

THE EFFECT OF SUGGESTION ON COGNITION IN SMOKERS

by

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DEDICATION

I would first like to dedicate this dissertation to my Mom and Dad, for their forever support of my educational pursuits. To my brother Brenden, whose own pursuit of knowledge provided me good motivation. To my best friends throughout life: Blake, Blake, Chris, Tim, and Christian, who supplied many laughs along the way. And to Grace, whose companionship, love, and care is unmatched.

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ABSTRACT

Title of Thesis: The Effect of Suggestion on Cognition in Smokers

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Cigarette smoking remains an extremely important public health concern. Despite decreasing prevalence rates, smoking is still the leading cause of preventable death in United States. Even when smokers use available efficacious treatments, most quit attempts end in failure (relapse). Therefore, novel smoking cessation interventions are required.

Recent research has identified cognitive processes associated with quit attempts as important targets for intervention. One intervention found to be effective in targeting cognitive processes is hypnotic suggestion. Several studies have demonstrated that hypnotic suggestion can reduce or eliminate the Stroop effect assessed using the classic Stroop task. Treatments that utilize hypnotic suggestion (e.g., clinical hypnosis) are popular, sought-after, brief, and tolerable interventions for smoking cessation. However, these treatments have yet to incorporate suggestions which directly target cognitive processes.

Using a counterbalanced within-subjects, this laboratory study examined if cognitive processes can be modified in smokers (N=33) using hypnotic suggestion.

Specific Aim 1 sought to replicate previous findings that hypnotic suggestion reduces the classic Stroop effect using a sample of smokers with high hypnotic susceptibility.

Specific Aim 2 investigated if hypnotic suggestion reduces attention to smoking cues on the smoking Stroop task (a modification of the emotional Stroop task). Exploratory analyses examined if hypnotic suggestion reduces craving. Descriptive statistics of hypnotic susceptibility and attitudes towards using hypnosis during a subsequent quit attempt in smokers were also presented.

The results demonstrated no evidence that hypnotic susceptibility moderated the effect of hypnotic suggestion on the classic Stroop effect or that hypnotic suggestion reduced the classic Stroop effect in individuals with high levels of susceptibility (Specific Aim 1). There was also no evidence that hypnotic susceptibility moderated the effect of hypnotic suggestion on the smoking Stroop effect or that hypnotic suggestion reduced the smoking Stroop effect in individuals with high levels of susceptibility (Specific Aim 2). An exploratory analysis demonstrated that hypnotic susceptibility did moderate the effect of hypnotic suggestion on craving, and hypnotic suggestion did reduce craving in individuals with high levels of susceptibility. Side effects of hypnotic suggestion were common but mild in intensity. The average hypnotic susceptibility was slightly above average, and perceptions of hypnosis were positive.

Overall, this study found that hypnotic suggestion did not have an effect on cognition but did decrease cigarette craving in high susceptible smokers. To the best of the author's knowledge, this is the first study using a counterbalanced design to report that hypnotic suggestion reduces craving for cigarettes. Further research into the mechanisms by which hypnotic suggestion reduces craving is warranted.

TABLE OF CONTENTS

LIST OF TABLES.....	xi
LIST OF FIGURES	xii
CHAPTER 1: INTRODUCTION	1
CIGARETTE SMOKING.....	1
Smoking Prevalence.....	1
Prevalence in Military.....	2
Health Consequences of Smoking	2
Monetary Impact.....	3
TREATMENT FOR SMOKING.....	3
Pharmacological Treatments.....	4
Nicotine Replacement.....	4
Bupropion	5
Varenicline.....	5
Psychological Treatments	6
Combination Treatments.....	6
Suggestion-Based Treatments.....	6
Importance of Suggestions and Susceptibility.....	8
Quitting & Relapse	11
Electronic Cigarettes.....	11
Summary	12
CHAPTER 2: AUTOMATIC COGNITIVE PROCESSES IN SMOKING.....	13
Assessment of Automatic Processes.....	14
Smoking Stroop	14
Dot-Probe Task	16
Cognition & Craving.....	17
Cognition & Consumption.....	17
Cognition & Relapse.....	18
Cognitive Interventions.....	18
Summary	19
CHAPTER 3: SUGGESTION AS A COGNITIVE INTERVENTION.....	20
Hypnosis	20
Relationship between Hypnosis and other Techniques	21
Theories of Hypnosis	22
Hypnotic Susceptibility.....	24
Susceptibility in Smokers	26
Theories of Classic Stroop.....	27
Neurobiology of the Classic Stroop.....	27

Clinical Disorders & Classic Stroop	28
Smoking & Classic Stroop in Smokers.....	29
Susceptibility & Classic Stroop	29
Modification of Classic Stroop	30
Modification of Smoking Stroop	30
Suggestion & Cognition.....	31
Suggestion & Classic Stroop	32
Suggestion & Flanker Task.....	34
Suggestion & Simon Task	34
Suggestion & Continuous Performance Task	35
Suggestion & McGurk Effect	36
Limits of Suggestion	36
Mechanism of Effect of Suggestion on Cognition.....	37
Summary	39
CHAPTER 4: STUDY RATIONALE & SPECIFIC AIMS.....	40
Study Rationale.....	40
STUDY AIMS	41
Specific Aim 1	41
Specific Aim 2	41
CHAPTER 5: METHODS	43
Participants.....	43
Procedure	44
Suggestion Condition.....	48
Control Condition	48
Measures	49
Biochemical Measure.....	49
Self-Report Assessments	49
Classic & Smoking Stroop.....	50
Hypnotic Susceptibility.....	53
Hardware & Software	54
DATA ANALYSIS.....	54
Specific Aim 1	55
Specific Aim 2	56
Exploratory Analyses.....	56
Covariates	57
Power Analysis	58
CHAPTER 6: RESULTS	61
Descriptive Statistics.....	61
Specific Aim 1	62
Specific Aim 2	63
Exploratory Analyses.....	64
Effect of Susceptibility and Suggestion on Craving.....	64
Mediation Analysis	64

Associations between Susceptibility and Perceptions of Hypnosis	65
Effects of Order.....	65
Effect of Susceptibility and Suggestion on Side Effects	66
CHAPTER 7: DISCUSSION.....	67
Effect of Suggestion on Classic Stroop	67
Effect of Suggestion on Smoking Stroop.....	69
Exploratory Aims.....	70
Effect of Suggestion on Craving.....	70
Perceptions of Hypnosis	72
STRENGTHS	73
LIMITATIONS.....	74
FUTURE DIRECTIONS	76
Summary	78
Appendix A: Hypnotic Susceptibility Scoresheet.....	122
Appendix B: Self-Report Measures & Phone Screening.....	128
Fagerström Test for Nicotine Dependence	128
Questionnaire of Smoking Urges.....	129
Perceptions of Hypnosis Questionnaire	130
Side Effects Questionnaire.....	131
Demographics	132
Appendix C: Procedure for Suggestions Condition.....	137
Appendix D: Approved Informed Consent Document	138
Appendix E. Control then Suggestion Condition Checklist	144
Appendix F. Suggestion then Control Condition Checklist.....	145
Appendix G: Introduction to Hypnosis Script	146
Appendix H. Laboratory Setting.....	151
Appendix I. Screenshot of QSU.....	152
Appendix J. Screenshot of Side Effects Questionnaire	153
Appendix K. Risks and Benefits of Hypnosis	154
Risks of Harm:	154
Measures to Minimize Risks of Harm (Precautions, safeguards):.....	155
Confidentiality Protections (for research records, data and/or specimens):	160
Potential Benefits	160
Privacy for Subjects:	161
Incidental or Unexpected Findings:	161

REFERENCES	163
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LIST OF TABLES

<i>Table 1.</i> Hypnosis for Smoking Clinical Trials	80
<i>Table 2.</i> Description of the Hypnosis used in Clinical Trials	87
<i>Table 3.</i> Differences between Hypnosis, Meditation, & Progressive Relaxation.....	93
<i>Table 4.</i> SHSS:C Norms	95
<i>Table 5.</i> Studies of Hypnotic Susceptibility in Smokers	96
<i>Table 6.</i> Summary of Studies of Suggestion and the Classic Stroop Since 2002	97
<i>Table 7.</i> Demographics of Study Participants from Studies of Suggestion and the Classic Stroop Since 2002	99
<i>Table 8.</i> Study Design and Lab Measures	102
<i>Table 9.</i> Adverse Events Reported for Clinical Trials on Clinicaltrial.gov - using Search for Study using the term “Hypnosis” and trials reporting “Completed Has Results”	107
<i>Table 10.</i> Participant Characteristics	109
<i>Table 11.</i> Summary Statistics	111
<i>Table 12.</i> Results of GLMs.....	112

LIST OF FIGURES

Figure 1. Conceptual model.....	113
Figure 2. Study Diagram.....	114
Figure 3: Consort Chart	115
Figure 4: Suggestion condition	116
Figure 5. Frequency Distribution of Hypnotic Susceptibility in Current Sample	117
Figure 6: Effect of Susceptibility and Suggestion on Classic Stroop Effect	118
Figure 7: Effect of Susceptibility and Suggestion on Smoking Stroop Effect	119
Figure 8: Effect of Susceptibility and Suggestion on QSU Ratings	120
Figure 9. Craving as a Function of Hypnotic Susceptibility.....	121

CHAPTER 1: INTRODUCTION

CIGARETTE SMOKING

Cigarette smoking is highly prevalent in US civilian and military populations and is associated with a myriad of medical problems. For these reasons, cigarette smoking results in a higher mortality rate than any other health-related behavior (Office of the Surgeon General, 2014). It also imparts a tremendous economic impact on society, which has led to the development of several interventions for smoking cessation. However, when patients use these treatments, they do not achieve abstinence at much greater rates than smokers who try to quit with no treatment (i.e., “cold turkey”; Shiffman, 2008). Overall, only a very low percentage of smokers (<5%) are able to stay abstinent in the long term when they try to quit smoking (Hughes, Keely, & Naud, 2004).

This dissertation is organized as follows. First, there is a review of the prevalence and health consequences of cigarette smoking. Second, the dissertation reviews recommended treatments for smoking cessation as well as hypnosis-based treatments. Third, there will be a detailed overview of the importance of automatic cognitive processes in smoking. Fourth, the dissertation details recent findings regarding the influence of hypnotic suggestion on automatic cognitive processing in general. Finally, the dissertation describes procedures of the current study including methodology, statistical considerations, specific aims, results, and discussion.

Smoking Prevalence

The prevalence of smoking in the US has dropped significantly over the past 50 years. However, reductions in recent years have been smaller than in previous decades. The prevalence of smoking in the US dropped from 42.4% in 1965 to 33.2% in 1980. In

1995, the rate dropped again to 24.7%. In 2010, 19.3% of Americans were regular smokers. At the last assessment in 2014, 16.8% Americans endorsed being a smoker (Centers for Disease Control [CDC], 2016). Importantly, the most recent Surgeon General's Report on Smoking cites growing disparities of smoking prevalence between ethnicities, socioeconomic statuses, and levels of educational achievement (Office of the Surgeon General, 2014).

Prevalence in Military

The current prevalence of cigarette smoking in the military is approximately 24% (Department of Defense, 2013). Cigarette smoking leads to lower operational readiness in terms of decreased fitness, acute and chronic health problems, as well as costs to the military health system. Smoking has also been reported to be a significant predictor of premature discharge (Haddock et al., 2013). Once a service member is discharged, the federal government transfers these burdens to the Veteran's Affairs Department where an estimated \$2.7 billion of their \$40.2 billion budget in 2010 was spent treating smoking-related illnesses (Barnett et al., 2015).

Health Consequences of Smoking

Smoking is best known for increasing risk of several forms of cancer (e.g., lung, esophageal), stroke, cardiovascular disease (e.g., myocardial infarction), and pulmonary diseases (e.g., chronic obstructive pulmonary disease, emphysema). Perhaps less appreciated is the Surgeon General's most recent report (2014) wherein the committee added several more diseases and health conditions as being smoking-related. Specifically, diabetes, liver disease, tuberculosis, decreased immunity, macular degeneration,

colorectal cancer, and decreased sexual functioning were cited as occurring at significantly higher rates in smokers (Office of the Surgeon General, 2014).

Monetary Impact

The US economy is severely affected by cigarette smoking. One component is the medical costs related to smoking. It is estimated that Americans pay approximately \$170 billion per year to treat their smoking-related diseases. Another cost is from loss of work potential caused by smoking-related health conditions. Per year, approximately \$156 billion is lost due to smoking-related loss of productivity and pre-mature death (Office of the Surgeon General, 2014; Xu et al., 2015).

TREATMENT FOR SMOKING

Recommended treatments for smoking include nicotine replacement therapy (NRT), two FDA approved prescription medications (varenicline and bupropion), and psychotherapy. In one survey from 2010, approximately 30% of smokers used a pharmacological treatment and approximately 6% used psychotherapy to help them quit smoking in the past year (National Health Interview Surveys, Center for Disease Control [CDC], 2011).

NRTs include a variety of products which include nicotine gum, nicotine lozenges, nicotine patches, nasal sprays, and an oral inhaler. NRT dosage is recommended based on cigarettes consumed per day while the two FDA-approved medications require a prescription from a physician. Overall, according to a recent Cochrane review, varenicline has been found to be superior to NRT and bupropion in promoting smoking cessation (Cahill, Stevens, Perera, & Lancaster, 2013). This review also stated that, compared to placebo, bupropion and NRT increased the odds of quitting

smoking by about 80%. Compared to NRT, varenicline increased the odds of quitting smoking by 50-70%.

It is also recommended that NRTs and these prescription medications can be used in conjunction with psychotherapy (US Public Health Service, 2008). Psychotherapy for smoking cessation can include a variety of techniques including motivational interviewing and cognitive-behavioral techniques (US Public Health Service, 2008; Fiore, et al., 2008).

Pertinent to the current proposal, suggestion-based hypnotherapies are unique psychotherapy techniques that attempts to change smoker's motivations and behavior using suggestions given under a hypnotic state. As described in more detail later, these types of treatments have received mixed results across clinical trials (Barnes et al., 2010).

The following section will review the mechanisms of each treatment and clinical trial results.

Pharmacological Treatments

Nicotine Replacement

NRTs help smokers by providing nicotine through safer delivery forms during smoking withdrawal. Although the rate of absorption of nicotine is slower in NRTs than cigarette-delivered nicotine, NRT maintains nicotine levels in the bloodstream (Stead, Perera, Bullen, & Mant, 2012). NRTs are widely accessible but they are typically sold as over-the-counter medications. The instructions for the patients recommend setting a quit date and to use the product at dosages and intervals based on their average cigarettes smoked per day. The goal of this treatment is to gradually reduce the dose of the NRT while maintaining cigarette abstinence. During clinical trials, NRT almost doubled the

odds of smokers being able to quit in comparison to smokers who attempted to quit without NRT (Nides, 2008; Silagy, Lancaster, Stead, Mant, & Fowler, 2004). The odds ratio for success for NRT compared to control treatment is approximately 1.77 (Silagy, Lancaster, Stead, Mant, & Fowler, 2004).

Bupropion

Bupropion (market name: Zyban and Wellbutrin) was first labeled by the FDA as an antidepressant medication. Subsequent research led to its approval for smoking cessation. Bupropion acts primarily as a dopamine and noradrenaline reuptake inhibitor. It is hypothesized that these actions help reduce adverse moods associated with cigarette withdrawal and decrease craving. Similar to NRT, bupropion roughly doubles the odds of abstinence when compared to those treated by placebo (Eisenberg et al., 2008; Hughes et al., 2014). The odds ratio for the effect of bupropion (vs. control treatment) on cessation is approximately 2.07 (Eisenberg et al., 2008).

Varenicline

Varenicline (market name Chantix) was approved by the FDA in 2006. Varenicline acts a partial agonist at $\alpha 4\beta 2$ nicotinic receptors. By occupying some of the same receptors as nicotine Varenicline decreases the pleasure of smoking when smokers take this medication. Therefore, it has been hypothesized this medication works in part through extinction (absence of pleasurable effects following smoking behavior). Studies have shown that varenicline also reduces craving and withdrawal symptoms in smokers (Coe, et al., 2005). The odds ratio for the effect of varenicline (vs. control treatment) on cessation is approximately 2.50 (Gonzales, et al., 2006; Jorenby, et al., 2006; Tonstad, et al., 2006; Eisenberg, et al., 2008).

Psychological Treatments

Several forms of psychotherapy have been tested for smoking cessation. Evidence suggests that no theoretical approach is superior to others (Lancaster & Stead, 2008). However, most guidelines include some form of behavioral strategies and decisional balance techniques found in motivational interviewing. These techniques help the patient to recognize situations where relapse is common, avoid them, and clarify what actions they will take to stay quit. The odds ratio for the effect of psychotherapy on smoking cessation is 1.44 when compared to control psychological treatments such as limited contact (Lancaster & Stead, 2005; Lancaster & Stead, 2008).

Combination Treatments

The US Department of Health and Human Services (HHS) guidelines for treating nicotine dependence gives its highest recommendation to combination therapies, which involve using pharmacotherapies listed above with adjunctive psychotherapy (Fiore et al., 2008). The guidelines state that group and individual psychotherapy are similarly effective (Fiore et al., 2008). However, a greater number of sessions of psychotherapy, and longer sessions of psychotherapy, increase efficacy (Fiore et al., 2008). Two components of psychotherapy are listed as particularly useful: techniques to increase social support, and problem-solving skills (Fiore et al., 2008). Combining psychotherapy with a medication such as nicotine replacement therapy resulted in higher rates of abstinence than psychotherapy or medication alone (Fiore et al., 2008).

Suggestion-Based Treatments

More pertinent to the current dissertation, suggestion-based treatments are associated with treatments that use hypnosis. As noted earlier, hypnosis can be defined as

“a state of consciousness involving focused attention and reduced peripheral awareness characterized by an enhanced capacity for response to suggestion” (APA Division 30 Executive Committee, 2014). Hypnosis is used as a method to enhance the strength of suggestions. A Cochrane systematic review and meta-analysis from 2010 identified a lack of high-quality research on hypnotic suggestion for smoking cessation and concluded that the available research does not support its status as an evidence-based treatment (Barnes et al., 2010). In their meta-analysis, a total of 11 trials were identified. Suggestion-based interventions differed greatly in terms of number of sessions and content of suggestions (See Table 1 & Table 2). The abstinence rate across trials ranged from 14.7% to 50% at follow-up periods of at least six months for groups who received an intervention using hypnotic suggestions. The number of sessions for hypnosis conditions ranged from 1 to 8 sessions and various adjunct therapies were used in conjunction with hypnotic suggestion, complicating data interpretation (see Table 1).

Data on attitudes towards hypnosis demonstrate that a large proportion of smokers endorse suggestion-based treatments as a possible aid for future quit attempts. In a sample of 792 current smokers, 40% reported interest in using hypnosis to quit with 13% reporting its usage to help quit in the past year (Sood et al., 2006). In 988 Swiss smokers, over 26% indicated they wanted to use hypnosis to help quit, which was comparable or higher than other cessation treatments surveyed in this study (Marques-Vidal et al. 2011). In another study of 600 inpatient smokers hospitalized for a variety of medical problems (circulatory, respiratory, etc.), 41.8% indicated an interest for using hypnosis for quitting smoking in the future (Thomas et al., 2015).

In contrast to the conclusions of Barnes et al. (2010), two recent randomized controlled trials (one included in the meta-analysis above) indicated that suggestion-based treatments may be effective as an adjunct or standalone treatment to NRT. In the largest trial utilizing hypnotic suggestion for smoking cessation, 286 smokers were given a two-month supply of nicotine patches along with three sessions of telephone counseling. Participants in the hypnotic suggestion treatment condition received two standardized sessions of hypnosis training along with an audiotape recording of the sessions to practice at home. Participants in the other condition received two 60-minute in-person sessions using an evidence-based behavioral intervention. At the 12-month follow-up, 20% of the hypnosis group versus 14% of the behavioral intervention group were biochemically verified as abstinent (Carmody et al., 2008).

In another randomized controlled trial, 164 participants were randomized to receive either a 30-day supply of NRT, a single-session hypnosis in addition to thirty days of NRT, or hypnotherapy only. The hypnosis only group was significantly more likely to be abstinent (biochemically verified) for at least the past seven days at the 36-week follow-up compared to the group that received only NRT (36.6% vs 18%). The hypnosis plus NRT group had similar rates of abstinence to the hypnosis only group (Hasan et al., 2014).

When compared to previous trials of hypnosis for smoking cessation, these two trials are noteworthy for their large sample sizes, biochemical verification of abstinence, use of adequate control groups, and use of longer follow-up periods.

Importance of Suggestions and Susceptibility

The trials reviewed used different suggestions during treatment (see Table 2). One popular and well-tested method known to hypnosis practitioners (Koop, 1988) is Spiegel's three-point method (Spiegel, 1970). The Spiegel method uses suggestions that tell participants to remember these three statements: 1. Smoking is a poison; 2. You need your body to live; 3. You owe your body respect and protection from smoking. Three trials (Hyman et al., 1986, Rabkin et al., 1984, Williams & Hall 1988) that used this method were included in the Cochrane meta-analysis. Only one of these trials found the Spiegel method to be superior to control treatment.

There is also evidence that specific smoking-related suggestions are important to cessation outcome. Pederson and colleagues (1979) compared a group that received specific smoking-related suggestions to a group that received generic relaxation-related suggestions. The abstinence rate for the smoking-related suggestion group was 53% and the rate for the relaxation-related suggestion group was only 12% at follow-up (Pederson et al., 1979).

There is no gold standard regarding what specific hypnotic suggestions are most effective for smoking cessation. In clinical practice, recommendations are to individually conceptualize the treatment and the suggestions to the patient's particular problem with quitting. The most common suggestions used in clinical trials are: imagery of being a non-smoker; enhancing coping; dealing with withdrawal symptoms; and decreasing cravings (see Table 2). Participants are also encouraged to listen to their hypnosis session at home and to practice hypnosis (both referred to as self-hypnosis). Based on the current literature, suggestions for changing automatic cognitions, such as attending away from smoking cues, have yet to be systematically tested.

The degree of hypnotic susceptibility (how deeply an individual can experience hypnosis) may be an important moderating variable when examining the efficacy of the suggestion-based interventions for smoking cessation. The assessment of hypnotic susceptibility will be described in detail later. In a large smoking cessation study in which all participants received a single hypnosis session, susceptibility was predictive of cessation success (Spiegel et al., 1993). In an earlier study, hypnotic susceptibility was related to reductions in cigarettes smoked after a suggestion-based treatment; susceptibility was not related to success in the other active condition (Schubert, 1983). Perry and Mullen (1975) also found that high susceptibility was related to decreased smoking after a suggestion-based intervention. However, not all results are consistent. In another study, participants received a variable number of hypnosis sessions for smoking cessation and found that susceptibility was not correlated with smoking abstinence (Holroyd, 1991). Of particular importance, none of the studies included in the Cochrane meta-analysis examined susceptibility as a moderator of the effect of treatment (they only examined susceptibility as a predictor variable).

If hypnotherapy is found to be effective for smoking cessation, the mechanisms by which it exerts its effects will need to be determined. As noted by Terhune et al. (2017), very little attention has been devoted to the mechanisms by which hypnosis achieves therapeutic effects in clinical domains. Hypnosis could engage many potential mechanisms, such as its effects on relaxation, imagery, and various cognitive processes (described later). The main focus of the current dissertation study is the effect on hypnosis on cognition, specifically executive control as measured by the classic Stroop task and attention towards smoking cues as measured by the smoking Stroop task.

Quitting & Relapse

Up to 75% of smokers state a desire to quit at any given time (U.S. Department of Health and Human Services, 2004) with 50% of smokers each year making an attempt to quit smoking. Estimates suggest that between 50% and 66% of smokers try to quit without using some form of treatment (Shiffman, 2008, Chapman & MacKenzie, 2010). One study reported that only 6.2% of smokers who make a quit attempt are successful (CDC, 2011). In another survey study, 38.5% of smokers had made a recent quit attempt, but only 3.1% achieved successful cessation for at least six months (U.S. Department of Commerce, 2012). Interestingly, smokers who make a quit attempt using treatment are less successful at quitting than smokers who tried to quit without using treatment (Shiffman, 2008). Even then, within those who did not use treatment, only 3-5% are able to stay quit for 6 to 12 months (Hughes, Keely, & Naud, 2004).

In sum, it appears many smokers who want to quit do not feel the need to use treatment in order to quit. Data also suggest that smokers who do use treatment are not significantly better off with the treatment options available, although it is possible that treatment-users may be a self-selected sample of heavier, more dependent, smokers. Nevertheless, the data indicate that new treatments need to be more effective, accessible, durable, and sought after.

Electronic Cigarettes

It is important to note that although cigarette smoking has declined in recent years the use of electronic cigarettes has increased (King et al., 2015). Some reports note that electronic cigarettes could be associated with less severe health outcomes in comparison to regular cigarettes. This could be due to the presence of fewer carcinogens and lower

levels of carbon monoxide present in electronic cigarette “vapor” compared to cigarette smoke (National Academies of Sciences, Engineering, & Medicine, 2018). However, studies of the health outcomes of long-term use of electronic cigarettes are not available at this time (Brandon et al., 2016). Presumably, due to the presence of nicotine in electronic cigarettes, there is potential for addiction to nicotine (Brandon et al., 2016). Interestingly, some self-help materials are already available online for treatment of electronic cigarette addiction that consist of suggestion-based treatments using self-hypnosis (Waud, 2017).

Summary

In summary, cigarette smoking continues to be a primary public health concern. The list of diseases associated with smoking continues to grow with each publication of the Surgeon General’s Report. Overall, the cigarette smoking prevalence is decreasing in the US but approximately one in six adults continues to smoke. Additionally, while most current smokers want to quit they are unable to do so. This problem continues despite several treatment options for smoking cessation.

Recent data on suggestion-based interventions using hypnosis show some promise in terms of efficacy and interest in these treatments. However, suggestion-based interventions require additional study, particularly regarding their efficacy as well as the mechanisms by which they may work. The following chapter focuses on the effect of suggestion on cognitive processes, the primary dependent variable in the current study.

CHAPTER 2: AUTOMATIC COGNITIVE PROCESSES IN SMOKING

As described in a recent review by Robinson et al. (2017), there has been growing interest in examining the impact of cognitive function in maintenance of tobacco use disorder. Some research has been concerned with assessment of automatic cognitive processes, such as attention to tobacco-related cues, described below. A second approach has examined the role of more effortful, controlled, executive cognitive processes, such as working memory. As noted by Robinson et al. (2017), both automatic and executive cognitive processes could serve as potential treatment targets for smoking cessation.

“Automatic cognitive processes” is an umbrella term for involuntary mental processes, usually in response to specific stimuli. For example, a research participant who is a smoker may preferentially and automatically attend to smoking cues during laboratory-based cue exposure (Shiffman et al., 2013). This increased attention to cues, or “attentional bias” to smoking cues, may also provoke craving.

Several tasks and paradigms have been developed to measure automatic cognitive processes in smoking. In general, these tests assess cognition through measuring reaction time. These tasks operationalize attention to smoking cues by comparing participant’s response times to smoking stimuli in comparison to neutral stimuli during the task. An accumulated body of research has shown that differences in reaction times to smoking and neutral stimuli are associated with greater craving, consumption, and relapse in smokers (Field et al., 2009; Rooke, Hine, & Thorsteinsson, 2008).

Notably, as noted above, another class of cognitive processes, executive cognitive processes, may be altered in smokers (Robinson et al., 2017). Executive cognitive processes are controlled, effortful cognitive functions such as working memory, sustained

attention, and planned behavior. Tasks that operationalize executive cognitive processes feel effortful to subjects and often assess memory capacity. Performance on these types of tasks have also been found to predict cessation success in smokers (Robinson et al., 2017).

The rest of this chapter will focus on theory and data relating to the importance of automatic cognitive processes such those observed during as the smoking Stroop task, describer later, which assesses attentional bias to smoking cues. The classic Stroop task, which is often regarded as a measure of executive functioning (Strauss, Sherman, & Spreen, 2006), will be more extensively reviewed in Chapter 3 of this proposal.

ASSESSMENT OF AUTOMATIC PROCESSES

Several tasks have been developed to measure automatic cognitive processes in smoking. A special focus for this study will be on the smoking Stroop task. A brief overview of another commonly used assessment (the dot-probe task) of automatic cognition will also be described. These two tests are amongst the most widely used within the smoking literature.

SMOKING STROOP

The smoking Stroop is a variant on the classic Stroop task (Stroop, 1935) and the “emotional Stroop” task. A description of the classic Stroop is provided first. In a classic Stroop task, trials consisting of individual words are presented one after the other in different colored text in the center of the screen. The task uses three categories of word stimuli: neutral words written in different colored text (neutral trials), color words written in the same color text (congruent trials), and color words written in different colored text than the written word (incongruent trials), e.g., the word GREEN written in red ink.

