EFFICACY OF IMAGERY AND COGNITIVE TASKS USED TO REDUCE CRAVING AND IMPLICATIONS FOR THE ELABORATED INTRUSION THEORY OF CRAVING

Amelia S. Versland

A Dissertation

Submitted to the Graduate College of Bowling Green State University in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

August 2006

Committee:

Harold Rosenberg, Advisor
Leigh R. Chiarello, Graduate Faculty Representative
Anne Gordon
Steve Jex
Based on the elaborated intrusion theory of desire (Kavanagh, Andrade, & May, 2005), this study was designed to examine the comparative impact of three types of imagery interventions (visual, olfactory, and a combination of visual and olfactory) versus a distraction intervention on self-reported craving for cigarettes by regular smokers. Participants included university students (N=54) who had been smoking at least a pack of cigarettes per day for the past 3 to 6 months and had been deprived of nicotine for at least 6 hours prior to their participation. Recruitment was performed via email announcements, classroom announcements, and web postings. Using the 10-item, self-report Questionnaire of Smoking Urges, Brief Version (Cox, Tiffany, & Christen, 2001), participants’ craving levels were assessed at baseline, following 2 minutes of in vivo cue-exposure, during a 2-minute imagery or distraction control intervention, and following the imagery or distraction control intervention. Participants showed significantly lower self-reported craving during the imagery conditions than during the distraction control condition. There was not a significant difference in the level of craving among the imagery conditions. Despite explicit instructions to focus on the designated form(s) of sensory imagery, a majority of participants in each of the imagery conditions reported experiencing additional forms of sensory imagery (e.g., auditory imagery). This finding suggests that it might be difficult for people to sustain uni-sensory images even over short periods of time. In general, participants’ vividness of imagery was not correlated with lower craving scores during the intervention. There was one exception; in the combined imagery condition, vividness of olfactory imagery was positively correlated with a decrease in self-reported craving. Notably,
in all conditions a “rebound effect” was observed in that craving increased shortly after the
imagery or distraction intervention had ended. Clinical implications for the elaborated intrusion
theory are discussed.
This dissertation is dedicated to my husband who is always there helping me turn my dreams into reality and to my mom who never tires of supporting me in all that I do.
ACKNOWLEDGMENTS

I would like to acknowledge and thank Dr. Harold Rosenberg for the countless hours he has served as my teacher, advisor, and mentor. I have learned a lot from Dr. Rosenberg which will make me a better researcher, clinician, and teacher, and which has already made me a better person. I would also like to recognize Dr. Rosenberg for his collaboration on this dissertation research. In addition, I would like to thank Dr. Anne Gordon, Dr. Steve Jex, and Dr. Leigh Chairelott who served on my dissertation committee and provided me with valuable suggestions that greatly improved this study.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>Theories of Craving</td>
<td>1</td>
</tr>
<tr>
<td>Drug Craving Research Bearing on EI Theory</td>
<td>6</td>
</tr>
<tr>
<td>Food Craving Research Bearing on EI Theory</td>
<td>10</td>
</tr>
<tr>
<td>Implications of EI Theory for My Research</td>
<td>15</td>
</tr>
<tr>
<td>METHOD</td>
<td>17</td>
</tr>
<tr>
<td>Participants</td>
<td>17</td>
</tr>
<tr>
<td>Measures</td>
<td>18</td>
</tr>
<tr>
<td>Procedure and Stimulus Materials</td>
<td>20</td>
</tr>
<tr>
<td>RESULTS</td>
<td>25</td>
</tr>
<tr>
<td>Hypotheses</td>
<td>25</td>
</tr>
<tr>
<td>Descriptive Statistics</td>
<td>25</td>
</tr>
<tr>
<td>Craving Analyses</td>
<td>26</td>
</tr>
<tr>
<td>Non-Instructed Imagery, Instructed Imagery and Vividness of Imagery</td>
<td>28</td>
</tr>
<tr>
<td>DISCUSSION</td>
<td>31</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>39</td>
</tr>
<tr>
<td>APPENDIX A. TABLES</td>
<td>42</td>
</tr>
<tr>
<td>APPENDIX B. MATERIALS</td>
<td>47</td>
</tr>
<tr>
<td>Table</td>
<td>Description</td>
</tr>
<tr>
<td>-------</td>
<td>-------------</td>
</tr>
<tr>
<td>1</td>
<td>Breakdown of Gender by Condition</td>
</tr>
<tr>
<td>2</td>
<td>Demographic and Smoking History Characteristics</td>
</tr>
<tr>
<td>3</td>
<td>Means and Standard Deviations of Craving Scores Across Time and Conditions</td>
</tr>
<tr>
<td>4</td>
<td>Means (and Standard Deviations) for Vividness Ratings of Instructed Imagery, Proportion of Participants Experiencing Additional Non-Instructed Imagery, and Vividness Ratings of Non-Instructed Imagery</td>
</tr>
</tbody>
</table>
### LIST OF MATERIALS

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Recruitment Email</td>
<td>47</td>
</tr>
<tr>
<td>2</td>
<td>Email to Interested Participants – Reminders of Eligibility Requirements &amp; Times Study is Being Conducted</td>
<td>48</td>
</tr>
<tr>
<td>3</td>
<td>Scheduling Email</td>
<td>49</td>
</tr>
<tr>
<td>4</td>
<td>QSU-Brief</td>
<td>50</td>
</tr>
<tr>
<td>5</td>
<td>Vividness Questionnaires</td>
<td>52</td>
</tr>
<tr>
<td>6</td>
<td>Demographic Questionnaire</td>
<td>55</td>
</tr>
<tr>
<td>7</td>
<td>Smoker-Modified Readiness to Change Questionnaire</td>
<td>57</td>
</tr>
<tr>
<td>8</td>
<td>Reminder Email</td>
<td>60</td>
</tr>
<tr>
<td>9</td>
<td>General Outline of Study</td>
<td>61</td>
</tr>
<tr>
<td>10</td>
<td>Debriefing Form</td>
<td>62</td>
</tr>
<tr>
<td>11</td>
<td>Olfactory Guided Imagery</td>
<td>63</td>
</tr>
<tr>
<td>12</td>
<td>Visual Guided Imagery</td>
<td>64</td>
</tr>
<tr>
<td>13</td>
<td>Combined Guided Imagery</td>
<td>65</td>
</tr>
</tbody>
</table>
Efficacy of Imagery and Distraction to Reduce Craving and Implications for the Elaborated Intrusion Theory

INTRODUCTION

Among researchers, there are a variety of ways to define and measure human craving for alcohol and drugs (Anton, 1999; Drobes & Thomas, 1999; Pickens & Johanson, 1992; Sayette et al., 2000). A narrow definition of craving might describe it as a subjective desire to take drugs that may lead to actual drug use, while broader definitions conceptualize it as a multidimensional phenomenon that consists of subjective, behavioral, physiological and neurochemical components (Mezinskis, Honos-Webb, Kropp, & Somoza, 2001). Despite the lack of agreement on what constitutes craving, many clinicians and researchers would at least agree that craving is experienced as an intense urge, desire, or need to drink or take drugs (Pickens & Johanson, 1992; Rohsenow & Monti, 1999).

Theories of Craving

Three major theoretical approaches have been employed to explain the phenomenon of craving: classical conditioning models, neuroadaptive models, and cognitive models. Classical conditioning models emphasize the repeated pairing of initially neutral stimuli (i.e., paraphernalia, drug taking environments, emotions) with drug intoxication or drug withdrawal—both of which comprise psychological and physiological reactions often subjectively experienced as craving (Anton, 1999; Litt & Cooney, 1999; Tiffany, 1999). After continued pairing of drug-related cues with intoxication or drug withdrawal, these previously neutral cues become conditioned stimuli that may elicit conditioned psychological and physiological reactions subjectively experienced as craving.
Robinson and Berridge (1993; 2003) proposed a neuroadaptive explanation of craving. Although rather complex in its full explanation, the key feature of Robinson and Berridge’s incentive-sensitization theory of addiction is that repeated drug use alters brain systems that mediate incentive-motivation such that relevant neural circuits become “hypersensitive” to drug stimuli and drug effects. Robinson and Berridge also acknowledge the importance of conditioned stimuli; in their theory, drug cues trigger activity in the sensitized neural systems resulting in exaggerated motivation for drugs (i.e., “wanting” or craving), which in turn leads to drug seeking, drug taking, and relapse. When exposure to conditioned stimuli triggers this “wanting” system, the individual seeks drugs, although not always with conscious recognition that one wants or craves the drug effects being sought.

Five variations of cognitive models have also been proposed to explain craving, including the cognitive labeling model, the outcome expectancy model, the dual-affect model, the cognitive processing model, and the elaborated intrusion theory (Kavanagh, Andrade, & May, 2005; Tiffany, 1999). Although each of these models recognizes the importance of classical conditioning to induce craving, and share a cognitive approach to the conceptualization of craving, they do not typically build upon each other or previously proposed cognitive models. The cognitive labeling model views craving as a cognitive interpretation of conditioned reactions. According to this model, when an individual is exposed to drug-related cues, he/she experiences physiological arousal. The individual may interpret and label this arousal as craving, especially if the arousal has occurred in the presence of drug-related cues.

The outcome expectancy model proposes that environmental cues elicit expectancies about the effects of drug taking. In this context, the term “expectancies” refers to the beliefs individuals hold regarding the psychological and physiological consequences that result from
consumption of a drug. For example, expectancies of alcohol consumption might include relaxation and decreased inhibition. Craving is experienced when these expectancies create a motivation to experience the anticipated positive effects of the drug or to relieve the anticipated uncomfortable effects of withdrawal.

The dual-affect model proposes two subtypes of craving: negative affect craving and positive affect craving (Baker, Morse, & Sherman, 1987; Tiffany, 1999). Negative affect craving is triggered by negative emotional states, aversive events, withdrawal, cues associated with previous withdrawal episodes, and obstruction of drug use. Negative affect craving results not only in the subjective experience of craving, but also in drug-seeking, negative affect, and withdrawal-like physiological responses. Positive affect craving is triggered by positive emotional states, consuming a small dose of the drug, cues associated with previous drug use, and information that the drug is available. Positive affect craving also results in the subjective experience of craving, as well as drug-seeking, positive affect, and physiological reactions similar to those that occur when the drug is consumed. These two craving subsystems are considered mutually inhibitory in that only one system (positive affect craving or negative affect craving) can be active at a time. Additionally, this model proposes that memory networks are stimulated when a person addicted to drugs encounters triggers that have previously provoked craving. The closer the match between the current trigger and previous triggers stored in memory, the stronger the craving is assumed to be. As the activation of these memory networks increases, drug craving and drug seeking are thought to increase.

