can decrease craving levels, which may decrease the likelihood of addictive and compulsive behavior.

Steel, Kemps, and Tiggemann (2006) investigated the interaction of hunger status (participants either came in “hungry” or “not hungry”) and the impact of visuospatial tasks on food cravings with female undergraduate students. Forty-two women were assigned to one of the “hungry” or “not hungry” conditions and completed measures of habitual food craving, restrained eating, imaging ability, and a VAS hunger rating. All participants listed three foods
they would like to eat most “right now” and imagined these foods during the task. At baseline, participants completed a VAS vividness scale (from “no image” to “image perfectly clear – as vivid as normal vision”) and craving scale (from “no desire or urge to eat this food” to “extremely strong desire or urge to eat this food”). The within-subject design entailed having the order of foods and the concurrent task conditions counterbalanced across participants with one trial for each food per concurrent task. Participants were asked to form an image of the food for five seconds and maintain the image for eight seconds while engaging in the visuospatial concurrent task (dynamic visual noise - a flickering pattern of black and white squares) and the control condition task (focusing on a blank computer screen). After the concurrent task, participants rated the current vividness of their food image and current craving.

Participants in the two hunger conditions did not differ in imaging ability; therefore, this variable was not used as a covariate in the analyses. Regardless of hunger level, visuospatial tasks were effective at decreasing or interrupting craving as compared to the control condition. Finally, a significant correlation indicated that the higher the ratings of vividness for the food image, the higher the ratings of food craving for both concurrent tasks and hunger status groups. This result is consistent with the tenet of EI theory stating that craving is related to vividness of imagery because increases in craving were linked to more vivid images of the craved substance.

Research using smokers has also examined imagery as part of the cigarette craving experience and demonstrated that imagery tasks can be used to induce and reduce craving. Furthermore, studies have evaluated the effectiveness of imagery interventions on craving and vividness. For example, Maude-Griffin and Tiffany (1996) assigned current smokers to 6 or 24 hour abstinent or non-abstinent group and asked participants to imagine different combinations of affect and urge content scripts via an audiotape. After listening to the scripts, participants
rated their urges and cravings to smoke. Results indicated that the scripts containing the urge
descriptions had significantly higher craving ratings as compared to the urge-neutral scripts,
regardless of affect description. This study demonstrated that craving could be effectively
induced via an imagery script containing urge descriptors and is consistent with EI theory’s
hypothesis that imagery appears to be part of the craving experience.

Similarly, Taylor, Harris, Singleton, Moolchan, and Heishman (2000) investigated
whether imagery could elicit craving in current tobacco smokers via imagery scripts. Taylor et
al. (2000) presented imagery scripts with urge content and without urge content to eighteen
smokers who were not interested in quitting smoking. In order to standardize the time since the
last tobacco use, participants smoked one cigarette prior to participating in the first experiment.
In the first experiment, participants were instructed to close their eyes and listen to an audiotape
of imagery scripts with combinations of positive, negative, or neutral affect content, with and
without urge content (six scripts). Participants completed craving measures prior to and after
listening to the imagery scripts. Results indicated that all craving measures (QSU-Brief, VAS
urge and craving scales) increased significantly from baseline for the imagery scripts containing
the urge content (regardless of affect content), while the scripts without urge content did not.
These results are also consistent with EI theory’s proposition that imagery can increase craving.

In Taylor et al. second experiment, only positive affect scripts were used and the intensity
of urge was modified to contain either no urge, low-urge, and high-urge content (only the
positive affect script was used so that the scripts remained consistent except for the intensity of
urge). Twenty-four current smokers participated in an identical procedure to that described
above for the first experiment. As hypothesized, craving levels were significantly higher in both
the low and high-urge script conditions as compared to the no urge condition. Additionally,
craving in the high-urge condition was significantly higher than in the low-urge condition. These results demonstrated that craving levels varied as a function of the intensity of the urge in the imagery script and that craving was induced via imagery.

In a study that experimentally manipulated the vividness of smoking-related imagery and evaluated its impact on craving, Baylen (unpublished dissertation) recruited 39 undergraduate student smokers who had abstained from smoking for six hours and randomly assigned them to one of three vividness conditions. First, participants were instructed to view a photograph of cigarette paraphernalia via audiotaped instructions and retain the image in their mind for 10 seconds. Next, participants imagined either stepping closer (increased vividness condition), stepping away (decreased vividness condition), or to imagine the photograph just as it was presented (no change in vividness control condition). Craving was measured using the Questionnaire of Smoking Urges-Brief (QSU-Brief) at baseline and after the experimental vividness task. In addition, a vividness survey of cigarette-related imagery was administered after the experimental vividness task.

Results indicated that craving change scores, measured by the QSU-Brief subscale 1 (representing strong desire/intention/smoking as rewarding), increased from baseline in the increased vividness condition and were significantly different from the decreased vividness and the no change in vividness conditions (which were equivalent). However, craving, as measured by the QSU-Brief subscale 2 (urgent desire/relief smoking) did not vary as a function of vividness of imagery condition. Across conditions, Baylen (unpublished dissertation) also found that vividness of smoking-related imagery was significantly and positively correlated with the QSU-Brief subscale 1, but not subscale 2. Overall, these results partially supported EI theory because increased vividness of smoking paraphernalia condition participants rated craving higher.
than the other conditions and increases in the vividness of smoking-related imagery were associated with increases in craving (on one scale of craving).

In a second study, Baylen (unpublished dissertation) evaluated the impact of a simple versus complex visuospatial task intervention on craving in 45 undergraduate students. Specifically, Baylen hypothesized that the complex task condition would require more cognitive resources and, therefore, would significantly reduce craving compared to the simple task and the no task control conditions. Cue-exposure consisted of the participants being asked via audiotape, to attend to the sight, smell, and feel of an unlit cigarette for approximately one minute. With the cigarette stimuli still in sight, participants were exposed to one of three conditions – a simple task (watching a group of six symbols moved across a computer screen at a slow pace), complex task (watching a group of ten smaller size symbols moved across a computer screen at a fast pace), or control condition task (participants were asked to take a break and rest their hands). The cigarette stimuli remained in sight throughout the rest of the experiment so that decreases in craving could not be attributed to removal of the cigarette-related stimuli. After participants completed the experimental task, they completed two measures of craving (a retrospective VAS asking about craving level during the task and a QSU-Brief), a vividness survey of cigarette-related imagery, and a questionnaire assessing the degree of effort used in the task.

Results showed that only the retrospective VAS rating that asked about craving during the task was significantly different among the conditions. Specifically, retrospective VAS craving scores decreased significantly during both the simple and complex task as compared to the control task, but there was no difference between the simple and complex tasks. These results are supportive of EI theory in that the tasks reduced craving and likely interfered with the elaboration of craved images. Although EI theory would have predicted that a complex task
would interfere more with elaboration over the simple and control tasks because more cognitive effort is required for the complex task, the authors speculated that this result may be attributed to the degree of cognitive effort being rated similarly by participants for the simple and complex tasks. That is, both the simple and complex tasks used the same amount of cognitive effort and did not require different levels of cognitive effort as intended.

Additionally, although EI theory would have predicted that craving would continue to be significantly lower after the task, the authors hypothesized that the tasks may have interrupted craving only temporarily. Moreover, results revealed that as all three measures of craving increased (retrospective VAS and the QSU-Brief subscale 1 and 2), vividness of smoking images also increased significantly. These results are also consistent with EI theory’s supposition that increases in the vividness of drug-related images are related to increases in craving. In other words, the more a person craves a substance, the more vivid and elaborated the images are in a person’s mind.

Versland and Rosenberg (2007) conducted a study to test whether imagery scripts emphasizing different sensory modalities would reduce cue-induced craving. The study examined the impact of three beach scene imagery interventions (olfactory, visual, and olfactory-plus-visual imagery) using an audiotape as compared to a cognitive distraction task of serial sevens (i.e., counting down by sevens from the number 500). Sixty-four university student smokers first completed the QSU-Brief at baseline. After two minutes of cigarette cue exposure, participants were asked about craving level during the intervention and after the intervention. Cue-exposure involved participants attending to the sensations associated with seeing, holding, and smelling an unlit cigarette from their pack. Then the experimenter lit the cigarette and set it in an ashtray in front of the participant for 90 seconds. As a manipulation check after the beach
scene imagery intervention, participants completed a vividness survey of the imagery interventions and a questionnaire asking whether they experienced other non-instructed forms of imagery (e.g., if the participant experienced olfactory imagery during the visual imagery task).