Participants are instructed to identify the color of the word. They are told they can ignore the meaning of the word itself, and to only focus on the color. Participants typically have three to four response choices, one which matches the font color of each trial. In some studies participants press buttons on a keyboard corresponding to the colors. The latency of the participant's correct responses is recorded for each trial.

For scoring, average response times are computed for each of the three trial types. Typically, participants have slower reaction times on incongruent trials in comparison to congruent trials (MacLeod, 1991). Following Raz and Campbell (2011), the classic Stroop effect can be defined as the difference in reaction times between incongruent and congruent stimuli. The same authors refer to the difference score between incongruent and neutral stimuli as "Stroop interference". "Stroop facilitation" occurs when participants are significantly faster in congruent trials than neutral trials. Thus, three scores can be derived from the average response times from the results of the classic Stroop task: incongruent-congruent ("classic Stroop effect"), incongruent-neutral (Stroop interference), and congruent-neutral (Stroop facilitation; Raz & Campbell, 2011). The classic Stroop effect is a primary focus of this study.

Some research has reported associations between subject variables and classic Stroop performance (Straus, Sherman, & Spreen, 2006). For example, race/ethnicity, educational attainment, and IQ, have been related to Stroop task performance (Straus, Sherman, & Spreen, 2006). There is little evidence for gender differences in performance on the classic Stroop task (Strauss, Sherman, & Spreen, 2006).

The smoking Stroop task is a modified form of the classic Stroop task (Cox, Fadardi, & Pothos, 2006), and of the emotional Stroop task. The emotional Stroop task

assesses reaction times for two classes of words: emotional words (such as stress-related or smoking-related words) and neutral words. The smoking Stroop also assesses reaction times for two classes of words: smoking words and neutral words. Like the classic Stroop, participants completing the emotional or smoking Stroop are required to identify the color of the text of each word as quickly and accurately as possible. A smoking Stroop effect is demonstrated when participants exhibit significant slower response times to identify colors of smoking related words than to identify colors of neutral words.

It is important to note that for both the classic and smoking Stroop tasks, the words are irrelevant to completion of the “primary task” of identifying the color. Nonetheless, on the smoking Stroop task, the task-irrelevant smoking words appear to capture attention and slow down performance of smokers on the primary task (Munafo et al., 2003). This process will be described in more detail later. The specific procedures of the classic and smoking Stroop tasks are also described in further detail in the methods section.

DOT-PROBE TASK

The dot-probe task will not be used in this study, but it will be briefly described as it is often used as a measure of automatic cognition in smoking. Notably, dot-probe tasks have also been modified in several studies of cognitive bias modification (CBM), a cognitive intervention (Robinson et al., 2017). In the dot-probe task, each trial involves presentation of a smoking related stimulus and neutral stimulus simultaneously, with each picture located on either side of a computer screen (e.g., smoking picture on left side of monitor, neutral picture on the right side on the monitor). Typically, the two pictures are presented for 500 ms for each trial. After the two stimuli disappear, a probe (usually a

dot) is presented at the location of either the smoking picture or the neutral picture. The participants then must indicate the location of the probe as quickly and accurately as possible (e.g., press the F key for “left”, and the J key for “right”). The difference in response times captures attentional bias to smoking cues. Typically, smokers are quicker to respond to probes replacing smoking stimuli than probes that replace neutral stimuli. The idea is that attentional resources are automatically allocated to the location where the smoking picture was located, thereby speeding responses to the probe when it replaces the smoking picture.

COGNITION & CRAVING

In a meta-analysis, a significant association was found between attentional bias to smoking cues and craving for cigarettes (Field et al., 2009). In this meta-analysis, the authors found a total of 68 studies, with 37 investigating attentional bias and craving in cigarette smokers. There was a significant correlation across all studies including the subset of smoking studies. The correlation between attentional bias and cigarette craving was Pearson's $r = .16$, $p < 0.001$, a small-to-moderate effect size (Field et al., 2009).

COGNITION & CONSUMPTION

Rooke, Hine, and Thorsteinsson's (2008) meta-analysis examined the correlation between measures of automatic cognition and consumption. Overall, they found 89 studies, with 45 studies specifically examining assessments such as the smoking Stroop and dot-probe task and their relationship to cigarette smoking. The overall correlation between measures of automatic cognition and consumption of cigarettes was $r = .29$, a significant result at $p < 0.001$ and a medium effect size (Rooke, Hine, & Thorsteinsson,

2008). One study also reported that smokers exhibited a larger smoking Stroop effect than never-smokers (Munafo et al., 2003).

COGNITION & RELAPSE

Some studies reported that the smoking Stroop effect is associated with unsuccessful smoking cessation (Christiansen, Schoenmakers, & Field, 2015). Notably, the magnitude of participant's smoking Stroop effect has been associated with shorter duration of abstinence after a quit attempt (Janes et al. 2010). Another clinical study reported that the magnitude of a participant's smoking Stroop effect predicted the days until relapse in a smoking cessation attempt (Waters et al., 2003).

COGNITIVE INTERVENTIONS

Taken together, the studies reviewed above suggest that automatic processes can serve as targets of interventions. Recently, as noted earlier, automatic cognitions have been targeted through a modification of cognitive tasks (Robinson et al., 2017). Most commonly, the dot-probe task is modified to have the probe replace the neutral stimuli on every trial in an attempt to reverse the automatic tendency for attention to be drawn to the smoking stimuli. These types of interventions have been termed cognitive bias modification (CBM) or attentional bias modification (ABM). Several recent trials have tested their efficacy in reducing automatic cognitive processes and promoting smoking abstinence.

In a recent meta-analysis of CBM for addictions, CBM had a significant effect on automatic cognitions. That is, cognitive bias modification was able to reduce attentional bias to addiction cues, as intended. However, the effect of CBM on consumption was not significant (Cristea, Kok, & Cuijpers, 2016). This study examined 25 studies across

addictions with 7 being clinical trials for smoking. Results were the similar across substances.

Laboratory studies have also examined the effect of CBM on craving (Robinson et al., 2017). One study demonstrated that CBM may decrease automatic cognitions and, in turn, decrease craving in males (Attwood, O'Sullivan, Leonards, Mackintosh, & Munafo, 2008). A field study also suggested that CBM reduced attentional bias and craving in smokers (Kerst & Waters, 2014). However, as described by Robinson et al. (2017), results have not been consistent.

SUMMARY

To summarize, automatic cognition in smokers is typically measured by reaction time tasks such as the smoking Stroop task. Performance on these tasks has been shown to have clinical relevance. For example, tasks measuring automatic cognition have been found in meta-analyses and review studies to correlate with measures of craving, consumption, and relapse. Therefore, interventions that effectively target and alter (reduce) these cognitive processes may have the potential to offer therapeutic benefit.

CBM is one potential intervention that has been investigated, with mixed results. Hypnotic suggestion is another method that could be examined. Although no research has examined the effect of hypnotic suggestion on automatic processes related to smoking, a series of studies have examined the effect of hypnotic suggestion on the classic Stroop task. Based on these data, there is reason to believe that hypnotic suggestion may reduce attentional bias to smoking cues. This literature is reviewed in the next chapter.

CHAPTER 3: SUGGESTION AS A COGNITIVE INTERVENTION

As noted at the end of the previous chapter, suggestion could be used as a cognitive intervention, and several studies have examined the effect of suggestion (hypnotic and non-hypnotic) on the classic Stroop task. Stated briefly, these studies have found that in individuals with high levels of hypnotic susceptibility, hypnotic suggestion decreases and in some cases eliminates the classic Stroop effect (Raz et al., 2002; Raz et al., 2005; Raz, Moreno-Íñiguez, Martin,& Zhu, 2007; Casiglia et al., 2010; Parris, Dienes, Bate, & Gothard, 2013; Parris & Dienes, 2013). Similar findings on the effect of suggestion in high susceptible participants has also been found for other tasks such as the ability to obviate perceptual illusions (e.g., McGurk Effect; Dery, Campbell, Lifshitz, & Raz, 2014). This section will present a more detailed review of hypnosis, hypnotic susceptibility, and the effect of hypnotic suggestion on cognitive processes.

HYPNOSIS

The definition of hypnosis provided by Division 30 of the American Psychological Association (Society of Psychological Hypnosis) states that hypnosis is “a state of consciousness involving focused attention and reduced peripheral awareness characterized by an enhanced capacity for response to suggestion” (Division 30 Executive Committee, 2014). Hypnotic suggestion has been researched for centuries to examine cognition and has also been used clinically to treat conditions such as chronic pain, labor pain, depression, anxiety, post-traumatic stress, and habits such as smoking (Spiegel et al., 1991, Jensen, 2011, Kirsch et al., 1999, Department of Veterans Affairs, 2010).

Hypnosis generally consists of three phases: induction, deepening, and suggestion. During the induction, a participant is asked to relax and pay attention to their internal and external environment. Participants are then asked to focus on the movement of their breath or the feeling of their body as it rests on the chair. During the deepening phase, the participant is told to become more comfortable and relaxed, usually by way of a countdown. Next, suggestions are given for the participant to experience specific physical or psychological sensations (e.g., feeling of weightlessness). These suggestions may also be posthypnotic, meaning the suggestions are intended to change behavior outside of the context of the relaxed, closed-eyed hypnotic state. These suggestions can be short- or long-term. For example, a short-term posthypnotic suggestion would be to change word reading at the sound of a clap and this effect would be reversed at the sound of two claps (similar to the suggestion condition used in this study). A long-term posthypnotic suggestion may occur in the context of a treatment using hypnosis for chronic pain. The suggestions given would be for the relief in pain encountered during hypnosis to last for the days, weeks, and months to come.

RELATIONSHIP BETWEEN HYPNOSIS AND OTHER TECHNIQUES

Hypnosis is often described as mind-body medicine or a complementary and alternative medicine (CAM). Hypnosis often includes elements in common with other mind-body techniques and CAMs such as mindfulness or progressive relaxation. Mindfulness is a technique in which participants are asked to pay “attention in a particular way: on purpose, in the present moment, nonjudgmentally” (Kabat-Zinn, 2013). Relaxation therapy (such as progressive relaxation) is taught as an “adoption of a relaxed, passive mode of thinking, brought about by focusing of attention on some

neutral target... while ignoring distracting thoughts” (Zhang et al., 2015). As noted earlier, hypnosis entails “an enhanced capacity for response to suggestion” (APA Division 30, 2014). Thus, according to the preceding definitions, the focus on response to suggestion is unique to hypnosis.

Hypnosis is different from mindfulness and relaxation in other ways (see Table 3 for a summary). First, hypnosis has been described as “a unique form of top-down regulation” (Terhune et al., 2017). “Top-down processing” is the process by which cognitions (in this case, suggestions) have the ability change emotional or sensory processing (e.g., suggestions for pain reduction induce cognitive changes [top] that result in reduced peripheral awareness [bottom]). During mindfulness, participants are asked to focus on the senses from the environment. The perception of senses during mindfulness then lead to changes in cognition. Progressive relaxation involves integration of both top-down and bottom-up cognitive processing. Progressive relaxation is similar to hypnosis in that participants are guided, but not suggested, to perform certain behaviors to increase relaxation (a top-down component; e.g., tighten and relax different muscle groups). The bottom-up component of progressive relaxation includes its focus on changes in bodily sensations during and after the exercise to induce a relaxed cognitive state. In sum, hypnosis is distinct from these other modalities in its use of suggestions which then in turn produce changes in behavior, emotions, and perceptions.

THEORIES OF HYPNOSIS

There have been several theories of hypnosis. They can be broadly categorized as either state or non-state theories. The two most dominant theories of each category are

Spanos's socio-cognitive theory of hypnosis (a non-state theory) and Hilgard's neodissociative model (a state theory).

Spanos postulated that hypnosis was not a special form of consciousness (non-state). He argued the effects of hypnosis were a result of participant's social expectations of hypnosis. From this point of view, hypnosis is effective in changing cognitions and behaviors due to the motivation of participants and the context of the hypnotic situation. In one experiment, he showed that pain perception was reduced during hypnosis, which is a highly reproducible effect of hypnosis (Spanos, 1983). However, when the same suggestions were used, but the procedure was not described as hypnosis, the pain reduction was significantly attenuated and similar to the control condition which used distraction (Spanos, 1983). Spanos also favored the view that hypnosis was under voluntary control and that the effects of suggestion are similar with or without an induction.

Spanos's socio-cognitive theory was a direct challenge to Hilgard's neodissociative model of hypnosis. Hilgard stated hypnosis did alter consciousness. Hilgard viewed hypnosis as a special form of consciousness where executive processes could be activated or deactivated (state). Hilgard was in favor of the view that responses under hypnosis were involuntary, but a "hidden observer" in participants can be activated that would be able to remember what occurred during hypnosis. The "hidden observer" is described as the part of mind responsible for executive action during waking states, but control functions are removed when a hypnotic state is achieved. Thus, suggestions can achieve cognitive changes because the participant's executive functioning has been taken "off-line".

Hilgard was also famous for developing the most widely used scale of assessing hypnotic susceptibility, the Stanford Hypnotic Susceptibility Scale: Form C (SHSS:C). Based on his findings that hypnotic susceptibility is stable across time, he also developed a trait theory of hypnosis. Brain imaging studies have revealed distinct brain changes occurring during hypnosis in high susceptibility participants in comparison to low susceptibility groups, indicating that high hypnotic susceptibility may have distinct neurobiological underpinnings (Jensen, 2011).

HYPNOTIC SUSCEPTIBILITY

Hypnotic susceptibility refers to a participant's propensity to experience hypnosis and experience a change in behavior/cognition during or after hypnosis. The gold standard for measuring hypnotic susceptibility in laboratory settings is the aforementioned SHSS:C (Weitzenhoffer & Hilgard, 1962; Champigny & Raz, 2015; see Table 4 for the SHSS:C original norms).

The SHSS:C is a performance test administered by a researcher who reads through the manual's script, which produces a hypnotic state in participants. Participants are scored based on behaviors they exhibit in response to hypnotic suggestions. The score is determined from responses to twelve progressively more difficult items during the suggestion phase of the manual's script. The script of the SHSS:C begins by telling participants to relax and focus on a specific point on the wall; this procedure is the induction. The script then informs the participants that their eyes will eventually become tired and close. Once the participant's eyes are closed, the researcher increases hypnosis by continuing to read the instructions that specify counting up from 1 to 20; with each number the participant is instructed to increase their state of hypnosis (this part of the

script is the “deepening”). After the number 20 has been read, the researcher reads through twelve hypnotic suggestions and assigns a score based on the participant’s behavioral responses to the suggestions (specific criteria for each item are listed in Appendix A). For example, item 1 asks the participants to hold out their arm and imagine a heavy ball in their hand. A positive score is coded by the researcher if a participant’s arm lowers by at least 6 inches. For item 5 (Arm Rigidity), the researcher reads a suggestion that the participant’s arm is becoming still and hard to move, after which the researcher asks the participant to try to bend their elbow. A positive score for this item is assigned if the participant does not move their elbow more than two inches for 10 seconds (Appendix A).

After all twelve items have been read to the participant, the researcher reads suggestions to end the hypnotic state. These “de-hypnosis” suggestions involve counting back from 20 to 1, with 1 signaling the participant to be fully alert and ready to answer questions about their experience. Further description of how the SHSS:C was used in the current dissertation study is listed in Chapter 5: Methods under the heading “Procedure” and “Hypnotic Susceptibility”. The full manual of the original SHSS:C that is to be used in this experiment is available online at <http://hypnosisandsuggestion.org/suggestibility-scales.html>.

In general, there is little evidence that gender, age, and ethnicity/nationality are strongly associated with hypnotic susceptibility. For example, one review reported that females have slightly higher susceptibility in large samples, usually ranging from 0.5 to 0.7 points higher (Page & Green, 2007). However, gender differences are not always found, and some studies have reported that males have higher hypnotic susceptibility scores than

females (Page & Green, 2007; Kihlstrom, 2008). There is also no evidence that stereotypical “feminine” individuals are more hypnotizable than stereotypical “masculine” individuals (Kihlstrom, 2008).

Regarding age, hypnotic susceptibility peaks between ages 9-12. There is a small decline in hypnotic susceptibility from ages 17-40, but the slope of this decline is small (Page & Green, 2007). Hypnotic susceptibility then gradually increases after age 40 (Page & Green, 2007). In sum, there is little evidence for a clear linear association between age and susceptibility.

Some research has reported that different nationalities differ in susceptibility. One study reported that average susceptibilities (assessed using HGSHS:A) were as follows: USA=7.39; Canada=5.55; Poland=6.26; Korea=6.95; Israel=5.61; Sweden=6.77; Romania=6.24; Italy=6.41; Finland=7.26; Denmark=7.64; Spain=7.13; Germany=6.51; Australia=5.45 (Freedman, 2012). More important for this dissertation study, within the USA there do not appear to be large differences in susceptibility across ethnic groups. For example, susceptibility of African Americans was reported to be similar to HGSHS:A norms (Sapp, 2004). However, this was a small study and sparse data were available for other ethnic groups.

SUSCEPTIBILITY IN SMOKERS

There are relatively few studies reporting descriptive statistics of hypnotic susceptibility in smokers (see Table 5). In what might be the only study of the SHSS:C in smokers, the authors recorded a sample mean score of 6.6 (n=49; Bliss, 1984). This score is slightly greater than the original SHSS:C normative sample (M=5.07). Other studies using different measures of hypnotic susceptibility have reported that smokers have

average levels of hypnotic susceptibility (Perry & Mullen, 1975; Frankel & Horne, 1976; Frischholz et al., 1982).

THEORIES OF CLASSIC STROOP

As noted earlier, hypnotic suggestion has been shown to influence the classic Stroop effect assessed using the classic Stroop task. This section will elaborate on theory relating to the classic Stroop effect.

There are several theories as to why the classic Stroop effect exists, that is, why the content of the task-irrelevant words influences reaction times on the color identification task (MacLeod, 1991). Raz and colleagues simplified these theories into two broader theories in their 2002 article: the “horse race” hypothesis and automaticity hypothesis. The “horse race” hypothesis is analogous to the “processing speed” theory: word reading is a faster cognitive process than color identification. The “automaticity” hypothesis refers to how word reading is automatic and that this interferes with color naming processing, a less automatic and deliberate cognitive process. Unfortunately, no consensus appears to exist regarding how these theories differ and whether they make different predictions regarding Stroop task performance. Most importantly for the current study, the Stroop effect is robustly and consistently observed (MacLeod, 1991).

NEUROBIOLOGY OF THE CLASSIC STROOP

Several studies have administered the classic Stroop to participants during brain scans that measure blood flow to different areas of the brain during functional magnetic resonance imaging (fMRI). Relative blood flow to different areas of the brain assessed during fMRI is a proxy for neural activation in those brain areas. The aggregated findings from fMRI studies of the classic Stroop show there is gross activation of the anterior

cingulate gyrus (ACC; Bush et al., 1998). The ACC is a subcortical brain structure postulated to be central in modulating “conflict” in the human brain (Raz et al., 2005). Conflict is defined as a period when the brain is tasked with two simultaneous demands. The classic Stroop is well suited to measure this conflict due to the simultaneous demands of identifying text color while not letting word reading interfere with the process of identifying and selecting the correct color.

Numerous studies have also investigated the neurobiology of the emotional Stroop task. When contrasting the results of neuroimaging between the classic and emotional Stroop tasks, the emotional Stroop results in activation of rostral areas of the ACC as opposed to greater activation in dorsal areas of the ACC during the classic Stroop (Whalen et al., 1998). Of note, neuroimaging studies have also shown decreased activation in the ACC when participants are given hypnotic suggestions (Oakley, 2008). This will be described in more detail later in this proposal in the “Suggestion and Classic Stroop” section.

CLINICAL DISORDERS & CLASSIC STROOP

The classic Stroop test is relevant to clinical psychology as it is a commonly used neuropsychological test of “executive attention”. Increased Stroop effect (poorer performance) has been observed in several psychiatric and neurological disorders. The Compendium of Neuropsychological Tests (Strauss, Sherman, & Spreen, 2006) notes that performance deficits on the classic Stroop are often found in neuropsychiatric disorders such as dementia, Parkinson’s disease, Huntington’s disease, alcohol dependence, bipolar disorder, attention deficit hyperactivity disorder (ADHD), schizophrenia, and in individuals with moderate-to-severe closed head injuries.

SMOKING & CLASSIC STROOP IN SMOKERS

Classic Stroop performance in smokers has also been studied. One study compared smokers (who were nicotine satiated) to nonsmokers and reported there were no between-group differences in the classic Stroop effect (Domier et al., 2007). The difference in the classic Stroop effect between nicotine satiated and nicotine deprived smokers' performance was also found to be nonsignificant in this study. A recent meta-analytic study of classic and smoking Stroop performance compared smokers' performance in their nicotine-deprived and in their nicotine-satiated states. The authors reported that there was no evidence that smoking abstinence or satiation influenced the magnitude of classic or smoking Stroop performance (Grabski et al., 2016).

SUSCEPTIBILITY & CLASSIC STROOP

Most pertinent to the current study, the classic Stroop has also been tested in individuals with variable levels of hypnotic susceptibility. This section will report on the classic Stroop performance during normal conditions without hypnotic suggestion. Recent findings were summarized in Varga, Németh, & Szekely (2011). A total of 8 studies were reported testing the classic Stroop in participants with various levels of hypnotic susceptibility. The first study on their table reported that the classic Stroop was not different between high and low susceptibility participants (Alkins & Ray, 2011). Two other studies used a modified version of the classic Stroop; these papers reported that high susceptible participants performed worse than lows (Dixon et al., 1990; Dixon & Laurence, 1992). The fourth study found no differences between high and low susceptible individuals on the classic Stroop task (Kallio et al., 2001). In the Raz et al (2002) study, no differences were found in the baseline condition between high and low susceptibility

participants. When Rubichi and colleagues (2005) compared low, medium, and high susceptibility participants, there was a significant negative correlation between susceptibility and the Stroop effect.

In a study conducted in conjunction with review article which involved a larger sample of participants with a range of hypnotic susceptibility, no difference was found in classic Stroop between susceptibility groups (Varga, Németh, & Szekely, 2011). Two other studies cited found no difference between high and low susceptibility participants during the classic Stroop (Sheehan, Donovan, & Macleod, 1988; Egner, Jamieson, & Gruzelier, 2005). Therefore, most of the studies reported high and low susceptibility participants do not differ in performance on the classic Stroop when assessed under “normal” conditions.

MODIFICATION OF CLASSIC STROOP

Aside from suggestion, performance on Classic Stroop can be modified by other task manipulations (Raz et al., 2003). One experiment found that telling participants the probability of incongruent words significantly improved Stroop performance (Logan, Zbrodoff, & Williamson, 1984). In another experiment, the Stroop effect was eliminated when the Stroop instructions were altered to ask participant to identify the presence or the absence of the target color (as opposed to identifying the current trial’s color), indicating that response sets could alter classic Stroop responding (Bauer & Besner, 1997). Other studies have also indicated that reducing the within-task semantic priming may improve Stroop performance (Besner & Stolz, 1999; Catena, Fuentes, & Tudela, 2002).

MODIFICATION OF SMOKING STROOP

A few studies have shown the smoking Stroop effect is modifiable by experimental manipulations. One experiment used three groups of participants who were told they: 1) could smoke soon, 2) could “maybe” smoke soon, or 3) could not smoke soon. Smoking Stroop scores were highest in the group 1, next highest in group 2, and lowest in group 3 (Wertz & Sayette, 2001). In another experiment, each participant was exposed to two conditions: a neutral cue exposure and a smoking cue exposure (Field, Rush, Cole, & Goudie, 2007). The neutral cue exposure consisted of the participant holding a pen for 10 seconds. The smoking cue exposure consisted of holding a lit cigarette for 10 seconds while abstaining from smoking. The smoking Stroop was completed after both the neutral and smoking cue exposure conditions. The authors reported that there was a significant increase in smoking Stroop scores after exposure to a smoking cue (Field, Rush, Cole, & Goudie, 2007). The studies reported above provide evidence that the smoking Stroop effect is modifiable in laboratory studies.

SUGGESTION & COGNITION

As noted earlier, suggestion can significantly modify cognition in participants with high hypnotic susceptibility. This effect may be more pronounced when participants are first given a hypnotic induction. Most commonly, suggestions are given after a hypnotic induction. This is known as “post-hypnotic” suggestion. However, three recent studies have shown imaginative suggestions (suggestions given without a hypnotic induction) also produce cognitive changes in participants with high susceptibility. In clinical contexts, suggestions are typically used during hypnosis.

As reviewed by Oakley & Halligan (2013) and Terhune et al. (2017), several recent experiments in experimental cognitive psychology have shown that scripted

suggestions are able to change a wide variety of cognitive processes to include perception, semantic and language processing, spatial orienting, and audiovisual integration. Hypnosis has also been shown to have effects on memory. In some studies, hypnosis is used to implant false memories, and in other cases it has been used to erase memories. A review of the literature on the effects of suggestion on perception and cognition is beyond the scope of the current manuscript. However, it should be noted that this literature is growing, and seems specific to hypnosis. The next section will focus on a small but important component of this literature, the effect of suggestion on the classic Stroop task and related tasks.

SUGGESTION & CLASSIC STROOP

There have been over a dozen studies published since 2002 examining the effect of suggestion on Stroop performance. Each study and the characteristics of their samples are summarized in Tables 6 & 7. An elaboration of their methods and findings is described below.

In a widely cited study, Raz and colleagues (2002) recruited groups with low hypnotic susceptibility and high hypnotic susceptibility. All participants took the classic Stroop under normal conditions (i.e., alert and not hypnotized) and after hypnotic suggestion (post-hypnotic suggestion). This was a within-subject design which is the most typical for these experiments. The specific suggestions are listed in Appendix C.

The script in the suggestion condition encourages participants to perceive the words in the Stroop task as foreign, scrambled, and hard to understand. The intention of the suggestion condition is to “turn off” semantic processing thereby making naming the color easier for participants, which is particularly important for incongruent trials (e.g.,

the word green written in blue font). A significant classic Stroop effect was present for all participants in the control condition. However, when high (but not low) hypnotic susceptibility participants completed the classic Stroop post-hypnotically in the suggestion condition, the Stroop effect disappeared. This finding is surprising given that Stroop effect is one of the most reproducible and robust (large) effects in all of psychology (MacLeod, 1991).

The results by Raz and colleagues (2002) appear to be reproducible. The same research group did a replication study with a larger sample size (N=84) and found a significant result (Raz & Campbell, 2011). Several studies with smaller sample sizes were also able to replicate their original findings using the same suggestions (Augustinova & Ferrand, 2012; Parris, Dienes, & Hodgson, 2012; Parris, Dienes, Bate, & Gothard, 2013). Variations on the original experiment have also supported the hypothesis that high susceptible participants can alter similar cognitive processes as measured by the flanker and Simon tasks (described more in the following sections).

Two studies have also examined the neurophysiological substrates of this effect. In one small study, hypnotic suggestion reduced the increased cardiovascular tone typically associated with incongruent trials. In a neuroimaging study, event-related potentials on electroencephalogram (EEG) and activation during functional magnetic resonance imaging (fMRI) after suggestion found reduced brain in the activation the ACC and visual cortex in participants with high susceptibility.

Interestingly, three experiments have shown that giving suggestions alone (without performing a hypnotic induction) may be able to eliminate the classic Stroop effect (Raz, Kirsch, Pollard, & Nitkin-Kaner, 2006; Parris & Dienes, 2013; Magalhaes

De Saldanha da Gama et al., 2013). In two of the experiments, the subjects were given the same suggestions used by Raz listed in Appendix C. Each experiment showed that suggestions were able to reduce the Stroop effect with participants with high hypnotic susceptibility without a formal hypnotic induction.

SUGGESTION & FLANKER TASK

In two experiments, Iani and colleagues (2006) recruited participants with either high or low hypnotic susceptibility. The participants were later asked to perform the flanker task (Eriksen & Eriksen, 1974), an inhibition task similar to the Stroop task. During each trial of the flanker, participants are presented with three arrows horizontally on a computer screen. The participant must respond to the center arrow's direction to the corresponding key in order to make a correct response. The arrows surrounding the center arrow on each trial type were either 1) same direction as the target (congruent trials) or 2) the opposite direction of the target arrow (incongruent trials). Participants generally take longer to respond to the incongruent trials. In their first experiment, a hypnotic suggestion was given to suggest that the non-target arrows would appear blurry and that the center targets would appear larger. Suggestions given after a hypnotic induction significantly reduced the incongruent trial reaction time for the high susceptibility group only. In their second experiment, using only high susceptibility participants, subjects received the same suggestions as the first experiment except without a hypnotic induction. In the second experiment, the "imaginative" suggestions did not significantly reduce reaction times during incongruent trials (Iani et al., 2006).