The cognitive processing model explains craving as a nonautomatic process (Tiffany, 1999). According to this model, after a long history of drug taking, the actions involved in acquiring and consuming drugs become “automatized” in that they are controlled by cognitive
processes that operate quickly and effortlessly and require minimal attention. These “automatized” actions are triggered when drug-related cues are present. This model posits two conditions that lead to craving. In the first condition, the cognitive processes responsible for automatized behavior are triggered (e.g., an individual with drug addiction sees a drug dealer and tries to acquire drugs), but some type of barrier prevents the automatized behavior from occurring (e.g., he/she does not have money to pay for the drugs he/she wishes to acquire). In the second condition, craving occurs when the cognitive processes responsible for automatized behavior are triggered, but the individual purposely and consciously attempts to abstain from engaging in the automatized behavior. According to Tiffany’s model (1990), drug use may occur without conscious craving if drug-seeking is not obstructed by either environmental barriers or personal attempts to abstain from drug use.

In an attempt to integrate classical conditioning, emotional, and cognitive explanations of craving, Kavanagh, Andrade, and May (2005) proposed the elaborated intrusion (EI) theory of desire. Although developed to explain drug craving, Kavanagh, Andrade, and May maintain that EI theory is applicable to all human desires. EI theory defines craving as an emotionally charged, conscious desire to use a substance to induce pleasure or relieve discomfort. According to this theory, both internal and external cues may trigger intrusive thoughts about the desired substance through classical conditioning, or semantic or episodic recall. Cues include physiological deficits (e.g., a drop in nicotine levels in the body), negative affect (e.g., anxiety), external cues (e.g., the site or smell of a cigarette burning), anticipatory responses to the target (e.g., salivation), and desire-related cognition (e.g., knowledge of imminent consumption or instruction to imagine the substance). Intrusive thoughts are transitory and do not normally result in craving. However, when intrusive thoughts are followed by either powerful affective
reactions or an awareness of deficit (e.g., the drug is not readily available), elaboration of these thoughts may occur. Elaboration consumes cognitive resources to attend to internal and external information relevant to the intrusive thought, retain this information in working memory, and embellish the initial intrusive thought. Internal information might include expectancies about drug use, physiological states, or episodic memories (e.g., remembering where one previously obtained a drug). External information might include physical locations or persons from whom the drug might be obtained. Kavanagh, Andrade, and May proposed that sensory imagery is essential to elaboration because sensory images contain the relevant internal and external information required for elaboration of the intrusive thoughts.

If EI theory is supported empirically, it could have important implications for the treatment of substance abuse including cigarette smoking. According to the Center for Disease Control and Prevention (CDC, 2005), 22.5% of adult Americans smoke cigarettes, and cigarette smoking remains the leading preventable cause of death in the United States. Given that craving is associated with drug relapse, providing clients with practical strategies to combat cravings might help reduce the rate of relapse in clients with substance dependence (Tracy, 1994). For instance, if cognitive interventions (e.g., distraction, visual imagery) are shown to reduce drug craving, presumably by interfering with elaboration of intrusive thoughts, then clinicians treating substance abuse might train their clients to use such anti-elaboration interventions as a method of reducing craving. These interventions might provide a low cost, effective method to reduce craving (in addition or instead of pharmacological agents such as nicotine replacement and Zyban) and could result in larger proportions of individuals successfully quitting smoking.
Drug Craving Research Bearing on EI Theory

Because EI theory has been proposed only recently, few studies have attempted to test this theory. May, Andrade, Panabokke, and Kavanagh (2004) set out to pit Tiffany’s cognitive processing model against EI theory by assessing whether sensory imagery was essential for craving to occur as specified by their theory and to demonstrate similar strength and experience of craving across desired substances. Specifically, these researchers mailed a craving questionnaire to 1500 English university students and asked them to complete the questionnaire when they found themselves craving any one of the following items: food, tobacco, an alcoholic beverage, or a non-alcoholic beverage. Participants were asked to rate their overall craving on a 10-point scale, rate the degree to which they agreed with 10 written descriptions of craving episodes on a 5-point scale (e.g., having it would feel very comforting right now, I am imagining the taste of it, I am visualizing it), and rate the degree to which 12 potential triggers “caused” their craving on a 5-point scale (e.g., suddenly thought of it, felt happy, pictured myself having it).

Of their 353 respondents (response rate = 24%; 155 males, 201 females), 61% reported food cravings, 17% reported tobacco cravings, 16% reported non-alcoholic beverage cravings, and 6% reported alcoholic beverage cravings. Out of the 10 descriptions of craving episodes, participants rated the following three descriptions as most salient: “Having it would feel very comforting right now,” “I am imagining the taste of it,” and “If I don’t think about it, my craving will go away.” However, the strongest description was rated only 3.3 on a 5-point scale ranging from 1 = “not at all” to 5 = “definitely.”

Out of the 12 potential triggers, participants rated the following four triggers as most salient: transitory thoughts, feelings of discomfort (somatovisceral sensations), imagining the
smell or taste of the substance, and visualizing themselves having it. The trigger endorsed the strongest was rated only 3.2 on a 5-point scale ranging from 1 = “not at all” to 5 = “definitely.” The finding that triggers were endorsed only moderately might indicate that an aggregate of multiple triggers, rather than just one trigger, leads to craving. It also might suggest that participants have difficulty self-reporting the triggers that cause their craving.

This study provides support for EI theory given that participants reported craving following spontaneous images and somatovisceral sensations (congruent with the EI theory’s description of the initiation of intrusive thoughts). Furthermore, participants endorsed imagery as a trigger for craving (e.g., visual, olfactory, and gustatory imagery of the desired substance) and endorsed descriptions of visual and gustatory imagery when describing their craving episode. These findings are congruent with the central role EI theory gives to imagery in elaboration. It is also noteworthy that few individuals endorsed auditory imagery as either a trigger or as occurring during a craving episode. Thus, this finding might suggest that only some forms of imagery are associated with elaboration.

Although supportive of EI theory, the design of May et al.’s research precluded a true test of Tiffany’s cognitive model of craving. For example, a crucial aspect of Tiffany’s theory is that craving occurs when individuals are prevented from using their desired substance. May et al. (2004) failed to ask participants about environmental or psychological obstacles they encountered in using their desired substance, which is an essential component of Tiffany’s explanation for how craving occurs. Second, Tiffany’s model applies to craving by those who are addicted to drugs, but May et al. did not use a sample of individuals dependent on drugs.

A second study by this same research group (Panabokke, May, Eade, Andrade, & Kavanagh, 2005) tested EI theory by studying whether visual and auditory imagery unrelated to
smoking could be used to reduce craving in smokers. These researchers hypothesized that a visual imagery intervention would block mental images assumed to occur as a part of the elaboration process, and thereby reduce craving. Based on their previous study (May, Andrade, Panabokke, & Kavanagh, 2004) which found that auditory imagery was not reported as a trigger of craving, they predicted that craving intensity would be unaffected by auditory imagery.

In the first of two experiments, Panabokke et al. randomly assigned 40 English university student and staff smokers to deprived or non-deprived smoking conditions. Deprived smokers (smokers who had abstained from smoking for 14-18 hours) read a multi-sensory script about smoking that was designed to induce craving and non-deprived smokers (smokers who had not been asked to abstain from smoking) read a multi-sensory script about washing dishes (unrelated to smoking). These scripts were adapted from prior research (Tiffany & Hakenewerth, 1991) and had been matched for vividness and equal numbers of positive and negative affect descriptions. Notably, these researchers confounded smoking deprivation (independent variable) with type of multi-sensory script (e.g., passage inducing craving vs. passage about washing dishes), and they did not consider type of multi-sensory script as an independent variable in their analyses.

Participants then completed the Questionnaire on Smoking Urges (QSU; Tiffany & Drobes, 1991), a 30-item self-report measurement of craving. Next, participants in the deprived and non-deprived conditions were randomly assigned to either an auditory or visual mental imagery intervention in which they were asked to imagine 18 cues for 10 seconds each. The cues were identical across participants, although half of the deprived and non-deprived smokers were asked to use auditory imagery in imagining each cue while the other half of the deprived and non-deprived smokers were asked to use visual imagery in imagining each cue. Examples of
the imagery cues include the sound of a phone ringing or a game of tennis being played (see Baddeley & Andrade, 2000 for a complete list of cues). After each cue, the participants were asked to rate the vividness of the cued images. After each set of six cues, the participants completed the QSU.

Over the course of the 18 cues, ratings of vividness increased irrespective of the experimental condition (visual or auditory imagery). More importantly, the researchers found that the deprived smokers in the visual imagery condition reported lower craving levels following the visual imagery intervention compared to their craving levels after the craving induction. Deprived and non-deprived smokers in the auditory imagery condition did not show a similar reduction in craving as a result of the auditory imagery intervention. Unexpectedly, craving increased among non-deprived smokers in the visual imagery condition.

In the second experiment, these researchers recruited 40 Sri Lankan university student and staff smokers who were randomly assigned to either a deprived or a non-deprived condition (this time, deprivation consisted of a 2-hour deprivation period). The procedure was the same as the first experiment, except the researchers added an additional component to the imagery interventions. Specifically, they added a dynamic visual noise display to the auditory imagery condition (squares flickered in black and white on a computer screen in a random pattern) and a static visual noise display to the visual imagery condition (black and white squares remained in the same position on the computer screen). The researchers added these additional components because they hypothesized that a visual task (dynamic visual noise) paired with the auditory imagery would result in a reduction in craving (similar to the deprived visual imagery condition in the first experiment) by interfering with visual imagery necessary for elaboration.
In this second study, the researchers found that engaging in a visual task (either the visual imagery paired with static visual noise or the auditory imagery paired with dynamic visual noise display) resulted in reported decreases in craving following the craving induction among deprived smokers. There were no decreases in craving reported among the non-deprived smokers for either condition, which is not surprising given that participants had not been deprived of nicotine and had not read the multi-sensory smoking script designed to induce craving.

These researchers argued that distraction is ineffective by itself in reducing craving unless it includes a visual imagery component. However, without additional research to support this claim, it seems plausible that other distraction interventions besides auditory imagery or even other forms of auditory imagery that do not involve a visual imagery intervention might still lead to reductions in craving. Even more problematic is that these researchers confounded smoking deprivation with the type of multi-sensory script (i.e., smoking versus washing dishes). Only the deprived smokers read the multi-sensory smoking script intended to induce craving. Consequently, the results from the non-deprived participants who read a script about washing dishes are irrelevant for the purposes of my review.