At baseline and prior to cue-exposure, the participants did not differ in ratings of craving. Results indicated that all three imagery interventions significantly reduced craving levels compared to serial sevens condition (the study did not include a no-task control condition) and there were no significant differences in craving among the three imagery interventions. Interestingly, participants’ craving ratings rebounded after the imagery interventions by an average of 10 points, and by approximately five points in the distraction condition (serial sevens). That is, participants’ craving levels were lower during the imagery task as compared to after the task was completed. This result demonstrated that the interruption and reduction of craving using these imagery interventions may be short-lived because craving rebounded and decreases in craving levels were not maintained once the intervention was completed.

In addition, the vividness of the beach images did not differ significantly among the different sensory imagery interventions. Results also indicated that reported vividness of the imagery during the intervention was not associated with craving levels, except that participants who had greater vividness ratings of olfactory imagery in the combined imagery condition reported lower craving ratings as compared to the other interventions. Although this result is consistent with EI theory, EI theory would predict that vividness of all imagery conditions would be significantly associated with decreases in craving. The results of this study were not consistent with the findings from food craving research showing that a visual task was typically more effective than other tasks at reducing craving. It is possible that visual imagery is no more effective than other types of sensory modalities for reducing cigarette cravings.
CHAPTER III: PRESENT STUDY

The purpose of my dissertation was to test two implications based on Elaborated Intrusion theory: a) that craving can be reduced using a competing imagery task as compared to a control condition and b) that a highly vivid imagery intervention will reduce craving more than a less vivid imagery task. EI hypothesizes that competing mental images (the imagery tasks) may interrupt the cognitive process of elaboration and, therefore, reduce craving. In addition, craving levels should vary as a function of vividness level in that a high vivid condition should be more effective at reducing craving than a low vivid and control condition.

I developed two imagery scripts as tasks to interrupt craving, as opposed to the visuospatial tasks used in the food craving studies, because of the clinical utility and portability of the imagery scripts. Also, using competing imagery with varied levels of vividness is a more direct test of EI theory, unlike the visuospatial tasks, which tested how craving selectively engaged working memory (e.g., the visuospatial sketchpad) and/or the effectiveness of the different sensory interventions on craving. Vividness of images was used as a proxy indicator of elaboration because EI theory posits that craving is based on the elaboration of intrusive thoughts and imagery. The subjective experience of craving was a focus of the study as opposed to physiological or behavioral measures of craving because EI theory focuses on the cognitive-emotional experience of craving.

This study extended previous substance abuse research by using an imagery script testing the influence of low and high vividness imagery on craving. Few studies have examined EI theory using regular smokers and this study directly examined the impact of vividness on interrupting cigarette craving by manipulating scripts containing high and low vivid images. Moreover, using a control group allowed an assessment of changes in craving that may occur
with the passage of time. In summary, three primary hypotheses were tested in the present study:

**Hypothesis 1**: The high vivid group will report a significant decrease in craving compared to the low vivid group, with the control group reporting the least reduction in craving (high vividness < low vividness < control).

**Hypothesis 2**: The vividness of instructed imagery will be negatively correlated with craving in the two intervention conditions. That is, the higher the vividness of one’s imagery of the competing task, the lower will be one’s craving level.

**Hypothesis 3**: Across the three conditions (high vivid, low vivid, and control), there will be a positive correlation between the vividness ratings of smoking related images/thoughts and craving levels.
METHOD

Pilot Study

I conducted a pilot study to help guide decisions about whether to employ a within-subjects design and whether the stimulus materials (imagery scripts) were viewed by participants as providing low vivid and high vivid information. I selected movie theatre related imagery as the content for the imagery tasks because most people have been to movie theatres in their lifetime. Two sets of university students (total n=15) served as pilot participants.

When the first set of pilot participants engaged in both low vivid and high vivid imagery, they reported being unable to focus on a subsequent script without recalling the imagery from the previous script (especially if the high vivid script was presented prior to the low vivid script). Therefore, I decided to employ a between-subjects design to eliminate this carryover effect. To evaluate how participants would react to a between-subjects design, a second set of pilot participants were recruited to practice only one of the two imagery scripts. In the low vivid group, several participants said that the scenario was vague and that they did not recall many details. In the high vivid group, participants recalled exact, detailed information. Also, all pilot participants were asked whether they used their senses (visual, auditory, olfactory) equally in the imagery scenario. Most participants said that they were able to engage all of their senses, although some participants reported that they engaged one sense more than another. Pilot participants also suggested that I include more details in the imagery scripts to make them more realistic (e.g., adding that they were walking from one place to another and how the sense was engaged).

In addition, I asked all pilot participants whether 30 seconds was long enough for them to be able to engage in imagining the scenario. Based on a review of their responses about the
timing, I decided that 30 seconds was sufficient time to allow participants to imagine the scenario. Also, participants reported that reading the script aloud one time was enough to be able to engage in the imagery task. Finally, none of the pilot participants in the within or between subject design reported that they were aware of what questions I would ask or what my study was examining.

Participants

Eligible participants were university students who smoked at least half a pack of cigarettes, at least five days a week, for at least the past three months. Participants were recruited via the web (see Appendix B) or email (see Appendix B), and received a $15 gift certificate to a local grocery store, amazon.com, or the university bookstore as compensation for their participation. Students enrolled in psychology classes also received extra credit for their participation in the study.

The 120 people who responded to recruitment notices were assessed via phone or email to see if they met inclusion criteria. Seventy-one people met inclusion criteria; of these 71 potential participants, eight people did not show up to their appointment, and 63 attended their appointment and completed the study. Data from three of the 63 participants were excluded from analyses. Specifically, one participant from the control group condition was excluded for not following instructions to complete all questionnaires. Additionally, one participant from the high vivid condition and one from the control condition were excluded because their z-scores for the QSU-Brief post-intervention were notably lower than the mean (z-scores were ≥ -2.5). Because lower craving scores might bias the statistical test in favor of finding a significant effect, I removed them from further analyses to ensure a more conservative test of my hypotheses. After removing these three potential participants, 60 remained for further analysis, with 20
participants in the high vivid group, 21 participants in the low vivid group, and 19 participants in the control condition group.

Measures

*Demographic Questionnaire*

The demographic questionnaire contained items about the participants’ age, race, gender, year in college, smoking history, whether the participant wanted to quit smoking, and whether the participant would engage in the imagery task used in the study for smoking cessation (see Appendix B). The participants ranged in age from 18-37 years old ($M = 22$ years old, $SD = 4.4$, mode = 19 years old) and there were 36 male and 23 female participants (one participant did not complete the demographic questionnaire). The population was primarily Caucasian ($n=56$). The average participant first began smoking at 15 years of age and participants had attempted to quit smoking, on average, 2.5 times prior to the study. Also, 11 participants had been smoking for three months to one year, 28 participants had been smoking for one to four years, nine participants had been smoking for five to six years, and 11 participants had been smoking for six or more years (see Table 1 in Appendix A for demographic and background information). Finally, 60% of participants in the movie theatre imagery conditions reported that they would use the imagery task to assist in quitting smoking if research demonstrated that it was useful. Additionally, 20% percent of participants indicated that they would not use the task as an intervention to assist in quitting smoking and another 20% were unsure whether they would use the task.

*Fagerström Test for Nicotine Dependence (FTND)*

The Fagerström test for nicotine dependence was used to assess nicotine dependence levels (see Appendix B). This six-item questionnaire assessed various indicators of nicotine
dependence, including the time to the first cigarette smoked after waking up, difficulty refraining from smoking when ill, and amount of cigarettes smoked per day (Heatherton, Kozlowski, Frecker, & Fagerström, 1991). A total score was calculated by summing across items (scores ranging from 0-10), with higher scores indicating a higher level of nicotine dependence. In the present study, FTND scores ranged from 0-9 with a mean score of 4.25 ($SD = 2.2$), indicating that average participant reported moderate nicotine dependence. The coefficient alpha for the questionnaire with the present sample was .63.

Heatherton et al. (1991) reported an internal consistency coefficient of .61 and found the FTND to be correlated with biochemical indices of smoking. Using a sample of Dutch daily smokers and ex-smokers, Vink, Willemsen, Beem, and Boomsma (2005) found similar internal consistency levels (coefficient alphas ranged from .65 to .71). FTND scores were also found to be higher in daily smokers as compared to ex-smokers. The same study also indicated that test-retest reliability scores ranged from .70 to .91 with the average time interval of 1.8 years ($SD = .25$ years) between measurements in a sample of daily smokers and ex-smokers (Vink et al., 2005).