SUGGESTION & SIMON TASK

The Simon task is a test of response selection as opposed to stimulus identification. The Simon task measures reaction time to congruent or incongruent spatial targets. For example, subjects respond slower when a blue target is placed on the right side of a screen when the left arrow key codes for blue targets. The reaction time is faster when a blue target is placed on the left side of the screen when the left arrow key codes for the blue target. In one experiment, high and low susceptible participants were recruited. Every participant completed the Simon tasks under normal conditions and again after hypnotic suggestions. Suggestions were given after an induction. The suggestions amplified attention to the color and emphasized disregarding distracter stimuli presented during the tasks. After suggestions, the highly susceptible group showed no differences in reaction times for incongruent and congruent trials (Iani et al., 2009).

SUGGESTION & CONTINUOUS PERFORMANCE TASK

The Continuous Performance Task (CPT) is best known as a diagnostic assessment used in ADHD assessment. During this task participants are asked to respond as quickly as possible to a target letter. The target letter and foils (other letters) are presented with variable time spacing between trials. The CPT measures response inhibition as well as attentional focus. In one experiment that tested the effect of suggestion on test performance, a modified version of the CPT was given to a sample of individuals with and without ADHD. During the experiment, the CPT was administered at four time points: before hypnosis, after completing a hypnotic induction (but without suggestions), after completing a hypnotic induction including suggestions, and after the termination of hypnosis (and cancellation of suggestions). The results showed no

significant differences between the ADHD and control group on CPT reaction time at any time point (Virta, Hiltunen, Mattsson, & Kallio, 2015). However, CPT performance in both the ADHD and control groups improved significantly after hypnotic suggestions (Virta, Hiltunen, Mattsson, & Kallio, 2015).

SUGGESTION & MCGURK EFFECT

The McGurk Effect is derived from an experiment where participants are presented a video of a person speaking with the mouth movements of “ba, ba, ba” while the audio is superimposed and changed to “ta, ta, ta”. Participants are consistently unable to correctly identify the correct content of the audio when the discrepant visual stimuli is presented (participants hear “ga” when “ta” is the audio and the visual of the mouth movements is “ba”).

To study the effect of suggestion on the McGurk effect, researchers again recruited high and low susceptibility participants. Participants were given the McGurk effect task which asks participants to correctly identify the content of the audio of the video. The investigators compared performance in both groups before and after hypnotic suggestions. The hypnotic suggestions given were for participants to enhance their auditory capacities. The high susceptibility group significantly improved their categorization of the “true” auditory stimuli in the suggestion condition. The same set of suggestions did not improve the auditory discriminating abilities of the low susceptibility group (Dery, Campbell, Lifshitz, & Raz, 2014).

LIMITS OF SUGGESTION

The limits of suggestion on basic psychological or physiological processes are not known. Some research, reviewed below, indicates that suggestion may affect biochemical

and molecular processes. However, these studies generally had small sample sizes and results should be treated with caution pending replication with larger samples. Moreover, studies with null findings may have been less likely to be published.

In a study using highly susceptible individuals, gastric acid secretion increased by 89% after suggestions to imagine eating “delicious meals” (Klein & Spiegel, 1989). In another experiment from the same paper, distraction hypnosis reduced resting gastric acid secretion by 39% (Klein & Spiegel). A final experiment administered pentagastrin, a pharmacological agent that stimulates acid production. In comparison to the control condition, the suggestion condition resulted in an 11% reduction of gastric acid output following drug administration (Klein & Spiegel, 1989).

Two small studies indicated that hypnosis may act on molecular targets. After seven sessions of “relaxation hypnosis” administered on consecutive days to nine participants, specific genes and cytokines such as COX-2 became overexpressed (Kovacs et al., 2008). A pilot study of three participants tracked changes in white blood cells before, during, and after a hypnotic intervention; hypnosis up-regulated 15 genes between 1.2 and 1.8 fold (Atkinson et al., 2012). However, a recent study found that neuromuscular fatigue was not significantly increased after suggestions for endurance (Dittrich et al., 2018), however, this study did not investigate highly susceptible individuals (see Takarada & Nozaki, 2014).

MECHANISM OF EFFECT OF SUGGESTION ON COGNITION

The cognitive and neurobiological mechanisms that underlie the effect of suggestion on the cognitive processes reviewed above are not well understood (Terhune, Cleeremans, Raz, & Lynn, 2017). One perspective is that suggestions induce cognitive

changes by altering top-down processing (Terhune, Cleeremans, Raz, & Lynn, 2017).

Top-down processing refers to how cognition can alter the processing of sensory input or lower-level processing (as opposed to bottom-up processing where sensory input alters higher-level cognition). Hypnotic suggestion has been shown in the experimental studies described above to have altered participants' perceptual processing. From this perspective hypnosis is a "unique form of top-down regulation".

Regarding the effect of suggestion on the classic Stroop task, Terhune et al. take the view that suggestions may not "improve" executive function or cognitive control. Rather suggestions reduce the distracting effect of the task-irrelevant words, thereby "obviating" the need for cognitive control. In this way, suggestions may be useful in any context in which an individual needs to ignore task-irrelevant information while focusing on a primary task. An everyday example might be the task of engaging in a conversation in a noisy room.

If this perspective is correct, it is not clear how hypnosis alters top-down processing (Terhune, Cleeremans, Raz, & Lynn, 2017). Neuroimaging and brain stimulation research have revealed that prefrontal, anterior cingulate, and parietal cortices are involved in different components of hypnotic responding and in individual differences in hypnotic suggestibility. These regions are known to be involved in top-down regulation of lower-level brain structures. It has been speculated that individual differences in response motivations to hypnosis, biologically-based susceptibility, ability to use meta-cognition (i.e., thoughts about thoughts), and developmentally-related changes in pre-frontal cortex functioning may ultimately explain the cognitive changes observed during hypnosis (Terhune, Cleeremans, Raz, & Lynn, 2017).

SUMMARY

Hypnosis is a process where an experimenter or clinician uses suggestions given under deep relaxation to change a participant's behavior, emotion, or most importantly for this study, cognition. Recently, several studies by cognitive scientists have shown that the classic Stroop effect can be modified by hypnotic suggestion. This effect is observed primarily in participants with high hypnotic susceptibility. These findings have been extended to other cognitive tasks but have yet to be tested in more clinically relevant cognitions observed in cigarette smokers. In addition, findings from basic cognitive psychology have yet to be applied to clinical aspects of hypnosis for smoking cessation.

The current study will examine whether hypnotic suggestion reduces classic Stroop effect in smokers with high susceptibility, and whether it reduces the smoking Stroop effect (attentional bias to smoking cues), described in the previous chapter.

CHAPTER 4: STUDY RATIONALE & SPECIFIC AIMS

STUDY RATIONALE

Cigarette smoking remains the leading cause of preventable death in the United States. Despite the availability of efficacious smoking cessation treatments, most quit attempts end in relapse. Therefore, novel smoking cessation interventions are needed.

Recent research has examined cognitive processes in smoking. There is accumulating evidence that cognitive processes underlie relapse. A number of interventions, such as cognitive bias modification, have been developed to target cognitive processes. However, the beneficial effects of cognitive interventions on abstinence have been modest or inconsistent.

Another intervention type that may effectively target cognitive processes is hypnotic suggestion. However, the effect of hypnotic suggestion on cognitive processes associated with smoking has not yet been examined, but theory suggests hypnotic suggestion could reduce attentional bias to smoking cues. That is, hypnotic suggestion may improve (through top-down regulation) a smoker's ability to ignore task-irrelevant smoking-related stimuli.

The overall purpose of the study is to examine the effect of hypnotic suggestion on attentional processes in smokers. I will provide descriptive statistics on hypnotic susceptibility in smokers as well as their attitudes towards using hypnosis during a subsequent quit attempt. As noted below, Specific Aim 1 seeks to replicate previous findings that hypnotic suggestion reduces the classic Stroop effect in individuals with high hypnotic susceptibility, and will do so using a sample of smokers. Specific Aim 2 will investigate if hypnotic suggestion reduces attentional bias to smoking cues on the

smoking Stroop task (a modification of an emotional Stroop task; see Figure 1 for a conceptual model of Specific Aims 1 & 2). In exploratory analyses, I will examine if suggestions reduce craving in participants with high hypnotic susceptibility.

The experiment will utilize a within-subjects design, whereby each participant will complete the classic and smoking Stroop task twice, after no suggestions and under normal conditions (hereafter referred to as the “control condition”), and after hypnotic suggestions (hereafter referred to as the “hypnotic suggestion condition”).

The Specific Aims are as follows:

STUDY AIMS

Specific Aim 1

Using a sample of smokers, to replicate past findings that hypnotic suggestion reduces the classic Stroop effect in participants with high levels of hypnotic susceptibility.

Hypothesis 1.1: Across all participants, the effect of the suggestion condition on the classic Stroop effect will be moderated by susceptibility, that is, the effect of the suggestion will be larger in individuals who have high susceptibility.

Hypothesis 1.2: Participants with high levels of hypnotic susceptibility will have a significantly smaller classic Stroop effect in the hypnotic suggestion condition than in the control condition.

Specific Aim 2

To examine if hypnotic suggestion reduces the smoking Stroop effect in participants with high levels of hypnotic susceptibility.

Hypothesis 2.1: Across all participants, the effect of suggestion on the smoking Stroop effect will be moderated by susceptibility, such that the effect of the suggestion will be larger in more susceptible individuals.

Hypothesis 2.2: Participants with high levels of hypnotic susceptibility will have a significantly smaller smoking Stroop effect in the hypnotic suggestion condition than in the control condition.

In exploratory analyses, I also examined if the effect of hypnotic suggestion on craving (QSU ratings) is moderated by susceptibility, such that the effect of the suggestion will be larger in more susceptible individuals.

CHAPTER 5: METHODS

PARTICIPANTS

Participants for this study were 33 adult smokers who were previous participants of the author's laboratory (LOCI: Laboratory of Cognitive Interventions) who agreed to be contacted for future studies while participating in USUHS protocol #G172MA. The persons were recruited from the Washington, DC metro area using the following methods, per the #G172MA protocol: "Participants will be recruited at the following outlets: NPR radio; Washington Post; Washington City Paper; Craigslist.com; Metrobus and Metrorail; Express newspaper; Washington Examiner; Washington Post; Montgomery County Ride On Buses; Washingtonian Magazine; National Naval Medical Center; Valpak; the study/lab Facebook page and website; and using flyers."

The inclusion criteria were as follows: (1) Aged 18-65; (2) Reported smoking at least 5 cigarettes/day; (3) Had a home address and a functioning telephone number; (4) Specified English as the first language. The exclusion criteria were: (1) Self-reported color vision deficiency; (2) Indicated a history of being diagnosed with schizophrenia, bipolar disorder, psychosis, a personality disorder, or PTSD; (3) Reported any "recent major life changes." Exclusion criteria #2 and #3 were mainly based on Jensen's (2011) manual detailing which participants may be at risk of experiencing anxiety during hypnosis. As per Jensen (2011): "A history of schizophrenia or psychotic/delusional symptoms, dissociative disorders, and personality disorders would be potential contraindications for hypnotic treatment...Patients with interpersonal relationship difficulties or who are otherwise vulnerable to emotional or psychotic decompensation (i.e., those presenting with current or a history of emotional disturbance or psychotic

symptoms) may be at greater risk than others for evidencing adverse events following hypnosis."

Participants received \$50 or \$100 for completing the single laboratory visit, which lasted approximately 120 minutes. The compensation was increased after the first ten participants (i.e., from \$50 to \$100) to facilitate recruitment.

PROCEDURE

I recruited 33 smokers from the Washington, D.C. area who had previously shown interest in being contacted for future studies, as noted above. Study procedures are illustrated in Table 8 and Figure 2. During the phone screening, participants were provided a description of the study and were asked to provide verbal agreement to be screened. The research assistant then assessed the participant's eligibility for the study via telephone interview. Eligible participants were scheduled for a single in-person laboratory session at USUHS.

In total, 64 persons were screened for eligibility over the telephone, 51 were eligible based on the phone screening, and 33 participants attended and completed the study session. No participants dropped out of the study once the session began (Figure 3).

Eligible participants attended one laboratory visit. Upon arrival, the research assistant provided a detailed description of the study to the participant and collected informed consent (Appendix D). Mean visit time was 1:38 PM (range = 10:00 AM to 5:30 PM). After collecting consent, participants provided an expired breath sample to assess carbon monoxide (described later). Participants then completed questionnaires using QDS software on a desktop computer. The questionnaires assessed: demographics, recent smoking, degree of nicotine dependence (Fagerström Test for Nicotine

Dependence; FTND, Heatherton et al., 1991), smoking urges (Questionnaire of Smoking Urges-Brief; QSU-B, Cox et al., 2001), perceptions of hypnosis (described later), and side effects (also described later) (see Appendix B for the full text of the questionnaires; see Table 8 for a full list of study assessments).

A primary independent variable is Suggestion (2 levels/conditions: hypnotic suggestion and control). Each participant completed the classic and smoking Stroop tasks at both levels of Suggestion (see Figure 2). This within-subjects design (for Suggestion) is consistent with the approach of past studies investigating the effect of hypnotic suggestion using the classic Stroop task (Raz et al., 2002; Raz et al., 2003; Raz et al., 2005).

As indicated by Figure 2, Order of completion of hypnotic suggestion and the control conditions was counterbalanced across participants. Once the subject had a confirmed appointment, he or she was allocated to their condition; 25 participants were initially scheduled to complete the hypnotic suggestion condition before the control condition (“Suggestion-Control”), and 25 were initially scheduled to complete the control condition before the suggestion condition (“Control-Suggestion”; see Appendix E & F to view how the conditions differed in terms of laboratory visit checklists). Sixteen participants actually completed the Suggestion-Control order and 17 completed the Control-Suggestion order.

Before the hypnotic suggestion condition, participants were read a scripted introduction to hypnosis (see Appendix G) that was adapted from a measure of hypnotic susceptibility administered in group formats (Harvard Group Scale of Hypnotic Susceptibility; HGSHS; Shor & Orne, 1962). Of note, the HGSHS is based on the

individually-administered SHSS:C; both are commonly used tests of hypnotic susceptibility. This standardized introduction was important because it gave the participant opportunity to ask questions, and because it gave the experimenter the opportunity to address any concerns, develop rapport, and dispel any misconceptions the participant may have had regarding hypnosis. Provision of an introduction to hypnosis is also recommended as a means of decreasing any possible hypnotic sequelae (Crawford, Hilgard, & MacDonald, 1982; Page & Green, 2002). The introduction followed all current recommendations to reduce the risks in hypnosis which include: assessing past experiences with hypnosis; assessing potential phobias and anxiety; collaborative psychoeducation about hypnosis; and not referencing potential side effects prior to hypnosis. In addition, a post-hypnosis “interview” was conducted to ensure hypnosis was no longer being experienced, and to assess for potential side effects (Page & Green, 2002).

A practice version involving 33 trials of meaningless letter strings (e.g., HHHH) was administered before the Stroop tasks. Participants were given practice on the Stroop task to ensure understanding of the task before the tasks were administered (see Appendix H to view laboratory setting and placement of laptop which displayed all versions of the Stroop tasks; the desktop computer to the right was used to collect questionnaire responses). The instructions, given just before the practice trials, informed participants that words would appear in different colored fonts on the computer screen, one after the other, and that their task was to indicate as rapidly and as accurately as possible which color the word was written in by pressing one of four response buttons on the computer keyboard. Specific computer keys corresponded to colors (e.g., F key for

red, J key for green, and U key for blue; these keys had stickers with corresponding colors on the top of each key). Participants were instructed they should ignore the meaning of the (target) word itself and to respond to the color.

The hypnotic suggestion condition used the same suggestions described in Raz et al. (2002) and Raz et al. (2005) (see Appendix C). The suggestions were preceded by a hypnotic induction and deepening from the SHSS:C manual (see Figure 4). These suggestions also included a signal (double clap) to cancel the suggestions after the completion of the task (see Appendix C for full description and script of the Suggestion condition).

After the first administration of the Stroop tasks, the participants had a ten-minute break. Depending on condition, participants completed the classic and smoking Stroop again under the control or suggestion condition. All participants completed the classic Stroop task before the smoking Stroop task.

After each classic/smoking Stroop administration, participants completed the QSU and questions on side effects (Figure 2; see Appendix I & J for view of computer presentation of these questionnaires). After the hypnotic suggestion condition only, the experimenter tested the suggestions had been cancelled by asking the participant to identify three colored words. If a participant was not able to complete this task with 100% accuracy, the experimenter would be required to perform a short induction with additional suggestions to cancel the suggestions until the participant was able to read the three words. (In the event, no participant required the “extra induction”). This was done as a precaution in order to ensure that participants’ semantic abilities were restored.

The Stanford Hypnotic Susceptibility Scale, Form C (SHSS:C) was administered after completion of the second administration of the classic and smoking Stroop task (Figure 2). During the SHSS:C administration, a structured induction and deepening is used. After the induction and deepening, the participant was rated on 10 progressively difficult behavioral tasks (see Appendix A for the scoring criteria for each item). Following the induction and deepening, a recommended debriefing was given to ensure participants were no longer experiencing hypnosis (p. 119-124, Crawford, Hilgard, & Macdonald, 1982). During the debrief, the experimenter gave suggestions to stop experiencing hypnosis by using a countdown and using questions recommended by the SHSS:C developer; these procedures are recommended to cancel the effects of hypnotic suggestions and also to reduce the chances of hypnotic sequelae (p. 119, Crawford, Hilgard, & Macdonald, 1982; Page & Green, 2002).

Each participant was offered local, state, and national resources on smoking cessation programs at the end of the experiment (Figure 2). Each participant was thanked for their participation and informed as to how they would receive compensation.

SUGGESTION CONDITION

As noted earlier, the same suggestions from a previous study (Raz et al., 2002) were used in the hypnotic suggestion condition (Appendix C). The suggestions were administered after hypnotic induction and deepening from the SHSS:C manual (Figure 4). The hypnosis was entirely scripted.

CONTROL CONDITION

In the control condition, participants did not undergo a hypnotic induction and deepening, and were not given suggestions. Participants performed the classic and smoking Stroop tasks under “normal” conditions as described later.

MEASURES

Biochemical Measure

I assessed recent smoking via breath carbon monoxide. Carbon monoxide (CO) was assessed using the Bedfont smokelyzer system. Light smokers typically score at least 8 parts per million (ppm) on this test, while heavier smokers usually score at least above 10 ppm (Ahluwalia et al., 2006). However, if a participant abstains from smoking overnight, their score will likely be below 8 ppm. Heavy smokers who smoke heavily before the session can have scores in excess of 40 ppm. The smokelyzer CO data provided an “objective” measure of smoking in our sample. These data were used as descriptive statistics.

Self-Report Assessments

The 10-item QSU-B (Cox, Tiffany, & Christen, 2001) was used to assess craving. A total score can be computed as well as two factor scores: 1) intention and desire to smoke and 2) desire for smoking to reduce negative affect. The total score was used in the current study. This questionnaire was administered after completing the classic and smoking Stroop at both levels of Suggestion (Figure 2). The QSU assessed craving “right now”. The reliability of the QSU is high (e.g., Cronbach’s alpha = 0.97; Toll, Katulak, and McKee, 2006). The validity of the QSU has been demonstrated through cigarette cue exposure experimental paradigms (Cox, Tiffany, & Christen, 2001).

The 6-item Fagerström Test for Nicotine Dependence (FTND; Heatherton, Kozlowski, Frecker, & Fagerström, 1991) is a well-validated self-report measure of nicotine dependence (Appendix B). Higher scores indicate higher levels of dependence. The FTND has been reported to have a Cronbach's alpha of .65 a sample of American and French smokers (Pomerleau, Carton, Lutzke, Flessland, & Pomerleau, 1994).

The attitudes towards using hypnosis questionnaire was adapted and modified from an assessment used by Miller et al. (2011). The measure used in the Miller et al. study investigated attitudes towards using hypnosis to decrease anxiety before receiving a colonoscopy. The assessment used in the current dissertation is comprised of four items (each assessed using a 0 to 10 scale) with higher scores indicating greater interest in using hypnosis for smoking cessation during a future quit attempt (see Appendix B).

A 3-item author constructed questionnaire was developed to assess side effects, and was based on the most commonly reported negative side effects of hypnosis. The side effects assessed were: drowsiness, confusion, and headache. Responses were made on a 0-4 scale: 0 = "not at all", 1 = "a little", 2 = "somewhat", 3 = "a lot", 4 = "very much". Side effects were assessed three timepoints: at baseline, after the control condition, and after the hypnotic suggestion condition.

Classic & Smoking Stroop

The classic and smoking Stroop tasks were implemented using e-Prime software. Participants sat at a viewing distance of approximately 65 cm from the computer monitor. At the outset of each trial, a black fixation cross was presented in the center of the computer screen. Each trial's stimulus (i.e., a written word) was a single word displayed in one of four colors (red, blue, green, yellow) appearing at the center of the computer

screen. All characters were displayed in upper case font against a white background; the stimuli subtended a visual angle of $\sim 0.5^\circ$ vertically, and 1.3° to 1.9° horizontally (depending on word length). The task for the subject was to identify the color in which the word is written by pressing a button corresponding to that color. Five-hundred milliseconds after a button-press response (or 500 ms after a 3-s timeout), a new word was presented. During the inter-trial interval, the screen was blank. All reaction times (RT) for each trial were recorded by e-PRIME software.

For the classic Stroop task, three classes of words were used: 1) congruent words (RED, BLUE, GREEN, and YELLOW) written in corresponding red, blue, green, and yellow ink; 2) incongruent words (RED, BLUE, GREEN, and YELLOW) in which the colors and words are mismatched, e.g., GREEN written in red ink; and 3) neutral words (LOT, SHIP, KNIFE, and FLOWER) used by Raz et al. (2002). The neutral words were length- and frequency-matched to the color words. There were 44 trials of congruent, incongruent, and neutral words, respectively, for a total of 132 trials during the classic Stroop task which took approximately six minutes to complete.

For the smoking Stroop task, two classes of words were used: 1) Smoking words, and 2) Neutral words. I used 11 smoking words (PACK, URGE, PUFF, DRAG, SMOKE, TOBACCO, ASHTRAY, CRAVING, NICOTINE, CIGARETTE, INHALE) used by Waters et al. (2003), and 11 matched neutral words (SINK, IRON, SOFA, COUCH, CARPET, LOUNGE, CURTAIN, HALLWAY, BOOKCASE, FURNITURE, TIDY). The word sets were of comparable length (5.91 vs 5.81 letters, respectively) and frequency (13.5 vs 15.3, respectively). There were 33 trials of Smoking and Neutral

words, respectively, for a total of 66 trials for the smoking Stroop task which took approximately 70 seconds to complete.

The estimated internal reliability of mean RT for the trial types of the smoking Stroop (neutral, smoking) have been shown to be excellent ($r = .94$ & $.92$, respectively) when using the Spearman-Brown formula, $2r/(1 + r)$, to obtain split-half reliability coefficients (Waters et al., 2003). The estimated internal reliability of the smoking Stroop effect (difference score) was $r = .64$ in that study: As is typical, the estimated internal reliability of the difference score is lower than that of the two trial types from which the difference score is derived (Parrott, 1991).

In the current dissertation study, for the control condition, the estimated internal reliabilities (using the Spearman-Brown formula for odd vs even trials) of mean RT for the incongruent and congruent trials in the classic Stroop were excellent ($r = .96$ & $.98$, respectively). The estimated internal reliability for the classic Stroop effect (the difference score) was $r = .54$. For the hypnotic suggestion condition, the estimated internal reliabilities of mean RT for the incongruent and congruent trials in the classic Stroop were excellent ($r = .94$ & $.97$, respectively). The estimated internal reliability for the classic Stroop effect was $r = .64$.

For the smoking Stroop task, for the control condition the estimated internal reliabilities (using the Spearman-Brown formula for odd vs even trials) of mean RT for the smoking and neutral trials in the smoking Stroop were excellent ($r = .97$ & $.97$, respectively). The estimated internal reliability for the smoking Stroop effect (the difference score) was $r = .80$. For the hypnotic suggestion condition, the estimated internal reliability of mean RT for the smoking and neutral trials in the smoking Stroop

were excellent ($r = .95$ & $.92$, respectively). The estimated internal reliability for the smoking Stroop effect was $r = .44$.

Hypnotic Susceptibility

The Stanford Scale of Hypnotic Susceptibility, Form C (SHSS:C; Weitzenhoffer & Hilgard, 1962) is considered the gold standard for assessing a research participant's ability to experience hypnosis. The SHSS:C was scored in this study using a 0-10 scale (as noted earlier, item #7 [age regression] items and item #9 [anosmia to ammonia] were omitted to reduce potential for adverse events; Raz et al., 2002; Raz et al., 2005; see Appendix K & Table 9 for a summary of research on the risk and benefits of hypnosis). I defined scores from 8-10 as "high" levels of susceptibility.

There is evidence that the test-retest reliability of the SHSS:C is strong. In one study, which re-tested participants 25 years after the original administration, the test-retest correlation was $r=.71$ (Piccione, Hilgard, & Zimbardo, 1989). The internal reliability as reported in the SHSS:C manual is $r=.85$ as determined by the Kuder-Richardson formula (a special case of Cronbach's alpha applied to binary data). The manual also states that reliability is not significantly affected by reducing or abbreviating the scale (Weitzenhoffer & Hilgard, 1962).

The validity of the SHSS:C has been demonstrated as follows. The SHSS:C correlates significantly with several other scales of hypnotic susceptibility (Hilgard, 1978), and it is also used as a "gold-standard" comparison when other susceptibility scales are developed (Elkins et al., 2016). Ratings from the SHSS:C also correlate with subjective/clinical ratings of susceptibility (O'Connell, Orne, & Shor, 1966). Multiple studies have also shown that degree of hypnotic susceptibility is correlated with smoking

abstinence after suggestion-based interventions (Perry & Mullen, 1975; Schubert, 1983; Barabasz et al., 1986; Spiegel et al., 1991). In other words, participants with higher scores on the SHSS:C tend to benefit more from suggestion-based interventions. Relevant to the current dissertation study, hypnotic suggestion reduces the classic Stroop effect in high susceptibility groups only (see Table 6).

Hardware & Software

Questionnaires were administered in the laboratory and during phone screening using Questionnaire Development System (QDS) software. Research staff manually entered CO & SHSS:C data into QDS. As noted earlier, the classic and smoking Stroop tasks were administered through E-Prime software (www.pstnet.com). (See Appendix H for a picture of the laboratory room where all study visits took place. Questionnaires administered through QDS were presented on the desktop computer. The classic and smoking Stroop tasks were administered on the laptop computer.)

DATA ANALYSIS

The independent variables were Susceptibility (continuous variable), and Suggestion (a within-subject categorical variable with 2 levels, hypnotic suggestion vs. control). The primary dependent variables were: classic Stroop effect (Aim 1); smoking Stroop effect (Aim 2); and QSU ratings (exploratory analysis).

On the Stroop tasks, reaction times (RTs) from all incorrect responses during the task were discarded in addition to RTs less than 100 milliseconds. The classic Stroop has three scores derived from average response times for each trial type: incongruent minus congruent (classic Stroop effect), incongruent minus neutral, and congruent minus neutral. The classic Stroop effect was the primary dependent variable for Aim 1. The

smoking Stroop effect was computed as smoking minus neutral and was the primary dependent variable for Aim 2.

For the primary analyses, a general linear model (SAS PROC GLM) was used to determine the effect of Susceptibility and Suggestion condition on the classic Stroop (Aim 1) and smoking Stroop (Aim 2) effects. Order (hypnotic suggestion condition first vs. control condition first) was included as a between-subjects independent variable; Order was not expected to interact with Susceptibility or Suggestion (Raz et al., 2002)..

Descriptive statistics on smoker's level of hypnotic susceptibility and attitudes towards using hypnosis for smoking cessation were also calculated. Descriptive statistics included the mean, median, standard deviation, skew, and kurtosis for the SHSS:C. The mean was expected to be approximately 5, indicating an average level of hypnotic susceptibility over participants. Descriptive statistics including the mean, median, standard deviation, skew, and kurtosis were also calculated for ratings on the attitudes towards hypnosis scale. The mean was expected to be at least 7 on each scale (0-10), indicating a generally favorable and optimistic view of hypnosis for smoking cessation.

Specific Aim 1

Using a sample of smokers, to replicate past findings that hypnotic suggestion reduces the classic Stroop effect in participants with high levels of hypnotic susceptibility.

Hypothesis 1.1: To examine whether the effect of Suggestion on the classic Stroop effect is moderated by Susceptibility, I used a general linear model (SAS PROC GLM) in which hypnotic Susceptibility was entered as a continuous independent variable (centered around 0) and Suggestion condition (hypnotic suggestion vs. control) was

entered as a within-subject variable. A significant Susceptibility x Suggestion interaction would indicate that the effect of Suggestion is moderated by Susceptibility.