*(Food Craving Research Bearing on EI Theory)*

Although differences likely exist in the psychology of someone experiencing a craving for a drug to which one is physically addicted versus someone experiencing a craving for food, Kavanagh et al. (2005) have argued for the applicability of EI theory to explain all human desires. Recent research examining food craving has supported EI theory. Specifically, Kemps, Tiggemann, Woods, and Soekov (2004) conducted two experiments to examine the efficacy of visuospatial tasks as a method for reducing food craving in dieting and non-dieting Australian,
female, undergraduate students. In the first study, 48 participants (24 dieting and 24 non-dieting) were presented with color photographs of six food items (e.g., chocolate, ice cream) and six neutral items (e.g., appliances, animals). Participants were presented with each photograph for 5 seconds and then were asked to retain the image for 8 seconds. For each photograph, participants rated the vividness of the image on a 100-mm visual analog scale (ranging from “no image at all” to “image perfectly clear – as vivid as normal vision”), and their food craving (ranging from “no desire or urge to eat” to “extremely strong desire or urge to eat”). Using a within-subjects design, participants were asked to simultaneously complete one of three visuospatial tasks or the control task during the 8-second retention period. Visual spatial tasks included an eye movement condition (participants moved their eyes to track a white square moving on the computer screen), a dynamic visual noise condition (participants watched black and white squares which flickered across the computer screen), and a spatial tapping condition (participants tapped at a rate of one tap per second in a square pattern). In the control condition, participants looked at a blank computer screen.

This study found no effect of dieting status on vividness ratings or craving levels. Overall, food images, as opposed to neutral images, resulted in higher vividness ratings and higher craving levels. During the visuospatial conditions (eye movement, dynamic visual noise, and spatial tapping), participants reported imagining the photographs less vividly than they did in the control condition, and participants reporting lower craving levels during the eye movement and dynamic visual noise conditions than during the control condition.

In the second experiment, Kemps, Tiggemann, Woods, and Soekov again studied food craving in 56 Australian, female, undergraduate students. Twenty-three participants were dieters and 23 were non-dieters. The procedure was identical to their first study, except the food and
neutral stimuli in this study were presented verbally rather than visually; thus, the procedure required participants to generate their own visual images.

Similarly to the first study, participants reported higher vividness ratings and higher craving levels for food images than neutral images irrespective of their dieting status, and again, participants imagined images more vividly in the control condition than they did in the visuospatial conditions. However, this second study found that participants reported lower craving levels during all three visuospatial conditions (eye movements, dynamic visual noise, and spatial tapping) compared to the control condition.

Taken together, these studies suggest that visual tasks (eye movements and dynamic visual noise) are effective methods of reducing food craving whether craving images are triggered visually or verbally. Furthermore, because a spatial task reduced craving when triggered by verbal cues, the mode in which food craving is triggered (visual versus verbal) might influence the degree to which an intervention will reduce food craving. Visual tasks (eye movements and dynamic visual noise) might have a more global effect on food craving irrespective of the type of trigger (e.g., visual or verbal), whereas spatial tasks (spatial tapping) may have a more specific effect for food craving induced verbally.

A surprising finding of this study was that dieting status did not induce higher levels of food craving among participants. According to EI theory, internal cues (e.g., physiological deficits) are associated with intrusive thoughts, which when elaborated, lead to craving. Although physiological deficits occur in individuals using psychoactive substances (e.g., a drop in nicotine level), there may not be a comparable physiological deficit that occurs in dieters. This might be because dieters are not abstaining completely from consuming food.
This same group of researchers conducted a study examining chocolate craving in 48 Australian, female, undergraduates (Kemps, Tiggemann, & Hart, 2005). Twenty-four participants self-identified as chocolate cravers and 24 as non-cravers. Participants were presented with 21 color pictures of chocolate foods. Similar to previous methodology, participants were asked to attend to the picture for 5 seconds and retain the image for 8 seconds while either looking at a blank computer screen (control condition), performing a concurrent visual noise task (watching black and white squares flicker randomly on a computer screen), or listening to irrelevant speech (listening to a woman read from a Dutch newspaper). Participants then rated their vividness of the image and their level of chocolate craving again using a 100mm visual analog scale similar to the one employed in their food craving study.

Overall, participants reported lower craving levels in the experimental conditions compared to the control condition, with craving levels being the lowest in the dynamic visual noise condition. Participants reported less vivid images during the irrelevant speech condition than during the control condition, but reported more vivid images during the irrelevant speech condition than during the dynamic visual noise condition. For chocolate cravers, vividness of images was positively correlated with craving levels, and chocolate cravers reported higher craving levels than non-cravers irrespective of the task condition.

This study supported EI theory in that visual and auditory tasks resulted in lower craving levels than did a control task. These results are congruent with EI theory’s proposal that as cognitive resources are diverted from elaboration (e.g., sensory imagery that embellishes intrusive thoughts are diverted to complete a competing imagery task), craving is less likely to occur.
A third study by this group of researchers (Harvey, Kemps, & Tiggemann, 2005) applied the methodology used in the experiment by Panabokke, May, Eade, Andrade, and Kavanagh (2005) to study food craving. These researchers hypothesized that mental imagery involved in food craving is predominantly visual in nature. One hundred twenty, Australian, female undergraduates (60 dieters and 60 non-dieters) were randomly assigned to imagine either a food induction scenario (asked to imagine eating their favorite food) or a holiday induction scenario (asked to imagine being on their favorite holiday/break). These scripts were adapted from prior research (Green, Rogers, & Elliman, 2000) and had been matched for vividness. Participants rated their food craving intensity on a 100-mm visual analogue scale. Then, replicating Panabokke et al.’s methodology, participants were assigned to imagine either 18 visual cues or 18 auditory cues (equal numbers of dieters and non-dieters were assigned to these two conditions). Participants were asked to maintain each image for 10 seconds and then rate the vividness of the image on the 100-mm visual analog scale. After each set of six cues, participants again rated the intensity of their food craving.

In the food induction condition, ratings of vividness increased over the course of the 18 cues, and participants in the visual imagery condition reported lower levels of craving than did participants in the auditory imagery condition. There were no significant results for participants in the holiday induction condition.

These researchers concluded that visual tasks are superior to auditory imagery tasks in reducing food craving. However, a potentially meaningful discrepancy in craving levels may have existed prior to the implementation of the imagery tasks. Following the food induction scenario and prior to the imagery tasks, participants in the visual imagery condition had a mean craving level of 58.5 on a 100-point scale as compared to participants in the auditory imagery
condition who had a mean craving level of only 39.2. Because the researchers neglected to report whether this was a significant difference in pre-imagery craving, it is possible that individuals in the visual imagery condition were more likely to experience a decrease in their craving level because their pre-imagery craving level was already so high.

**Implications of EI Theory for My Research**

As noted above, Panabokke, May, Eade, Andrade, and Kavanagh (2005) and Harvey, Kemps, and Tiggemann (2005) have argued for the superiority of visual imagery over other forms of sensory imagery to interrupt elaboration and reduce craving. This may be difficult to test, however, as it may be difficult if not impossible to focus on visual images without another form of sensory imagery co-occurring. For instance, it is difficult to imagine the sight of a bell ringing without also imagining the sound. In regards to smoking, it might be difficult for smokers to imagine the sight of a cigarette burning without imagining the smell of the cigarette smoke, the feel of the cigarette in their hand, and the taste of the cigarette in their mouth. Therefore, past research studying EI theory might have erroneously presumed that uni-sensory visual imagery reduced craving when the combination of visual imagery and other sensory imagery might have reduced craving.

Based on predictions derived from EI theory and previous research, and the clinical importance of developing practical strategies for clients to use in reducing cravings, my dissertation research tested the effectiveness of selected cognitive interventions in reducing craving. Specifically, I tested the comparative impact of distraction (serial sevens) and several forms of imagery (visual, olfactory, and a combination of visual and olfactory) to reduce craving in deprived smokers. In accordance with EI theory, I hypothesized that both the cognitive distraction intervention and imagery interventions would reduce craving because cognitive
resources would be used to perform the mental intervention leaving fewer cognitive resources available for elaboration. However, I hypothesized that sensory imagery would produce a larger reduction in craving compared to distraction because of the essential role sensory imagery is presumed to play in elaborating intrusive thoughts.

Although it is inconsistent with the traditional practice of predicting the rejection of the null hypothesis, and with previous studies arguing for the superiority of visual imagery over other forms of imagery (Panabokke, May, Eade, Andrade, & Kavanagh, 2005; Harvey, Kemps, & Tiggemann, 2005), I predicted that olfactory imagery would be as effective as visual imagery in reducing craving. I further predicted there would be no difference between the uni-sensory imagery conditions (olfactory imagery and visual imagery) versus the bi-sensory imagery condition (combined olfactory and visual imagery). These predictions were based on my belief that it may be difficult or impossible for participants to focus on only one form of imagery (e.g., olfactory) without another form of sensory imagery (e.g., visual) co-occurring. Thus, despite explicit instructions to focus on only one or two instructed forms of sensory imagery in each condition, I predicted all three imagery conditions would be equally effective in reducing craving because participants would incorporate additional forms of sensory imagery into the uni-sensory or bi-sensory imagery task.

Finally, I predicted that the more vividly participants were able to imagine the sensory imagery cues, the lower their levels of craving would be. This prediction was consistent with EI theory, because as more cognitive resources are used to evoke vivid images, fewer cognitive resources should be available for elaboration to occur.
METHOD

Participants

Following approval to conduct this study by the Bowling Green State University Human Subjects Review Board, I notified undergraduate students attending Bowling Green State University in the spring of 2005 of this research opportunity via email (a random subset of approximately 5000 female and 3000 male undergraduates were contacted by email; see Appendix B, Item 1), announcements made in general psychology classrooms, and/or an internet posting on the Psychology Department’s experimetrix website. Students were eligible for participation if they had smoked at least one pack of cigarettes a day for the past 3 to 6 months and agreed to abstain from smoking cigarettes 6 hours prior to the time they participated. As compensation for their participation, participants were paid (undergraduates not enrolled in general psychology received $10 and undergraduates enrolled in general psychology received $9 plus course credit).

A total of 140 students responded by email indicating their interest to participate in this study. One hundred nineteen of these students were sent a reply email (see Appendix B, Items 2 and 3), reminding them of the eligibility requirements and providing a list of times at which the study was being conducted. These participants were asked to respond with their availability to participate at the times the study was being conducted. The remaining 21 students who were interested in participating were sent an email informing them that the maximum number of participants already had been recruited.

Of the 119 students asked to respond with the times they could participate in the study, 21 did not reply to this email, 19 replied that they were unable to participate during the times when the study was being conducted, and 4 replied that they did not meet the eligibility
requirements. The remaining 75 undergraduate students were scheduled to participate in the study. Eleven of these students subsequently cancelled or did not attend their appointment. All of the remaining 64 potential participants who began the study completed it in its entirety.

