January 2013

# The Effects of Caloric Preload and Dietary Restraint on Smoking and Eating Behavior

Michelle Kovacs
*University of South Florida*, michelle2@mail.usf.edu

# The Effects of Caloric Preload and Dietary Restraint on Smoking and Eating Behavior

by

Michelle A. Kovacs

A thesis submitted in partial fulfillment
of the requirements for the degree of
Master of Arts
Department of Psychology
College of Arts and Sciences
University of South Florida

Major Professor: Thomas Brandon, Ph.D.
Kevin Thompson, Ph.D.
Jamie Goldenberg, Ph.D.

Date of Approval:
April 2, 2013

Keywords: Tobacco, Cigarettes, Craving, Restrained Eating, Food Prime

## Dedication

I would like to dedicate this thesis to my family, friends, and colleagues, as their unwavering encouragement and inspiration helped me through the entire process.

**Acknowledgments**

I would like to sincerely thank those who have supported and encouraged this project from the very beginning and throughout including my advisor, Thomas Brandon, Ph.D. who provided me with excellent guidance and support, and my thesis committee, Kevin Thompson, Ph.D. and Jamie Goldenberg, Ph.D. In addition, I would like to acknowledge and thank all of the graduate students, faculty and staff at the Tobacco Research and Intervention Program (TRIP) laboratory. A special thanks goes to my research assistants, John Correa and Natalie Downey; I could not have completed this project without your hard work and dedication.

## Table of Contents

## List of Tables

## List of Figures

**Abstract**

Rates of smoking are elevated in eating-disordered populations, especially among females (Pomerleau & Snedecor, 2008; Klesges & Klesges, 1988). Restrained eaters ignore physiological cues of satiation and hunger, and instead attempt to employ cognitive control over decisions to eat. Additionally, they are prone to eat in a disinhibited manner after a salient emotional or food cue interrupts their restraint. This eating style is also associated with increased rates of smoking compared with the general population. Although there is a great deal of literature on the relationship between smoking and eating, the role of eating in momentary decisions regarding smoking remains to be explored. The current study tested whether a food prime, which has been found to elicit disinhibited eating in restrained eaters, could also motivate smoking as an alternative to eating. In a randomized two-arm (Prime/No-Prime) between-subjects design, it was hypothesized that smokers, particularly those high in eating restraint, receiving a food prime would be more likely to smoke than eat when given the option, compared to smokers who did not receive the food prime. Although main effects on smoking variables were not found, restraint status did moderate the effect of the food prime upon latency to first puff, number of puffs, and cigarette craving. Moreover, the moderation effect was reversed upon eating variables, suggesting that after a food prime, weight-control smokers appear to choose to smoke to prevent further food intake. This conclusion was bolstered by the finding that the moderation effect on smoking was further moderated by expectancies regarding the effect of smoking upon appetite and weight. In summary, this study identified psychological mechanisms that appear to underlie the population-based covariance between disordered eating and smoking.

# The Effects of Caloric Preload and Dietary Restraint on Smoking and Eating Behavior

Smoking is one of the leading causes of death in the United States, yet the Centers for Disease Control and Prevention (CDC; 2010) report that 19.3% of adults are current smokers. When broken down by age group, smoking rates range from 20.1-22% in younger smokers, ages 18-44. Concurrently, another major social problem, that disproportionately impacts young people (especially females), is the dramatic increase in incidence and prevalence of eating disorders over the past several decades in the US. This likely results from a complex interaction of factors, including the sociocultural influence on current standards of beauty (Gordon, 2000). Those who strive to adhere to these standards of beauty may resort to unhealthy behaviors to achieve the goal of weight control. One such unhealthy behavior that is used for these purposes is cigarette smoking.

## The Relationship Between Smoking and Weight Control

There is robust literature on the relationship between smoking and eating. Smoking suppresses weight (Lycett, Munafo, Johnstone, Murphy, & Aveyard, 2011); conversely, when people quit smoking, some gain a substantial amount of weight. Weight-control smokers (i.e. those who use cigarettes to control body weight and food intake) have been found to have no significant differences in demographics or dependence on nicotine that distinguish them from non weight-control smokers. However, when subjected to temporary abstinence from smoking, weight-controllers eat more food than non-weight-controllers (Pomerleau, Ehrlich, Tate, Marks, Flessland, & Pomerleau, 1993). Essentially, cigarettes appear to serve as a tool for these smokers to restrain their eating and control their weight; removing this tool leads to disinhibited overeating.

In one study of self-reported dieting strategies used in the prior 6 months (Klesges & Klesges, 1988), nearly one third of smokers reported using cigarettes for weight control, and one third of all participants had gained weight after quitting. Additionally, smokers more concerned

about gaining weight after cessation have been found to be less likely to show up for, and quit smoking during a community smoking cessation intervention ( Meyers, Klesges, Winders, Ward, Peterson, & Eck, 1997). This well-established relationship between smoking and desire to reduce weight and food consumption (Saarni, Silventoinen, Rissanen, Sarlio-Lahteenkorva, & Kaprio, 2004) is strengthened as severity of eating pathology increases (George & Waller, 2005; Kendzor et al., 2008).