Hypothesis 1.2: A GLM tested whether subjects who scored in the range of 8-10 (high hypnotic susceptibility, estimated $n=10$) exhibited a smaller classic Stroop effect in the hypnotic suggestion condition than in the control condition.

Specific Aim 2

To examine if hypnotic suggestion reduces the smoking Stroop effect in participants with high levels of hypnotic susceptibility.

Hypothesis 2.1: To examine whether the effect of Suggestion on the smoking Stroop effect is moderated by Susceptibility, I used a general linear model (SAS PROC GLM) in which hypnotic Susceptibility was entered as a continuous independent variable (centered around 0) and Suggestion condition (hypnotic suggestion vs. control) was entered as a within-subject variable. A significant Susceptibility x Suggestion interaction would indicate whether that the effect of Suggestion was moderated by Susceptibility.

Hypothesis 2.2: A GLM tested whether the subjects who scored in the range of 8-10 (high hypnotic susceptibility, estimated to be $n=10$) exhibited a smaller smoking Stroop effect in the hypnotic suggestion condition than in the control condition.

Exploratory Analyses

To make full use of the dataset, I conducted a number of exploratory analyses. First, I explored whether Suggestion reduced craving (QSU ratings), particularly in individuals with high levels of Susceptibility. Second, if hypnotic suggestion reduced the smoking Stroop effect as well as craving, I intended to explore if any effect of hypnotic suggestion on craving was mediated by an effect of Suggestion on the smoking Stroop

effect. Third, I explored if Susceptibility was correlated with perceptions of using hypnosis for smoking cessation. Items 2 and 3 assess participant's perceived efficacy of hypnosis. Previous research and theory indicate that hypnosis can be a result of highly motivated behavior which leads to behavioral changes during suggestions (Spanos, 1982). I examined whether scores on items 2 and 3 from the perceptions of hypnosis scale were correlated with Susceptibility. Items 2 and 3 assess the perceived efficacy of hypnosis for smoking cessation.

Covariates

If a variable was correlated with Susceptibility, I considered inclusion of that variable as a covariate in GLMs. Gender (coded as 1=male, 2=female) was not significantly associated with SHSS:C ($r=-.12, p=.49$). Additionally, there was no evidence that age ($r=-.27, p=.12$), race (coded as 0=Other, 1=AA) ($r=-.27, p=.12$), years of education ($r=.02, p=.89$), or income ($r=.25, p=.16$) were associated with SHSS:C scores. Therefore, gender, age, race, years of education, and income were not included as covariates. Finally, as described later, subjects attended the lab session at different times of day. There was no evidence that time of day was associated with Susceptibility ($r = -0.06, p = .76$).

Additionally, I examined whether gender, age, race, years of education, and income were associated with study dependent variables. Gender was not significantly associated with the classic Stroop effect in the hypnotic suggestion ($r=.10, p=.57$) or control condition ($r=.08, p=.65$), or with the smoking Stroop effect in the hypnotic suggestion ($r=-.07, p=.70$) or control condition ($r=-.11, p=.54$), or with QSU ratings in the hypnotic suggestion ($r=-.08, p=.65$) or control condition ($r=-.20, p=.27$). Age, race

(binary), and income were also not significantly associated with the classic Stroop effect in the hypnotic suggestion or control condition, or with the smoking Stroop effect in the hypnotic suggestion or control condition, or with QSU ratings in the hypnotic suggestion or control condition (all $ps > .13$, $.21$, and $.32$ for age, race, and income respectively). Years of education was correlated with the smoking Stroop effect in the control condition ($p = .01$), but not the other variables (all $ps > .14$). Inclusion of years of education (centered) as a covariate in analysis of the smoking Stroop effect did not change any of the findings.

Regarding smoking variables, there was no evidence that FTND scores ($r = 0.02$, $p = .91$) or expired breath CO level ($r = 0.09$, $p = .63$) were associated with Susceptibility. There was also no evidence that FTND scores were associated with the classic Stroop, smoking Stroop, or QSU ratings in the hypnotic suggestion condition (all $ps > .18$) or the Control condition (all $ps > .16$). Likewise, there was also no evidence that expired breath CO levels were associated with the classic Stroop, smoking Stroop, or QSU ratings in the hypnotic suggestion condition (all $ps > .63$) or the Control condition (all $ps > .17$).

Power Analysis

All tests used were 2-tailed, with alpha value set to $.05$. Power analyses were performed using G Power Version 3 (Faul, Erdfelder, Lang, & Buchner, 2007). For Aims 1 and 2, I estimated the effect size for the Susceptibility x Suggestion interaction based on data presented in Raz et al. (2002). The effect sizes reported in Raz et al. for the pertinent Group x Suggestion interaction term for the incongruent-congruent trials, $F(1,28)=17.13$ (corresponding to a t value of 4.14) was converted to an r value ($r=.62$,

i.e., a large effect sizes). For Hypotheses 1.1 and 2.1, with $N=50$ and $r=.62$, the study had estimated power = .99 to detect an interaction between Susceptibility (entered as a continuous variable) and Suggestion (a within-subjects variable with 2 levels: hypnotic suggestion vs control).

The power analysis above derived the estimated effect size from a study (Raz et al., 2002) that used an extreme group design (sampling participants with only either high and low susceptibility). In the current dissertation, Susceptibility was treated as a continuous variable (recruiting participants with low, medium, and high susceptibility). This raises the question as to what effect size would have occurred in the Raz et al. (2002) study if the investigators enrolled a full range of susceptibility scores (i.e., treated Susceptibility as a continuous variable, as in the current study). To investigate this, a simulation study was conducted (Olsen, email communication, 03/09/17). The simulation study generated 100 bivariate normal samples (x_1 , x_2), each with $N = 100$, Mean = 0, $SD = 1$, and a correlation between x_1 and x_2 of $r = .5$. A binary variable, x_3 , was created such that $x_3=0$ if $x_2 < -1$, and $x_3 = 1$ if $x_2 > 1$ (x_3 was missing otherwise). The average r between x_1 and the (binary) x_3 variable was .65. Thus, the effect size with a binary variable, $r = .65$, is reduced by 23% if the full continuous variable were used.

The above suggests that the true effect size in Raz et al. study may have been smaller if participants with a full range of scores were recruited. I therefore conducted an additional power analysis reducing the effect size r of .62 by 23% (i.e., to .48). Even with the reduced effect size ($r = .48$), the study still had power = .95 to detect an interaction.

For Hypotheses 1.2 and 2.2, with 10 highly susceptible individuals, the study has power = .80 to detect a difference (between Suggestion conditions) in the Stroop effect of

$d=1.00$. Based on the F value presented in Raz et al., $F(1, 30) = 29.25$, the estimated effect size for this within-subject comparison is $d = 1.96$, and therefore larger than $d = 1.00$.

The power analysis for Hypotheses 2.1 and 2.2 assumes that 10 participants (20% of sample) would have SHSS:C scores of 8 or more. To investigate the plausibility of this assumption, I examined the distribution of SHSS:C scores from two previous studies. In addition, bootstrapping was used (using IBM SPSS Version 24) to estimate the 95% confidential intervals (CIs) for the proportions (and percentages).

As reported in the SHSS:C manual, of the 203 participants, 23.15% of participants scored 8 or higher. When the 95% CIs for this proportion was generated using the 203 participants, the 95% CIs were 17.24% and 29.06%. A more recent paper reported hypnotic susceptibility scores (Parris & Dienes, 2013), and 28.13% of the sample of 32 participants scored 8 or above on a measure of hypnotic susceptibility. When bootstrapping was used with this sample to generate 95% CIs for the proportion, the 95% CIs were 21.40% and 43.75%. In sum, based on the above data, it was considered likely at least 10 participants would have SHSS:C scores of 8 or more.

CHAPTER 6: RESULTS

Demographic data are presented in Table 10. Participants were on average 50.70 years old ($SD = 9.78$), and 54.55% were female. The majority of the participants (78.79%) self-identified as Black. The total sample reported smoking an average of 13.18 cigarettes per day ($SD = 7.96$).

DESCRIPTIVE STATISTICS

Descriptive statistics for the SHSS:C were as follows: *Mean* = 5.09, *Median* = 5.00, *SD* = 2.30, *Skew* = -0.30 ($SE = 0.41$), and *Kurtosis* = -0.59 ($SE = 0.80$; see Figure 5 for frequency plot of distribution). The distribution did not appear to be inconsistent with a sample that has been drawn from a normal distribution. Four participants reported SHSS:C scores ≥ 8 , which was fewer than expected. Given the smaller than expected number of “high susceptible” individuals, all analyses that involved the examination of the effect of hypnotic suggestion on outcomes were also conducted using a cut-off of SHSS:C scores ≥ 7 (11 individuals). For the Perceptions of Hypnosis Questionnaire, the descriptive statistics (aggregated over 4 items) were: *Mean* = 7.64, *Median* = 7.50, *SD* = 1.58, *Skew* = -0.68 ($SE = 0.41$), and *Kurtosis* = 0.25 ($SE = 0.80$).

For the control condition, the average reaction times for each condition were as follows: incongruent trials = 889.12 ms ($SD = 168.03$), congruent trials = 776.06 ms ($SD = 138.26$), smoking trials = 806.63 ms ($SD = 154.58$), and neutral trials (smoking Stroop) = 801.12 ms ($SD = 135.36$). For the hypnotic suggestion condition, the average reaction times were: incongruent trials = 899.87 ms ($SD = 152.49$ ms), congruent trials = 786.79 ms ($SD = 134.64$), smoking trials = 831.91 ms ($SD = 151.50$), and neutral trials (smoking

Stroop) = 833.57 ms (*SD* = 123.69). Descriptive statistics for the classic Stroop effect and smoking Stroop effect are reported in Table 11.

The presence of a side effect was defined by ≥ 1 point increase in the side effect when compared to the most proximal assessment before hypnosis was administered. Using this definition, side effects due to hypnosis were fairly common (54.45% of all subjects reported at least 1 side effect). The most common side effect (as defined by the change score above) was “drowsiness” (48.48%). The next most common side effect (as defined by the change score) was “confusion” (18.18% of participants), and the side effect of “headache” was reported by one subject (3.03% of the sample). Side effects were also mild. In the hypnosis condition, no side effect item was rated with an (absolute) value of 3 [“a lot”] or 4 [“very much”] (on a 0-4 scale); all side effect items were either rated as a 1 [“very little”] or 2 [“somewhat”].

SPECIFIC AIM 1

Specific Aim 1 examined if hypnotic suggestion reduced the classic Stroop effect in smokers with high levels of susceptibility.

Hypothesis 1.1 examined whether the effect of Suggestion on the classic Stroop effect was moderated by Susceptibility. The Susceptibility x Suggestion interaction was not significant (Table 12, Figure 6). Therefore, contrary to hypothesis, there was no evidence that participants with higher Susceptibility scores exhibited a greater decrease in the classic Stroop effect during hypnotic suggestion (vs. control condition) than participants with lower Susceptibility scores.

Hypothesis 1.2 examined whether participants with high levels of hypnotic susceptibility would exhibit a significantly smaller classic Stroop effect in the hypnotic

suggestion condition than in the control condition. As noted in Table 12, when high susceptibility was defined as SHSS:C scores ≥ 8 , there was no evidence that the classic Stroop effect was lower in the hypnotic suggestion condition (vs. control condition) in participants with high levels of hypnotic susceptibility. When high susceptibility was defined as SHSS:C scores ≥ 7 , there was similarly no evidence that the classic Stroop effect was lower in the hypnotic suggestion condition (vs. control condition), $F(1, 9) = 0.73$, $p = .41$ (not shown in Table 12) in participants with high levels of hypnotic susceptibility.

SPECIFIC AIM 2

Specific Aim 2 examined if hypnotic suggestion reduced the smoking Stroop effect in smokers with high levels of susceptibility.

Hypothesis 2.1 examined whether the effect of Suggestion on the smoking Stroop effect was moderated by Susceptibility. The Susceptibility x Suggestion interaction was not significant (Table 12, Figure 7). Therefore, contrary to hypothesis, there was no evidence that participants with higher Susceptibility scores exhibited a greater decrease in the smoking Stroop effect during hypnotic suggestion (vs. control condition) than participants with lower Susceptibility scores.

Hypothesis 2.2 examined whether participants with high levels of hypnotic susceptibility would exhibit a significantly smaller smoking Stroop effect in the hypnotic suggestion condition than in the control condition. Figure 7 appears to suggest that hypnotic induction does indeed reduce the smoking Stroop effect in the four individuals with SHSS:C scores ≥ 8 . However, as noted in Table 12, the p value indicated that there was no evidence that the smoking Stroop effect was lower in the hypnotic suggestion

condition (vs. control condition) in participants with high levels of hypnotic susceptibility. When high susceptibility was defined as SHSS:C scores ≥ 7 , there was similarly no evidence that the smoking Stroop effect was lower in the hypnotic suggestion condition (vs. control condition), $F(1, 9) = 0.35$, $p = .57$ (not shown in Table 12) in participants with high levels of hypnotic susceptibility.

EXPLORATORY ANALYSES

Effect of Susceptibility and Suggestion on Craving

The first exploratory aim examined if Suggestion reduced craving (QSU ratings), particularly in individuals with high levels of Susceptibility. The Susceptibility x Suggestion interaction was significant (Table 12, Figures 8 & 9). Therefore, there was evidence that participants with higher Susceptibility scores exhibited a greater decrease in craving ratings during hypnotic suggestion (vs. control condition) than participants with lower Susceptibility scores. When high susceptibility was defined as SHSS:C scores ≥ 8 , there was no evidence that QSU ratings were lower in the hypnotic suggestion condition (vs. control condition) in participants with high levels of hypnotic susceptibility, $F(1, 2) = 3.13$, $p = .22$ (not shown in Table 12). However, when high susceptibility was defined as SHSS:C scores ≥ 7 , there was evidence that QSU ratings were lower in the hypnotic suggestion condition (vs. control condition), $F(1, 9) = 12.41$, $p = .007$ (not shown in Table 12) in participants with high levels of hypnotic susceptibility.

Mediation Analysis

The second exploratory aim was to examine if an effect of Suggestion on craving is mediated by an effect on the smoking Stroop effect. Because Suggestion did not have an effect on the smoking Stroop effect, either over all participants or in high susceptible

participants, there could be no mediation. Therefore, a mediation analysis was not conducted.

Associations between Susceptibility and Perceptions of Hypnosis

The third exploratory aim examined if Susceptibility was correlated with perceptions of using hypnosis for smoking cessation. The mean score on item 2 (1-10 scale) was 5.84 ($SD = 2.27$), and the mean score on item 3 (1-10 scale) was 6.84 ($SD = 2.63$). There was no evidence that perception of hypnosis (assessed using an average of items 2 and 3) was correlated with SHSS:C scores, $r(30) = .26$, $p = .15$.

Effects of Order

Seventeen subjects completed the Control-Hypnosis condition, and 16 completed the Hypnosis-Control condition. Order of completion (0=Control-Hypnosis, 1=Hypnosis-Control) was not correlated with SHSS:C, $r(31) = .10$, $p = .60$. As noted earlier, Order was included as a variable in all GLMs.

Participants in the Control-Hypnosis condition had a classic Stroop effect of 127.50 ms ($SD = 75.03$) in the control condition (the first condition they completed), and a classic Stroop effect of 99.49 ms ($SD = 62.52$) in the hypnotic suggestion condition (the second condition they completed). Participants in the Hypnosis-Control condition had a classic Stroop effect of 127.52 ms ($SD = 78.62$) in the hypnotic suggestion condition (the first condition they completed), and a classic Stroop effect of 97.71 ms ($SD = 51.50$) in the control condition (the second condition they completed). Therefore, participants tended to have a higher classic Stroop effect in the condition they performed first, which is consistent with the idea that subjects' performance improves with practice (i.e., subjects exhibit smaller classic Stroop effects over repeated assessments). This is

reflected in the presence of a significant Suggestion x Order interaction, $F(1, 30) = 5.06$, $p = .03$ in the analysis of Specific Aim 1.

In contrast with the results for Specific Aim 1, in the analysis of data for Specific Aim 2 there was no evidence for a Suggestion x Order interaction, $F(1, 29) = 0.00$, $p = .97$.

Participants in the Control-Hypnosis condition had a mean QSU rating of 45.88 ($SD = 31.00$) in the control condition (the first condition they completed), and a mean QSU rating of 41.59 ($SD = 33.15$) in the hypnotic suggestion condition (the second condition they completed). Participants in the Hypnosis-Control condition had a mean QSU rating of 34.63 ($SD = 26.59$) in the hypnotic suggestion condition (the first condition they completed), and a mean QSU rating of 31.66 ($SD = 27.21$) in the control condition (the second condition they completed). Therefore, participants tended to report more craving in the condition they performed first, which is consistent with the idea that craving declines during the course of the study. This is reflected in the presence of a significant Suggestion x Order interaction, $F(1, 30) = 4.24$, $p = .04$ in the analysis of craving data.

Effect of Susceptibility and Suggestion on Side Effects

A GLM examined the effect of Susceptibility and Suggestion on side effects (mean of 3 items, which all used a 0-4 scale). The main effect of Suggestion was significant, $F(1, 30) = 14.64$, $p < .001$, meaning that there was evidence that side effects were higher in the hypnotic suggestion condition ($M = 0.41$, $SD = 0.39$) than the control condition ($M = 0.18$, $SD = 0.24$). There was no evidence that the effect of Suggestion was moderated by Susceptibility, $F(1, 30) = 0.57$, $p = .46$.

CHAPTER 7: DISCUSSION

The main results of this study were as follows. First, contrary to Hypothesis 1.1, there was no evidence that hypnotic susceptibility moderated the effect of Suggestion on the classic Stroop effect. In addition, contrary to Hypothesis 1.2, there was no evidence that the classic Stroop effect was reduced by hypnotic suggestion in individuals with high levels of hypnotic susceptibility. Second, contrary to Hypothesis 2.1, there was no evidence that hypnotic susceptibility moderated the effect of Suggestion on the smoking Stroop effect. In addition, contrary to Hypothesis 2.2, there was no evidence that the smoking Stroop effect was reduced by hypnotic suggestion in individuals with high levels of hypnotic susceptibility. In sum, the main hypotheses of the study were not supported.

However, within the exploratory analyses, it was found that susceptibility did significantly moderate the effect of hypnotic suggestion on craving. The higher the susceptibility, the greater reduction in cigarette craving after the hypnotic suggestion condition in comparison to the control condition. Results from each aim will be discussed in further detail below.

EFFECT OF SUGGESTION ON CLASSIC STROOP

To restate, susceptibility did not moderate the effect of hypnotic suggestion on classic Stroop scores, and hypnotic suggestion did not reduce the classic Stroop effect in individuals with high susceptibility scores. There could be a number of reasons for the lack of effect in the current study as opposed to the studies listed in Table 6. First, the current study used a lower threshold for high hypnotic susceptibility: it used “ ≥ 8 ” as a cut-off, whereas most studies used “ ≥ 10 ” as a cut-off. Most studies used a very low group and a very high group, whereas the current study used a design where the entire range of

hypnotic susceptibility was sampled. One other study used an approach similar to that used in the current study (Parris & Dienes, 2013), but they used non-hypnotic suggestions (rather than hypnotic suggestions). In addition, Parris & Dienes (2013) did report that susceptibility moderated the effect of suggestion on the classic Stroop effect.

Second, the current study used subjects from a very different population. Whereas other studies generally used student volunteers, the current study recruited an older, predominantly African American population (see Table 7). Third, the current study recruited smokers who were smoking normally at the time of the study. That is, the sample was not instructed to abstain from smoking, leading to variability in recent nicotine exposure, which may have subsequently affected Stroop performance (though see Grabski et al., 2016).

Contemporary theories of hypnosis state that participant's expectations of hypnosis' efficacy predict their response to hypnosis (Kirsch & Lynn, 1999). In this sample, more susceptible subjects may have expected hypnosis to have an impact on craving due to hypnosis' well-known use as a method to quit smoking. However, these participants may not have had expectations that hypnosis would improve performance on computer task such as the classic and smoking Stroop. Participants in previous studies such as Raz et al (2002) may have held expectations that hypnosis could change cognition due to their education and prior knowledge of hypnosis' diverse effects on consciousness. Thus, the demand characteristic to change cognitive performance may not have been present in our community sample.

A noteworthy finding from Specific Aim 1 was that there was a significant order effect whereby the classic Stroop effect was smaller during the second administration of

the task than the first. For example, if a participant was in the Control-Suggestion condition, the classic Stroop scores tended to be smaller in the hypnotic suggestion condition. If a participant was in the Suggestion-Control condition, the classic Stroop scores tended to be smaller in the Control condition. This pattern of data is suggestive of a practice effect, whereby performance is better (i.e., the classic Stroop effect is smaller) in the second administration. The classic Stroop task was approximately 6 minutes in duration (on average) and therefore gave plenty of opportunity for practice. Although no effect of Order was observed on the smoking Stroop task, it is possible that practice on the classic Stroop task (which was completed before the smoking Stroop task) served to reduce the smoking Stroop effect in both conditions.

EFFECT OF SUGGESTION ON SMOKING STROOP

To restate, susceptibility did not moderate the effect of hypnotic suggestion on smoking Stroop scores, and hypnotic suggestion did not reduce the smoking Stroop effect in individuals with high susceptibility scores. In contrast to Specific Aim 1, this part of the study was novel: it was the first to attempt to reduce an emotional Stroop effect via hypnotic suggestion. Data from the smoking Stroop task indicated that participants as a whole did not exhibit a significant smoking Stroop effect in either the control or hypnotic suggestion condition (Table 11). (In contrast, subjects did exhibit a robust and significant classic Stroop effect in both the control and hypnotic suggestion conditions). The smoking Stroop task used was one which yielded a robust smoking Stroop effect in a large sample ($N=203$) of non-abstinent smokers (Leventhal et al., 2010), so it is unclear why a robust smoking Stroop effect was not observed in the current study.

The smoking Stroop effect was administered after completion of the classic Stroop task. The participants could have been “over-practiced” in performing Stroop tasks at this point which distorted data in the smoking Stroop. For example, participants may have adopted strategies to try to minimize the distracting effect of the incongruent words, such as trying to focus on individual letters. In any case, the absence of a robust smoking Stroop effect in the control condition may have made it more difficult to reduce the smoking Stroop effect during the hypnotic suggestion condition. Moreover, although the estimated internal reliability of the smoking Stroop effect was good in the control condition ($r = .80$) it was lower in the hypnotic suggestion condition ($r = .44$). The lower reliability in the hypnotic suggestion condition may have made it more difficult to detect moderation by an individual difference variable (Susceptibility) (see Hedge et al. 2017 for discussion of the psychometric issues relating to difference scores in cognitive paradigms).

EXPLORATORY AIMS

Effect of Suggestion on Craving

The most interesting finding of the study was that susceptibility moderated the effect of hypnotic suggestion on craving ratings, such that individuals with SHSS:C scores ≥ 7 reported lower craving in the hypnotic suggestion condition than in the control condition. Therefore, an assessment of hypnotic susceptibility can help identify smokers whose craving can be reduced, at least acutely, by hypnotic suggestion. Given that hypnotic suggestion had no significant effect on the smoking Stroop (or classic Stroop) effect, the effect of hypnotic suggestion on craving appears to be independent of any effect of hypnotic suggestion on cognitive processes measured during this study. That

said, it is possible that hypnotic suggestion does influence cognitive processes, but the assessments used in the current study were not sufficiently sensitive to detect an effect. Also, note that no suggestions were given for decreasing craving, only suggestions for changing performance during the Stroop tasks.

Although an examination of the effect of hypnosis on craving does not appear to have been reported in reports of clinical trials, one laboratory study reported that hypnotic suggestions significantly reduced cigarette craving, assessed using the Tobacco Craving Questionnaire (TCQ) (Li et al., 2017). Li et al. used a “disgust” suggestion - smokers were told that cigarettes would smell and taste like excrement. However, one should note a methodological limitation in the Li et al. study: All participants completed a baseline (control) condition before the suggestion condition, meaning that completion of conditions (baseline vs. suggestion) was not counterbalanced over participants. This limitation diminishes the internal validity of the Li et al. study.

Li et al. (2017) also reported that greater delta coherence (synchrony) between the right-frontal and left-posterior areas in response to hypnotic suggestion for aversion to cigarettes was associated with greater craving reductions. Delta waves are typically associated with deep sleep and may imply greater relaxation. These results may indicate that hypnotic suggestion reduces craving through inducing relaxation, drowsiness, and/or reducing stress. Hypnotic suggestions using shorter, less sedating, and less relaxing inductions may not result in craving reductions. In addition, there may be additive effects of the relaxing inductions and hypnotic suggestions tailored to reduce cigarette craving.

Participants also reported higher levels of side effects in the hypnotic suggestion condition than the control condition. However, these side effects are unlikely to mediate

the effect of Suggestion on craving because there was no interaction between Susceptibility and Suggestion for side effects. Moreover, at least one of the side effects, drowsiness, might be expected to increase (not decrease) craving ratings due to its status as a withdrawal symptom. For example, drowsiness could potentially elicit a conditioned withdrawal response (Wikler 1948) and increase craving.

In addition, craving across the sample as a whole decreased throughout the study (see Table 11). One might have expected craving to increase due to emerging symptoms of withdrawal (the study visit lasted approximately 2 hours). The effect of hypnotic suggestion (on craving) may have been greater than that of emergent withdrawal. In addition, the absence of smoking cues (see Laboratory Environment shown in Appendix H) could have also inhibited cravings. Finally, demand characteristics to report lower craving to the researcher over time may have also accounted for the decline in craving ratings.

Perceptions of Hypnosis

Perceptions of using hypnosis were uniformly positive. The experimenter noted that participants were interested, curious, and intrigued by hypnosis. Side effects were also mild, and no participant dropped out of the study. Many subjects noted a feeling of deep relaxation after hypnosis. This relaxation may have been associated with the side effect of drowsiness.

Note also that the sedation may also have prevented the hypnotic suggestions from “sticking” and may have inhibited performance on the Stroop. Because the hypnotic induction from the SHSS:C was very long and (quite literally) suggests a sleep-like state, some participants may have been too drowsy, sedated, or inattentive to the final

suggestions given right before the Stroop tasks were administered in the hypnotic suggestion condition. A handful of participants were not re-alerted by the single-clap and the researcher had to give additional suggestions and/or tap the participant to re-alert them and to begin the Stroop tasks, indicating deep hypnotic trance or possibly sleep which may have prevented suggestions be received adequately. On the other hand, it was observed that persons appeared to be asleep during hypnosis, but upon re-alerting, followed hypnotic suggestions faithfully. An example is when stage hypnotists give suggestions for sleep with additional suggestions to perform an entertaining act upon awakening. After re-alerting, the participant does exactly what was suggested. This phenomenon indicates that suggestions can work even if participants appear to be asleep during hypnosis. However, the measures used in this study did not permit examination of the patient's depth of hypnosis, somnolence, or sleep at the moment suggestions were administered.

Finally, it is worth noting that susceptibility scores, after adjusting for missing items, were slightly higher than previous studies (see Table 5). This suggests that current smokers (in 2018) may have relatively high susceptibility which may bode well for hypnosis-based treatments.

STRENGTHS

The strengths of the study included the following. First, this is the first study to examine the effect of hypnotic suggestion on an emotional Stroop task (smoking Stroop task) and on craving. Second, I recruited a community sample, whereas a majority of studies have examined student samples. Therefore, the study permitted an assessment of the generalizability of findings that have been observed in university settings. Third, I

recruited participants across the whole range of hypnotic susceptibility, which only one other study had previously (Parris & Dienes, 2013; see Table 6). However, in that study, suggestions were imaginative (rather than hypnotic). In addition, only one other study assessed a medium hypnotic susceptible group (Parris, Dienes, Bate, & Gothard, 2014). This is important because a majority of persons fall in the average range of susceptibility (Hilgard, 1965), and so, in the long run, it seems important to investigate the effect of hypnotic suggestions across the entire range of susceptibility scores.

LIMITATIONS

The most important limitation of the current study is that only recruited 33 participants were recruited (rather than 50 participants) which reduced power of analyses. As noted earlier, for Aims 1 and 2, the effect size for the Susceptibility x Suggestion interaction was based on data presented in Raz et al. (2002). The F value reported in Raz et al. for the pertinent Group x Suggestion interaction term for the classic Stroop effect corresponded to an r value of (.62, i.e., large effect size). If the power analysis had been conducted assuming $N=33$ (rather than $N = 50$), the study still had power = .98 to detect the pertinent interaction. Of course, these power analyses assume that the effect size reported in Raz et al. reflects the “true” effect size in the population, which is a big assumption, especially for Aim 2. If the true effect size for the interaction were smaller than the data reported by Raz et al. suggest, say $r = .30$ (a moderate effect size), then power = .40 to detect the pertinent interaction. Note that there is evidence that effect sizes reported in the literature may be over-estimates of the “true” effect sizes (Open Science Collaboration, 2015).