**Questionnaire of Smoking Urges-Brief (QSU-Brief)**

The Questionnaire of smoking urges-Brief was used to assess the subjective experience of craving (see Appendix B). Participants rated 10 items using a seven-point scale ranging from 0 = “strongly disagree” to 6 = “strongly agree.” Cox et al. (2001) reported a two-factor structure, with Factor 1 representing a strong desire and intention to smoke (items 1, 3, 6, 7, and 10) and Factor 2 representing anticipation of relief from negative affect and an urgent desire to smoke (items 2, 4, 5, 8, and 9). Because Cox et al. (2001) found the internal consistency for the overall questionnaire to be high (coefficient alpha of .97) and the two factor subscales to be correlated ($r$
= .73), I used the total craving score (scores ranging from 0-60). For my sample, the coefficient alphas for the entire measure were high at all four measurement times (baseline coefficient alpha = .87, post-cue-exposure coefficient alpha = .88, post-intervention coefficient alpha = .89, post-experiment coefficient alpha = 1.00).

**Vividness Surveys**

A four-item vividness survey was used to assess how “vivid,” “detailed,” “vague,” and “fuzzy” the smoking-related imagery and movie theatre-related imagery were after the imagery task or control condition. These items were rated using a seven-point scale from 0 = “not at all” to 6 = “extremely” (see Appendix B). A previous study by Baylen (unpublished dissertation) found that the four questions had high internal consistency (coefficient alpha = .92). The coefficient alphas for the vividness of the movie theatre survey and the vividness of smoking images/thoughts survey in my study were also high (both coefficient alphas = .89). Therefore, I summed all four items as the total score for these surveys.

As the last question on either the movie theatre imagery vividness questionnaire or the smoking-related vividness survey in the control condition (since the control condition only completed the smoking-related imagery/thoughts vividness survey), participants answered a question asking them to assess the degree to which they were able to engage in the imagery intervention or control task on a seven-point scale from 0 = “not at all engaged” to 6 = “extremely engaged.” An ANOVA indicated that there were no significant differences in the degree to which the groups engaged in the task \( F (2, 55) = 0.417, p = .66 \).

**Questionnaire upon Mental Imagery (QMI)-Brief**

The QMI-Brief, based on Sheehan (1967), was used to assess whether pre-existing differences existed in overall imaging ability across the conditions (see Appendix B). The QMI-
Brief assesses imaging ability across five senses – visual, olfactory (smell), gustatory (taste), tactile (touch), and auditory (sound). There are five items per sensory modality (total of 25 items) and each item was rated using a seven point rating scale ranging from 7 = “perfectly clear and as vivid as the actual experience” to 1 = “no image present at all, you only ‘know’ that you are thinking of the object.” The seven point scale was reversed from the original questionnaire so that higher scores indicated higher imaging ability. Betts (1909) reported a high correlation between the total scores from the shortened QMI-Brief and total scores from the original 135-item QMI questionnaire ($r = .92$). A few items were changed so that the items would be more applicable to my population.

For my sample, total scores on the QMI-Brief ranged from 49 to 172 points and the average score was 124 points ($SD = 25$). An ANOVA indicated that there were no significant differences in imaging ability [$F (2, 57) = .585, p = .68$] among the low vivid ($M = 125$), high vivid ($M = 125$), and control condition group ($M = 120$). Internal consistency for each scale was acceptable with coefficient alphas ranging from .78 to .87 (visual coefficient alpha = .78, tactile coefficient alpha = .80, olfactory coefficient alpha = .83, auditory coefficient alpha = .85, gustatory coefficient alpha = .87).

Procedure

During the screening phase, questions about current pattern of smoking (e.g., “How many days a week do you smoke?”) were asked of all potential participants to confirm that they were current and regular smokers (see Appendix B). Participants meeting the inclusion criteria were scheduled for an appointment and asked to abstain from smoking for at least three hours prior to attending their appointment. Each participant was told that their abstention from cigarettes would be verified by the experimenter (I did not specify how I would test their abstention) to
encourage them to abstain from smoking for at least the requested three hours.

Upon arrival at their appointment, participants reviewed the informed consent (see Appendix C) and completed the QSU-Brief to obtain a baseline measure of craving. Abstention from smoking was assessed via verbal self-report and all participants were asked to record the time and date of their last cigarette on the demographic questionnaire.

Participants were randomly assigned to one of three experimental conditions: a) high vivid movie theatre-related imagery task, b) low vivid movie theatre-related imagery task, or c) a control condition task (see Appendix B for the scripts). The two movie imagery tasks contained similar content, but the high vivid imagery script was more detailed (e.g., “you can distinctly see a man who is sitting a few seats away to the right of you”), whereas the low vivid script was not detailed and was vague (e.g., “you can see only the outline of a man who is sitting a few seats away to the right of you”). Participants in the control condition were asked to imagine staring at a blank, white wall. Prior to cue-exposure, all participants read aloud the task one time and practiced imagining the task for 30 seconds as preparation for engaging in just the imagery portion of the task after cue-exposure. Participants were asked to read aloud the imagery script so that their visual and auditory senses were engaged prior to participating in the imagery task and so that the manipulation was consistent across conditions.

In an adjacent room, participants were cue-exposed to the sight, smell, and feel of a cigarette, lighter, matches, and ashtray in the laboratory. An audiotaped cue-exposure script that lasted approximately 30 seconds asked participants to hold and smell the cigarette and other cigarette-related items while imagining themselves smoking (see Appendix B). After 30 seconds, the tape told participants that the experimenter was going to light the cigarette. Exposure to the lit cigarette and other paraphernalia continued for one minute. At the end of the
cue-exposure, the tips of the lit cigarettes were dipped in water immediately to decrease the smell of the cigarette after it had been extinguished.

The combination of cue-exposure plus deprivation of smoking for at least three hours was designed to create a significant increase in craving against which to test the imagery interventions. The experimenter asked that participants bring their own preferred brand of cigarettes to the experiment, but three varieties of popular cigarette brands (regular or light tar/nicotine cigarettes) were available in case a participant forgot to bring his/her preferred brand of cigarettes to the experiment. In this case, participants were asked to choose a cigarette brand they currently smoke or would prefer to smoke from the available cigarette brands. Five participants did not bring their cigarettes with them when they arrived to the experiment and chose from one of the brands available.

Following one and half minutes of cue-exposure, participants completed a second QSU-Brief to assess craving levels after cue-exposure. Participants returned to the adjacent room so that they were not continuously cue-exposed to smoke for the entire experiment. The cigarettes, lighter, matches, and ashtray were left next to the participant throughout the rest of the experiment so that subsequent decreases in vividness or craving were not the result of the smoking stimuli being removed from the room.

After cue-exposure and completion of the second craving questionnaire, participants were asked to close their eyes and engage in the assigned imagery task for 30 seconds. Participants did not read aloud the instructions so that decreases in craving could not attributed to reading or hearing themselves read the task. After participants engaged in the imagery task for 30 seconds, they completed a third QSU-Brief craving measure, vividness survey of the movie theatre-related imagery, vividness survey of cigarette-related imagery, a demographic questionnaire, and the
QMI–Brief.

Five to 20 minutes post-experiment, the last questionnaire administered was a fourth QSU-Brief to assess their craving levels at the completion of the study. This final assessment allowed exploration of the stability of any reduction in craving some minutes after the intervention. Participants were then debriefed, provided their incentive, and thanked for their participation (see Appendix B for the debriefing script and outline of the study).
RESULTS

Analyses

Normality and Randomization Checks

I inspected the data for violations of normality and found no significant violations for the dependent variables (i.e., craving scores at the four different times) or demographic/background characteristics (i.e., nicotine dependence, imaging ability, degree to which participants were able to imagine the task, whether participants wanted to quit smoking, vividness scores for the low and high vivid interventions and smoking related imagery/thoughts). Chi-square analyses revealed no significant associations between condition and any of the demographic variables (i.e., age band, gender, race, year in college, age band of first cigarette, smoking durations, how many times participants quit smoking in the past, whether participant wanted to quit smoking, and nicotine dependence [FTND] categories). In addition, I tested whether nicotine dependence (FTND) and imaging ability (QMI-Brief) differed among the conditions using one way ANOVAs. Neither the ANOVA for nicotine dependence \( F(2, 57) = 0.376, p = .69 \) nor the ANOVA for general imaging ability \( F(2, 57) = 0.385, p = .68 \) were significant; therefore, these variables were not used as covariates to test my chief hypothesis.

Questions and Hypotheses

Did craving differ by condition at baseline and post cue-exposure (prior to the intervention) and did cue-exposure increase craving across the three conditions? I expected that groups would report similar levels of craving at baseline (when deprived of smoking) and after cue-exposure (after being exposed to cigarette smoke and cigarette-related items). If so, post-intervention differences could not be attributed to participants reporting different craving levels prior to the intervention. Therefore, I conducted a 2 (time: baseline, post-cue exposure) by 3
mixed ANOVA. The analysis revealed no main effect for condition or interaction between condition and time. Therefore, all groups were at similar levels of craving at baseline and post cue-exposure. There was a main effect for time \( F(1, 57) = 26.7, p = .000 \) and examination of the means confirmed that cue exposure increased craving compared to baseline across all three conditions \( t(57) = 5.21, p = .000 \), Mean difference = 4.2).