Measures

The 10-item version of the Questionnaire of Smoking Urges (QSU-Brief; Cox, Tiffany, & Christen, 2001) was used to assess craving (see Appendix B, Item 4). The QSU-Brief uses a 7-point scale with anchors ranging from “strongly disagree” to “strongly agree.” The scores for each item are summed to arrive at an overall craving score. Higher scores on the QSU-Brief correspond to higher levels of craving. This measure is completed in less than 2 minutes and has excellent internal consistency in both clinical and laboratory studies (Cronbach’s alpha = 0.97). Furthermore, Shadel, Niaura, and Abrams (2001) found that the act of completing the QSU-Brief was not associated with increases in self-reported craving on a verbal craving assessment which asked participants, “On a scale from 0 to 100, where 0 is ‘no craving at all’ and 100 is an ‘extremely strong craving’ how strong is your craving to smoke right now?” (p.266). Because I administered the QSU-Brief several times to each participant, the order of the items was varied randomly on each administration to control for boredom and response set.

I used the standard instructions for the instrument when the QSU-Brief was administered to participants when they entered the lab (Baseline), following cue-exposure (Post-Induction), and following the intervention (Post-Intervention). That is, participants were asked to rate craving statements based on “…how you are thinking and feeling right now as you are filling out the questionnaire.” However, to assess craving during the imagery or distraction control interventions (Intervention Craving), the directions asked participants to rate craving statements based on “…how you were thinking and feeling just before you finished the [imagery/counting]
exercise.” This change allowed me to assess craving during the interventions, even though the questionnaire was administered after the intervention had been completed.

A self-report vividness questionnaire based on research by Baddley and Andrade (2000) and Panabokke et al. (2005) was used to assess participants’ vividness of imagery in the olfactory, visual, and combined imagery conditions (see Appendix B, Item 5). For example, after participants were instructed to imagine the visual sights associated with a beach, they were asked to “Rate the vividness or realness of your imagery for imagining what the beach looked like” on a 7-point scale ranging from “I was not at all able to imagine the sight” to “I was able to imagine the sight as clear and vivid as real life.” Participants also were asked about their experience of additional forms of sensory imagery. For example, in the visual imagery condition participants were asked whether they also imagined olfactory or auditory images during the 2-minute intervention task. Participants in the distraction control condition were not administered a vividness questionnaire, but they were asked whether or not they had visualized numbers during the counting exercise.

A demographic questionnaire (see Appendix B, Item 6) and a Smoker–Modified Readiness to Change Questionnaire (see Appendix B, Item 7; Rollnick, Heather, Gold, & 1992) were administered to assess the participant’s age, sex, ethnicity, length of time they had been smoking at least one pack of cigarettes per day, the average number of cigarettes they smoked per day, the number of times they had tried to quit smoking, and their motivation to quit smoking. Participants were instructed to abstain from smoking for at least 6 hours before their appointment, and I asked participants on the anonymous demographic questionnaire when they smoked their last cigarette as a subtle way to verify whether they had followed this instruction.
Procedure and Stimulus Materials

Participants were sent a reminder email approximately 24 hours before their scheduled appointment (see Appendix B, Item 8). This email reminded participants of their appointment and instructed them to abstain from smoking for at least 6 hours prior to their scheduled appointment (all appointments were in the morning to minimize participants’ discomfort in abstaining from smoking during the day) and to bring a pack of their own cigarettes with them to the appointment. Once they arrived to their appointment, participants were asked verbally if they met the eligibility requirements (i.e., smoked at least a pack a day for the past 3 months) and if they had abstained from smoking for at least 6 hours. All participants reported meeting the eligibility requirements and successfully abstaining for this period of time. Twenty-six percent had abstained for 6 to 8 hours, 46% for 8.5 to 10 hours, 20% for 10.5 to 12 hours, and 7% for 12.5 to 22 hours. Notably, Intervention Craving levels were not correlated with the length of time participants had abstained from smoking prior to their participation in the study.

Once informed consent was obtained, participants were asked to complete the QSU-Brief to obtain a baseline measure of craving (see Appendix B, Item 9 for an outline of the procedure). Next, participants went into an adjacent room where they underwent 2 minutes of in vivo exposure to a real cigarette and cigarette smoke. This separate room was used for the cue-exposure to ensure that participants were not exposed to cigarette smoke or other room-related cues while completing the questionnaires and the interventions.

To induce craving using in vivo exposure, participants were asked to remove a cigarette from their own pack and attend to the sensations associated with seeing, holding, and smelling the unlit cigarette for 30 seconds. The researcher then lit the cigarette and set it in an ashtray in front of the participant for 90 seconds. During the time period during which the cigarette was
burning, participants were asked to focus on the sight and the smell of the burning cigarette as well as to imagine what the cigarette would taste like if they could smoke it. This duration of cue-exposure was chosen based on previous research that used a similar time frame (Maude-Griffin & Tiffany, 1996; Drobes & Tiffany, 1997) and pilot testing which found that 2 minutes was an adequate time frame to provoke craving without creating boredom.

Following the in vivo exposure, participants were escorted back to the first room where they completed the QSU-Brief (Post-Induction Craving). Then participants were assigned quasi-randomly to one of four conditions with the constraint that approximately equal numbers of males and females were assigned to each condition (no significant differences were found for gender on craving levels or vividness of imagery). The four conditions were: distraction control, olfactory imagery, visual imagery, or a combination of olfactory and visual imagery. I had initially planned to assign an equal proportion of low cravers (score of less than 35 on the QSU-Brief at Post-Induction) and high cravers (score of 35 or more on the QSU-Brief at Post-Induction) to the four different conditions, but all participants scored as high cravers (mean score of 55 (SD = 9) on a scale that ranges from 10 to 70).

I read the following instructions to participants in the **Distraction Control Condition**:

“For the next 2 minutes, in your head, count down by 7s from the number 500. For example, you should count to yourself, 500, 493, 486, etcetera. If you reach 0 before I tell you to stop, start again from 500 and count down by 8s. It is really important that you follow these instructions and continue to count until I tell you to stop. If at any point during the next 2 minutes you find that you start thinking about something else, I want you to try to refocus your attention back to counting down by sevens. Keep going, even if you make a mistake. Ready?”

Once the participants verbally stated they were ready, they were told to start and timing began.
After 2 minutes of counting, participants were asked to complete the Intervention Craving QSU-Brief questionnaire and the Post-Intervention Craving QSU-Brief questionnaire. Participants also responded to a written question asking them if they had visualized the numbers during the counting exercise and completed a demographic questionnaire including a Smoker–Modified Readiness to Change Questionnaire. Last of all, participants were debriefed (see Appendix B, Item 10), paid, and thanked for their participation.

Participants in the **Olfactory Imagery Condition** were led through guided imagery that instructed them to focus on the *smells* associated with a beach (see Appendix B, Item 11). At the beginning of the guided imagery, participants in the olfactory imagery condition were told, “For the next 2 minutes, I am going to have you listen to an audiotape in which you will be asked to imagine the smells associated with a beach. For this exercise, I want you to sit in a relaxed position and close your eyes. It is really important that you follow these instructions and try as hard as you can to imagine the smells associated with a beach. If at any point during the next 2 minutes you find that you start thinking about something else or you start to focus on other aspects of beach, for instance, thinking about what the beach looks like or sounds associated with the beach, I want you to try to refocus your attention to smells associated with the beach. Ready?” Once the participants verbally stated they were ready, the 2-minute audiotape containing the olfactory imagery script was played. After the script was completed, participants were asked to complete the Intervention Craving QSU-Brief questionnaire. Next, I administered the Post-Intervention Craving QSU-Brief questionnaire and the vividness questionnaire asking about the vividness of the imagery and the presence of olfactory and auditory imagery during the exercise. Participants then completed the demographic questionnaire including the Smoker–
Modified Readiness to Change Questionnaire. Last of all, participants were debriefed, paid, and thanked for their participation.

Participants in the **Visual Imagery Condition** were led through guided imagery that instructed them to focus on the *sights* associated with a beach (see Appendix B, Item 12). At the beginning of the guided imagery they were told, “For the next 2 minutes, I am going to have you listen to an audiotape in which you will be asked to imagine the sights associated with a beach. For this exercise, I want you to sit in a relaxed position and close your eyes. It is really important that you follow these instructions and try as hard as you can to imagine the sights associated with a beach. If at any point during the next 2 minutes you find that you start thinking about something else or you start to focus on other aspects of the beach, for instance, thinking about what the beach smells like or sounds associated with the beach, I want you to try to refocus your attention to the sight of the beach. Ready?” Once the participants verbally stated that they were ready, the 2-minute audiotape containing the visual imagery script was played. After the script was completed, participants were asked to complete the Intervention Craving QSU-Brief questionnaire. Next, I administered the Post-Intervention Craving QSU-Brief questionnaire and the vividness questionnaire asking about the vividness of the imagery and the presence of olfactory and auditory imagery during the exercise. Participants then completed the demographic questionnaire including the Smoker–Modified Readiness to Change Questionnaire. Last of all, participants were debriefed, paid, and thanked for their participation.

Participants in the **Combination Olfactory and Visual Imagery** condition were led through guided imagery that instructed them to focus on both the *sights* and *smells* associated with a beach (see Appendix B, Item 13). At the beginning of the guided imagery they were told, “For the next 2 minutes, I am going to have you listen to an audiotape in which you will be asked
to imagine the sights and smells associated with a beach. For this exercise, I want you to sit in a relaxed position and close your eyes. It is really important that you follow these instructions and try as hard as you can to imagine the sights and smells associated with a beach. If at any point during the next 2 minutes you find that you start thinking about something else or you start to focus on other aspects of the beach, for instance, thinking about sounds associated with the beach, I want you to try to refocus your attention to the sights and smells associated with the beach. Ready?” Once the participants verbally stated that they were ready, the 2-minute audiotape containing the visual imagery script was played. After the script was completed, participants were asked to complete the Intervention Craving QSU-Brief questionnaire. Next, I administered the Post-Intervention Craving QSU-Brief questionnaire and the vividness questionnaire asking about the vividness of the imagery and the presence of olfactory and auditory imagery during the exercise. Participants then completed the demographic questionnaire including the Smoker–Modified Readiness to Change Questionnaire. Last of all, participants were debriefed, paid, and thanked for their participation.
RESULTS

Hypotheses

I proposed four key hypotheses: (1) the distraction and imagery interventions would reduce craving, (2) the olfactory, visual, and combined imagery interventions would reduce craving significantly more than a distraction control intervention, (3) the three imagery conditions would be equally effective in reducing craving because participants would experience additional forms of sensory imagery into the uni-sensory and bi-sensory imagery interventions, and (4) greater vividness of instructed imagery (i.e., sensory imagery participants were instructed to imagine in their assigned condition) would be associated with lower levels of Intervention Craving.