Many recent methodological articles have described the problems associated with low- or under-powered studies (e.g., Button et al., 2013). Most pertinent here, Field (2017) has even argued if you intend to run 100 participants in a study and are only able to collect data from 93 participants, the p value (based on 93 participants) is incorrect. In other words, the validity of the p value is dependent on the intention of the researcher at the outset of the experiment.

A second limitation is that a smaller proportion of participants (12.12%) than expected (20.00%) scored in the highly susceptible range. Thus, there were small sample sizes for testing of Hypotheses 1.2 and 2.2. This limitation seems particularly relevant to Hypothesis 2.2, as the data appeared to indicate that the effect of hypnotic induction tended in right direction (though, to restate, statistical significance was not obtained). The low number of participants scoring at least 8 was likely caused in part due to two items being omitted from SHSS:C due to safety precautions. These two items (SHSS:C items 6 & 8) could have been passed by several participants. Items 10 and 11, involve suggesting auditory and visual hallucinations, are more difficult and a large number of participants failed them, which led to discontinuation (2 consecutive failures of items is the recommended stopping point in administration of the SHSS:C). The cutoff for high susceptibility may also have been too low. In the original Raz et al (2002) study, the group of highs scored ≥ 10 (versus ≥ 8) on the SHSS:C. Note that a majority of studies reviewed in Table 6 used higher cutoffs than ≥ 8 for high susceptibility.

Other, more minor, limitations included the following. There was variability in recency of smoking prior to the study which could have affected cognition and craving. Regarding the former, and as stated earlier, note that Grabski et al. (2016) reported that

there was no effect of abstinence on the classic Stroop effect or smoking Stroop effect. Unfortunately, recency of smoking prior to the session was not assessed using self-report. In addition, variables such as degree of sleepiness or level of caffeine intake could have influenced cognition and susceptibility to hypnosis, and data on these and other “state” variables were not collected.

Regarding the assessment of susceptibility, the script used for hypnosis from the SHSS:C was fairly dated and refers to hypnosis as “sleep-like”, and this type of language is not always used for inductions. Efforts have been made to develop briefer measures of hypnotic susceptibility. One such test is the Elkins Hypnotizability Scale, which was developed using expert consensus on item selection on different constructs of hypnotic responding. A validation study found the new scale to be reliable and valid, with participant scores correlating strongly with the SHSS:C (Kekecs et al., 2016).

Finally, the within-subject design permits the possibility of carry-over effects, which can complicate interpretation of data. Last, the classic Stroop task was based on a fMRI paradigm for the classic Stroop (Raz et al., 2005) and may not have been optimal for the laboratory setting used in this study.

FUTURE DIRECTIONS

Future research should examine the effect of hypnotic suggestion on cognition in larger samples of highly susceptible smokers to gain a more precise estimate of the effect of hypnotic suggestion on cognition in this population. Future research could also examine if hypnotic suggestion can exert durable changes in craving. Craving could be assessed using ecological momentary assessment (EMA) and assessed over time. This type of study could evaluate if and when the effects of hypnotic suggestion dissipate.

Further investigations could also test different “types” of hypnotic suggestion to determine the suggestion types that are most effective in reducing craving. As stated above, the suggestions used in this dissertation targeted cognitive (semantic) processing, whereas Li et al. (2017) used an aversive hypnotic suggestion procedure. Aversive suggestions typically ask participants to imagine that tobacco related cues are associated with negatively perceived sensations, such as disgust or unpleasant taste. Li et al (2017) found that greater delta activity, which are slow brain waves associated with deep sleep and relaxation, was associated with greater reduction in craving. These results may indicate that relaxation is a key mechanism in hypnosis-related craving reduction.

The effect of other types of hypnotic suggestions on craving needs further exploration. A future study could examine if craving differs after: suggestions targeting relaxation only; aversive suggestions (similar to Li et al., 2017); suggestions targeting cognition; and suggestions directly targeting specific aspects of craving. One could also test if formal hypnotic inductions are needed. The study reported in this dissertation also used an extensive hypnotic induction which induced relaxation and drowsiness. An experiment that randomizes participants to different conditions, e.g., induction only, suggestion only, or induction plus suggestions, may be able to identify the specific processes underlying hypnotic suggestion that best reduces cigarette cravings.

Additional research on hypnotic suggestion could investigate why high susceptible participants respond to hypnotic suggestions. This research could clarify if high susceptible individuals are unique in psychosocial history, neurophysiology, genetics, or psychological factors. Future research could also benefit from additional psychometric research on the SHSS:C and other assessments of hypnotic susceptibility.

For example, it would be useful to determine the factor structure of susceptibility in this population, as well as the test-retest reliability.

Future research could also examine the specific cognitive processes involved in addiction that are most modifiable by hypnotic induction. For example, some tasks, such as emotional Stroop tasks, involve processing of emotional information. However, hypnosis is best known clinically for its ability to affect peripheral nervous system targets such as pain. Smoking craving is also associated with somatic sensations which were decreased in this study in participants with high susceptibility. However, higher level cognition, in the form of executive processing and emotional processing, was not changed. The results presented here once again indicate that hypnotic interventions may be best at modulating lower-level neurobiological targets. Emotional processing may be especially difficult to modulate with hypnotic intervention, but greater research is needed in this area given the possible methodological problems with our emotional processing measure (i.e., practice effect was observed with the classic Stroop affecting performance on the smoking Stroop).

Finally, hypnotic suggestion-based treatments may be developed for high susceptible individuals. If craving is malleable even in a subset of smokers, this may hold important treatment implications.

SUMMARY

In summary, this study provided no evidence that susceptibility moderated the effect of hypnotic suggestion on cognition, or that hypnotic suggestion influenced cognition in individuals with high susceptibility scores. However, there was evidence that susceptibility moderated the effect of hypnotic suggestion on craving. To the best of our

knowledge, this is the first study to report that hypnotic suggestion acutely reduces craving in high susceptible individuals. Further research can examine the mechanisms by which hypnotic suggestion acutely reduces craving in high susceptible individuals. Further research can examine the mechanisms by which hypnotic suggestion acutely reduces craving in high susceptible individuals.

Table 1. Hypnosis for Smoking Clinical Trials

Paper: First Author & Year	Total Sample Size (# per condition)	Recruitment Setting	Hypnotherapy Suggestions	Hypnotherapy Duration	Comparison Condition(s)	Abstinence Verification Method	Abstinence at Follow-up	Notes
Barkely, 1977	N=29 (8 hypnosis, 12 rapid smoking, 9 attention- control)	University students and affiliated persons	Hall and Crasilneck (1970); diseases associated with smoking	7 sessions 60 minutes (first and last 15 minute discussion, 30 minutes of treatment)	Rapid smoking was a session of continuous smoking to induce unpleasant feelings Attention- placebo was advice on cold turkey, film on smoking, handouts, psychoeducation	Daily record, data collected by interview, mail, and over the phone	9 month: 25% hypnosis 41.7% rapid smoking 0% attention control	All conditions were administered in group format with equal number of sessions
Carmody, 2008	N=286 (141 hypnosis, 129 behavioral)	VA patients	Skill-based to reduce craving during temptations, relaxation, imagery to be a non-smoker, self- hypnosis audiotape	2 sessions 60 minutes each	Behavioral counseling (two 60 minute sessions)	7-day point prevalence verified by cotinine or statement by significant other	6 month: 29% hypnosis 23% behavioral 12 month: 24% hypnosis, 16% behavioral	Both groups given nicotine patches

Carmody, 2017	N=102 (48 hypnosis, 54 CBT)	Unspecified	Skill-based to reduce craving during temptations, relaxation, imagery to be a non-smoker, self-hypnosis audiotape	2 sessions 60 minutes each	CBT based on social learning theory and Stages of Change Model	7-day point prevalence verified by cotinine level of <15 ng/mL	6 month: 35% hypnosis 42% CBT 12 month: 29% hypnosis 18% CBT	Sample consisted of smokers who self-reported being abstinent for at least 3 days
Elkins, 2006	N=20 (10 hypnosis, 10 waitlist control)	Physician referral and advertisements	Dissociation from craving, image as a non-smoker, self-hypnosis instructions	4 sessions + 4 counseling sessions 60 minutes each	Waitlist control were given NCI psychoeducation and instructions on setting a quit date	7-day point-prevalence determined by self-report verified by carbon monoxide reading of less than 8 ppm	26 weeks: 40% hypnotherapy 0% waitlist	Number of participants in each group was not specified in paper Supportive calls given to both conditions
Dickerson-Spillmann, 2013	N=223 (116 hypnosis, 101 relaxation)	Recruited from online and newspapers	Disconnect pleasure from smoking; word to re-experience hypnosis; image of being a non-smoker; cognitive control over craving;	1 session 100 minutes (40 psychoeducation, 40 intervention, 20 debrief)	Relaxation with music followed by suggestions from hypnosis group	30-day point prevalence verified by saliva sample	6 month: 14.7 % hypnosis, 17.8% relaxation	Both treatment groups were group-administered

			audiotape of session					
Fee, 1977	N=232 (57 hypnosis, 60 aversion, 58 fenfluramine, 57 placebo)	Smoking cessation clinic in Scotland from general practitioner referral	Not specified	Not reported; 9 sessions attended for each condition	Aversion (covert sensitization) Fenfluramine Placebo	Unspecified length of point prevalence	12 month: Not specified	Data only available from Cochrane (2010)
Hasan, 2014	N=122	Hospitalized cardiac or pulmonary patients	Imagery of good health; dissociate pleasure from smoking; negative affect to nicotine; cognitive control; self-hypnosis tape	1 session 90 minutes 1-2 weeks after hospital discharge	Hypnotherapy and NRT NRT only: one-month of patches based on the pre-hospitalization cigarettes per day	7-day point prevalence verified by urinary cotinine or confirmed by household proxy	26 week: 36.6% hypnosis only, 18% NRT only 34.2% hypnosis & NRT	Group which declined treatment also participated (n=42; abstinence rate: 27.3%)

Hyman, 1986	N=60 (15 in either hypnosis, “focused smoking”, attention placebo, waitlist control)	50% referred from local hospital, other 50% from newspaper advertisement	Spiegel method: repetition of 1. Smoking’s poison 2. Protect your body 3. Being nonsmoker is healthy	4 sessions Time not specified	4 sessions of three fifteen minute sessions of focused smoking 4 attention control sessions Waitlist control	Blood thiocyanate level	6 month: 40% hypnosis, 20% “focused smoking” 40% attention placebo 0% waitlist control	Abstinence is approximate based on figure in publication
Lambe, 1986	N=180 (90 hypnosis, 90 control)	Family Medicine Program	Not fully specified, self-hypnosis instructions, quit date under hypnosis	2 sessions 40 minutes	Control consisted of letter from clinic, NIH quit smoking pamphlet	Telephone or questionnaire ; length of time to be considered quit was not specified	6 month: 18% hypnosis 19% control 12 month: 22% hypnosis 20% control	n/a
Pederson, 1975	N=48 (16 hypnosis, 16 counseling and health testing, 16 waitlist control)	Not specified	Description of health effects of not smoking and relaxation and six sessions of group based smoking counseling	1 session 90 minutes	6 group sessions of smoking counseling Waitlist control	Three month point-prevalence	10 month: 50% hypnosis 0 % counseling only	n/a

							12.5% waitlist control	
Pederson, 1979	N=65 (17 live hypnosis + counseling, 16 videotape hypnosis + counseling, 16 relaxation hypnosis + counseling, 16 counseling only)	Participants in a smoking withdrawal program	Reasons for quitting, health benefits, how to cope with withdrawal	9 group counseling sessions with the hypnotherapy occurring the third session	Videotape hypnosis + counseling Relaxation hypnosis with no smoking suggestions Counseling alone	3-month point prevalence reported verbally	6 month: 53% live hypnosis + counseling 18% videotape hypnosis + counseling 12% relaxation hypnosis + counseling 18% counseling alone	9 group sessions was given to every condition
Pederson, 1980	N=53 (9 hypnosis + counseling, 23 rapid smoking + hypnosis + counseling, 21 rapid	Smoking withdrawal program	Reasons for quitting, benefits of quitting, how to cope with withdrawal	1 session + 7 sessions of group therapy 90 minutes	Rapid smoking + counseling: 1 session of rapid smoking + 8 session of group therapy Rapid smoking + hypnosis +	Self-reported 3-month point prevalence	6 months: 56% hypnosis + counseling 13% rapid smoking + hypnosis + smoking,	Hypnosis was group-delivered

	smoking + counseling				counseling: 1 session of hypnosis + 1 session of rapid smoking + 7 sessions of group therapy		38% rapid smoking + counseling	
Rabkin, 1984	N=140 (30 hypnosis, 31 education, 38 behavioral modification , 33 control)	Radio and newspaper advertisements	Modified Spiegel's method; instructions on self-hypnosis	1 session 30 minutes	Behavior modification was five 45-90 minute group sessions using stimulus control techniques Health education was one group based session on physiological impact of smoking including a statement of personal reasons for quitting with a follow-up individual meeting	Self-report, also measured serum thiocyanate	6 month: 31% hypnosis, 36% health education 24% behavioral modification	Serum thiocyanate examined as aggregated data for each group

Williams, 1988	N=60 (20 hypnosis, 20 placebo control, 20 no-treatment control)	Newsletters to three manufacturing companies	Modified Spiegel's method; decreased desire for smoking, no desire in specific situations; self- hypnosis with water drinking if craving	1 session 150 minutes (two 45 minute hypnotic experiences, 15 minute break in between, & 45 minute question period)	Placebo control was a 150 minute discussion on reasons for quitting No-treatment control given in ructions on smoking self- monitoring	7-day point prevalence	6 month: 40% hypnosis 0% placebo control 0% no- treatment control 48 week: 45% hypnosis 0% placebo control 0% no- treatment control	Self-report only
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Table 2. Description of the Hypnosis used in Clinical Trials

First Author, Year	Exact Language from Protocol regarding treatment received in hypnosis condition
Barkely, 1977	“The eight Ss in this condition spent the middle of their treatment hour receiving the relaxation instructions, the hypnotic induction, and hypnotic suggestion, and removal from the hypnotic induction. The hypnotic induction consisted of suggestions of relaxation drowsiness, and body sensitivity (warmth in the palm of the hand and arm levitation). The hypnotic suggestions were the same as those reported by Hall and Crasilneck (1970) and were repeated with slight variations during the treatment session. Intermixed with these suggestions were repeated statement about the various ailment and diseases associated with smoking. It should be noted that smoking, itself, did not occur during these treatment sessions.”
Carmody, 2008	“The hypnosis intervention was administered by a public health educator who received intensive training and ongoing supervision from the first author. The hypnosis intervention was scripted and audiotaped. Participants randomized to the hypnosis treatment group participated in two 60-min face-to face sessions of hypnosis training and were provided with an audiotape of this training to use daily at home. The hypnosis intervention utilized suggestions and guided imagery procedures developed by Spiegel (1994), Lynn et al. (1993), Green (1996, 1999), and Gorassini and Spanos (1986). Learning, practicing, and employing hypnotic skills in resisting the urge to smoke were core components of this intervention. The goal of this treatment was for participants to master hypnosis skills and to use these skills to increase motivation and self-efficacy for resisting temptations to smoke. Hypnosis was viewed as a set of skills and “self-directed responses to suggestions” aimed at facilitating self-control over smoking behavior and motivation for quitting and continued abstinence from smoking. Participants were provided with a menu of skills for coping with withdrawal symptoms and the urge to smoke. Hypnotic suggestions encouraged relaxation, commitment to quitting, self-image as a nonsmoker, ability to resist the urge to smoke, mood management, and development of a healthy lifestyle. Suggestions involving “anchoring” gestures were included to help participants to generate adaptive coping responses to sustain abstinence from smoking in “high-risk” situations. The hypnosis suggestions for both sessions were provided on audiotape so that participants could practice this technique on their own. The hypnotic suggestions and use of the training audiotape were reinforced during the three follow-up phone calls.”
Carmody 2017	“The hypnosis intervention was administered by a public health educator who received intensive training and ongoing supervision from the first author. The hypnosis intervention was scripted, audio-recorded, and utilized suggestions and guided imagery procedures developed by Gorassini and Spanos (1986), Spiegel (1994), Lynn et al. (1993), and Green (1996, 1999). Learning, practicing, and employing hypnotic skills in resisting the urge to smoke were core components of this intervention. Hypnosis was viewed as a set of skills and self-directed responses to suggestions aimed at facilitating self-control over smoking behavior and motivation for continued abstinence from smoking. Hypnotic suggestions encouraged relaxation, commitment to quitting, self-image as a non-smoker, ability to resist the urge to smoke, mood management, and development of a healthy lifestyle. Post-hypnotic suggestions involving cues or “anchoring” gestures were included to help participants to generate adaptive coping responses to sustain abstinence from smoking in “high-risk” situation. Participants were provided with a compact disc (CD) of the hypnosis

	suggestions for both sessions so that they could practice this technique on their own. The hypnotic suggestions and use of the training CD were reinforced during the four follow-up phone calls.
Elkins, 2006	“The intensive hypnotherapy intervention was provided by a doctoral clinical psychologist (PsyD) or physician (MD). The therapists completed 40 hours of training in hypnotherapy provided by the primary investigator. Training followed the guidelines and learning objectives outlined in the publication, Standards of Training in Clinical Hypnosis (Hammond & Elkins, 1994). Therapists also received additional training in the hypnotherapy treatment used in the study. Subjects assigned to the intensive hypnotherapy intervention met with a research therapist and at the first visit (preparation visit) were provided with a brief discussion regarding myths and misconceptions about hypnosis and the process used in hypnotic induction (Elkins & Handel, 2001). At the first visit (preparation visit), subjects also received self-help material from the National Cancer Institute (Glynn & Manley, 1990). Subjects received a 30-minute counseling session that included exploring ambivalence about quitting, preparing to quit, problem solving difficult situations, and commitment following semistructured counseling scripts. Subjects were asked to set a target quit date approximately 7 days later. Also, subjects in the intensive hypnotherapy group were provided with a self-hypnosis tape recording and a tape player and instructed in the daily practice of self-hypnosis..... Subjects in the intensive hypnotherapy intervention group received eight sessions, and each session lasted approximately 1 hour. A brief counseling session occurred at each visit at which time subjects received encouragement to practice self-hypnosis. The hypnotic inductions were completed at Sessions 1, 2, 4, and 7 and were standardized following a transcript. Suggestions were given for deepening relaxation, absorption in relaxing imagery, commitment to stop smoking, decreased craving for nicotine, posthypnotic suggestions, practice of self-hypnosis, and visualization of the positive benefits of smoking cessation. Subjects were asked at each session for their preferences for specific imagery for relaxation and dissociation. The suggestions followed a transcript; however, the specific imagery for relaxation and the positive benefits for smoking cessation were individualized based upon questions to determine the patient’s preference regarding such imagery. The hypnotic induction used is summarized below. (a) Eye-focus induction. Begin by focusing your attention on a spot on the wall. As you concentrate, begin to feel more relaxed. Concentrate intensely so that other things begin to fade into the background. As this occurs, noticing a relaxed and heavy feeling and allowing your eye-lids to close. (b) Relaxation. Noticing a wave of relaxation that begins at the top of your head and spreads across your forehead, face, neck, and shoulders. Every muscle and every fiber of your body becoming more and more completely relaxed. More and more noticing a feeling of letting go and becoming so deeply relaxed. (c) Comfort. . . . and as you become and remain more relaxed, finding a feeling of comfort. Feeling safe and secure. A peaceful feeling, calm and secure. Feeling so calm that nothing bothers or interferes with this feeling of comfort. (d) Mental imagery for relaxation. As you can hear my voice with a part of your mind, with another part going to a place where you feel safe and secure. A place where you become so deeply relaxed that you are able to respond to each suggestion just as you would like to, feeling everything you need to feel and to experience. (e) Commitment for smoking cessation. . . . and today becoming a

	nonsmoker, becoming free from nicotine and free from cigarettes...you will not smoke cigarettes or use tobacco again. With each day that passes, your commitment to remain free from cigarettes will become stronger and each time you enter this relaxed state you will remember the reasons you want to stop smoking. (f) Dissociation from cravings. As you enter an even deeper level of hypnosis, you may notice a floating sensation, less aware of your body, just floating in space. Your body floating in a feeling of comfort and your mind, just so aware of being in that pleasant place [individualized imagery for a pleasant place]. As your body floats, you will not be bothered by craving nicotine. Your mind blocks from conscious awareness any cravings and you can feel more detached from your body as you become more relaxed. (g) Posthypnotic suggestions. ... and as you become and as you remain free from nicotine and free from cigarettes, you will find a sense of satisfaction and accomplishment. You will find that, more and more, you are able to sleep very well, your sense of smell will improve, and your sense of taste will improve. You will not eat excessively and you will find an appropriate amount of food to be satisfying to you. (h) Self-hypnosis. Each time you practice self-hypnosis or listen to the tape recording that I will provide to you today, you will be able to enter a very deep state of relaxation, just as deep as you are today...and within this relaxed state, you will find a feeling of control. You will be able to become so deeply relaxed that you will become very comfortable and you will be able to have a feeling of dissociation that keeps from conscious awareness any excessive craving for nicotine. Within this relaxed state, your commitment to remain free from cigarettes will become even stronger, and you will find a kind of strength from your practice of self-hypnosis. (i) Positive imagery for benefits of smoking cessation. . .now, seeing yourself in the future as a nonsmoker, free from nicotine and cigarettes. Notice all of the good things going on around you, how healthy you feel, and [here, individualized imagery is introduced, depending on the patients perceived benefits from smoking cessation]. Seeing how well you are able to feel and you will not smoke, no matter if times become stressful or difficult. You will be able to remain calm and relaxed, both now and in the future.”
Dickerson-Spillmann, 2013	“The therapy sessions were conducted in Swiss German language by a 37-year old male hypnosis and relaxation therapist. The therapy sessions consisted of three parts: a psycho-educational part (40 minutes), the actual intervention (40 min), and a debriefing (20 min). The contents of each part were recorded in a script which the therapist was instructed to follow. The psycho-educational part, which consisted of discussing the benefits of smoking cessation, was equal in both conditions. In the second part, the actual intervention took place with dimmed lights and soft background music. Hypnosis was induced using guided imagery. Using a calm tone of voice, the therapist invited the participants to travel through their body and to progressively feel heavier, warmer and more comfortable. For example, the participants were asked to “feel your toes, heels, ankles, calves, knees and thighs becoming heavier and heavier”, to finally “experience the comfortable heaviness of your whole legs” and then to “sink deeper and deeper into this state”. This exercise was repeated until the whole body was covered. The induction of hypnosis required ten minutes (an extension of five minutes compared to the protocol) before the first set of suggestions was made to disconnect pleasant experiences, such as socialising, from the act of smoking. Hypnosis was then deepened by repeating statements involving relaxation and by associating (“anchoring”) the resulting state of deep relaxation with a key word that was subsequently repeated to maintain this state. During

	deep relaxation, the participants were given suggestions targeted at switching their self-image from that of smokers to non-smokers. The suggestions contained elements of cognitive-behavioural approaches to hypnotherapy for smoking cessation. Suggestions were made for the participants to use their power to resist smoking in tempting situations and to deal with symptoms such as mood swings or enhanced appetite following smoking cessation. Another set of suggestions referred to evoking a positive commitment to smoking cessation, assuming responsibility for the own body and reducing the physiological and psychological effects of smoking withdrawal. At the end of the session, the participants were led back to full awareness....All participants were debriefed about the intervention at the end of the session. The debriefing included information on the intervention they had undergone and responding any open questions from the participants. Furthermore, the participants received a compact disc (CD) for use at home that included the contents of the actual intervention.”
Fee, 1977	Not available
Hasan, 2014	“Patients randomized to hypnotherapy received a one time in-person hypnotherapy session within 1—2 weeks of hospital discharge, which consisted of a 90-min individualized session with a certified hypnotist and a tobacco treatment specialist (KP). Sessions began with an interview to assess motives and triggers for smoking. Hypnotherapy was then introduced as a collaborative and positive relationship that can only happen with the patient consent, and any concerns about power and control were addressed. Through repetitive statements and deep breathing, a state of relaxation and focused attention was achieved. All patients achieved a trance state during hypnosis. Sets of suggestions with visual imagery were then made to emphasize good health and healing and to dissociate pleasant experiences from smoking. Suggestions were also made to create negative affectivity toward nicotine, building of self worth, and urge control to resist smoking. The sessions were individualized to reinforce the patient’s main reasons and triggers for wanting to stop smoking. Patients were also trained in self hypnosis, and a standardized tape for smoking cessation and relaxation was given at the end of the session for continued use at home to reinforce behavior modification and abstinence.”
Hyman, 1986	“A standard induction method, as suggested by Weitzenhoffer and Hilgard (1967), was used. The actual hypnotic treatment was based on a modified version of the treatment proposed by Spiegel (1970). This involved repeating the following critical points while the subject was in a trance state: 1. For your body smoking is a poison. 2. You owe your body respect and protection from smoking. 3. Life as a nonsmoker means a far healthier, longer life; clear lungs, mouth and clothes; and a great personal pride for having given up the habit. The positive aspects of not smoking were emphasized. Four treatment sessions were carried out at weekly intervals. It was stressed that they were expected to abstain after the first treatment session. The subjects received all four hypnotic sessions whether they had already successfully abstained or not.”
Lambe, 1986	“The hypnotherapy consisted of two 40-minute sessions, two weeks apart. At the first visit, after obtaining informed consent, the hypnotists followed a standard protocol (available on request from the authors). After the trance was terminated, the method of autohypnosis was explained and a list of instructions given. An evaluation of depth of trance was noted by the hypnotists on a

	standard form. At the time of the second session, a trance was induced again, and suggestions reinforced. During the trance, the subject was asked to choose a quit date.”
Pederson, 1975	“The 16 subjects in the hypnosis plus counseling group participated in a single session of group hypnosis led by the second author in addition to the same procedures as the counseling group. The 1 1/2-hour hypnosis session contained a description of the benefits of not smoking and instruction in simple relaxation techniques”
Pederson, 1979	“The hypnosis session occurred at the third weekly session. The second author conducted the hypnotherapy sessions for the live-hypnosis plus counseling group and the relaxation-hypnosis plus counseling group. For the live hypnosis plus counseling group, the session consisted of a presentation of the reasons for quitting, benefits of continuing abstinence, and deep-breathing techniques useful for coping with withdrawal. There was no mention of possible aversion experiences (e.g., nausea and vomiting) associated with subsequent smoking. A videotape of this hypnosis session was presented to the videotape-hypnosis plus counseling group. The hypnotherapist was present for the relaxation-hypnosis plus counseling session, but the content of the session varied. Detailed instruction in relaxation techniques was presented in order to aid people who quit smoking handle the resultant tension and irritability. No mention of benefits or reasons for quitting was made.”
Pederson, 1980	“The 1 ½ hour session consisted of a presentation of reasons for quitting, benefits of continuing abstinence, and techniques for coping with withdrawal.”
Rabkin, 1984	“The hypnosis sessions were conducted on a one-on-one basis by a psychiatrist with special training and expertise in hypnosis. The individuals were previously unknown to the hypnotist. The technique used was that of Spiegel’s single treatment methods (Berkowitz, Ross-Townsend, & Khabberger, 1979; Spiegel, 1970). It involves the use of suggestion and teaching the individual to use autohypnosis. The subject was introduced to the process, initially by the psychiatrist explaining the framework in which hypnosis would be utilized. The individual was asked about any concerns he had regarding the hypnotic technique and process. The individual was then hypnotized and instructed in the technique of autohypnosis. Induction of the trance used what has been referred to as the eye roll technique, a process by which the individual is requested to roll his eyes upward as far as he is able. While looking up he is asked to slowly close his eye lids, This method is a frequently used approach for induction of a trance state. Suggestions were subsequently given that smoking is dangerous and that the individual must give up smoking. These suggestions were given in the following manner: 1. You have a responsibility to your body. 2. Smoking is poisonous for you. 3. It is important to respect yourself and your body. 4. You must give up smoking as this is critical for you.