**Hypothesis 1: Did the imagery intervention groups significantly decrease craving compared to the control group?** Based on EI theory, I hypothesized that the high vivid movie imagery task would result in lower craving ratings than the low vivid task and that both movie imagery tasks would result in lower craving levels than the control condition (high vivid < low vivid < control). Given the previous randomization checks showing that craving did not differ significantly by condition at either baseline or post-cue exposure, I conducted a one way ANOVA to test my chief hypothesis that the movie-theatre imagery conditions would impact craving. The analysis revealed no significant difference among the post-intervention craving scores as a function of condition \( F(2, 57) = .299, p = .743 \). See Table 2 for the means by condition and Figure 1 for a graph of the means by condition in Appendix A.

Because visual inspection of Table 2 revealed that craving appeared to be lower in both the high vivid and low vivid conditions relative to the control condition, I conducted an exploratory analysis in which I combined the high and low vivid groups for contrast against the control group. This test statistic also was not significant \( t(57) = .62, p = .537 \).

**Did craving change over time regardless of condition?** Although there was no effect of condition on craving at post-intervention, I wanted to test whether craving changed from cue exposure to post-intervention regardless of condition. That is, did the passage of time or
engaging in any type of imagery (control group imagery or movie theatre imagery) result in a decrement in craving. Because there were no significant differences among the three conditions post-intervention, I conducted a paired t-test comparing the craving reported by the 60 participants at post-cue exposure to their craving post-intervention. The test statistic was not significant \[\text{paired } t (59) = 1.45, p = .152\].

For my manipulation check, I expected the vividness ratings of the low vivid movie theatre-related imagery condition to be significantly less vivid than ratings in the high vivid condition. More specifically, I expected participants in the low vivid group to rate their imagery as less “vivid” or “detailed,” and more “vague” or “fuzzy” compared to the ratings in the high vivid condition. To evaluate whether the ratings of vividness differed between the high and low vividness groups, I conducted an independent samples t-test. There was no significant difference \[t (39) = -1.55, p = .13\] between the mean for the high vivid condition \((M = 13.8)\) and the mean for the low vivid condition \((M = 11.1)\). Given the size of the critical value of the \(t\), the difference between the group means is not an issue of insufficient power.

**Hypothesis 2: Were higher vividness scores of the movie-theatre imagery related to lower craving scores?** I hypothesized that the vividness ratings of the movie theatre-related imagery would be negatively correlated with cigarette craving. That is, the higher the ratings of vividness of the intervention-based imagery, the lower the cigarette craving scores at post-intervention. Using the 41 participants in the two vividness manipulation conditions, I calculated a Pearson-product correlation to assess if craving and vividness scores from the movie-theatre imagery were significantly related. The correlation was significant and negative \((r = -.52, p < .00)\), indicating that the more vividly participants imagined the movie theatre scenario, the lower their craving scores at post-intervention.
Hypothesis 3: Across all three groups, were higher vividness scores of cigarette-related thoughts/images related to higher craving scores? Based on EI theory, I hypothesized that the vividness of cigarette-related thoughts/images – regardless of condition – would be positively correlated with cigarette craving at post-intervention. That is, I predicted that the higher one’s vividness of cigarette-related imagery, the greater one’s cigarette craving. Using data from all three conditions (N=60), the Pearson-product correlation was positive and significant ($r = .57, p < .00$).

There was no impact of the intervention on craving or vividness of movie imagery at post-intervention, but I nonetheless wanted to evaluate whether craving changed by the completion of the experiment. As an exploratory analysis, I first conducted a one way ANOVA to test whether craving differed at post-experiment as a function of condition. The test statistic was not significant ($F (2, 56) = .57, p = .57$).

Secondly, I conducted a paired t-test to evaluate whether craving decreased over time from post-cue exposure (Time 2) to post-experiment (Time 4) regardless of condition. The test statistic was significant [paired $t (58) = 4.15, p = .000$, Mean difference = 3.01]. This decrease in craving across all groups could have resulted from several influences, such as distraction from completing the questionnaires, passage of time, or thinking that the last questionnaire indicated that the participant would soon be able to smoke.
DISCUSSION

Craving is considered a prominent and distressing part of withdrawal when people are trying to quit smoking (West et al., 1989). Smoking cessation may be facilitated by reducing craving both by those who have quit and those attempting to stop smoking. The current study was designed to evaluate an implication of EI theory, that vivid non-smoking imagery would compete with and reduce craving. I expected the high vivid movie imagery intervention group to yield lower craving scores compared to the low vivid group, and that the control group would report the least reduction in craving (high vivid < low vivid < control). Contrary to this hypothesis, neither the low or high vivid interventions decreased craving compared to the control condition.

One explanation for this result is that this implication from the theory is incorrect. Alternatively, this implication from the theory may be correct, but my imagery intervention was ineffective. The latter explanation is supported by the manipulation check that revealed no differences in the movie-theatre imagery vividness scores between the low and high vivid conditions. One possible reason for the non-significant differences is that participants in the high vivid group may not have elaborated their images as instructed. However, none of the participants spontaneously mentioned this idea during the post-experiment interview.

Conversely, many participants in the low vivid imagery condition mentioned that they “added in their own details” to their script. Therefore, it may be that participants in the low vivid condition created their own details or enhanced the mental imagery they were instructed to use, thus, actually engaging in imagery that was similar to the high vivid condition. For example, one person in the low vivid condition asked, “How do I vaguely remember something, without being detailed or making it vivid?” Another participant in the low vivid condition said, “I filled in the
details.” It appears that some people were unable or unwilling to engage in the low vivid imagery task as instructed.

These comments during debriefing are consistent with another finding indicating that participants in all conditions were not especially engaged in the task. Specifically, I asked participants to report their level of engagement in the task. There was no significant difference in the degree to which the groups were able to imagine the assigned task and, more importantly, examination of the mean level of imagining across participants revealed that they were not highly able to imagine in the task (combined $M = 3.5, SD = 1.5$, using a 0=“not at all engaged” to 6 = “extremely engaged” scale). Future research could include instructions to enhance compliance with the imagery instructions to provide a more sensitive test of the influence of the intervention on craving.

Even some participants in the control group reported engaging in detailed imagery that may have been equivalent to the “low vivid” or “high vivid” condition. For example, during the post-experiment interview, some control group participants said that they thought of different borders of the white, blank wall. Another control group participant said that he added in his own details because he wondered, “Where am I standing as I look at the wall?” or “Should I think of the white wall that is in this room or a different one?” Apparently, it was difficult to only think of a white, blank wall without any context, which may have caused participants to add their own details, thus, creating a task equivalent to the low of high vivid imagery interventions. Another participant said that he felt white was a soft, peaceful color that had a calming affect on him. This experience may have reduced craving similarly to the movie imagery interventions. In summary, there may have not been two or three distinct vividness conditions, which could account for the non-significant differences in the craving scores at post-intervention.
It is also possible that the imagery one participant experiences and rates as highly vivid would be experienced and rated as only moderately or even lowly vivid by another participant. Therefore, it may be difficult to create different levels of vividness or a genuine control group based on imagery if imagery is such an individual experience. In retrospect, one way to increase the likelihood of contrasting high versus low vividness would have been to use a within-subjects design so that the same participant created his/her own low and high vivid imagery conditions – conditions that would be more likely to differ within each participant. However, a within-subjects design appeared to have limitations since the pilot testing demonstrated that those participants who imagined the high vivid imagery task first were unable to engage in the low vivid imagery task without recalling the details of high vivid imagery task.

Other limitations of my methodology include having participants engage in only one practice trial of the imagery task prior to cue exposure and the actual test of its impact on craving. Multiple practice sessions to imagine the movie scene prior to cue-exposure could improve performance and compliance, perhaps especially in the high vividness condition, and thereby yield a different impact on craving. Additionally, the imagery tasks lasted only 30 seconds and, although pilot testing indicated this would be sufficient, engaging in the imagery for a longer period of time might increase the likelihood that the person engages in the task as instructed. In addition, a longer duration of time or more practice trials may assist in creating more highly vivid imagery and lower craving. However, a longer period of imagining could be counterproductive if the low vivid group continues to add in details during the practice trial prior to the cue-exposure.

It is also possible that participants who frequently attend movies or who had recently been to a movie theatre may have had a more “vivid” imagined scenario, whether assigned to the
low or high vivid condition. Support for this idea came from at least one participant who spontaneously noted that it was easy to imagine a movie theatre since she had recently attended one the night before the experiment. Participants in the high vivid condition who do not attend movies might have had difficulty making the imagery vivid. It may be that the interventions are effective for those who have frequent movie attendance or recently attended a movie because they experience increased vividness of the imagery, which may lead to reduced craving. For those in the low vivid condition, frequent or recent movie attendance may have made it difficult to engage in the task in a less vivid manner. This consideration was not taken into account during the experiment and should be assessed in future studies using imagery.