Descriptive Statistics

Sixty four university students who had smoked at least a pack a day for the past 3 to 6 months participated in a study testing the comparative impact of distraction versus three imagery interventions on cue-induced craving (olfactory, visual, combination of olfactory and visual). Data from 2 participants were excluded because participants failed to follow procedural instructions. Although all participants were informed of the eligibility requirements for participation prior to volunteering for and completing the study, 8 additional participants who initially reported meeting these requirements were later excluded based on their written responses to demographic background questions in which they indicated smoking less than a pack a day and/or not smoking at least a pack a day for the past 3 to 6 months. Notably, the key findings (i.e., observed differences on craving analyses between experimental and control conditions) did not differ when these 8 participants were included in the analyses.
The remaining 54 participants included 27 females, 26 males, and one person who did not report his/her gender (see Table 1 for a breakdown of participant gender by condition). All but two of the participants self-identified as European/White, one self-identified as Black/African American, and one self-identified as Asian/Pacific Islander. Seventy-one percent were between the ages of 18 to 21 and 29% were 22 to 26 years old. On average, participants first started smoking at age 15. Eighty-five percent of participants smoked one pack of cigarettes per day, indicating that most participants were “regular smokers,” and 15% smoked more than one pack but less than two packs per day, indicating that a smaller subset of participants were “heavy smokers.” Thirty-two percent had been smoking at least a pack a day for 3 months to 1 year, 45% had been smoking at least a pack a day for 1 to 3 years, and 24% had been smoking at least a pack a day for 3 or more years. Although 66% of participants felt their smoking was either somewhat or completely under their control, 93% of participants reported that quitting smoking in the next month would be somewhat or very difficult. On average, participants had attempted to quit smoking on three prior occasions, indicating participants met at least one of the criteria (i.e., failed attempts to quit smoking) for nicotine dependence. Additional demographic information is included in Table 2.

**Craving Analyses**

To assess whether participants in the four conditions had similar levels of craving prior to implementing the cognitive interventions, I employed oneway ANOVAs to examine Baseline Craving and Post-Induction Craving. Baseline Craving was not significantly different among the conditions \[F(3, 50) = 0.7, p=.54\], indicating that participants in each of the four conditions began the experiment with similar levels of craving (means ranged from 44 to 49 on the QSU-Brief). As intended, cue-exposure significantly increased craving from Baseline to Post-
Induction (means ranged from 53 to 57 on the QSU-Brief) \( t(53) = -9.7, p = .00 \); as importantly, there was no significant difference among the conditions in Post-Induction Craving \[ F(3,50) = 0.4, p = .73 \]. Together, these findings indicated that any differences among conditions for Intervention Craving and Post-Intervention Craving resulted from the intervention rather than any differences in pre-intervention craving between the conditions.

I employed a oneway ANOVA to test my hypotheses regarding the effects of the type of cognitive intervention (distraction and three imagery conditions) on self-reported craving. There was a statistically significant effect of condition on Intervention Craving, with Post-Induction Craving entered as a covariate \[ F(3, 49) = 4.8, p < .01 \]. As Table 3 reveals, LSD pairwise comparisons revealed that participants in the olfactory imagery condition (M=36.87), visual imagery condition (M=36.31), and combined imagery condition (M=36.85) had significantly lower Intervention Craving (all \( p \)’s < .02) than did participants in the distraction control condition (M=50.23). Furthermore, Intervention Craving was not statistically different among the three imagery conditions. This finding provides support for my hypothesis that sensory imagery conditions would result in a greater reduction in craving compared to the distraction control condition.

I did not make any specific hypotheses about a rebound effect, defined as the degree to which craving scores increased after the distraction and imagery interventions were discontinued. However, to ascertain whether Intervention Craving was statistically different than Post-Induction Craving within each condition, I conducted four paired \( t \) tests. In all four conditions, participants reported significantly higher levels of Post-Intervention Craving compared to Intervention Craving (\( t \) scores ranging from -2.8 to -4.6, all \( p \)’s ≤ .02)
To ascertain whether the interventions had short-term, residual effects on craving levels, I conducted four paired t tests comparing craving levels following the intervention (Post-Intervention Craving) with craving levels immediately following cue-exposure (Post-Induction Craving). In the distraction control condition, participants reported significantly higher levels of Post-Intervention Craving than Post-Induction Craving (t(12) = -2.2, p < .05), indicating that craving was even higher for these participants after completing the counting exercise than it had been following cue-exposure. In each of the three imagery conditions, Post-Intervention Craving was lower than Post-Induction Craving (t scores ranging from 2.9 to 4.0, all p’s ≤ .01) indicating that imagery had short-term residual effects on the reduction of craving.

Non-Instructed Imagery, Instructed Imagery, and Vividness of Imagery

To determine the number of participants who visualized the numbers during the distraction control condition, I performed a frequency count. In the distraction control condition, 46% of participants reported visualizing the numbers during the serial sevens counting task. To assess whether visualizing or not visualizing numbers during the counting intervention was related to Intervention Craving, I conducted a partial correlation between Intervention Craving and visualization of numbers controlling for Post-Induction Craving assessed. This correlation was not significant (r(10) = .23, p = .23).

I employed a one-way ANOVA to examine differences in vividness among the three imagery conditions and descriptive statistics to examine participants’ mean vividness ratings for instructed imagery, the frequency with which participants experienced additional forms of sensory imagery, and the mean vividness ratings for the additional forms of sensory imagery (see Table 4). There was no significant difference among the three imagery conditions (F(2, 37) = .988, ns). In the olfactory imagery condition, participants reported a mean vividness rating for
olfactory imagery of 4.6 (scale ranging from 0 = “I was not at all able to imagine the sight” to 7 = “I was able to imagine the sight as clear and vivid as real life”). To assess whether participants complied with the uni-sensory instructions to focus on only olfactory stimuli, participants were asked about the presence of additional forms of sensory imagery. Eleven of the 15 participants in this condition reported experiencing visual imagery. The mean vividness rating for visual imagery for these 11 participants was 4.6. Nine of the 15 participants in this condition also reported experiencing auditory imagery, with a mean vividness rating of 4.3.

In the visual imagery condition, participants reported a mean vividness rating for visual imagery of 5.2. To assess whether participants complied with the uni-sensory instructions to focus on only visual stimuli, participants were asked about the presence of additional forms of sensory imagery. Only 1 of the 13 participants in this condition reported also experiencing olfactory imagery (vividness rating of 5.0). However, 8 of the 13 participants reported experiencing auditory imagery, with a mean vividness rating of 4.5.

In the combined imagery condition, participants reported a mean vividness rating of 3.8 for olfactory imagery and 5.3 for visual imagery. To assess whether participants reported higher levels of vividness for one type of instructed imagery in this combined imagery condition, I performed a paired t test and found that participants reported higher levels of vividness for visual imagery than olfactory imagery ($t(12) = 5.3, p = .00$). To assess whether participants complied with the bi-sensory instructions to focus only on olfactory and visual stimuli, participants were asked about the presence of auditory imagery. Twelve of the 13 participants in this condition also reported experiencing auditory imagery, with a mean vividness rating of 4.6.

To test my hypothesis that vividness of instructed imagery would be negatively associated with Intervention Craving within each condition, I performed a series of partial
correlations between Intervention Craving and olfactory, auditory, and visual imagery vividness scores controlling for Post-Induction Craving. Contrary to my prediction, the correlations were not significant in the olfactory imagery condition and the visual imagery condition. In the combined condition, the correlation was not significant for visual imagery. However, the partial correlation between vividness ratings of olfactory imagery and Intervention Craving was significant \((r(9) = -0.64, p < .02)\), indicating that individuals who experienced greater vividness of olfactory imagery in the combined imagery condition reported lower Intervention Craving.
DISCUSSION

Fifty-four college student smokers who met eligibility requirements participated in a study examining the comparative impact of three imagery interventions and one distraction control intervention on self-reported craving. Participants reported lower levels of Intervention Craving than Post-Induction Craving in all four conditions, and Intervention Craving was lower in the three imagery conditions compared to the distraction control condition. Although craving levels rebounded once the imagery interventions ended, assessments of Post-Intervention Craving revealed short-term residual effects of the imagery interventions in that those craving levels were still lower than Post-Induction craving levels. In the distraction control condition, Post-Intervention Craving rebounded to a level that was higher than Post-Induction Craving.

This study also examined participants’ ratings of vividness for the images in the imagery conditions and the frequency with which participants imagined additional non-instructed forms of sensory imagery (e.g., auditory imagery during the olfactory condition). On average, participants in the three different imagery conditions reported at least a moderate degree of vividness for the instructed imagery cues. However, vividness for imagery tended to be unrelated to the level of Intervention Craving, except for olfactory imagery in the combined imagery condition. Further, most participants reported imagining additional forms of sensory imagery other than the instructed imagery they were told to imagine.

Overall, this study supports EI theory’s proposal that cognitive interventions (especially sensory imagery interventions) effectively reduce craving. EI theory explains this reduction in craving as the outcome of engaging in cognitive tasks that interrupt the elaboration process. All four of the cognitive tasks in my study resulted in this reduction in craving and, in fact, the three sensory imagery tasks were more effective than the distraction control task in reducing craving.
Although some researchers have argued that visual imagery is more effective in reducing craving than other forms of imagery (Panabokke, May, Eade, Andrade, and Kavanagh, 2005; Harvey, Kemps, and Tiggemann, 2005), I hypothesized there would be no difference among the imagery conditions. This hypothesis was based on my belief that many participants would have difficulty imagining uni-sensory or bi-sensory imagery and would instead engage in multi-sensory imagery. Consistent with my hypothesis, I found no significant difference in Intervention Craving between the visual imagery condition and the other two conditions (olfactory imagery condition and combination olfactory and visual imagery condition). It is noteworthy that this lack of statistical difference among the three imagery conditions is not a result of a large test statistic with an insufficient sample size; in fact, the Intervention Craving means differ by a fraction and even an infinite number of degrees of freedom would not yield a statistically significant result. Additionally, participants in my study tended to incorporate additional forms of sensory imagery into the uni-sensory and bi-sensory imagery interventions. Thus, the results from this study call into question whether a “true” test of uni-sensory visual imagery can be performed allowing researchers to test one form of sensory imagery against another.

Although EI theory does not explicitly predict the long-term effectiveness of cognitive interventions in reducing craving levels or the likelihood that a rebound effect will occur upon completion of the intervention, the theory does predict that elaboration is more likely to occur when individuals experience a strong sense of deprivation and a strong desire to smoke. Because my participants had deprived themselves of nicotine for at least 6 hours and had undergone cue-exposure just minutes before the cognitive interventions, the 2-minute cognitive interventions probably lacked the power to continue disrupting elaboration after the intervention had been
terminated. Future research might explore whether longer durations of imagery reduce craving for longer periods of time after the interventions have ended.

Despite the finding that craving levels rebounded upon completion of the cognitive task, Post-Intervention Craving was still significantly lower (between 11-15% lower) than Post-Induction Craving in the imagery conditions, suggesting a short-term residual effect of the imagery interventions on craving. The distraction control condition resulted in a rebound in which Post-Intervention Craving was significantly higher than Post-Induction Craving. However, it is noteworthy that this statistically significant finding may have less clinical significance because the increase was only 5%.