	Subjects were also given the following suggestions while in the trance. “Every hour or hour and a half over the next week and whenever necessary afterwards you will sit down and induce a trance state through the use the use of the technique shown to you. You will repeat the statements regarding smoking three times with each self induced trance state.” The trance was then terminated. The patients were not seen again. The sessions lasted approximately 30 minutes so that they would be equivalent in time per therapist in each program.”
Williams, 1988	“The single session of hypnosis was 2-1/2 hours in length. Using a procedure adapted from Spiegel (1970) and Stanton (1978), the hypnotherapist (a male, certified in hypnotherapy) first encouraged deep breathing and instructed participants to relax (via a 7-1 countdown procedure), then made positive, ego-enhancing suggestions and specific suggestions to stop smoking. Participants were told that they no longer desired to smoke and would never smoke again for any reason. This was followed by suggestions that there would be no need or desire to smoke in response to specific cueing situations. All suggestions were phrased in the present tense and fostered positive expectancies for success. In an attempt to shorten the reaffirmation process used by Spiegel (1970), the hypnotherapist chose to use a post-hypnotic suggestion rather than have the subjects memorize “key phrases.” Subjects were told that if they felt the desire to smoke, they should take a deep breath, mentally repeat to themselves the word “relax” and drink a glass of water. Remembering positive statements was suggested as a follow-up method of reducing desire to smoke. Use of a deep breath and of the word “relax” was designed to reinforce the hypnotic state and enhance recall of the suggestions, while the glass of water offered a substitute consummatory and handling behavior. Success visualizations were employed to enhance self-determination to reduce craving. The 2-1/2 hour session consisted of two 45 minute hypnosis trials (with a 15minute break between trials) followed by a 45minute question period. The question and answer period was designed to help subjects understand the procedure they had undergone, to alleviate any misconceptions, and to clarify the self-monitoring procedure. “

Note: All studies listed in the table except Dickerson-Hillman, 2013 & Hasan, 2014 were included in a recent Cochrane Review (2010) which required a follow-up of at least 6 months.

Table 3. Differences between Hypnosis, Meditation, & Progressive Relaxation

Method→	Hypnosis	Meditation/Mindfulness	Relaxation Therapies
Definition	“a state of focused attention...characterized by...response to suggestion” (APA Division 30, 2014).	“Paying attention in a particular way: on purpose, in the present moment, nonjudgmentally” (Kabat-Zinn, 1994)	“adoption of a relaxed, passive mode of thinking, brought about by focusing of attention on some neutral target... while ignoring distracting thoughts” (Zhang et al., 2015)
Neuroanatomical	Decoupling of prefrontal cortex and ACC (Otani, 2016)	Coupling of prefrontal cortex and ACC (Otani, 2016)	Activation of Frontal gyrus & PCC (Kobayashi & Koitabashi, 2016)
Electrophysiology	Increase in Alpha & Theta power (Wells, 2015); Greater Delta coherence between right-frontal and left-posterior areas (Li et al., 2017)	Increase in Alpha power (De Benedittis, 2015)	Increase in Theta power (Wells, 2015)
Autonomic Nervous System	Primarily parasympathetic but also sympathetic possible (Williamson et al., 2001)	Parasympathetic	Parasympathetic
Disorders Treated (Stewart, 2015; APA Division 12, 2016)	IBS, Chronic Pain, warts, depression	Chronic pain, depression, OCD	Panic disorder, PTSD, Insomnia
Example of methods/protocols	Hypnosis for Chronic Pain, Ericksonian Hypnosis, Hypnoanalysis	Acceptance and Commitment Therapy, Mindfulness-based Stress Reduction	Progressive muscle relaxation, Stress Inoculation Training, Guided Imagery

Table: ACC = Anterior Cingulate Cortex; PCC = Posterior Cingulate Cortex; IBS = Irritable bowel syndrome; OCD= Obsessive Compulsive Disorder; PTSD = Post-traumatic Stress Disorder

Table 4. SHSS:C Norms

Study	Measure	Scale Parameters	N	Mean	Std.	Notes
Hilgard, 1965	Stanford Hypnotic Susceptibility Scale Form C (SHSS:C)	0-12*	203	5.07	3.15	Original USA Norms

Note: *Raz et al. (2002) used shortened version: 0-11. Out of 85 subjects screened, at least 16 (18.8%) scored in the high range [10-11] and 16 in the low range [2-3]; high scorers have also been defined by score ranges from 8-12

Table 5. Studies of Hypnotic Susceptibility in Smokers

Study	Measure	Scale Parameters	N	Mean	Std.	Notes
Perry & Mullen, 1975	Diagnostic Rating Procedure (DRP)	0-14	38	7.7	3.7	Reported as participant data for clinical trial
Frankel & Horne, 1976	Harvard Group Scale (HGS)* or SHSS	0-12	24	6.08	2.98	*Structured from the SHSS, Form A
Frischholz et al., 1982	Hypnotic Induction Profile (HIP)**	0-10	202	6.63	2.46	**Correlation with SHSS:C ranges from 0.34-0.7
Bliss, 1984	Stanford Hypnotic Susceptibility Scale: Form C (SHSS:C)	0-12	49	6.6	0.37	Standard deviation likely reported incorrectly in manuscript
Barabasz et al., 1986	Stanford Hypnotic Clinical Scale (SHCS)	0-5	83	2.38	1.45	From clinical trial, correlated with abstinence
Holroyd, 1991	Stanford Hypnotic Clinical Scale (SHCS)	0-5	96	2.7	n/a	Standard deviation not reported; sample mean was noted to be similar to SHCS mean from norms; susceptibility not correlated with abstinence
Current study	Stanford Hypnotic Susceptibility Scale: Form C (SHSS:C)	0-10	33	5.09	2.30	Items 5 & 7 omitted; adjusted mean for 12-point scale would be 6.12

Table 6. Summary of Studies of Suggestion and the Classic Stroop Since 2002

Paper	Sample Size	Participant Hypnotic Susceptibility and Measure Used	Group IVs	Other IVs	Suggestions: Posthypnotic or Imaginative	Suggestions: Within or Between	Findings	Notes
Raz et al., 2002	N=32 (recruited from pool of 75)	16 highs (10-11/11) 16 lows (2-3/11) SHSS:C	Highs vs. Lows	Post-hypnotic suggestion vs. Control Order	Post-hypnotic	Within	Significant Group x Suggestion interaction	N/A
Raz et al., 2003	N=12 (recruited from pool of 75)	6 highs (8-11/11) 6 lows (1-4/11) SHSS:C	Highs vs. Lows	Posthypnotic suggestion (for highs)/looking away (for lows) vs. Control vs. posthypnotic suggestion with cycloplegia Order	Post-hypnotic	Within	Looking away, posthypnotic suggestion, and posthypnotic suggestion with cycloplegia had similar levels of Stroop reduction	N/A
Raz, Fan, & Posner, 2005	N=16	8 highs (10-11/11) 8 lows (1-2/11) HGSHS & SHSS:C	Highs vs. Lows	Posthypnotic suggestion vs. Control Order	Post-hypnotic	Within	For both ERP and fMRI sessions, Stroop was significantly reduced in highs after suggestions	Primary result was fMRI and ERP data; ERP done only in highs

Raz, Kirsch, Pollard, & Nitkin-Kaner, 2006	N=25	25 highs (5-7/7) CURSS:C	N/A (all highs)	Hypnosis vs. Imaginative (between subjects) Suggestion vs. No Suggestion (within subjects) Order	Both	Within	Main effect of Suggestion	N/A
Raz, Moreno-Íñiguez, Martin, & Zhu, 2007	N=49	All highs (10-12/12 on HGSHS:A or 9-11 on SHSS:C) HGSHS:A & SHSS:C	N/A (all highs)	Post-hypnotic suggestion vs. Control Order	Post-hypnotic	Within	Suggestion significantly reduced Stroop effect	N/A
Casiglia et al., 2010	N=12	6 highs (≥ 9) 6 lows (≤ 4) SHSS:C	Highs vs. Lows	Post-hypnotic suggestion vs. Control Order	Post-hypnotic	Within	Significant reduction in cardiovascular tone and Stroop measures during incongruent trials for Highs only	N/A
Raz & Campbell, 2011	N=83 (screened from a pool of 500)	49 highs (10-11/11 on SHSS:C or top 5% on HGSHS:A)	Highs vs. Lows	Post-hypnotic suggestion vs. Control Order	Post-hypnotic	Within	Significant Suggestion x Suggestibility interaction	

		34 lows (0-1/11 on SHSS:C or bottom 5% of HGSHS:A) HGSHS:A & SHSS:C		NP vs. control trials				
Augustinova & Ferrand, 2012	N=43 (Less than 6% score high from pool of 750) N=28 in Experiment #1 N= 15 in Experiment #2	All highs (10-12/12 on HGSHS:A or 9-11/11 of SHSS:C) HGSHS:A & SHSS:C	N/A (all Highs)	Semantic Stroop vs. Classic Stroop Post-hypnotic suggestion vs. Control (between subjects in Exp. #1 & within subjects in Exp. #2) Order (Exp. #2)	Post-hypnotic	Both	Significant Type of Stroop x Suggestion Interaction Effect of Suggestion on classic Stroop effect in both studies No effect of Suggestion on Semantic Stroop in both experiments	N/A
Parris, Dienes, & Hodgson, 2012	N=19 (from a pool of 180)	All highs (8-11/11) WSGSHS:C	N/A (all highs)	Post-hypnotic Suggestion vs. Control Short vs. Long Response Time Interval (RSI; within subjects; 500	Post-hypnotic	Within	Significant 3 way interaction indicating Stroop effect based on RSI Suggestion significant for short but not long RSI	Also analyzed Congruency Sequence Effect (CSE) CSE = trials when N-1 is an

				ms vs. 3500 ms) Order of RSI conditions Order of Suggestions Order of Suggestion vs. Control			Suggestion's effect for RSI was stronger based on order (greater effect when completing shorter RSI after longer RSI)	incongruent trial Positive CSE in short RSI & Negative CSE in long RSI
Parris & Dienes, 2013	N=35 (recruited from a pool of 100)	11 lows (0-3) 13 mediums (4-7) 11 highs (8-11) WSGHS:C	Highs vs. Lows vs. Mediums	Imaginative suggestion vs. Control	Imaginative	Within	Significant regression coefficient for susceptibility in suggestion condition	N/A
Parris, Dienes, Bate, & Gothard, 2014	N=36 (recruited from a pool of 137)	36 mediums (4-7/11) WSGHS:C	N/A (all mediums)	Post-hypnotic Suggestion vs. Control Oxytocin spray vs. placebo spray (between subjects)	Post-hypnotic	Within	Significant effect of Suggestion in placebo condition only	No significant interaction between Suggestion and interference in oxytocin condition

Magalhaes De Saldanha da Gama et al., 2013	N=28 (experiment 1) N=28 (experiment 2)	N/A (not measured)	N/A (not measured)	Positive placebo-suggestion vs. Negative-placebo Suggestion (between subjects) Positive Imaginative Suggestion vs. Negative Imaginative Suggestion (between subjects) Control vs. suggestion for both experiments (within subjects)	Placebo suggestion (experiment 1) Imaginative Suggestion (experiment 2)	Within	Placebo suggestions increased or decreased accuracy and variability but not latency in intended direction in experiment 1 Negative imaginative suggestions increased latencies in comparison to Control but positive imaginative suggestions did not decrease latencies	Placebo condition was information and environmental cues that an inert EEG would be able to increase or decrease color perception
Zahedi et al., 2017	N=12	12 highs (10-12/12) HGSHS-A	N/A	Control vs. suggestion vs. hypnosis without suggestions	Post-hypnotic	Within	Classic Stroop effect reduced in suggestion condition	EEG measure of theta waves was elevated in suggestion condition

Table Notes: SHSS:C = Stanford Scale of Hypnotic Susceptibility, Form C; HGSHS:A = Harvard Group Scale of Hypnotic Susceptibility, Form A; CURSS:C = Connecticut Adaptation of the Carleton University Responsiveness to Suggestion Scale; WSGHS:C = Waterloo-Stanford Group Scale of Hypnotic Susceptibility, Form C; I-C = incongruent minus congruent trials; I-N = incongruent minus neutral trials; RT = reaction time; Control = completing the Stroop under normal conditions

Table 7. Demographics of Study Participants from Studies of Suggestion and the Classic Stroop Since 2002

Paper	Sample Size	Population	Country	Mean Age (standard deviation)	Gender	Ethnicity	Socioeconomic Status	Education
Raz et al., 2002	N=32	“mostly medical students”	USA (New York)	Not reported	46.88% female 53.13% male	Not reported	Not reported	Not reported
Raz et al., 2003	N=12	Not reported	USA (New York, assumed)	Not reported	50% female 50% male	Not reported	Not reported	Not reported
Raz, Fan, & Posner, 2005	N=16	Not reported	USA (New York)	Mean=27	50% female 50% male	Not reported	Not reported	Not reported
Raz, Kirsch, Pollard, & Nitkin-Kaner, 2006	N=25	College Students	USA (Connecticut)	Not reported	60% female 40% male	Not reported	Not reported	Not reported
Raz, Moreno-Íñiguez, Martin, & Zhu, 2007	N=49	Not reported	USA (New York, not reported, assumed)	27	48.98% female 51.02% male	Not reported	Not reported	Not reported
Casiglia et al., 2010	N=12	“medical and psychological staff of the University of Padova”	Italy	28.6 (3.8)	66.66% female 33.33% male	Not reported	Not reported	Not reported
Raz & Campbell, 2011	N=83	“most participants were medical	Canada (assumed)	29	45.78% female 54.22% male	Not reported	Not reported	Not reported

		and graduate students”						
Augustinova & Ferrand, 2012	N=43	Undergraduates	France	Not reported	Not reported	Not reported	Not reported	Not reported
Parris, Dienes, & Hodgson, 2012	N=19	College students at Universities of Sussex and Bournemouth	Great Britain	21.6 (2.4)	68.42% female 31.58% male	Not reported	Not reported	Not reported
Parris & Dienes, 2013	N=35	University of Sussex	Great Britain	25.5 (4.02)	71.43% female 28.57% male	Not reported	Not reported	Not reported
Parris, Dienes, Bate, & Gothard, 2014	N=36	Students from the University of Bournemouth	Great Britain	19.94 (1.56)	72.22% female 27.78% male	Not reported	Not reported	Not reported
Magalhaes De Saldanha da Gama et al., 2013	N=28	“recruited through posters and web announcements, and agreed to participate in exchange for monetary compensation	Belgium	24 (6.03)	64.29% female 35.71% male	Not reported	Not reported	Not reported
	N=28			19 (1.97)	75% female 25% male	Not reported	Not reported	Not reported

		“Recruited through posters and agreed to participate in exchange for course credits”						
Zahedi et al., 2017	N=12	University students	Iran	24.4 (3.0)	33.33% female 66.66% male	Not reported	Not reported	Not reported

Table 8. Study Design and Lab Measures

Setting→	Screening	Study Visit
Day of Study		1
Setting	Telephone	Lab
Inclusion/Exclusion	X	
Order of Suggestion vs. Control		X
INTERVENTION		
Suggestion Condition		X
Control Condition		X
LAB MEASURES		
Carbon Monoxide		X
Demographics	X	X
Tobacco History Questionnaire	X	X
FTND		X
Perceptions of Hypnosis		X
Classic Stroop		X**
Smoking Stroop		X**
QSU		X***
SHSS:C		X
RESOURCES		
Smoking Cessation Resources		X
OTHER		
Compensation		\$50
Duration (Min.)	20	120

Table Note: **Administered twice; ***Administered three times (see Procedures in text)

Table 9. Adverse Events Reported for Clinical Trials on Clinicaltrial.gov - using Search for Study using the term “Hypnosis” and trials reporting “Completed Has Results”

Trial Topic	Clinicaltrials.gov Identifier	Sponsor	Serious AEs	Other AEs	Notes
Hypnosis for Breast Biopsy as an adjunct to Anesthesia	NCT00122369	United States Department of Defense	0/78	3/78 - hematoma	Other conditions AEs: Standard of care condition had 5/76 hematomas; empathetic attention had 9/82 hematomas
Hypnosis for Increasing Quality of Life Ovarian Cancer	NCT00293293	Randy Shaver Cancer Research Fund	2/23 – dehydration/vomiting /gastrointestinal Infection	0/23	Patient were also receiving chemotherapy
Hypnosis for Chronic Back Pain (VA study)	NCT00361270	VA Office of Research and Development	0/49 0/39 0/35	0/49 1/39-disturbing images 1/35 -nightmares	3 groups received 2, 8, 8 (plus home recordings) sessions hypnosis
Hypnosis Irritable Bowel Syndrome Symptom	NCT01248013	Mind-Body Digestive Center	0/89	0/89	n/a
Hypnosis for Over-reactive Bladder	NCT00793611	University of New Mexico	0/10	0/10	n/a
Hypnosis for Hot flashes during menopause	NCT01293695	National Institutes of Health/National Center for Complementary and Integrative Health	0/93	13/93 – “mild skin irritation from the skin conductance monitor electrode adhesive, requiring no medical intervention to resolve”	Other AE attributed to “Sternal Skin Conductance Monitor Used to Physiologically Measure Skin Moisture”
Hypnosis for Hot flashes during menopause	NCT00711529	Women and Infants Hospital of Rhode Island	0/13	0/13	n/a
Absolute Total	n/a	n/a	2/429 (0.47%)	18/429 (4.2%)	All AEs except for 2 attributed to other interventions used during clinical trial

Adjusted Total – excluding AEs due to adjunctive intervention's effects	n/a	n/a	0/429 (0%)	2/429 (0.47%)	Nightmares and disturbing images likely related to hypnosis
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Table 10. Participant Characteristics

Variable ↓	Mean/%	SD
Age (years)	50.70	9.78
Education (number of years)	13.48	1.94
Gender		
Female	54.55%	
Male	45.45%	
Marital Status		
Single, never married	48.48%	
Married	21.21%	
Divorced	21.21%	
Widowed	3.03%	
Living with significant other	6.06%	
Race		
African American/Black	78.79%	
Mixed race	9.09%	
Anglo American/Euro American/ White	6.06%	
Other	6.06%	
Employment Status		
Regular full time (30+hours per week)	21.21%	
Regular part time (< 30 hours per week)	18.18%	
Unable to work or disabled	18.18%	
Unemployed, currently looking for work	12.12%	
Unemployed, NOT currently looking for work	12.12%	
Retired	9.09%	
Other	6.06%	
Student	3.03%	
Income		
Less than \$10,000 per year	21.21%	
Between \$10,000 and \$19,999 per year	15.15%	
Between \$20,000 and \$29,999 per year	15.15%	
Between \$30,000 and \$39,999 per year	6.06%	
Between \$40,000 and \$49,999 per yea	15.15%	
Between \$50,000 and \$59,999 per year	12.12%	
Between \$60,000 and \$69,999 per year	6.06%	
Between \$70,000 and \$79,999 per year	6.06%	
Between \$80,000 and \$89,999 per year	3.03%	
Main source of Income		
A Job	42.42%	
VA/disability/Social Security income	27.27%	
Other	15.15%	
A spouse/significant other/parent	9.09%	
Unemployment benefits	6.06%	
Cigarettes Smoked Per Day	13.18	7.96
FTND (0-10)	4.55	2.31
Expired breath CO level (ppm)	17.30	11.22
Perceptions (0-40)	30.59	6.43

Mean (*SD*) (continuous measures) and % (categorical measures)

Table 11. Summary Statistics

Measure ↓	Baseline	Control Condition	Hypnosis Condition
Classic Stroop (ms)	n/a	113.05 (65.47)	113.08 (71.09)
Smoking Stroop (ms)	n/a	5.51 (59.08)	-1.66 (71.09)
QSU-B (0-100)	44.57 (31.14)	38.99 (29.66)	38.22 (29.89)
Side Effects (0-4)	0.15 (0.24)	0.18 (0.24)	0.41 (0.39)

Mean (SD) for study measures; n/a = not measured at this timepoint. Ns = 33 except Smoking Stroop (n=32)

Table 12. Results of GLMs

DV ↓	H	n	df	Condition			df	Susceptibility			Susceptibility x Condition			
				F	p	η_p^2		F	P	η_p^2	df	F	p	η_p^2
Classic Stroop	1.1	33	1, 30	0.01	.94	0.000	1, 30	1.42	.24	0.045	1, 30	0.01	.91	0.000
	1.2	4	1, 2	0.55	.53	0.217	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Smoking Stroop	2.1	32	1, 29	0.26	.62	0.009	1, 29	0.03	.87	0.001	1, 29	0.02	.89	0.001
	2.2	4	1, 2	6.27	.13	0.758	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
QSU	Expl	33	1, 30	0.14	.71	0.004	1, 30	0.026	.873	.001	1, 30	4.24	.048	0.124
.														

Table Note: *n* = number of subjects. H = Hypothesis; *F* = F value from GLM; Expl. = Exploratory analysis. Order is included as a between-subject factor. Order is included as categorical variable in models (effects of Order not shown).

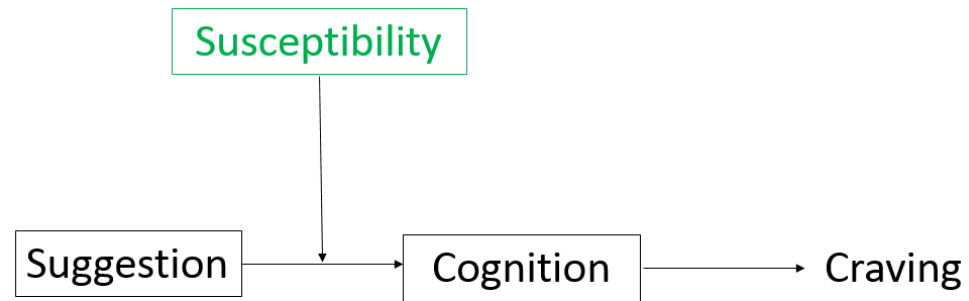


Figure 1. Conceptual model

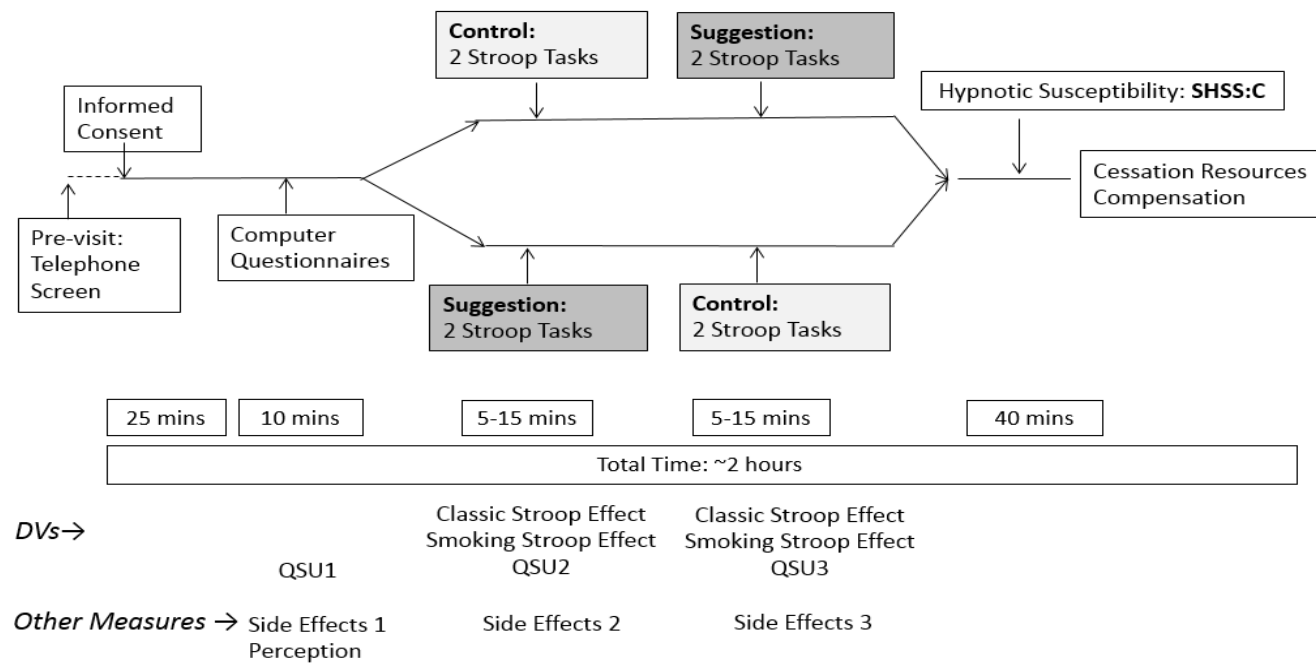
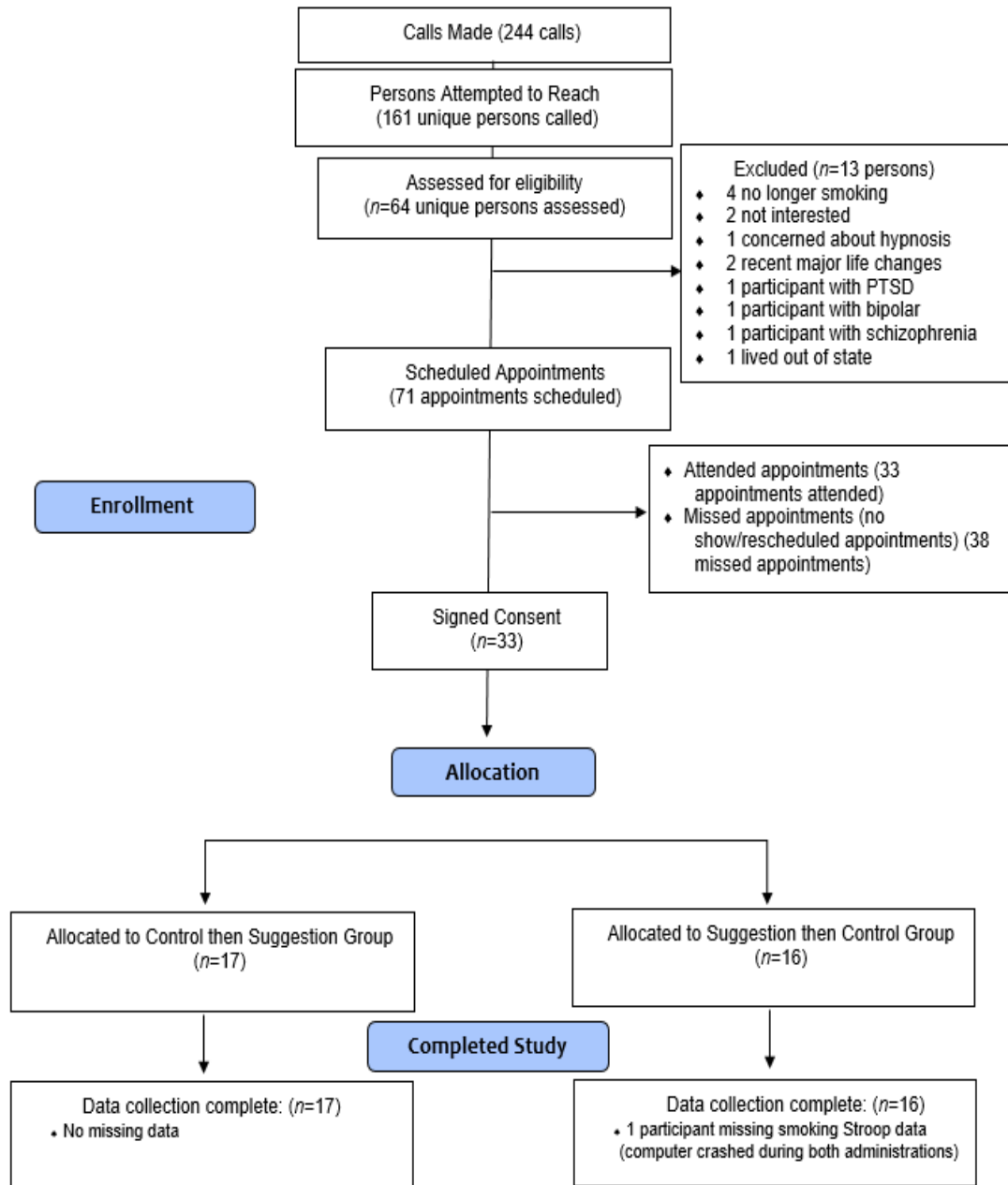