My second hypothesis was that the vividness of the movie theatre imagery would be negatively correlated with cigarette craving levels. This hypothesis was supported in that the higher the participants rated the vividness of the movie imagery in the low and high vivid groups, the lower their craving at post-intervention. This finding is consistent with EI theory in that non-smoking vivid images/thoughts are presumed to interrupt elaboration and thereby result in decreased craving. This result also supports the idea that the interventions in the current study may be useful for some people, with usefulness potentially varying as a function of individual differences in imagery ability rather than the intervention conditions. If the participant has good imaging ability and is able to imagine the scenario as instructed, then the intervention may work at decreasing craving. Because imaging ability on the QMI-Brief questionnaire was similar across all groups, it is possible that too few people were good enough at imaging or able to engage in the imagery tasks, thus eliminating any differences.

Therefore, future studies may also want to figure out a “threshold” of imaging ability for including people in a study where imaging is paramount to the interventions. It may be that there
is certain level of imaging ability that is necessary for someone to be able to engage in imagining a scenario so the intervention can be reliably tested. Furthermore, studies may evaluate how different groups (e.g., “low imagers” vs. “high imagers”) react to imagery interventions. It may be that the interventions are effective only for those people with moderate or high imaging capability.

My third hypothesis was also supported in that the more vivid were smoking-related thoughts/images, the higher were craving scores. This correlation suggests that if one engaged in imagining vivid images/thoughts related to the addictive substance, then craving might increase. Alternately, it may be that craving caused by some other process results in imagining the addictive substance. This correlation is consistent with EI theory and suggests the possible value of using competing imagery interventions because there is a relationship between the vividness with which one imagines and has thoughts of the substance and increased craving.

Future studies could include several variables that may have affected craving that were not evaluated in this study. One consideration is that mood may be a significant variable affecting craving. Evidence supporting this idea came from participants who said that the movie theatre elicited emotions. For example, a participant in the high vivid group said that the movie theatre was an “irritable experience” because he disliked thinking of people talking behind him or making noises with candy wrappers in a movie theatre. Additionally, some people were nervous as they read the script aloud prior to the intervention, which may have affected craving levels. Another participant said that she felt “extremely anxious” during cue-exposure.

Additionally, perceived availability of the substance is another factor that may have affected people actively engaging in the tasks and may affect craving (Wertz & Sayette, 2001). Evidence for this idea was supported by several participants who said that they were fully aware
that they were going to have a cigarette once the experiment was over. Therefore, craving may not change over the course of the experiment if one expects to have a cigarette after the experiment is over. In addition, some participants said they were used to refraining from cigarettes when necessary, and this may have overshadowed the effect of any imagery intervention on craving. Future studies may want to examine how perceived availability of the substance in those who are not abstaining from substances affects the results.

Another limitation of the present study was that people may have engaged different subsets of sensory images during the movie scenario. For example, one participant said she only used her auditory senses, and not other senses. It is possible that the imagery experiences were different for those who engaged all senses as compared to those who only engaged a few senses or one sense. Therefore, it may be that craving, using imagery, is reduced differentially depending on the sense being used and could be examined in future studies. This line of research has been conducted with food cravings (e.g., Kemps & Tiggeman, 2007), but I only found one study that evaluated this idea with smokers. Versland and Rosenberg (2007) found that there were no significant differences in cigarette craving across three imagery/sensory interventions (olfactory, visual, olfactory-plus-visual beach imagery conditions), but that craving was significantly lower in all interventions compared to the distracting cognitive task condition (serial sevens). Versland and Rosenberg (2007) were the first investigators to examine this idea with smokers and future studies could further evaluate this idea. Emphasizing different senses in imagery scripts would allow examination of whether certain senses are more effective at reducing craving.

Tailoring interventions to each participant to make the imagery task more relevant and accessible to participants could increase the effectiveness of the intervention. Perhaps if the
experimenter knows what specific senses are used when an individual is experiencing craving, a tailored imagery intervention engaging that sense could more effectively compete with craving. When I spoke with participants, many indicated that specific senses used during the cue-exposure induced craving. For example, one participant said that holding a cigarette induced craving, while another participant said that lighting the cigarette induced craving. It appears that some people have conditioned associations that elicit craving, and that a competing imagery intervention using the same sense may effectively decrease craving for the individual (e.g., for someone who likes the smell of cigarettes, the experimenter could use that to increase craving and then use a script in which the participant smells something else as the competing task).

Another possibility is that the imagery interventions were not “strong enough” to significantly reduce craving. The craving experience may be so powerful that it continues even when competing images meant to engage senses and/or cognitions are imagined. For example, many participants stated that they were unable to engage or concentrate on imagining the task since craving was so strong. Other participants said that they were so affected by the cue-exposure that they could not engage in the imagery task. One participant in the high vivid condition said that craving was so strong that everything in the scenario reminded him of cigarettes. For example, the crinkling of the candy wrappers made him think of noises that he associated with cigarettes. Another participant in the high vivid condition said that she was preoccupied with the cigarette and had trouble engaging in the imagery task due to craving. This participant also called the imagery “fuzzy.” Therefore, this person may have actually imagined the scenario like the low vivid participants. The strength of craving was also apparent in people who said that they were able to effectively do the task when they read it aloud the first time prior to cue-exposure, but found it difficult to engage in the imagery after craving was induced via
Other evidence supporting EI theory’s definition or process of craving was apparent in talking with many participants in the control group during the post-experiment interview. Some participants in the control group said that they were thinking of cigarettes after cue-exposure and could not think of anything else. One participant said that he thought of a cigarette painted on the wall when he thought of the white, blank wall. This comment is consistent with EI theory and tells us about the strength of craving.

Additional limitations of the study were that the sample was comprised of college students who had not been smoking for as many years as other samples of smokers. Duration of smoking history may affect the experience of craving, and craving may be higher in those who have been smoking for more years. For example, it may be even more difficult to interrupt craving in those who have been smoking longer.

Overall, however, the results of the present study supported some predictions based on EI theory and expanded our understanding of whether imagery tasks are effective for disrupting craving in smokers. The main tenets that were supported include the findings that a) the vividness with which smokers imagine and/or have thoughts about smoking were related to increases in craving and b) the more vivid one imagines an interrupting task, the lower the craving. With regard to the imagery interventions, modifications may be necessary for them to reduce craving. Although additional work, as described above, is needed to understand more about the conditions for the effectiveness of imagery tasks as interventions to reduce craving, this study showed that such an avenue of research holds promise.
REFERENCES


of smoking urges (QSU-Brief) in laboratory and clinical settings. *Nicotine & Tobacco Research*, 3(1), 7-16.


Footnote

1 As another way to test the effect of time and condition on craving, I conducted a 3 (conditions) x 4 (measurement times) mixed ANOVA. Results indicated that there was a significant main effect for time [Wilk’s Lambda = .62; \( F(2, 117) = 10.8, p = .00 \), with the Greenhouse-Geisser correction applied], no main effect for condition [\( F(2, 55) = .88, p = .41 \)], and no significant interaction between condition and time [Wilk’s Lambda = .95; \( F(6,106) = .48, p = .82 \)].
APPENDIX A: TABLES AND FIGURE
### Table 1