Based on EI theory’s proposition that vividness of elaboration imagery should be positively related to craving level, I hypothesized that vividness of intervention imagery would be negatively correlated with Intervention Craving levels. In general, higher vividness ratings were not related to lower Intervention Craving levels. This finding may be explained, in part, by the lack of variability in participants’ vividness ratings. Participants’ mean vividness ratings for olfactory, visual, and auditory imagery clustered between 4.3 and 5.0 on a 7-point scale, and the standard deviations ranged from 0 to 1.6.

Although not initially intended as a manipulation check, the frequency with which participants reported that they could not imagine or could only barely imagine the sights or smells as instructed serves as a check on the degree to which they followed the instructions. Only 1 participant in the olfactory condition reported being unable to imagine the instructed imagery (self-rating of 0 on the 7-point scale which ranged from 0 = “not at all able to imagine …” to 7 = “able to imagine as clear and vivid as real life …”) and two participants in the combined olfactory and visual imagery condition reported difficulty imagining the olfactory
imagery (self-ratings of 1 on the same 7-point scale). Thus, the vast majority of participants apparently complied with the instructions in the imagery conditions.

An exception to the general finding that vividness was unrelated to Intervention Craving occurred in the combined condition. Vividness of the olfactory imagery was positively correlated with Intervention Craving. This finding is especially interesting because participants in this condition reported lower levels of vividness for olfactory imagery, on average, compared to visual imagery. Future research should investigate how imagery eliciting varying degrees of vividness might differentially impact self-reported craving, and whether teaching individuals to imagine olfactory imagery more vividly in conjunction with visual imagery results in lower Intervention Craving.

This study improved upon previous research by employing in vivo cue-exposure to induce craving rather than imaginal exposure. Cue-exposure has the advantage of being more ecologically valid because it more closely resembles the external cues that trigger cigarette craving in smokers’ daily lives. My research also examined the effects of previously unexamined forms of sensory imagery on craving—that is, olfactory imagery and a combination of olfactory and visual imagery. Lastly, this study included a distraction control condition to test the possibility that reductions in craving resulted merely from utilizing cognitive resources.

Although other distraction tasks could have used in this study, I chose the serial sevens task based on the ease of administration and the reputability of this procedure as an attentional task. A potential disadvantage of using the serial sevens task is the possibility for some participants to feel anxious while completing the task. Anxiety on similar cognitive tasks previously has been associated with an increase in self-reported craving (Kavanagh, Andrade, & May, 2005). This potential problem seems less likely to have affected my results because of the
manner in which the serial sevens task was conducted. Specifically, participants were asked to
silently count to themselves rather than to count aloud. This procedural instruction probably
reduced the likelihood that participants felt anxious in regards to external evaluation of their
accuracy or speed of counting. Furthermore, because participants in the distraction control
condition had lower Intervention Craving than Post-Induction Craving (rather than higher or
equivalent Intervention Craving compared to Post-Induction Craving), it seems unlikely that
anxiety was a significant factor influencing this result.

Another potential limitation of this study was that only one stimulus (a beach setting) was
used in the imagery conditions. It is possible that the use of different stimuli would have been
more or less likely to elicit uni-sensory imagery or would have resulted in higher or lower
vividness ratings. Different stimuli also might have had different effects on Intervention
Craving. For example, imagining the smell of coffee might increase Intervention Craving
because of the association smokers might make between drinking coffee and smoking a cigarette.
Furthermore, instructions to focus on alternative forms of imagery (e.g., auditory, tactile) for the
imagery stimulus might have had a different effect on craving levels or might have been more
likely to elicit uni-sensory imagery, rather than multi-sensory imagery.

Another limitation is that only one experimenter interacted with participants during the
course of the study. It is possible that participants might have reported different levels of craving
if another experimenter had induced the craving or conducted the cognitive interventions.
Experimenter characteristics such as nonverbal behavior, voice quality, and physical appearance
could have influenced the results obtained in this study.

This study recruited primarily Caucasian, college student smokers who smoked at least a
pack a day for the past 3 to 6 months. I chose to conduct this study with a college student sample
largely because of the ease with which this sample could be recruited using email announcements sent to university email accounts. The use of college student smokers in this study might limit the generalizability of these results to other populations of smokers. For example, a community sample of smokers is likely to include participants with longer smoking histories and more severe dependence on nicotine due to the inclusion of middle age and older age adults. Thus, elaboration of craving might be more difficult to interrupt in a community sample compared to a college student sample.

Although I did not administer a test of nicotine dependence to my participants, I was able to assess the relationship between craving and two background characteristics indicative of dependence. Partial correlations between Intervention Craving and those background characteristics (controlling for Post-Induction Craving) revealed that lower levels of Intervention Craving were associated with longer histories of smoking a pack a day ($r = -.30$, $p = .03$) and perceiving oneself as having less control over one’s use of cigarettes ($r = .28$, $p = .05$). Thus, future research might explore whether anti-elaboration interventions are actually more effective for those individuals who have a greater severity of nicotine dependence.

Lastly, it is important to note that this study focused on participants’ self-report of craving as measured by the QSU-Brief. Self-report is a correlate of the construct of craving rather than a direct measure of craving, and may be subject to demand characteristics. However, because participants in the imagery conditions reported lower Intervention Craving than did participants in the distraction condition, it seems more likely that the type of intervention rather than demand characteristics accounted for the decrease in self-reported craving. Although other assessments of craving could have been employed (e.g., autonomic physiological activity or
behavioral responses), these assessments are also limited in that they assess correlates of craving. At this time, a direct assessment of craving does not exist.

My findings have important clinical implications. Deprived smokers were experiencing a moderate level of craving when they arrived for the study (mean Baseline Craving for each condition ranged from 44 to 49 on the QSU-Brief; the QSU-Brief ranges from 10-70). However, following cue-exposure, craving levels in all four conditions increased an average of 13% to 16%, suggesting that cue-exposure was effective in eliciting higher levels of craving. In the three imagery conditions, Intervention Craving was 29-34% lower than Post-Induction Craving, and in the distraction control condition, Intervention Craving was 5% lower than the Post-Induction Craving. The magnitude of the reductions in Intervention Craving among the imagery conditions suggests that the brief 2-minute imagery interventions used in this study might be a useful intervention for smokers to use when they are seeking immediate relief from high levels of cigarette craving. Furthermore, clinicians might consider recommending the use of imagery rather than distraction as a method to reduce cravings because of the superior ability of imagery to reduce craving, at least over a short period.

Overall, my findings that distraction and imagery tasks result in a reduction in craving are congruent with EI theory’s prediction that elaboration can be interrupted when cognitive resources are used to complete other cognitive tasks, thus lowering craving. More importantly, my finding that sensory imagery was superior to distraction to reduce craving adds further support to the essential role sensory imagery is thought to play in the elaboration process. Furthermore, I found that olfactory imagery was as effective as visual imagery in reducing craving. However, because the majority of my participants incorporated additional forms of sensory imagery into the uni-sensory intervention, it may not be possible to test the effectiveness
of “true” uni-sensory imagery. As research continues to test EI theory, smokers stand to benefit from increased knowledge about the processes that lead to craving and the interventions that could lower craving.
REFERENCES


Table 1

Breakdown of Gender by Condition

<table>
<thead>
<tr>
<th>Condition</th>
<th>Male n</th>
<th>Female n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distraction</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Olfactory Imagery</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Visual Imagery</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Combined Imagery</td>
<td>6</td>
<td>7</td>
</tr>
</tbody>
</table>

*Note.* N=54; One participant assigned to the olfactory imagery condition did not report his/her gender.
Table 2

Demographic and Smoking History Characteristics (n=54)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>50</td>
</tr>
<tr>
<td>Male</td>
<td>48</td>
</tr>
<tr>
<td>Unknown</td>
<td>2</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>6</td>
</tr>
<tr>
<td>19</td>
<td>26</td>
</tr>
<tr>
<td>20</td>
<td>19</td>
</tr>
<tr>
<td>21</td>
<td>20</td>
</tr>
<tr>
<td>22-23</td>
<td>18</td>
</tr>
<tr>
<td>24-26</td>
<td>11</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
</tr>
<tr>
<td>European/White</td>
<td>96</td>
</tr>
<tr>
<td>African American/Black</td>
<td>2</td>
</tr>
<tr>
<td>Asian</td>
<td>2</td>
</tr>
<tr>
<td><strong>Days Per Week Participant Smokes</strong></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>94</td>
</tr>
<tr>
<td><strong>Amount Participant Smokes</strong></td>
<td></td>
</tr>
<tr>
<td>1 pack</td>
<td>85</td>
</tr>
<tr>
<td>More than 1 pack but less than 2 packs</td>
<td>15</td>
</tr>
<tr>
<td><strong>Money Spent Per Week on Cigarettes</strong></td>
<td></td>
</tr>
<tr>
<td>$10-15</td>
<td>19</td>
</tr>
<tr>
<td>$16-20</td>
<td>17</td>
</tr>
<tr>
<td>$21-25</td>
<td>39</td>
</tr>
<tr>
<td>$26-38</td>
<td>26</td>
</tr>
<tr>
<td><strong>Duration of Smoking at Least a Pack Per Day</strong></td>
<td></td>
</tr>
<tr>
<td>3 - 6 months</td>
<td>6</td>
</tr>
<tr>
<td>6 months – 1 year</td>
<td>26</td>
</tr>
<tr>
<td>1 – 2 years</td>
<td>30</td>
</tr>
<tr>
<td>2-3 years</td>
<td>15</td>
</tr>
<tr>
<td>3 or more years</td>
<td>24</td>
</tr>
</tbody>
</table>
Table 2 (continued)