Figure 2. Study Diagram

Figure 3: Consort Chart



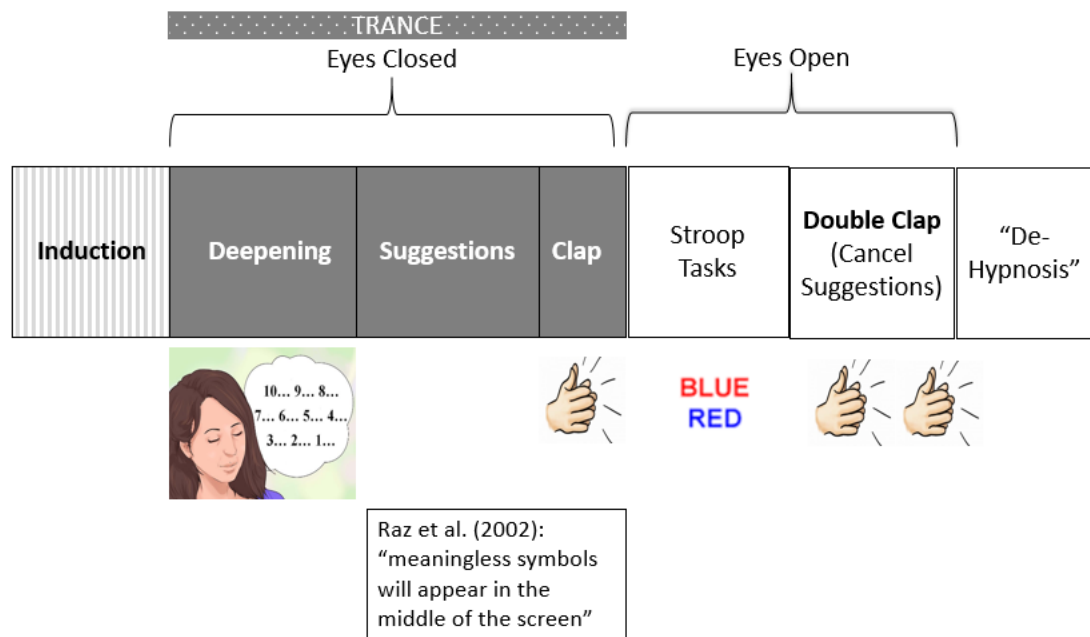


Figure 4: Suggestion condition

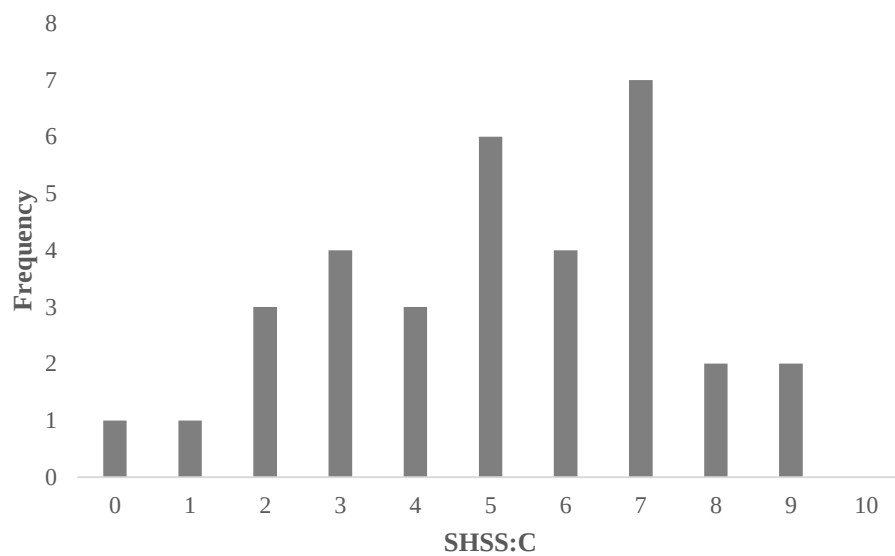


Figure 5. Frequency Distribution of Hypnotic Susceptibility in Current Sample

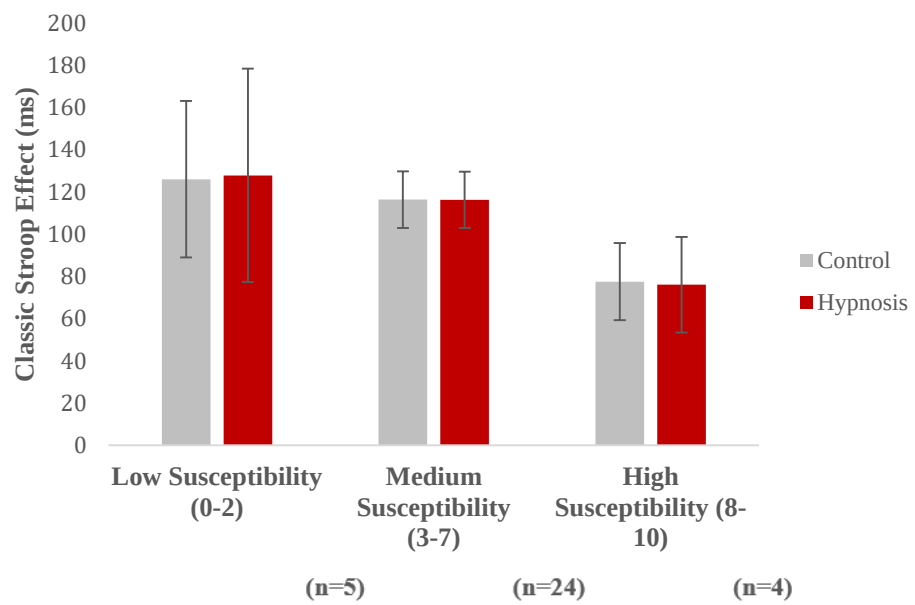


Figure 6: Effect of Susceptibility and Suggestion on Classic Stroop Effect

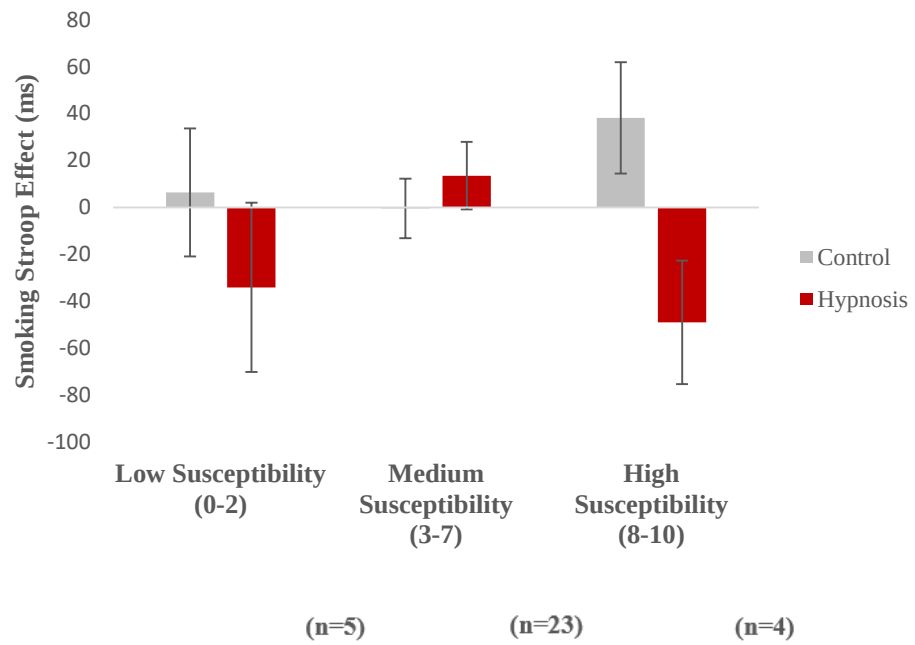


Figure 7: Effect of Susceptibility and Suggestion on Smoking Stroop Effect

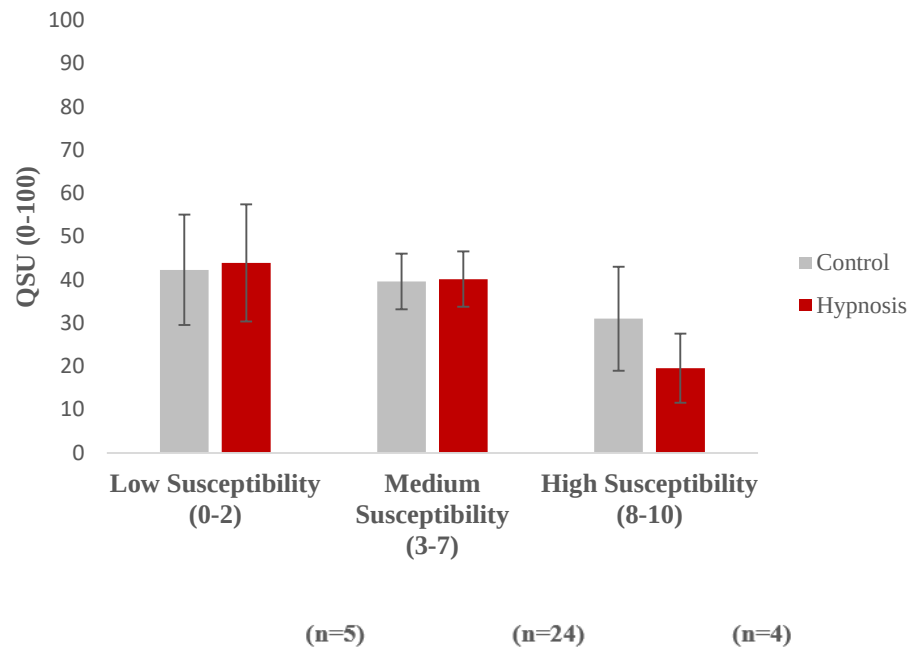


Figure 8: Effect of Susceptibility and Suggestion on QSU Ratings

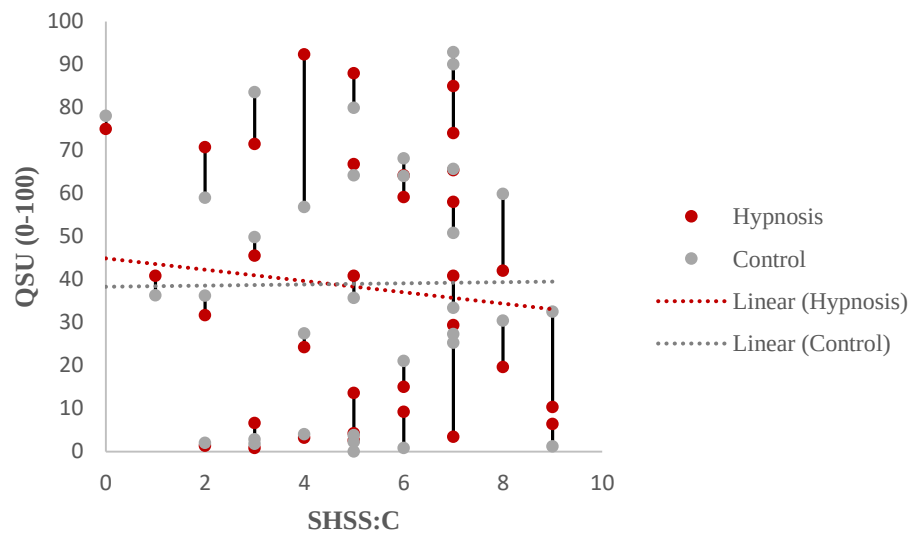


Figure 9. Craving as a Function of Hypnotic Susceptibility (Vertical lines connect data from same subject)

Appendix A: Hypnotic Susceptibility Scoresheet

Stanford Hypnotic Susceptibility Scale: Form C Scoresheets from the SHSS:C Manual*

*this study will exclude items #7 & #9

SCORING BOOKLET: FORM C

To be used in connection with Weitzenhoffer and Hilgard's Stanford Hypnotic Susceptibility Scale: Form C, Consulting Psychologists Press, Inc., Palo Alto, California.

Subject No. Date Total Score
Name Hypnotist

Summary of Scores

Details on the pages that follow	Score (+ or -)
0. Eye closure (not counted in total score)	()
1. Hand Lowering (Right Hand)	
2. Moving Hands Apart	
3. Mosquito Hallucination	
4. Taste Hallucination	
5. Arm Rigidity (Right Arm)	
6. Dream	
7. Age Regression (School)	
8. Arm Immobilization (Left Arm)	
9. Anosmia to Ammonia	
10. Hallucinated Voice	
11. Negative Visual Hallucination (Three Boxes)	
12. Post-Hypnotic Amnesia	
Total (+) score	

Record of Recall in Test for Amnesia

	Order of Mention		Order of Mention
Hand lowering		Age regression	
Moving hands apart		Arm immobilization	
Mosquito hallucination		Anosmia to ammonia	
Taste hallucination		Hallucinated voice	
Arm rigidity		Negative visual	
Dream		hallucination	
Total number of items recalled 			

ITEM	SCORE
0. RESPONSE TO INDUCTION a. (If Eye Closure used) Eyes: _____: _____: close without forcing do do not b. (If other method of induction used) Method _____ Response _____	() (Not counted)
1. HAND LOWERING (RIGHT HAND) Remarks: Score (+) if hand has lowered at least six inches by end of 10 seconds.	(1) _____
2. MOVING HANDS APART Remarks: Score (+) if hands are six inches or more apart at end of 10 seconds.	(2) _____
3. MOSQUITO HALLUCINATION Remarks: Score (+) for any grimacing, movement, or acknowledgment of effect.	(3) _____
4. TASTE HALLUCINATION A. Taste of sweet: _____: _____: _____: _____; none vague weak strong Overt signs: _____: _____; yes no B. Taste of sour: _____: _____: _____: _____; none vague weak strong Overt signs: _____: _____; yes no Remarks: Score (+) if <u>both</u> tastes are experienced and <u>either</u> one strong <u>or</u> one with overt movements.	(4) _____

ITEM	SCORE
5. ARM RIGIDITY (RIGHT ARM) Remarks: Score (+) if there is less than 2 inches of arm bending in 10 seconds.	(5) _____
6. DREAM (Record dream here, if any; or any report of passing thoughts, fantasies, etc.) Score (+) if subject dreams well (i.e., has an experience comparable to a dream--not just vague, fleeting experiences, or just feelings or thoughts without accompanying imagery). It is possible to obtain a plus score, even though the subject may insist it was not a real dream, provided the hypnotist notes that the imagery and action are not under volitional control.	(6) _____

ITEM	SCORE
7. AGE REGRESSION (SCHOOL) a. <u>Verbal evidence: Fifth Grade</u> How old are you? _____ Where are you? _____ What are you doing? _____ Who is your teacher? _____ Other information _____ Rating: _____; _____; _____; No regression Fair Good b. <u>Verbal evidence: Second Grade</u> What is your name? _____ And how old are you? _____ Where are you? _____ Who is your teacher? _____ Other information _____ Rating: _____; _____; _____; No regression Fair Good c. <u>Handwriting evidence</u> Fifth grade: _____; _____; _____; no change some change striking change Second grade: _____; _____; _____; no change some change striking change Score (+) if clear change in handwriting between the present and <u>one</u> of the regressed ages.	(7) _____
8. ARM IMMOBILIZATION (LEFT ARM) Remarks: Score (+) if arm rises less than one inch in 10 seconds.	(8) _____

ITEM	SCORE
9. ANOSMIA TO AMMONIA Smell of ammonia: _____; _____; _____; _____; none vague weak strong Overt signs: _____; _____; yes no Remarks: Score (+) if odor of ammonia denied and overt signs absent	(9) _____
10. HALLUCINATED VOICE Record conversation, if any: Score (+) if subject answers realistically at least once	(10) _____
11. NEGATIVE VISUAL HALLUCINATION: THREE BOXES Subject reports 3 boxes: _____ Subject reports 2 boxes: Colors _____ and _____ What is color of third box? _____ Remarks: Score (+) if hallucination is present, whether or not sustained. Sometimes the third box is perceived vaguely as a colored spot or shadow. The score is still (+).	(11) _____

ITEM	SCORE
12. POST-HYPNOTIC AMNESIA (1) Please tell me now in your own words everything that has happened from the time that (refer to induction used). (List items in order of mention. If blocked, ask, "Anything else?" until subject reaches a further impasse.) Anything else? You have forgotten (all the, many, a few) things which happened. Can you tell me a little what it feels like? (If necessary, probe in order to ascertain nature of amnesia, i.e., whether true, verbal inhibition, etc.) (2) Listen carefully to my words. Now you can remember everything. Anything else now? (List in order of mention.) Remind subject of omitted items. Remarks on nature of amnesic experience ("about your inability to recall a while ago, how real was it to you?") Score (+) if subject recalls 3 or fewer items before "Now you can remember everything."	(12) _____

Appendix B: Self-Report Measures & Phone Screening

FAGERSTRÖM TEST FOR NICOTINE DEPENDENCE

1. How soon after you wake up do you smoke your <u>first</u> cigarette?	Within: 5, 6 to 30, 31 to 60, or After 60 minutes
2. Do you find it difficult to refrain from smoking in places where it is forbidden, e.g., in church, at the library, in the cinema, etc.?	Yes No
3. Which cigarette would you hate to give up most?	1st one in the A.M. All others
4. How many cigarettes per day do you smoke?	10 or less, 11-20 21-30 31 or more
5. Do you smoke more frequently during the first hours after waking than the rest of the day?	Yes No
6. Do you smoke if you are so ill that you are in bed most of the day?	Yes No

QUESTIONNAIRE OF SMOKING URGES

	Strongly Disagree			Strongly Agree		
1. I have a desire for a cigarette.	0	1	2	3	4	5
2. Nothing would be better than smoking a cigarette.	0	1	2	3	4	5
3. If it were possible, I probably would smoke a cigarette.	0	1	2	3	4	5
4. I would control things better if I could smoke.	0	1	2	3	4	5
5. All I want is a cigarette.	0	1	2	3	4	5
6. I have an urge for a cigarette.	0	1	2	3	4	5
7. A cigarette would taste good.	0	1	2	3	4	5
8. I would do almost anything for a cigarette.	0	1	2	3	4	5
9. Smoking would make me less depressed.	0	1	2	3	4	5
10. I am going to smoke as soon as possible	0	1	2			
	3	4	5			

PERCEPTIONS OF HYPNOSIS QUESTIONNAIRE (ADAPTED FROM MILLER ET AL., 2011)

1. How interested would you be in using hypnosis for quitting smoking? (0 = not at all interested, 10 = extremely interested)
2. How confident are you that hypnosis could help you quit smoking? (0 = not at all confident, 10 = extremely confident)
3. How helpful would hypnosis be for quitting smoking? (0 = not at all helpful, 10 = extremely helpful)
4. Would you be willing to try hypnosis for smoking cessation? (0 = not at all willing; 10 = extremely willing).

SIDE EFFECTS QUESTIONNAIRE

Please rate how you feel right now:

	Not at All	Very little	Some- what	A Lot	Very much
1. I feel drowsy	0	1	2	4	5
2. I feel confused	0	1	2	4	5
3. I have a headache	0	1	2	4	5

DEMOGRAPHICS

1. What is your date of birth?
2. What is your gender?
3. Which answer best describes your marital status?
 - a. single, never married
 - b. married
 - c. divorced
 - d. widowed
 - e. living with significant other
 - f. separated
4. How many years of education have you completed? (Choose one)
 - a. 1 (elementary school)
 - b. 2 (elementary school)
 - c. 3 (elementary school)
 - d. 4 (elementary school)
 - e. 5 (elementary school)
 - f. 6 (middle school)
 - g. 7 (middle school)
 - h. 8 (middle school)
 - i. 9 (high school)
 - j. 10 (high school)
 - k. 11 (high school)
 - l. 12 (high school)
 - m. 13 (some college)
 - n. 14 (vocational or community college degree)
 - o. 16 four-year college degree
 - p. 17 (some graduate school)
 - q. 18 (Master's degree)
 - r. 19 Doctoral degree (MD, PhD, DDS, DVM, DrPH, etc.)
5. Are you of Hispanic or Latino origin?
6. What category best described your race? (choose one)
 - a. Anglo American/ Euro American/ White
 - b. African American/ Black
 - c. Asian/ Asian American
 - d. Native of Hawaii or other Pacific Islander
 - e. Native American or Alaska native
 - f. Mixed race
 - g. Other
7. What is your total family income, before taxes?
 - a. Less than \$10,000 per year or less than about \$833 per month
 - b. Between \$10,000 and \$19,999 per year or less than about \$1,250 per month
 - c. Between \$20,000 and \$29,999 per year or less than about \$2083 per month

- d. Between \$30,000 and \$39,999 per year or less than about \$2,916 per month
 - e. Between \$40,000 and \$49,999 per year or less than about \$3,750 per month
 - f. Between \$50,000 and \$59,999 per year or less than about \$4,583 per month
 - g. Between \$60,000 and \$69,999 per year or less than about \$5,416 per month
 - h. Between \$70,000 and \$79,999 per year or less than about \$6,250 per month
 - i. Between \$80,000 and \$89,999 per year or less than about \$7,083 per month
 - j. Between \$90,000 and \$99,999 per year or less than about \$7,916 per month
 - k. More than \$100,000 per year or more than about \$8,333 per month
8. Which answer best describes your employment status? (choose one)
- a. Regular full time (30 or more hours per week)
 - b. Regular part time (less than 30 hours per week)
 - c. Unemployed, currently looking for work
 - d. Unemployed, NOT currently looking for work
 - e. Homemaker or stay-at-home parent
 - f. Student
 - g. Retired
 - h. Unable to work or disabled
 - i. Other
9. What is your primary source of income?
- a. A job
 - b. Unemployment benefits
 - c. VA/disability/Social Security income
 - d. Welfare/food stamps/Temporary Assistance to Needy Families (TANF)
 - e. Alimony or child support
 - f. A spouse/partner/significant other/parent is my main source of income
 - g. Other

Phone Screen introduction (& script)

1. Enter Call Log ID number
2. Date of call
3. Name of Interviewer
4. Hello, may I please speak with (subject's name)?
5. This is (your name) calling from the Uniformed Services University of the Health Sciences. I am calling in regards to the interest you cited during a telephone interview or lab visit in participating in future studies at the Uniformed Services University in Bethesda, MD. Is this a convenient time for me to tell you about a new study and see if you might be interested in participating? (If no, schedule time to call back).
6. This is a study for smokers. We are interested in knowing what people's attitudes are regarding using hypnosis for quitting smoking. We are also interested in how hypnotizable are and if this influences their attention. This study may help us make more effective quitting programs in the future. Importantly this study does not offer hypnosis treatment for quitting smoking and does not require you to quit smoking. Participants will be paid for their time attending the study sessions here at the Uniformed Services University in Bethesda, Maryland. Would you like to be screened for the study?
 - If no: We appreciate your interest in our study. If you like, I can give you some information about programs that can help you quit smoking? (If yes = You can call 1-800-QUIT-NOW (1-800-784-8669) for telephone counseling or you can go to www.quitnow.net. You may be eligible to receive free nicotine replacement products as well as education and coaching. If no = Thank you for your time)
7. During the screening I will ask you a few questions about you, your smoking, and your health history to make sure you meet the eligibility criteria for the study. This will only take a few minutes.

Contact Information/Demographics

1. Name
2. Address
3. Phone number
4. Email address (if applicable)
5. Age
6. Gender

Smoking history

1. How many cigarettes do you usually smoke in a day?
2. If you qualify, would you be able to bring your personal cigarettes to our laboratory in order to participate?

Exclusion criteria

1. Are you color-blind?
2. What is your first language?
3. Are you currently pregnant or breastfeeding? (women only)
4. Have you ever been diagnosed with schizophrenia?
5. Have you ever been diagnosed with bipolar disorder?
6. Have you ever been diagnosed with PTSD?
7. Have you ever been diagnosed with a psychotic disorder?
8. Have you ever been diagnosed with a personality disorder?

Script if eligible

1. Based on the information that you have given to me, you may be eligible for our study. If you like, I can give you some more information about the study. (If participant wants to hear more): If you want to participate in this study, you will be scheduled for one in-person session here at the Uniformed Services University in Bethesda, MD. During that session, we will provide a detailed overview of the study, answer any questions you may have, and determine if you would like to participate. At the session, you will be asked to complete some questionnaires, computerized reaction time tests, a test of how hypnotizable you are, and two other experiences with hypnosis. You will also be offered information on local resources about how to quit smoking at the end of the session. If you consent to participate, you could receive at least \$20 for the time you spend participating in the study. If you complete the study, you will receive \$40. If you decide you do not want to participate, you will be given \$12 for your travel.
2. Should we go ahead and schedule your session now? The next available appointment we have is on _____ at _____. Can you come at that time? The first visit will take between 2 and 2 1/2 hours. We are located on the campus of the Walter Reed National Military Medical Center in Bethesda, MD. The Medical Center Metro stop on the Red Line is just across the street from the campus. To be admitted to the campus, you will need to bring a valid government-issued ID, such as a driver's license, non-driver identification card, or passport, when you come to your appointment. We ask that childcare arrangements be made for your children because we do not have a childcare area or playroom. Do you wear contacts? (If yes, you'll be having your eyes closed for some time during the hypnosis. For that reason, we suggested that those of you who wear contact lenses might want to remove them before the session). I will send you a packet of information including a reminder of your appointment date and time, directions to our location, and instructions on where to park. Would you like to receive this information by email or regular mail? If you have any questions or want to

reschedule, please call us at 301-295-1535. Can I answer any questions for you at this time?

Script if ineligible

1. Thank you for the time you have provided to see if you are eligible for the study. Unfortunately, it appears that you are not eligible for this particular study. However, we are anticipating other studies in the future that you may be eligible for. Would you like for us to call you with information about future studies? If you like, I can also provide you with some other resources that may help you quit smoking. Would you like me to provide that information? (If yes: You can call 1-800-QUIT-NOW (1-800-784-8669) for telephone counseling or you can go to www.quitnow.net. You may be eligible to receive free nicotine replacement products as well as education and coaching. If no = Thank you for your time)

Appendix C: Procedure for Suggestions Condition

1. The induction and deepening procedure from Weitzenhoffer & Hilgard (1962; p. 5-16 of manual) will be recited before the following the suggestions are administered. This same induction and deepening and was used in previous studies (Raz et al., 2002; Raz et al., 2005; Raz & Campbell, 2011).

2. Suggestions below will be read after the deepening is complete (from Raz et al., 2002; Raz et al., 2005; Raz, Kirsch, Pollard, & Nitkin-Kaner, 2006; Raz & Campbell, 2011):

“Very soon you will be playing the computer game. When I clap my hands, meaningless symbols will appear in the middle of the screen. They will feel like characters of a foreign language that you do not know, and you will not attempt to attribute any meaning to them. This gibberish will be printed in one of 4 ink colors: red, blue, green or yellow. Although you will only be able to attend to the symbols' ink color, you will look straight at the scrambled signs and crisply see all of them. Your job is to quickly and accurately depress the key that corresponds to the ink color shown. You will find that you can play this game easily and effortlessly. When I clap my hands twice, you will regain your normal reading abilities”

3. Participant will then complete the smoking and classic Stroop.

4. After completion of the classic and smoking Stroop, the experimenter will say (adapted from Zahedi et al., 2017):

“Close your eyes. I will now count down from 20 to 1: when 5 has been reached, you will open your eyes but you will be very slightly hypnotized; when I say 1, you will return to the here and now, and be completely alert and awake, and no longer hypnotized at all”

5. The debriefing described in Crawford, Hilgard, & MacDonald (1982)

6. Recommended semi-structured interview with participant regarding their experience of hypnosis (Page & Green, 2002):

Check in with participant regarding their experience with hypnosis, ensure hypnosis is no longer being experienced (this experiment will all verify reading capability), and assess potential side effects

Appendix D: Approved Informed Consent Document



UNIFORMED SERVICES UNIVERSITY OF THE HEALTH SCIENCES

**F. Edward Hébert School of Medicine
4301 JONES BRIDGE ROAD
BETHESDA, MARYLAND 20814-4799**

This consent form is valid only if it contains the IRB stamped date

Consent for Voluntary Participation in a Non-Clinical Research Study

1. INTRODUCTION OF THE STUDY

You are invited to volunteer in a research study called “The Effect of Suggestion on Cognition in Smokers,” at the Uniformed Services University (USU), Bethesda, Maryland. You can participate in this study because you are a smoker. You previously agreed on the phone or in person to be contacted for future studies when you completed a telephone screening or laboratory visit or you responded to our study's advertisements. Your participation is voluntary. Please read the information below, and ask questions about anything you do not understand, before deciding whether to take part in the study.

2. PURPOSE OF THE STUDY

The purpose of this study is to test whether suggestions given during hypnosis can change smokers' attention during a computer test. This study is not a treatment for smoking. However, you will be offered information on local resources for smoking cessation at the end of the study. Results from this study may help researchers understand how to improve quitting programs. In previous research by other scientists, hypnosis has been used to change attention during one of the computer tests given during this study. We want to see if these same suggestions change attention during this test and an additional computer test. We also want to measure smokers' opinions about hypnosis.

3. PROCEDURES TO BE FOLLOWED

If you agree to be in this study, you will complete one session lasting around two hours in Building 28 at USU, your present location. You will first complete questions that will ask about you and your smoking habits. The researcher will then give you information about hypnosis before you undergo hypnosis. At that time, you will be able to ask questions about hypnosis and what will occur during hypnosis.

Next, the researcher will hypnotize you and give you a set of suggestions (hypnosis condition). Hypnosis is a state of deep relaxation and focused attention. Please note that at any time during the hypnosis you will not lose control of the situation, and you are free to stop the study at any time. This is not like hypnosis you see on television, you will not be asked to perform strange acts during hypnosis. An example of a suggestion may be that your arm feels heavier than it usually does.