**Participant Demographics**

<table>
<thead>
<tr>
<th>Demographic</th>
<th>N or M (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>36</td>
</tr>
<tr>
<td>Female</td>
<td>23</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
</tr>
<tr>
<td>18-37 years old</td>
<td>M = 22 (4.3)</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
</tr>
<tr>
<td>White/Euro-American</td>
<td>55</td>
</tr>
<tr>
<td>Non-White</td>
<td>4</td>
</tr>
<tr>
<td><strong>Year in college</strong></td>
<td></td>
</tr>
<tr>
<td>Freshmen</td>
<td>11</td>
</tr>
<tr>
<td>Sophomore</td>
<td>12</td>
</tr>
<tr>
<td>Junior</td>
<td>9</td>
</tr>
<tr>
<td>Senior</td>
<td>16</td>
</tr>
<tr>
<td>Other</td>
<td>10</td>
</tr>
<tr>
<td><strong>Age of first cigarette</strong></td>
<td></td>
</tr>
<tr>
<td>11-12</td>
<td>6</td>
</tr>
<tr>
<td>13-14</td>
<td>16</td>
</tr>
<tr>
<td>15-16</td>
<td>15</td>
</tr>
<tr>
<td>17-18</td>
<td>11</td>
</tr>
<tr>
<td>19-20</td>
<td>5</td>
</tr>
<tr>
<td>21-22</td>
<td>2</td>
</tr>
<tr>
<td><strong>Length of time smoking</strong></td>
<td></td>
</tr>
<tr>
<td>3 months</td>
<td>3</td>
</tr>
<tr>
<td>3-6 months</td>
<td>1</td>
</tr>
<tr>
<td>6 months to 1 year</td>
<td>6</td>
</tr>
<tr>
<td>1-2 years</td>
<td>5</td>
</tr>
<tr>
<td>2-3 years</td>
<td>14</td>
</tr>
<tr>
<td>3-4 years</td>
<td>9</td>
</tr>
<tr>
<td>5-6 years</td>
<td>9</td>
</tr>
<tr>
<td>&gt;6 years</td>
<td>11</td>
</tr>
<tr>
<td><strong>Do you currently want to quit?</strong></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>11</td>
</tr>
<tr>
<td>No</td>
<td>21</td>
</tr>
<tr>
<td>Unsure</td>
<td>25</td>
</tr>
<tr>
<td><strong>For those who participated in</strong></td>
<td></td>
</tr>
<tr>
<td>the imagery task (not the control</td>
<td></td>
</tr>
<tr>
<td>group), would you use it if you</td>
<td></td>
</tr>
<tr>
<td>know that research demonstrated</td>
<td></td>
</tr>
<tr>
<td>that it assisted in quitting</td>
<td></td>
</tr>
<tr>
<td>smoking?</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>24</td>
</tr>
<tr>
<td>No</td>
<td>9</td>
</tr>
<tr>
<td>Unsure</td>
<td>8</td>
</tr>
</tbody>
</table>
Table 2

Average QSU-Brief Craving Scores across Time (score range: 0-60)

<table>
<thead>
<tr>
<th>Condition</th>
<th>Baseline</th>
<th>Post Cue-Exposure</th>
<th>Post - Intervention</th>
<th>Post-Experiment</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Vivid</td>
<td>45.5 (8.5)</td>
<td>50.9 (8.5)</td>
<td>50.6 (8.1)</td>
<td>48.6 (7.8)</td>
</tr>
<tr>
<td>Low Vivid</td>
<td>48.0 (10.0)</td>
<td>52.3 (10.1)</td>
<td>51.6 (10.9)</td>
<td>48.5 (11.9)</td>
</tr>
<tr>
<td>Control</td>
<td>52.0 (10.5)</td>
<td>54.6 (12.1)</td>
<td>53.3 (12.9)</td>
<td>51.7 (12.2)</td>
</tr>
<tr>
<td>Grand Mean</td>
<td>48.4 (9.9)</td>
<td>52.6 (10.3)</td>
<td>51.8 (10.7)</td>
<td>49.6 (10.7)</td>
</tr>
</tbody>
</table>
Figure 1. Graph of the average QSU-Brief craving scores across time
APPENDIX B: MATERIALS AND QUESTIONNAIRES
Experimetrix Post to Psychology Students

Must be at least 18 years old. This study is seeking current smokers. Paid participation.

We are examining craving in current smokers. You will be asked to complete a task and a set of questionnaires. The study will last approximately 30 minutes and you will receive ½ research credit and payment. Please contact the experimenter at insert number or insert email.
Mass Recruitment Email

Subject Line: BGSU Smokers – Earn $15 by participating in a ½ hr research study

Dear BGSU student:

You email address was selected at random from a list of students enrolled this fall/summer.

I am emailing you to invite you to participate in my dissertation research study that is designed to examine craving in cigarette smokers.

You are eligible to participate if you are at least 18 years old and a current smoker.

Your participation will involve: a) abstaining from smoking for at least three hours prior to participating in the study, b) bringing a pack of your own cigarettes to your appointment, c) reading a set of instructions, and d) completing a set of questionnaires. I estimate that your participation in the study will last approximately 30 minutes. The study will be held on the BGSU campus.

The benefits of this research are that the study will provide an increased understanding of craving in smokers. You will also receive a $15 gift certificate for Amazon.com, a grocery store, or the University bookstore for participating in the study.

Please note that this study is completely voluntary.

Please respond to this email if you are interested in participating in the study. Please respond by providing your name, phone number, and email address so that I can contact you. People will be scheduled on a first come, first serve basis.

Please note that e-mail is not 100% secure, so it is possible that someone intercepting your e-mail will gain knowledge of your interest in the study.

Thank you,
Shanna Murray
Graduate Student
Demographic Questionnaire

Age: ________

Sex: □ Male □ Female

Race:
□ Caucasian/White/European □ Black/African-American
□ Hispanic/Latino(a) □ Native American
□ Indian/Pakistani □ Other, specify_________
□ Asian/Pacific Islander

Year in college: □ Freshman □ Sophomore □ Junior □ Senior □ Other, specify _____

How old were you when you smoked your first cigarette? ________

How long have you been smoking at least a half a pack of cigarettes per day?
□ 3 months □ 2 – 3 years
□ 3 – 6 months □ 3 – 4 years
□ 6 months to 1 year □ 5 – 6 years
□ 1 – 2 years □ More than 6 years

Approximately how many times have you attempted to quit smoking cigarettes?
Number of quit attempts: ______

When was the date (for example, 05/11/07) and time of day (for example, 9:30 p.m.) of your last cigarette?
Date: _________ Time: _________

Do you want to quit smoking at the present time? □ Yes □ No □ Unsure

For those who participated in the imagery task, would you use the imagery technique you practiced in this experiment to quit smoking if you knew that research demonstrated that it assisted in quitting smoking? Do not answer if you were asked to stare at a blank wall.

□ Yes □ No □ Unsure

If you answered “no” or “unsure,” please briefly explain why you would not use this technique or why you are unsure if you would use this technique (remember your answers are anonymous):

________________________________________________________________________
________________________________________________________________________
Fagerström Test for Nicotine Dependence (FTND)

1. How soon after you wake up do you smoke your first cigarette?
   - [ ] Within 5 minutes
   - [ ] 6-30 minutes
   - [ ] 31-60 minutes
   - [ ] After 60 minutes

2. Do you find it difficult to refrain from smoking in places where it is forbidden?
   - [ ] Yes
   - [ ] No

3. Which cigarette would you hate most to give up?
   - [ ] The first in the morning
   - [ ] Any other

4. How many cigarettes per day do you smoke?
   - [ ] 31 or more
   - [ ] 21-30
   - [ ] 11-20
   - [ ] 10 or fewer

5. Do you smoke more frequently during the first hours after awakening than during the rest of the day?
   - [ ] Yes
   - [ ] No

6. Do you smoke if you are so ill that you are in bed most of the day?
   - [ ] Yes
   - [ ] No
The Questionnaire of Smoking Urges – Brief (QSU-Brief)  

Indicate how much you agree or disagree with each of the following statements by placing a single checkmark along each line between Strongly Disagree and Strongly Agree. The closer you place your checkmark to one end or the other indicates the strength of your agreement or disagreement. We are interested in how you are thinking and feeling right now as you are filling out the questionnaire.

1. I have a desire for a cigarette right now.  
   Strongly Disagree  
   Strongly Agree

2. Nothing would be better than smoking a cigarette right now.  
   Strongly Disagree  
   Strongly Agree

3. If it were possible, I probably would smoke right now.  
   Strongly Disagree  
   Strongly Agree

4. I could control things better right now if I could smoke.  
   Strongly Disagree  
   Strongly Agree

5. All I want right now is a cigarette.  
   Strongly Disagree  
   Strongly Agree

6. I have an urge for a cigarette.  
   Strongly Disagree  
   Strongly Agree

7. A cigarette would taste good right now.  
   Strongly Disagree  
   Strongly Agree

8. I would do almost anything for a cigarette now.  
   Strongly Disagree  
   Strongly Agree

9. Smoking would make me less depressed.  
   Strongly Disagree  
   Strongly Agree

10. I am going to smoke as soon as possible.  
    Strongly Disagree  
    Strongly Agree
Vividness of Smoking Images/Thoughts Survey

Please answer these questions based on what you experienced right after the second time you imagined the movie theatre.