Demographic and Smoking History Characteristics (n=54)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Who They Smoke With</td>
<td></td>
</tr>
<tr>
<td>Alone</td>
<td>32</td>
</tr>
<tr>
<td>With Friends</td>
<td>69</td>
</tr>
<tr>
<td>Smoking Status of Their Friends</td>
<td></td>
</tr>
<tr>
<td>Almost all or all</td>
<td>13</td>
</tr>
<tr>
<td>More than half but not all</td>
<td>65</td>
</tr>
<tr>
<td>Less than half smoke</td>
<td>19</td>
</tr>
<tr>
<td>Age First Smoked</td>
<td></td>
</tr>
<tr>
<td>10-13</td>
<td>19</td>
</tr>
<tr>
<td>14-17</td>
<td>69</td>
</tr>
<tr>
<td>18-19</td>
<td>13</td>
</tr>
<tr>
<td>Perceived Control Over Smoking</td>
<td></td>
</tr>
<tr>
<td>Completely Under My Control</td>
<td>7</td>
</tr>
<tr>
<td>Somewhat Under My Control</td>
<td>59</td>
</tr>
<tr>
<td>Somewhat Out of My Control</td>
<td>22</td>
</tr>
<tr>
<td>Completely Out of My Control</td>
<td>11</td>
</tr>
<tr>
<td>Perceived Ease/Difficulty Of Quitting In Next Month</td>
<td></td>
</tr>
<tr>
<td>Very Easy</td>
<td>2</td>
</tr>
<tr>
<td>Somewhat Easy</td>
<td>6</td>
</tr>
<tr>
<td>Somewhat Difficult</td>
<td>43</td>
</tr>
<tr>
<td>Very Difficult</td>
<td>50</td>
</tr>
<tr>
<td>Number of Prior Quit Attempts</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>1-2</td>
<td>35</td>
</tr>
<tr>
<td>3-4</td>
<td>33</td>
</tr>
<tr>
<td>5-7</td>
<td>13</td>
</tr>
<tr>
<td>10 or more</td>
<td>7</td>
</tr>
<tr>
<td>Participant’s Stage of Change (Smoker–Modified RTC Questionnaire)</td>
<td></td>
</tr>
<tr>
<td>Precontemplation</td>
<td>11</td>
</tr>
<tr>
<td>Contemplation</td>
<td>79</td>
</tr>
<tr>
<td>Action</td>
<td>9</td>
</tr>
</tbody>
</table>

Note. Percentages may not add to 100 for each item due to rounding or missing data.
Table 3

Means (and Standard Deviations) of Craving Scores Across Time and Conditions

<table>
<thead>
<tr>
<th>Condition</th>
<th>Baseline</th>
<th>Post Induction</th>
<th>Intervention</th>
<th>Post Intervention</th>
<th>Reduction</th>
<th>Rebound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distraction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>44.31</td>
<td>53.08</td>
<td>50.23(^{abc})</td>
<td>55.69</td>
<td>2.85</td>
<td>5.46</td>
</tr>
<tr>
<td>(SD)</td>
<td>(13.86)</td>
<td>(10.79)</td>
<td>(14.88)</td>
<td>(10.55)</td>
<td>(11.13)</td>
<td>(7.33)</td>
</tr>
<tr>
<td>Olfactory Imagery</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>44.67</td>
<td>54.00</td>
<td>36.87(^a)</td>
<td>46.20</td>
<td>17.13</td>
<td>9.33</td>
</tr>
<tr>
<td>(SD)</td>
<td>(9.60)</td>
<td>(7.34)</td>
<td>(13.59)</td>
<td>(11.52)</td>
<td>(13.78)</td>
<td>(10.93)</td>
</tr>
<tr>
<td>Visual Imagery</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>48.46</td>
<td>54.85</td>
<td>36.31(^b)</td>
<td>48.85</td>
<td>18.54</td>
<td>12.54</td>
</tr>
<tr>
<td>(SD)</td>
<td>(9.92)</td>
<td>(9.21)</td>
<td>(17.01)</td>
<td>(12.21)</td>
<td>(15.68)</td>
<td>(13.73)</td>
</tr>
<tr>
<td>Combined Imagery</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>49.38</td>
<td>57.00</td>
<td>36.85(^c)</td>
<td>48.38</td>
<td>20.15</td>
<td>11.54</td>
</tr>
<tr>
<td>(SD)</td>
<td>(10.75)</td>
<td>(9.30)</td>
<td>(15.99)</td>
<td>(9.91)</td>
<td>(16.08)</td>
<td>(9.12)</td>
</tr>
</tbody>
</table>

\(p\) level  

\(p > .05\)  \(p > .05\)  \(p \leq .01\)  \(p > .05\)  \(p > .05\)  \(p > .05\)

*Note.* Superscript letters denote significant differences between conditions in the columns at \(p \leq .01\). The \(n=13\) for all conditions, except olfactory imagery where \(n=15\). Cravings scores (baseline, post-induction, intervention, post-intervention) have a possible range from 10 (minimum level of craving) to 70 (maximum level of craving). Reduction calculated as Post-Induction Craving minus Intervention Craving. Rebound calculated as to Post-Intervention Craving minus Intervention Craving.
Table 4

Means (and Standard Deviations) for Vividness Ratings of Instructed Imagery, Proportion of Participants Experiencing Additional Non-Instructed Imagery, and Vividness Ratings of Non-Instructed Imagery

<table>
<thead>
<tr>
<th>Condition</th>
<th>Instructed Imagery</th>
<th>% w/ Non-Instructed Imagery</th>
<th>Non-Instructed Imagery Vividness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Vividness</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Olfactory Imagery</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Olfactory Imagery (n=14)</td>
<td>4.6 (1.4)</td>
<td>-----</td>
<td>-------</td>
</tr>
<tr>
<td>Visual Imagery (n=15)</td>
<td>73% 4.6 (1.6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auditory Imagery (n=15)</td>
<td>60% 4.3 (1.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Visual Imagery</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visual Imagery (n=13)</td>
<td>5.2 (1.3)</td>
<td>8%</td>
<td>5.0 (0.0)</td>
</tr>
<tr>
<td>Olfactory Imagery (n=13)</td>
<td>8% 5.0 (0.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auditory Imagery (13)</td>
<td>60% 4.5 (1.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Combined Imagery</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visual Imagery (n=13)</td>
<td>5.3 (1.1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Olfactory Imagery (n=13)</td>
<td>3.8 (1.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auditory Imagery (n=13)</td>
<td>92% 4.6 (1.1)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* Instructed imagery refers to the imagery that participants were asked to imagine. Non-Instructed imagery refers to additional imagery that participants reported experiencing in addition to the instructed imagery. Vividness ratings ranged from ranged from 1 = “I was not at all able to imagine the [image]” to 7 = “I was able to imagine the [image] as clear and vivid as real life.”
Subject Line: BGSU Smokers – Earn $10 by Participating in a ½ Hour Research Study

Dear BGSU Student,

Your email address was selected at random from the list of every undergraduate student now attending BGSU.

I am emailing to invite you to participate in my dissertation research study which is designed to examine the effects of nicotine deprivation in smokers.

You are eligible to participate if you are at least 18 years old, are a BGSU undergraduate student, and have smoked at least one pack of cigarettes on a daily basis for the past 6 months.

Your participation will involve (1) abstaining from smoking at least 6 - 9 hours prior to your participation (this includes hours spent sleeping), (2) bringing a pack of your own cigarettes to your appointment (one cigarette will be used in the course of the study), (3) completing brief questionnaires, and (4) completing a 2 minute mental intervention.

I anticipate that this study should take about 20-30 minutes to complete. The study will be held in room 429 in the psychology building on the BGSU campus.

The benefits of participating include helping psychology better understand nicotine deprivation in smokers and to help inform future interventions for smokers. Each participant will be paid $10 for his/her participation. [If you are a general psychology student wishing to earn research credit, you can alternatively earn $9 plus 1/2 hour of research credit for your participation.]

Please note that participation in this study is completely voluntary.

Please respond by email to smkrstudy@bgnet.bgsu.edu if you are interested in participating. In your email please provide your name, a phone number at which you can be reached, an email address that you check on a regular basis, times you are available on Tuesday, Thursday, Friday, Saturday and Sunday mornings beginning 3/28/05 through 5/6/05.

Interested persons will be scheduled to participate in this study on a first come basis.

Thank you!
Amelia Versland
Dear __________

Thanks for your interest in participating in this study. The study is being run (Tuesday, Thursday, Friday, Saturday, and Sunday mornings between 7a.m. and noon). If you have times available at these times, please email me with 1/2 hour time slots that you are available to participate. Based on the schedule that you send me and the openings that I have available, I will try to schedule you for a half hour appointment to participate in this study. Please note again that participants are being scheduled on a first come basis, so the sooner you reply, the better your chances of being in the study.

Also, if you are a psychology 101 student, I will need you to provide me with the name of your psychology instructor so that you can be awarded research credit in addition to the monetary payment.

**Please note that you MUST be a smoker to participate in this study (smoke at least 1 pack per day for the past 6 months).**

*Your participation will involve* (1) abstaining from smoking at least 6 - 9 hours prior to your participation (this includes hours spent sleeping), (2) bringing a pack of your own cigarettes to your appointment (one cigarette will be used in the course of the study), (3) completing brief questionnaires, and (4) completing a 2 minute mental intervention. The study is being conducted in room 429 in the psychology building.

Please email me to let me know the 1/2 hour time slots that you are available between 7a.m. and noon on Tu, Th, F, Sa, and Su. Also, if applicable, please email me the name of your psychology 101 professor. If you have any further questions, you can also email those to me as well.

Again, thanks for you willingness to participate in this study. I look forward to hearing from you.

Thank you,
Amelia
smkrstude@bgsu.edu
Hi ______,

Thanks for your interest in participating in this study! I have an opening on this [Inserted Day of Week], [Inserted Date] from [Inserted Time]. Please email me ASAP to let me know if you can make this time. I have gotten a lot of responses from people who want to participate, therefore, if I don't hear back from you by [Insert 1-2 Day Time Slot], this appointment time might be given to another student.

Please note that you MUST be a smoker to participate in this study (meaning you must smoke at least 1 pack per day for the past 6 months). If you do not smoke at least a pack a day, you cannot participate in this study.

Your participation will involve (1) abstaining from smoking at least 6 - 9 hours prior to your participation (this includes hours spent sleeping), (2) bringing a pack of your own cigarettes to your appointment (one cigarette will be used in the course of the study), (3) completing brief questionnaires, and (4) completing a 2 minute mental intervention. The study is being conducted in room 429 in the psychology building.

Please email me to let me know if you can make the research appointment on [Insert Day, Date, and Time of Appointment]. Also, if you have any further questions, you can also email those to me as well.

Again, thanks for you willingness to participate in this study. I look forward to hearing from you.

Thank you,
Amelia
smkrstudy@bgsu.edu
Item 4

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 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

Note. Because this instrument is given multiple times over the course of the study, the order of the items will be changed to avoid boredom or response set.
Item 5

Vividness Questionnaires

I. Vividness Questionnaire for Olfactory Imagery

1.) Rate the vividness or realness of your imagery for smell associated with the beach:

I was **not** at all able ___:___:___:___:___:___:___ I was able to imagine to imagine the smell ___:___:___:___:___:___:___ I was able to imagine the smell as clear and vivid as real life

2.) While you were imagining the smell of the beach, did you also imagine what the beach looked like?

□ No ► Skip to next question (number 3)

□ Yes ► If yes, rate the vividness or realness of your imagery for the sight of the beach.

I was **not** at all able ___:___:___:___:___:___:___ I was able to imagine to imagine the sight ___:___:___:___:___:___:___ I was able to imagine the sight as clear and vivid as real life

3.) While you were imagining the smell of the beach, did you also imagine sounds associated with the beach?

□ No ► End of questionnaire

□ Yes ► If yes, rate the vividness or realness of your imagery for sounds associated with the beach.