After a set of suggestions given to you during hypnosis by the experimenter, you will complete two computer tests. These computer tests are reaction time tests that you will complete with your eyes open. In the tests you will identify the colors of words as quickly as possible by pressing a key on a keyboard. You will also complete the two tests without hypnosis (non-hypnosis condition).

Half the subjects will perform the hypnosis condition before the non-hypnosis condition, and the other half will perform the non-hypnosis condition before the hypnosis condition. The order you complete will be determined a number generated at random.

You will then be given a test which measures how hypnotizable you are. This involves hypnosis and involves moving your hand and may involve imagining different situations, or being asked to tell the researcher what you are experiencing. There's a chance that you may experience forgetting over a brief period (a minute or so).

After each of the two hypnosis experiences, the researcher will return you out of hypnosis and ask you questions about your experience. The researcher giving the hypnosis has completed training provided by the American Society of Clinical Hypnosis.

At the end of the session today, the researcher will give you information on resources for smoking cessation treatments.

4. NUMBER OF PEOPLE THAT WILL TAKE PART IN THIS STUDY

Up to 55 volunteers are expected to take part in this study at USUHS.

5. AMOUNT OF TIME FOR YOU TO COMPLETE THE STUDY

This study is expected to last around two hours.

6. ELIGIBILITY AND PAYMENT FOR BEING IN THIS STUDY

Civilians and military personnel may participate in this study. Federal civilians and military personnel must receive supervisor approval to take part in this study, and they may only participate during off-duty status.

Only non-federal civilians may be compensated for participation in this study. Payments will be made after study completion.

For completing the session, you will receive \$100 as compensation for your time and for travel expenses.

If you choose not to sign this document, you will receive \$12 as compensation for your time and for travel expenses. If you wish to participate in the study and sign this document, but drop out for any reason during the study, you will receive \$50 as compensation for your time and for travel expenses.

7. POSSIBLE RISKS OR DISCOMFORTS FROM BEING IN THIS STUDY

If you agree to participate, the risks or discomforts from being in this study are expected to be small. During or after hypnosis, you may experience drowsiness, confusion, or headache. There is a very small chance (0.5%) of experiencing an adverse event such as anxiety during the study. Please let the researcher know if you experience any discomfort.

You may refuse to answer any question that makes you feel uncomfortable. If you have concerns after completing any of the tests today, you are encouraged to contact your doctor or the study chair.

If something in this study makes you uncomfortable or upset, you may choose to stop taking part in this study at any time. If the researcher notices any distress or anxiety, the study will stop and you will receive referrals, if appropriate.

Do not leave the laboratory if you continue to feel lasting effects from the study. The researcher will make sure that you are back to normal before leaving.

8. POSSIBLE BENEFITS FROM BEING IN THIS STUDY

No benefit can be guaranteed from participating in this study. Hypnosis may help you relax. The smoking cessation resources provided may help you quit and this may be very beneficial to your health. The information we learn from the study may help us develop better smoking cessation programs.

9. CONFIDENTIALITY/PRIVACY AND HOW YOUR IDENTITY AND YOUR RESEARCH RECORDS WILL BE MAINTAINED

All information you provide as part of this study will be confidential and will be protected to the fullest extent provided by law. Your responses will be maintained in a locked filing cabinet or on a password-protected computer in lab offices in the Department of Medical and Clinical Psychology. All records related to this study will be accessible only to those persons directly involved in conducting this study and members

of the USUHS Institutional Review Board (IRB), who provide oversight for protection of human research volunteers. In addition, the IRB at USUHS and other federal agencies that help protect people who are involved in research studies may need to see the information you give us. Other than those groups, records from this study will be kept private. Reports that come out of this study will not use your name or identify you in any way.

Your data will be stored on a password-protected computer in Room 113 of Building 28. The password is only known to the research staff. Because you are free to drop out of the study at any time, you can request that records be destroyed.

Records of your participation in this research study may only be disclosed in accordance with state and federal law, including the Federal Privacy Act, 5 U.S.C.552a, and its implementing regulations. DD Form 2005, Privacy Act Statement - Military Health Records, contains the Privacy Act Statement for the records. A copy of DD Form 2005 can be given to you upon request, or you can read on-line at:
<http://www.dtic.mil/whs/directives/infomgt/forms/eforms/dd2005.pdf>.

Researchers will make every effort to protect your privacy and confidentiality; however, there are risks of breach of information security and information loss. All information you provide will be confidential and will be protected to the fullest extent provided by law. Your responses to our questionnaire and data we collect will be in a locked filing cabinet. All records related to this study will be accessible to those persons directly involved in conducting this study: Jared William Bollinger the PI and members of the research team. In addition, the IRB at USUHS and other federal agencies that help protect people who are involved in research studies, may need to see the information you give us. Other than those groups, records from this study and follow-up phase will be kept private to the fullest extent of the law. Scientific reports that come out of this study and follow-up phase will represent your data, but will not use your name and thus in no way identify you.

If you sign this document, you give permission for the researchers to use your Private Identifiable information (PII) that identifies you for the research study described here: "The Effect of Suggestion on Cognition in Smokers". The PII that we may use for this research includes demographics, the date of birth, race, employment information, education information, financial information. You will also be asked certain Private Health Information (PHI) questions such as if you were ever diagnosed with Schizophrenia, bipolar disorder, PTSD and psychosis or a psychotic disorder.

Please note that you do not have to sign this Authorization, and if you wish not to.

Please note that you may change your mind and revoke (take back) this Authorization at any time, except to the extent that USUHS has already acted based on this Authorization.

To revoke this Authorization, you must write to: PI: at this address: 4301 Jones Bridge Rd, Bethesda, MD 20814. This Authorization does not have an expiration date.

10. CONDITIONS WHICH YOUR PARTICIPATION IN THIS STUDY MAY BE STOPPED WITHOUT YOUR CONSENT

The investigator may stop you from taking part in this study if being in the study is unsafe or dangerous to you. The investigator may also stop you from participating if you experience difficulty in following the procedures. The experiment may also be stopped if the experiment may start to interfere with the military's mission.

11. IF YOU DECIDE TO STOP TAKING PART IN THIS STUDY AND THE INSTRUCTIONS FOR STOPPING EARLY

Participation in this study is voluntary, refusing to participate or withdrawing from the study will have no effect on medical treatment to which you are otherwise entitled to. You have the right to withdraw from this study at any time. If you decide to stop taking part in this study, you should tell the researcher right away. If you decide to withdraw from the study, you will receive partial compensation (\$50) for all study activities completed prior to withdrawing from the study.

12. RECOURSE IN THE EVENT OF INJURY

This study should not entail any physical or mental risk beyond those described above. We do not expect complications to occur, but if, for any reason, you feel that continuing this study would constitute a hardship for you, we will end your participation in the study. If at any time you believe you have suffered an injury or illness as a result of participating in this research project, you should contact the Director of Human Research Protections Program at the Uniformed Services University of the Health Sciences, Bethesda, Maryland 20814-4799 at (301) 295-9534. This office can review the matter with you, can provide information about your rights as a subject, and may be able to identify resources available to you. If you believe the government or one of the government's employees has injured you, a claim for damages (money) against the federal government (including the military) may be filed under the Federal Torts Claims Act. Information about judicial avenues of compensation is available from the University's General Counsel at (301) 295-3028.

13. CONTACT FOR QUESTIONS OR PROBLEMS

If you have questions about this research, you should contact Jared Bollinger, B.S., the person in charge of the study. His phone number at USUHS is 301-295-1535. Even in the evening or on weekends, you can leave a message at either number. If you have questions about your rights as a research subject, you should call the Director of Human Research Protections Program, at USUHS at (301) 295-9534. She is your representative and has no connection to the researcher conducting this study.

**SIGNATURE OF RESEARCH PARTICIPANT OR LEGAL
RESPRESENTATIVE**

You have read (or someone has read to you) the information in this consent form. You have been given a chance to ask questions and all of your questions have been answered to your satisfaction.

**BY SIGNING THIS CONSENT FORM, YOU FREELY AGREE TO TAKE PART
IN THE RESEARCH IT DESCRIBES.**

Participant's Signature

Date

Participant's Printed Name

SIGNATURE OF INVESTIGATOR/RESEARCH TEAM MEMBER

You have explained the research to the participant, or his/her legal representative, and answered all of his/her questions. You believe that the volunteer subject understands the information described in this document and freely consents to participate.

Investigator's/Research Team Member's Signature Date (must be the same as the participant's)

Investigator's/Research Team Member's Printed Name

Appendix E. Control then Suggestion Condition Checklist

Control then Suggestion, Condition 1, Checklist

Call Log ID/Study ID:

Activity:	Signature:
1. Informed Consent	
2. Carbon Monoxide	
3. Baseline Questionnaires (including QSU 1 & Side Effect 1)	
4. Practice Stroop Task	
5. Control Classic Stroop	
6. Control Smoking Stroop	
7. QSU 2 & Side Effects 2	
8. 5-10 minute break	
9. Introduction to Hypnosis (How hypnotized now? __)	
10. Induction, Deepening, & Suggestions	
11. Suggestion Classic Stroop	
12. Suggestion Smoking Stroop	
13. QSU 3	
14. De-hypnosis	
15. Identification of Three Colored Words	
16. Side Effects 3	
14. Discuss Hypnosis Experience (how hypnotized now? __)	
15. SHSS:C	
16. Discuss Hypnosis Experience (how hypnotized now? __)	
17. Smoking Cessation Resources	

Appendix F. Suggestion then Control Condition Checklist

Suggestion then Control, Condition 2, Checklist

Call Log ID/Study ID:

Activity:	Signature:
1. Informed Consent	
2. Carbon Monoxide	
3. Baseline Questionnaires (including QSU 1 & Side Effect 1)	
4. Practice Stroop Task	
5. Introduction to Hypnosis (How hypnotized now? __)	
6. Induction, Deepening, & Suggestions	
7. Suggestion Classic Stroop	
8. Suggestion Smoking Stroop	
9. QSU 2	
10. De-hypnosis	
11. Identification of Three Colored Words	
12. Side Effects 2	
13. Discuss Hypnosis Experience (how hypnotized now? __)	
14. 5-10 minute break	
15. Control Classic Stroop	
16. Control Smoking Stroop	
17. QSU & Side Effects 3	
15. SHSS:C	
16. Discuss Hypnosis Experience (how hypnotized now? __)	
17. Smoking Cessation Resources	

Appendix G: Introduction to Hypnosis Script (adapted from Kihlstrom, 2013 & Shor & Orne, 1962)

Before administering the Suggestion Condition, there will be an introduction to hypnosis given to every participant. This script is adapted from John Kihlstrom's protocol (2013) derived from the Harvard Group Scale of Hypnotic Susceptibility, Form A (Shor & Orne, 1962), which is a validated, experiment instrument of hypnotic susceptibility for group forms.

“Before we begin the hypnosis part of the experiment I'd like to take just a couple of minutes to introduce ourselves to you, talk some more about hypnosis and the research project.

First, let me introduce myself again. I'm Jared Bollinger, a graduate student in the Department of Psychology at USUHS, and it's my lab that does this research.

I'm sure that you have had some contact with hypnosis at some point in your life. You may have been hypnotized yourself, or know someone who has. Certainly you've read about it, or seen it in the movies. We are interested in hypnosis as a means of studying basic psychological processes -- how people perceive, think, and remember; the relations between behavior and experience, and between personality and social processes.

As I'm sure you know, hypnosis has a number of clinical applications as well. It's often used by physicians and dentists to help control pain, by psychotherapists to help people relax and free up the flow of ideas and memories. We hope that by finding out more about hypnosis, what it can do and what it can't, who can be hypnotized and who can't, we can help clinicians to use hypnosis more appropriately and effectively in their

practice. But we are strictly a research outfit, and don't do any therapeutic work ourselves.

Probably the single most important thing about hypnosis is that it reflects an ability that people have. Hypnosis is a skilled activity, very much like playing the piano or tennis. What that means is that probably everyone can experience hypnosis to at least some degree, with practice. But some people experience hypnosis quite readily, while others need some practice than others. And even with a great deal of practice, some people can have many experiences, and others only just a few. Most of us fall somewhere in the middle, between these extremes. But the important thing to realize is that hypnosis is an ability, a capacity, which normal people have.

Because of this fact, the role of the hypnotist is actually very limited. The hypnotist functions as a sort of a coach or tutor, whose role is to assist people to experience hypnosis -- to do something that they're perfectly capable of doing on their own, if only they knew how. It doesn't really take any skill to induce hypnosis. Of course, it takes a great deal of skill and training to use hypnosis appropriately in a clinical or research situation, but hypnosis itself is quite simple: the subject does all the work.

The script you'll hear is a very useful and old way to experience hypnosis. By virtue of this script, which has been use for more than 50 years, thousands of people like yourself have been able to experience hypnosis.

What's going to go on? This presents a kind of a "script" for a hypnotic experience. It begins with an induction procedure that asks you to get as comfortable as you can, to relax, focus your eyes on a target, and pay close attention to the voice.

Eventually you'll probably close your eyes, and at that point will go on to give you some suggestions for the kinds of experiences that hypnotized people can sometimes have.

What we'd like you to do is to take each suggestion, work with it, and see what happens. Some of you will experience many of the things that are suggested, others will experience only just a few, and most of you will fall somewhere in between. We are interested in the entire range of response to hypnosis -- we're as interested in people who experience lots of the suggestions as we are in those who don't experience much of anything. So just concentrate on having the experiences. Don't push an experience that isn't happening, but don't hold back on it either. Just let things happen as they happen, because we're interested in whatever you experience.

Let me say something more about the purpose of this experiment. We sometimes call hypnosis a "special state of consciousness", but it isn't really all that different from certain experiences that you have had in the ordinary course of everyday living. Hypnosis is a lot like those occasions when you're reading a book or watching a movie, and you get really absorbed in what is going on, perhaps you identify with one of the characters and feel what they feel. You're not paying too much attention to other things that are going on, so that they don't distract you from the imaginative experience that you're having. Hypnosis is largely a matter of focusing your attention on one particular thing, to the exclusion of everything else. In these studies, we are interested in determining how hypnosis related to other instances in everyday life where attention is intensely focused in this manner.

Finally, let me say again that we don't use hypnosis as a tool for changing people. In fact, hypnosis is a particularly bad technique for controlling behavior and changing

people. People can't be hypnotized against their will, and even if they're deeply hypnotized they can't be led through suggestion to do things, and experience things, that they don't want to. It goes without saying that we won't be asking you any personal questions while you're hypnotized -- we're not going to be prying into your deepest, darkest secrets. And we won't ask you to do anything that might embarrass you -- we won't ask you to run around like a chicken or anything like that.

But at a somewhat different level, we want you to be assured that you'll leave the experimental session the same person as you were when you arrived. You won't have any fewer problems or hangups than you did before -- but you won't have any more, either. You'll be somewhat richer for the experience -- you'll be better informed about hypnosis, and you'll have some extra cash in your pocket, but I'm sorry to say that if you couldn't play the piano before you came in, you won't be able to play like Rubenstein after you leave.

We'll have a chance to talk more about hypnosis after you've had a chance to try it. But before we begin the next phase, I'd be pleased to address any questions that any of you might have about hypnosis, the lab, or the experiment. Anything at all? [answer all questions before proceeding].

All right, you'll be having your eyes closed for some time during the hypnosis. For that reason, we suggested that those of you who wear contact lenses might want to remove them before the session. If you wish to remove your lenses, but haven't already done so, this is the time to do it. If you forgot your case, and they're hard lenses, we have some tissues here that you can wrap them up in. We also have some wetting solution that you can use to get them back in. If you should leave your lenses in, and for any reason

they get uncomfortable, just open your eyes, blink to wet them a little, and then close your eyes and go back into hypnosis. This won't detract from the experiment in any way.

One thing that really gets in the way is chewing gum. It is very hard to concentrate on being hypnotized when you're trying to remember where your gum was last time you noticed it. For that reason, we ask -- actually, we insist -- that you dispose of your gum for the rest of the experiment. Again, we have some tissues that you can use if you need them.

All set? Make yourselves comfortable -- but not too comfortable. I will talk to you for a while before we get down to business.”

Appendix H. Laboratory Setting



Appendix I. Screenshot of QSU

The next set of questions will ask about your urge to smoke a cigarette right now.

Don't Know

Refuse to Answer

Not Applicable

Previous Question

Next Question

Repeat the Question

I have a desire for a cigarette right now.

Strongly Disagree

0 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 60 63 66 69 72 75 78 81 84 87 90 93 96 100

Strongly Agree

Don't Know

Refuse to Answer

Not Applicable

Previous Question

Next Question

Repeat the Question

Appendix J. Screenshot of Side Effects Questionnaire

Please rate how you feel right now.

Don't Know

Refuse to Answer

Not Applicable

Previous Question

Next Question

Repeat the Question

I feel drowsy.

Not at all.

Very Little

Somewhat

A Lot

Very much

Don't Know

Refuse to Answer

Not Applicable

Previous Question

Next Question

Repeat the Question

Appendix K. Risks and Benefits of Hypnosis

RISKS OF HARM:

The study does not involve investigational drugs nor any other treatment for smoking cessation. There are no known risks associated with the questionnaire or cognitive assessments. There is no reason to believe that participants' smoking will be increased by participation in the study.

The risks of hypnosis have been described as minimal (Jensen, 2011). For example, it has been stated that the risks are comparable to risks of adverse reactions to psychotherapy (Lynn et al., 1996). In all previous studies examining hypnotic suggestions and Stroop effect (studies listed in Table 6), no adverse effects or side effects were reported.

In regards to risks when using the SHSS:C, one study with 209 participants reported perceived stress (from completing the SHSS:C) was no more than that experienced when performing a verbal learning psychology experiment, taking a college exam, attending a college class, or college life in general (Coe & Williams, 1979). In addition, the sample rated the SHSS:C as more pleasant than the four comparison conditions, and no participant rated the SHSS:C as "unpleasant" or "very unpleasant". The most common side-effects associated with administering the SHSS:C are drowsiness, confusion, and headaches. A majority of the side-effects are noted to be transient (5 minutes to 1 hours) and mild in intensity. Altogether, minor side-effects (e.g., drowsiness) occur in 29-49% of participants who complete the SHSS:C (Hilgard, 1974; Coe & Ryken, 1979; Crawford, Hilgard, & MacDonald, 1982).

One researcher estimated that the rate of serious side effects (e.g., increased stress) when conducting hypnotic suggestion experiments was 0.5% (Kihlstrom, 2013).

When reviewing publically available data for clinical trials that used hypnosis, the rate of “serious adverse events” directly related to hypnosis was 0.00%, and the rate of “other adverse events” was 0.47% (Bollinger, 2018; see Table 8). For these reasons, we anticipate that in very rare cases (<1%), participants may feel emotional distress due to hypnotic suggestions. We also expect that adverse events and unanticipated problems will occur within the “Less Likely ($1\% \leq \text{Event Rate} < 5\%$)” range. Notably, hypnosis used in research studies (such as this protocol) is associated with lower risk than when using hypnosis in clinical settings (Kihlstrom, 2013).

Interestingly, two experimental studies reported that informing participants of the potential side effects of hypnosis increased the chances of those side effects occurring (Page & Handley, 1993; Coe, Peterson, & Gwynn, 1995). As such, we will discuss common minor side effects (e.g., drowsiness) of hypnosis during the informed consent process but not directly before the hypnosis (we will follow the introduction to hypnosis script, adapted from Shor & Orne, 1962, which does not re-state potential side effects). This procedure should further minimize the likelihood of side effects and adverse events and is also recommended by American Society of Clinical Hypnosis (Page & Green, 1992).

In sum, it is unlikely that completing the hypnotic susceptibility scale, receiving suggestions, or completing the questionnaires and Stroop tasks will lead to any legal, social, or psychological problems.

MEASURES TO MINIMIZE RISKS OF HARM (PRECAUTIONS, SAFEGUARDS):

To minimize the risk of adverse events, we will exclude participants with schizophrenia, psychosis, bipolar disorder, psychosis, personality disorders, and PTSD who may be at greater risk for adverse reactions during and after hypnosis (Jensen, 2011).

The informed consent will thoroughly explain the study procedures and specifically note that participants are allowed to drop out of the study at any time.

The hypnotic susceptibility scale and suggestion condition will be solely administered by a graduate student (J.B.) who has completed 40 hours of American Psychological Association and American Medical Association approved continuing education credits in hypnosis education. John Kihlstrom, Ph.D. (a leader in the hypnosis and cognition field with over 30 years of experience conducting hypnosis research) states the following regarding qualifications for experimenters to conduct hypnosis research: “while it takes considerable training and expertise to use hypnosis appropriately in clinical practice, it takes very little skill to be a hypnotist. Beyond the hypnotist's ability to develop rapport with the subject, the most important factor determining hypnotic response is the hypnotizability of the individual subject” (Kihlstrom, 2015). Kihlstrom's laboratory at the University of California, Berkeley, also regularly uses undergraduate research assistants to administer hypnotic suggestions (Kihlstrom, 2013). J.B. (the study PI) has obtained training in clinical hypnosis which is more rigorous than conventional laboratory-based training in hypnosis due to its focus on using hypnosis for more sensitive populations than this study is intending to sample. In sum, we believe the training (and, noted below, supervision) of the experimenter is extensive and greater than normal for experimental protocols and also serves to reduce any unnecessary risks.

We will also exclude two items from the SHSS:C to minimize any risk for (a) tissue damage related to the item suggesting anosmia for ammonia (Raz et al., 2002) and (b) the occurrence of negative intrusive memories during the age aggression item.

The introduction and de-hypnosis procedures are as recommended by the developers of the SHSS:C (Crawford, Hilgard, & Macdonald, 1982; Page & Green, 2002). These recommendations will be used for the suggestion condition and for the administration of the SHSS:C. The recommendations state that the experimenter asks the participant to stretch on a countdown from 10 to 0 with the suggestion to become very alert at the 0 count, to assess their depth of hypnosis during the most recent experience, and to re-assess their current state (these procedures are further elaborated on p. 119, 124 of Crawford, Hilgard, & Macdonald, 1982).

After the SHSS:C, participants will be asked to report any discomfort. If a participant reports distress and wishes to discontinue, the experiment will be stopped immediately. In the rare case that a participant cites emotional distress, they will be provided with contact information for local mental health services in Maryland, Virginia, and Washington, D.C (as is on file for our laboratory's previous studies).

In addition, Charles Beadling, M.D. will serve as the PI's clinical supervisor for this project. He has reviewed and approved the experimental procedures for this study. Dr. Beadling has over 30 years of experience using hypnosis for clinical purposes in his work as an Air Force Family Medicine physician. He was originally trained in clinical hypnosis at USUHS and Walter Reed Army Medical Center and is Certified Consultant by the American Society of Clinical Hypnosis. The training plan for the PI is as follows:

Dr. Beadling will also provide observation of the PI of practice trials of the procedures (using laboratory members) before subjects are run through the protocol.

Serious and Other Adverse Events (AEs) will be defined in this study by using standardized criteria (U.S. National Library of Medicine, U.S. National Institutes of Health, U.S. Department of Human Services, 2016). Serious AE will be defined as “an adverse event that results in death, is life-threatening, requires inpatient hospitalization or extends a current hospital stay, results in an ongoing or significant incapacity or interferes substantially with normal life functions, or causes a congenital anomaly or birth defect. Medical events that do not result in death, are not life-threatening, or do not require hospitalization may be considered serious adverse events if they put the participant in danger or require medical or surgical intervention to prevent one of the results listed above” (U.S. National Library of Medicine, U.S. National Institutes of Health, U.S. Department of Human Services, 2016).

In the event of a Serious AE, the procedure will be as follows. The experiment will immediately be stopped, the experimenter will call 911, the Naval Support Activity Bethesda police will also be called to provide additional assistance. The incident including the timing, description, and resolution of the Serious AE will be reported to the USUHS IRB as soon as possible (i.e., the next business day). The experiment will also be voluntarily suspended by our laboratory. The event of a Serious AE as a result of this experiment would be unprecedented as life threatening consequences due to hypnosis have not been documented in the hypnosis literature.

Other AEs are to be defined as “an adverse event that is not a serious adverse event, meaning that it does not result in death, is not life-threatening, does not require

inpatient hospitalization or extend a current hospital stay, does not result in an ongoing or significant incapacity or interfere substantially with normal life functions, and does not cause a congenital anomaly or birth defect; it also does not put the participant in danger and does not require medical or surgical intervention to prevent one of the results listed above” (U.S. National Library of Medicine, U.S. National Institutes of Health, U.S. Department of Human Services, 2016). Side effects assessed during this study will not be defined as Other AEs because they are expected, relatively common, and minor. However, if the side effects assessed (drowsiness, confusion, headache; see Appendix B for the full side effect questionnaire) prevent the participant from continuing the experiment, the Other AE procedure will then be utilized in which the event will be recorded as described below.

The procedure in the event of an Other AE will be as follows. The experiment will immediately be stopped, the experimenter will call the on-call clinical supervisor (Charles Beadling, M.D.), and the participant will be offered mental health resources in the community. The experimenter will document the onset and severity of the Other AE and report the Other AE to the USUHS IRB as soon as possible (i.e., the next business day). The rate of Other AEs is estimated to occur in approximately 0.5% of participants (Kihlstrom, 2013; Bollinger, 2018) undergoing hypnosis. However, the rate of Other AEs in research (vs clinical) studies involving hypnosis is likely much lower than this. Other AEs are typically some form of increased anxiety such as having a disturbing memory coming to mind during hypnosis. It has also been noted that Other AEs due to hypnosis are usually transitory and primarily due to pre-existing psychiatric conditions (Stanley & Burrows, 2001).

CONFIDENTIALITY PROTECTIONS (FOR RESEARCH RECORDS, DATA AND/OR SPECIMENS):

All information provided by the participant as part of this study will be confidential and will be protected to the fullest extent provided by law. Responses to questionnaires will be maintained in a locked filing cabinet in lab offices in Building 28 (28-113). Responses on the phone screening interview (including the participant's email address and phone number), and the questionnaires will be entered into excel spreadsheets; these spreadsheets will be stored on a password protected computer in 28-113. The informed consent documents will be stored in a locked filing cabinet in lab offices in 28-113. Responses on the questionnaires administered in QDS and the cognitive assessments collected on e-Prime software will be stored in electronic format on a password protected computer in the LOCI laboratory (28-101).

POTENTIAL BENEFITS

There also may be benefits to participants. Some participants may significantly improve their health after engaging with the local smoking cessation resources provided at the end of the experiment. In addition, undergoing hypnosis is also noted to be a relaxing and pleasant experience by the majority of research participants (Coe & Ryken, 1979).

Information gained from this study may be beneficial to smokers and society as a whole. Hypnosis is increasingly used to study how cognitive processes can be modified (see Table 6). For example, the classic Stroop effect has been observed to be very robust (MacLeod, 1991), but can be modified by specific hypnotic suggestions (Appendix C). If this attenuation is observed in this study, then this experiment will bolster confidence in this finding.

This study may give the scientific community impetus to study how hypnotic suggestion can modify clinically relevant cognitive processes in other disorders (Terhune et al., 2017). Hypnosis is likely different from other relaxation techniques in its ability to modify a number of cognitive processes including perception (Jensen, 2011; Terhune et al., 2017).

This study may also lead to new insight on clinical applications of hypnosis to smoking cessation. Data from the study may also help us ascertain if specific suggestions are useful in modifying smoking-related cognitions observed in nicotine dependence. The results will help us determine whether future studies using specific hypnotic suggestions in smokers are warranted. The results may be instrumental in developing new, efficacious hypnosis-based treatments for smoking cessation. This is especially relevant given the wide-spread health effects of smoking, hypnosis' high treatment acceptability, and high relapse rates with standard treatments.

PRIVACY FOR SUBJECTS:

Participants' names will be linked to a subject ID/log number on a master code sheet. All data analysis and other documentation will reference the subject number ID number. The master code will be saved on a password protected computer in our lab room that is kept locked (Building 28-113). In addition to regularly scheduled server backups, researchers will backup data daily to a secure computer within the lab. Any paper documents containing identifying patient information will be stored in a locked file cabinet.

INCIDENTAL OR UNEXPECTED FINDINGS:

None of the questionnaires administered during the laboratory session contain items about physical or mental health. Thus, incidental information concerning health is not anticipated to be encountered or revealed. However, there is a small probability that some participants may experience distress during hypnosis that may indicative of an underlying stressor. In such as cases they will be given mental health resources for the DC/MD/VA area.

In addition, participants who score high in hypnotic susceptibility (>7 on the SHSS:C) will be informed of their result. They will be told they may benefit from suggestion-based interventions (Spiegel et al., 1993) performed by a qualified health care professional.

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