1. Cigarette-related images and/or thoughts were **vivid** after the imagery task was completed.

   
   0 1 2 3 4 5 6
   not at all somewhat extremely
   vivid vivid vivid

2. Cigarette-related images and/or thoughts were **detailed** after the imagery task was completed.

   
   0 1 2 3 4 5 6
   not at all somewhat extremely
detailed detailed detailed

3. Cigarette-related images and/or thoughts were **vague** after the imagery task was completed.

   
   0 1 2 3 4 5 6
   not at all somewhat extremely
   vague vague vague

4. Cigarette-related images and/or thoughts were **fuzzy** after the imagery task was completed.

   
   0 1 2 3 4 5 6
   not at all somewhat extremely
   fuzzy fuzzy fuzzy
Movie Theatre Imagery Vividness Questionnaire

1. My mental image of the movie theatre was **vivid** during the most recent imagery task.

   0  1  2  3  4  5  6
not at all  somewhat vivid  extremely vivid

2. My mental image of the movie theatre was **vague** during the most recent imagery task.

   0  1  2  3  4  5  6
not at all  somewhat vague  extremely vague

3. My mental image of the movie theatre was **detailed** during the most recent imagery task.

   0  1  2  3  4  5  6
not at all  somewhat detailed  extremely detailed

4. My mental image of the movie theatre was **fuzzy** during the most recent imagery task.

   0  1  2  3  4  5  6
not at all  somewhat fuzzy  extremely fuzzy

5. To what degree were you able to create the movie images described in the script during the most recent imagery task?

   0  1  2  3  4  5  6
not at all  somewhat  extremely
IMAGERY VIVIDNESS

The aim of this test is to determine the vividness of your imagery. The items of the test will bring certain images to your mind. You are to rate the vividness of each image using the accompanying rating scale, which is shown below. For example, if your image is ‘vague and dim’ you give it a rating of 3. Record your answer by circling the appropriate number. Before you begin, familiarize yourself with the different descriptions on the rating scale. Throughout the test, refer to the rating scale when judging the vividness of each image. A copy of the rating scale will be printed on the top of each page. Please do not turn to the next page until you have completed the items on the page you are doing, and do not turn back to check on other items you have done. Complete each page before moving on to the next page. Try to rate the vividness of each image separately no matter how you may have rated other items.

**Rating Scale:** The image aroused by an item of this test may be:

| Not present at all, you only ‘know’ that you are thinking of the object | Rating 1 |
| So vague and dim as to be hardly clear | Rating 2 |
| Vague and dim | Rating 3 |
| Not clear or vivid, but recognizable | Rating 4 |
| Moderately clear and vivid | Rating 5 |
| Very clear and comparable in vividness to the actual experience | Rating 6 |
| Perfectly clear and as vivid as the actual experience | Rating 7 |

Think of seeing the following and consider carefully the *picture* that comes to your mind. Rate the degree of vagueness or vividness of the pictures in your mind using the Rating Scale outlined above.

**Circle the rating of each image**

1. Think of the face of your current best friend
   1 2 3 4 5 6 7
2. The sun as it is sinking below the horizon
   1 2 3 4 5 6 7
3. A large tree with its leaves blowing in the wind
   1 2 3 4 5 6 7
4. A bird as it is flying through the air
   1 2 3 4 5 6 7
5. A colorful clown costume
   1 2 3 4 5 6 7
**Rating Scale:** The image aroused by an item of this test may be:

- Not present at all, you only ‘know’ that you are thinking of the object  
  Rating 1
- So vague and dim as to be hardly clear  
  Rating 2
- Vague and dim  
  Rating 3
- Not clear or vivid, but recognizable  
  Rating 4
- Moderately clear and vivid  
  Rating 5
- Very clear and comparable in vividness to the actual experience  
  Rating 6
- Perfectly clear and as vivid as the actual experience  
  Rating 7

Think of each of the following **sounds**, considering carefully the sound that comes to mind. Rate the degree of vagueness or vividness of the sounds in your mind using the Rating Scale outlined above.

<table>
<thead>
<tr>
<th>Sound</th>
<th>Circle the rating of each image</th>
</tr>
</thead>
<tbody>
<tr>
<td>6. The sound of birds chirping</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>7. The honk of an automobile</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>8. The meowing of a cat</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>9. The sound of steam escaping from a tea kettle</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>10. The clapping of hands in applause</td>
<td>1 2 3 4 5 6 7</td>
</tr>
</tbody>
</table>

Think of ‘**feeling** or touching’ each of the following things, considering carefully the physical sensations that come to your mind. Rate the degree of vagueness or vividness of each item in your mind using the Rating Scale outlined above.

<table>
<thead>
<tr>
<th>Item</th>
<th>Circle the rating of each image</th>
</tr>
</thead>
<tbody>
<tr>
<td>11. Sand</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>12. Soft cotton blanket</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>13. Fur</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>14. The prick of a pin</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>15. The warmth of a bath</td>
<td>1 2 3 4 5 6 7</td>
</tr>
</tbody>
</table>
**Rating Scale:** The image aroused by an item of this test may be:

- Not present at all, you only ‘know’ that you are thinking of the object
- So vague and dim as to be hardly clear
- Vague and dim
- Not clear or vivid, but recognizable
- Moderately clear and vivid
- Very clear and comparable in vividness to the actual experience
- Perfectly clear and as vivid as the actual experience

Think of **tasting** each of the following, considering carefully the taste that comes to your mind. Rate the degree of vagueness or vividness of the tastes in your mind using the Rating Scale outlined above.

<table>
<thead>
<tr>
<th>Image</th>
<th>Rating Scale</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>16. Salt</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17. Sugar</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18. An orange</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19. Peppermint candy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20. Pizza</td>
<td></td>
<td></td>
<td></td>
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</table>

Think of **smelling** each of the following, considering carefully the smell that comes to your mind. Rate the degree of vagueness or vividness of the smells in your mind using the Rating Scale outlined above.

<table>
<thead>
<tr>
<th>Image</th>
<th>Rating Scale</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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</thead>
<tbody>
<tr>
<td>21. A musty basement</td>
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<td>22. An open bottle of mustard</td>
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<td>23. Popcorn</td>
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<tr>
<td>24. Fresh paint</td>
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<tr>
<td>25. New leather</td>
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</table>
Telephone or E-mail Screening Script for Eligibility

The experimenter will ask these screening questions to determine eligibility via phone or email:

On average, how many cigarettes a day do you smoke? ____________
*Note: participant must smoke at least a half a pack (10 cigarettes) a day*

On average, how many days a week do you smoke this amount of cigarettes? _________
*Note: participant must smoke half a pack a day for at least five days a week*

For how many months have you been smoking this amount of cigarettes? ____________
*Note: participant must smoke half a pack a day for at least five days a week for the last three months*

Is the participant eligible to enter the study?

☐ Yes – ask the participant to refrain from smoking for at least 3 hours prior to coming to their appointment. Ask them to bring a pack of their own cigarettes to the experiment. Set up an appointment with them and tell them where to meet the experimenter. Explain that the experimenter will send a confirmation email a day prior to the appointment.

Date and Time of Meeting: _________________________________________________

E-mail address and other contact information: ________________________________

☐ No – explain to the participant why they are not eligible to participate in the study. Explain that we need people who were smoking for a longer period of time, etc. If they are interested in being on the waiting list, complete the following information below, but let the participant know that they will likely not be part of the study.

Name: ___________________

Contact info: ______________
Read aloud by experimenter for all conditions:

Please focus on imagining the scenario that you are about to read. I will not be asking you questions about what you remember from the script. Do you have any questions before we begin? Go ahead and read aloud the script one time.

**High Vivid Condition**

*Participant reads this aloud one time:*
It is Friday night and you and your friend decide to see a movie at the movie theater. You walk to the box office, stand in line, purchase a ticket, and walk toward the theatre in which your movie is playing. As you walk toward your theatre, you can vividly see and hear people walking around, smell the assortment of food at the concession stand, and hear the many conversations going on at the same time.

As you pass the concession stand, you can distinctly smell popcorn and you also notice a man walking alongside you with a blue bag filled with white popcorn. You take a deep breath and smell the strong aroma of the salt and the butter on the popcorn.

You continue walking with your friend toward the theatre and pick a place to sit. You notice that the air conditioner is on and you feel the sensation of cool air on your skin. As you sit down, you hear a loud conversation from the couple sitting behind you. You clearly hear the man tell the woman in a loud voice about how he had gone to the park and walked his dog for an hour.

Because the movie theatre is well-lit, you can distinctly see a man who is sitting a few seats away to the right of you. He is getting ready to open up a chocolate candy bar. You see that he is opening it up and you clearly hear the crinkling of the candy bar wrapper. As you hear the crinkling of the candy bar wrapper, you also take in the strong smell of the chocolate candy bar.

Then you see a woman sitting a few rows in front of you open up a box of jelly beans. She tilts the box so that a small handful of jelly beans land in her hand. You can clearly hear the rattling of the jelly beans and you watch them come out of the box and into her hand. As you watch her put each one in her mouth and bite down, you first smell the strong scent of a lemon jelly bean, then she bites into a strawberry jelly bean, and then she has a watermelon jelly bean.

*Experimenter reads to participant after the reading:*
Now please close your eyes (pause for a few seconds). Please spend the next 30 seconds imagining the scenario in your mind. This includes putting yourself in this situation in the theatre, and watching, smelling, and hearing what is going on around you in as much detail as you can. Until I tell you to stop, keep imagining, with as much detail and vividly as possible, the scenario you just read.
**Low Vivid Condition**

*Participant reads this aloud one time:*

It is Friday night and you and your friend decide to see a movie at the movie theater. You walk to the box office, stand in line, purchase a ticket, and walk toward the theatre in which your movie is playing. As you walk toward your theatre, you are so eager to find a seat that you aren’t paying much attention and have only a vague impression of people walking around, the food at the concession stand, and conversations going on around you.