I was **not** at all able ___:___:___:___:___:___:___ I was able to imagine to imagine the sounds ___:___:___:___:___:___:___ I was able to imagine the sounds as clear and vivid as real life
II. Vividness Questionnaire for Visual Imagery

1.) Rate the vividness or realness of your imagery for imaging what the beach looked like:

I was not at all able to imagine the sight ___: ___: ___: ___: ___: ___: ___ I was able to imagine the sight as clear and vivid as real life

2.) While you were imagining the sight of the beach, did you also imagine what the beach smelled like?

☐ No ► Skip to next question (number 3)

☐ Yes ► If yes, rate the vividness or realness of your imagery for smelling the BEACH.

I was not at all able to imagine the smell ___: ___: ___: ___: ___: ___: ___ I was able to imagine the smell as clear and vivid as real life

3.) While you were imagining the sight of the beach, did you also imagine sounds associated with the beach?

☐ No ► End of questionnaire

☐ Yes ► If yes, rate the vividness or realness of your imagery for sounds associated with the beach.

I was not at all able to imagine the sounds ___: ___: ___: ___: ___: ___: ___ I was able to imagine the sounds as clear and vivid as real life
III. Vividness Questionnaire for Combined Imagery

1.) Rate the vividness or realness of your imagery for imaging what the beach looked like:

I was *not* at all able ___: ___: ___: ___: ___: ___: ___ I was able to imagine the sight as clear and vivid as real life

2.) Rate the vividness or realness of your imagery for smelling the beach:

I was *not* at all able ___: ___: ___: ___: ___: ___: ___ I was able to imagine the smell as clear and vivid as real life

3.) While you were imagining the sight of the beach, did you also imagine sounds associated with the beach?

☐ No ► End of questionnaire

☐ Yes ► If yes, rate the vividness or realness of your imagery for sounds associated with the beach.

I was *not* at all able ___: ___: ___: ___: ___: ___ I was able to imagine the sounds as clear and vivid as real life
Item 6

Demographic Questionnaire

Please answer the following questions about yourself.

What is your age? _________

What is your sex?
    Female
    Male

What is your race/ethnicity?
    Asian/Pacific Islander
    Black/African American
    Hispanic/Latino
    Native American/Aleutian
    White/European
    Other _________________

In the last 6 months, how many **days a week** on average have you smoked cigarettes?
    0
    1
    2
    3
    4
    5
    6
    7

In the last 6 months, how many cigarettes do you smoke **on a daily basis**?
    Less than 1 pack a day
    1 pack a day
    More than 1 pack but less than 2 packs a day
    2 or more packs a day

About how much money do you spend on tobacco **in a typical week**? ______

How long have you been smoking **at least one pack of cigarettes a day**?
    Less than 3 months
    3 to 6 months
    6 months to 1 year
    1 to 2 years
    2 to 3 years
    3 or more years

How old were you when you first smoked cigarettes? ______
When you smoke, who are usually with (check one)?

__ alone   __ with friends   __ with family

How many of your friends also smoke cigarettes (check one)?

__ None  __ Less than half  __ More than half, but not all  __ Almost all or all

Circle the answer below that best describes the degree to which your use of tobacco is under your control:

Completely under my control   Somewhat under my control   Somewhat out of my control   Completely out of my control

Circle how easy or difficult it would be for you to go without taking tobacco for the next month?

Very easy   Somewhat easy   Somewhat difficult   Very difficult

How many times have you attempted to quit smoking cigarettes?

1
2
3
4
5
6
7
8
9
10 or more

What was the date and time of your last cigarette?

Date: ___________

Time: ___________
Item 7

Smoker–Modified Readiness to Change Questionnaire

The following questions are designed to identify how much you personally feel about your smoking right now. Please read each of the questions below carefully, and then decide whether you agree or disagree with the statements. Please choose the answer of your choice to each question. Your answers are completely private and confidential.

I don't think I smoke too much.
   Strongly Disagree
   Disagree
   Unsure
   Agree
   Strongly Agree

I am trying to smoke less than I used to.
   Strongly Disagree
   Disagree
   Unsure
   Agree
   Strongly Agree

I enjoy my smoking, but sometimes I think I smoke too much.
   Strongly Disagree
   Disagree
   Unsure
   Agree
   Strongly Agree

Sometimes I think I should cut down on my smoking.
   Strongly Disagree
   Disagree
   Unsure
   Agree
   Strongly Agree

It's a waste of time thinking about my smoking.
   Strongly Disagree
   Disagree
   Unsure
   Agree
   Strongly Agree
I have just recently changed my smoking habits.
    Strongly Disagree
    Disagree
    Unsure
    Agree
    Strongly Agree

Anyone can talk about wanting to do something about smoking, but I am actually doing something about it.
    Strongly Disagree
    Disagree
    Unsure
    Agree
    Strongly Agree

I am at the stage where I should think about smoking less.
    Strongly Disagree
    Disagree
    Unsure
    Agree
    Strongly Agree

My smoking is a problem sometimes.
    Strongly Disagree
    Disagree
    Unsure
    Agree
    Strongly Agree

There is no need for me to think about changing my smoking habits right now.
    Strongly Disagree
    Disagree
    Unsure
    Agree
    Strongly Agree

I am actually changing my smoking habits right now.
    Strongly Disagree
    Disagree
    Unsure
    Agree
    Strongly Agree
Smoking less would be pointless for me.
  Strongly Disagree
  Disagree
  Unsure
  Agree
  Strongly Agree
Item 8

Reminder Email

Subject Line: Reminder Email Regarding Your Participation in the Smoker Study

Dear _______.

Just a quick email to remind you that you are scheduled to participate tomorrow (Day, Date) from (Start Time) to (End Time) in the BGSU Smoker Study. The study is being held in room 429 in the psychology building (on the 4th floor).

Also, please remember to:
(1) abstain from smoking from cigarettes for at least 6-9 hours prior to your appointment (this includes hours spent sleeping), and
(2) bring a pack of your cigarettes to the study (1 cigarette will be used in the course of the study; the pack doesn't have to be a full pack)

Please note that you must be smoker (smoke at least a pack of cigarettes a day) to participate in this study. You will be paid cash at your appointment and will receive research credit in your general psychology course (if applicable). If you have any further questions, you can email me or ask me at your appointment tomorrow.

[If you need to cancel or reschedule the appointment, please notify me ASAP so that I can schedule another student in your spot.]

Thank you,
Amelia
smkrststudy@bgsu.edu
Item 9

General Outline of Study

Participants give informed consent

↓

Participants complete QSU-Brief (Baseline Craving)

↓

2 minute in vivo exposure

↓

Participants complete QSU-Brief (Post-Induction Craving)

↓

Participants assigned to 1 of 4 conditions (15-20 per group)

↓

D VI OI COMB

↓

Participants complete the QSU-Brief (Intervention Craving and Post-Intervention Craving)

↓

Participants in VI, OI, and COMB rate the vividness of the imagery & interference of other imagery

↓

Participants Complete Demographic Questionnaire and Smoker–Modified Readiness to Change Questionnaire

↓

Participants debriefed, paid, and thanked for their time

Key for Study Outline

D = Distraction Control Condition
VI = Visual Imagery Condition
OI = Olfactory Imagery Condition
COMB = Combination of Olfactory and Visual Imagery Condition
Thank you for your participation in today's study. As stated earlier, we are interested in learning about deprivation of smoking. Specifically, we are interested in the types of mental interventions that can be used to reduce craving (e.g., distraction or imagery) in deprived smokers. Previous research has suggested that visual imagery can reduce craving in smokers (Panabokke, May, Eade, Andrade, & Kavanagh, 2005).

In addition to the questions that we asked regarding your craving, we also asked you about the vividness of imagery, information regarding your own smoking behavior, and background information. This information will be used to help us interpret our findings and to describe our overall sample.

Your participation is greatly appreciated and will help psychologists better understand craving. We ask that you do not discuss the nature of the study with others who may later participate in it, as this could affect the validity of our research conclusions. If you have any questions or concerns, you are welcome to talk with Amelia Versland of the Psychology Department at (419) 372-4503. If you have any questions about participant rights, you may contact the chair of the Human Subjects Review Board at Bowling Green State University at (419) 372-7716.

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


THANK YOU AGAIN FOR YOUR PARTICIPATION.
Item 11

Olfactory Guided Imagery

You are sitting on the beach with your eyes closed and begin to pay particular attention to the various smells around you. First, you notice the smell of your freshly laundered beach towel that smells like laundry soap. Next you notice the coconut scent of suntan lotion which you applied earlier this afternoon. As you take a deep breath in through your nose, you smell the shampoo you used to wash your hair earlier this morning. With the next deep breath, you smell the fresh air. Then, you notice the smell of the sand through your towel. As you focus on the different smells around you, you are able to detect even fainter smells that are farther away. You smell wood smoke coming from the direction of a picnic area near the beach. You also smell the odor of a wet dog. As you continue to sit on the beach, you focus on all the different smells— the towel, the suntan lotion, your hair, the fresh air, the sand, the smoke, and the wet dog.

[Words = 175; Flesch reading ease = 73.5; Flesch-Kincaid grade level = 7.3]
You are sitting on the beach watching activities taking place around you. First, you notice as the person next to you carefully straightens an orange beach towel. Once the towel is situated, the person sits down. Carefully, the person squirts white suntan lotion from a bottle into their hand. The person slowly rubs the lotion to their body until the white color of the lotion disappears. You look in another direction and notice as a young, blonde haired boy throws a Frisbee to another boy. You watch as they throw the bright green Frisbee as high as they can. They then dive into the sand to catch the Frisbee before it hits the ground. You look in another direction and notice a long-haired dog. The dog is leaping and swimming in the blue waves in order to retrieve a stick. As you continue to sit on the beach, you imagine all these images— the woman with the orange beach towel and suntan lotion, the boys playing with a green Frisbee, and the long-haired dog retrieving a stick.
You are sitting on the beach attending to the various smells and sights around you. You notice the smell of laundry soap coming from your orange beach towel. Next, you notice as the person next to you squirts white suntan lotion from a brown bottle into their hand. The person is so close you can smell the lotion’s coconut scent and you watch as the person slowly rubs in the lotion until the white color disappears. The smell of the lotion is replaced by the fresh air blowing in from the water. You look up and see a young, blonde haired boy throw a bright green Frisbee to another boy. You watch as they throw the Frisbee high and dive to catch it before it hits the sand. Suddenly you smell a wet dog. You look toward the water and see a long-haired dog leaping and swimming into the waves to retrieve a stick. As you continue to sit on the beach, you take in all the scenes and smells (your beach towel, the person applying lotion, the fresh air, the boys playing, and the dog).

[Words = 186;  Flesch reading ease = 74.2; Flesch-Kincaid grade level = 7.5]