As you pass the concession stand, you get a slight whiff of popcorn and you also notice a man walking alongside you, but you aren’t sure if you can see whether he is carrying a bag of popcorn. You take a short breath and get a weak smell of salt and butter on the popcorn.

You continue walking with your friend toward the theatre and pick a place to sit. You notice that the air conditioner is on. As you sit down, you hear a quiet conversation from a couple sitting behind you, but you can’t really make out what they are talking about – only that you hear voices.

Next, because the movie theatre lights are dimmed, you can see only the outline of a man who is sitting a few seats away to the right of you. It looks as if he is getting ready to open up something. You think you see that he is opening up what might be a chocolate candy bar and you can almost hear the crinkling of the wrapper. As you listen, you a get weak smell of the chocolate candy bar.

Then you notice what looks to be an outline of a woman sitting a few rows in front of you. She opens what appears to be a box of jelly beans and she tilts the box. From a distance, you can vaguely hear the sound of the jelly beans and you think you can see maybe a few land in her hand. As she puts each one in her mouth and bites down, you think you smell some kind of fruit, but none of the smells are distinct or easy to identify.

*Experimenter reads to participant after the reading:*

Now please close your eyes right now (pause for a few seconds). Please spend the next 30 seconds imagining this scenario in your mind. This includes putting yourself in the situation in the theatre, and watching, smelling, and hearing what is going on around you even though none of it seems very clear or distinct. Until I tell you to stop, keep imagining, without much detail, the scenario you just read.
Control Condition

*Participant reads this aloud one time:*

Imagine yourself facing a blank, white wall and staring at it.

*Experimenter reads to participant after the reading:*

Now please close your eyes right now (pause for a few seconds) and follow the instructions to imagine yourself facing a blank, white wall and staring at it for 30 seconds. Follow these instructions and only imagine yourself staring at a blank, white wall until I tell you to stop.
Cue-exposure Script (via audiotape)

(Approximately a 30 second script)
On the table in front of you, you see a book of matches, lighter, a pack of cigarettes, and an ashtray with a cigarette in it. I want you to take a moment to look at these items. Next, I would like you to pick up the cigarette as if you were about to smoke it. Hold it in your fingers as if you were about to smoke it and pay attention to how it feels in your hand for a few moments (pause for 10 seconds). Next, I want you to smell the cigarette. Hold it up to your nose and take a deep breath so that you can smell the tobacco. Take a few moments to enjoy the aroma (pause for 10 seconds). Next, I want you to hear the lighter working. Now set the cigarette back in the ashtray. Please take a few moments to just look and touch any of the other items as you wish until I tell you to stop. While doing so, imagine how enjoyable it would be to actually smoke the cigarette.

Now the experimenter is going to light a cigarette. While the cigarette is lit, I want you to imagine how enjoyable it would be to actually smoke the cigarette (the experimenter lights the cigarette for approximately one minute).
Debriefing Form

Thank you for participating in this study. As was stated in the consent form, we are interesting in learning about cigarette craving. Specifically, we are interested whether mental imagery tasks can be used to reduce craving. Previous research has suggested that tasks may reduce or interrupt craving (Versland & Rosenberg, in press; Harvey, Kemps, & Tiggeman, 2005). Additionally, we are interested in examining whether the vividness of your imagery is related to craving. Previous research has demonstrated that the more vivid your imagery is for cigarettes, the higher your craving level (Harvey et al., 2005). Research has also demonstrated that the more vivid your image for the task, the lower your craving level (Baylen, unpublished dissertation; Kemps, Tiggemann, & Hart, 2005).

In addition to asking you about craving and vividness levels, we also asked you about your smoking history and background information. This information will be used to help us interpret our findings and describe our sample of participants.

Your participation is appreciated and will help psychologists understand craving and the effectiveness of interventions at reducing craving. We ask that you do not discuss the study with others who may later participate, as it may affect how participants answer the questionnaires. If you have any questions or concerns, please contact the graduate student in charge of this study, Shanna Murray, MA in the Psychology Department at (419) 372-2540 or (419) 372-4305. If you have any questions regarding your rights as a research participant, please contact the chair of the Bowling Green State University Human Subjects Review Board at (419) 372-7716.

If you would like to learn more about this research topic, we suggest these references:


Outline of Study

Potential subjects contacted via experimetrix, email, phone
↓
Eligibility confirmed via the eligibility questionnaire
↓
Participant arrives for appointment
↓
Participants give informed consent
↓
Participants complete QSU-Brief1 (baseline craving)
↓
Participant is randomly assigned to one of three experimental conditions:

<table>
<thead>
<tr>
<th>Participant reads aloud and practices for 30 seconds the high vividness movie-theatre imagery task one time</th>
<th>Participant reads aloud and practices for 30 seconds the low vividness movie-theatre imagery task one time</th>
<th>Participant reads aloud and practices for 30 seconds the control condition task one time</th>
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Participants are cue-exposed to the sight and smell of a cigarette for approximately 1.5 minutes
↓
Complete QSU-Brief2 (post cue-exposure)
↓

<table>
<thead>
<tr>
<th>Participant engages in the high vividness movie-theatre imagery task without reading aloud for 30 seconds</th>
<th>Participant engages in the low vividness movie-theatre imagery task without reading aloud for 30 seconds</th>
<th>Participant engages in the control condition task without reading aloud for 30 seconds</th>
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Participant completes the QSU-Brief3 (post-intervention), Vividness Survey of Movie-Theatre Related Imagery, Vividness Survey of Smoking-Related Imagery, Demographic Questionnaire, Questionnaire Upon Mental imagery – Brief, Fagerström Test for Nicotine Dependence
↓
Complete the QSU-Brief4 (post-experiment)
↓
Participants debriefed and provided experimental class credit via experimetrix and a $15 certificate
APPENDIX C: CONSENT LETTER
PARTICIPANT CONSENT FORM  
HSRB Project # H07D258GE7

Purpose of Research
The purpose of this study is to examine craving in current smokers and is being completed as part of a dissertation. This study is conducted by Shanna Murray, MA and supervised by Harold Rosenberg, PhD in the Psychology Department at BGSU.

Eligibility Criteria
You are eligible to participate if you are at least 18 years old, smoke at least a half a pack of cigarettes a day for at least five days out of the week, and have been smoking for at least three months. Prior participating in the study, you will have been asked to refrain from smoking for at least 3 hours.

Benefits of Research
The benefits of this research are that the study will provide an increased understanding of craving in smokers. The benefits to the individual are that you will have the opportunity to learn more about craving. If you are interested, you will be provided with references of articles about craving. In addition, your participation in the present research will allow you to gain an understanding of the research process (you have the opportunity to ask questions about research). Also, you may request the results of the study. You will receive a $15 gift certificate for Amazon.com, a grocery store, or University bookstore, for participating in my study. If you are enrolled in a psychology 101 class, you will also be given ½ research credit.

Duration of Participation and Specific Procedures to be Used
I estimate that your participation will take approximately a ½ hour in which you will be asked to look and hold cigarettes, read a set of instructions, and complete a set of questionnaires.

Risks to the Individual
There are minimal risks involved with this research. The anticipated risks to you are no greater than those normally encountered in daily life. If the procedures used in the study cause stress, you can decide not to participate in the study.

Confidentiality
All responses are confidential. Information you provide such as your name, email, and phone number will be kept confidential and separate from your questionnaire responses. The study is confidential and your questionnaires will be marked with a code number that will correspond to your name on a separate document. Only members of the research team will have access to the data you provide and your data will be stored in a locked file cabinet. The results of this study will be summarized and no one person’s answers will be presented.

Voluntary Nature of Participation
Your participation in this study is completely voluntary, and you can refrain from answering any questions without penalty or explanation. If you have any questions or comments about this study, you can contact Shanna Murray, MA at 419.353.7944 or 419.495.3086; smurray@bgsu.edu or my project advisor, Dr. Harold Rosenberg at 419.372.7255; hrosenbgnet.bgsu.edu. If you have questions about the conduct of this study or your rights as a research participant, you may contact the Chair of Bowling Green State University’s Human Subjects Review Board at 419.372.7716 (hsrb@bgsu.edu). If you decline to participate in this study, your grades, class standing, or relationship to the institution is not impacted. Completion and return of the questionnaires indicates your consent to participate in the study.
I have had the opportunity to read this consent form, ask questions, and am prepared to participate in this project. I will be provided with a copy of this consent form.

Participant’s Name (Please Print)  Participant’s Signature  Date