Whereas smoking patterns are commonly influenced by weight concerns in general, female smokers may be a special sub-population for which this relationship is exacerbated, as they self-report using smoking for weight and/or food intake control purposes disproportionately more than males (Pomerleau & Snedecor, 2008; Klesges & Klesges, 1988). Beyond self-report, female abstaining smokers are known to eat more than non-abstaining smokers, with this increased food intake being related to increased craving for both food and cigarettes (Ogden, 1994).

Although smokers do weigh less on average than non-smokers, general expectancies of how much smoking really does suppress one's body weight may be inflated estimates (John, Hanke, Rumpf, & Thryian, 2005; White, McKee, & O'Malley, 2007). Unfortunately, exaggerated beliefs about smoking's weight-control properties are most strongly associated with concerns about weight and eating. As will be discussed next, restrained eaters (especially females) are a special subgroup of people who may be particularly prone to smoke to control weight and eating.

## Restrained Eating

### Restraint theory.

Restraint Theory posits that dieters switch their cues to eat from a physiologically-controlled to a cognitively-controlled process to decrease their food intake (Herman & Polivy, 1975; Spoor et al., 2006). Put another way, restrained eating refers to consciously controlling food intake, rather than eating in accordance to physiological hunger and satiation cues. This type of eating can become problematic, leading to unrestrained, or "disinhibited" eating, whereby a salient environmental, physical, or emotional cue will prompt a person to override their restraint and eat in an uninhibited manner, once again disregarding physical cues of satiation. Disinhibited

eating can occur in situations that do not involve food consumption, including after a demanding cognitive task (Lattimore & Caswell, 2004), or in the mere presence of palatable food (without a preload) (Rogers, & Hill, 1989). Restrained eating is akin to dieting; however, they are not synonymous concepts, in that a person can diet without necessarily ignoring his or her internal cues for satiation and hunger. Nevertheless, the two concepts are related, and may converge in the case of chronic dieting.

Experimental trials evaluating restrained eating typically use in-vivo food priming techniques (Strobe, 2008). This entails instructing research participants to consume a small amount of food, called a preload (e.g. a milkshake), then giving them access to ad-libitum food to determine how much they will eat. Level of restrained eating, as measured by the Restraint Scale (RS) (Herman & Polivy, 1980), is typically found to moderate the amount of food a participant will eat. With higher levels of restraint, the food prime disinhibits the restrictions that participants place on their eating, leading to an abstinence-violation, and consequently, increased food intake. Those who are not restrained eaters show the opposite pattern after a food prime; they will subsequently eat less food following a preload (Strobe, 2008; Urbszat, Herman, & Polivy, 2002). Finally, the effects of disinhibited eating in restrained eaters are more pronounced in females, who have higher rates of eating pathology than men in the general population (Lowe & Thomas, 2009; Ogden, 1994).

**Associations Among Restrained Eating, Eating Disorders, Negative Affect, and Smoking**

Smokers who are restrained eaters use smoking for weight control to a greater degree than non-restrained eaters (McKee, Nhean, Hinson, and Mase, 2006). Additionally, smokers who are disinhibited eaters tend to gain more weight after quitting than the typical weight gain associated with quitting smoking (Addicott, Gray & Todd, 2009; Hudmon, Gritz, Clayton, & Nisenbaum, 1999). Furthermore, stronger explicit expectancies (such as believing cigarette smoking can suppress appetite and weight) have been found to predict increases in level of restrained eating and disinhibited eating (Copeland & Carney, 2003).

This manner of eating is not only physically unhealthy, but it can also lead to, or exacerbate, mental health problems. There is a well-established relationship between smoking

and negative affect (Brandon, 1994). Negative affect induction has been found to lead to increased temptation to smoke in those who exhibit higher levels of dietary restraint (Addicott, Gray, & Todd, 2009). Restrained eating is also often comorbid with substance use and abuse (Addicott, Gray & Todd, 2009; Hudmon et al., 1999; Stewart, Angelopoulos, Baker & Boland 2000), and can lead to more severe eating pathology and eating disorders (Rudderman & Grace, 1987; Rudderman & Grace, 1988). Restrained eating can also lead to the severe eating disorder, bulimia nervosa (BN). Ruderman and Grace (1987) found that both of the subscales or factors of the Restraint Scale (RS), "Concern for Dieting" and "Weight Fluctuation," were highly correlated with BN. In addition, Bulik et al. (1992) found that up to 52% of patients with bulimia nervosa were smokers.

Anzengruber et al. (2006) found that increased rates of eating disorders were associated with overall increased rates of dependence on nicotine and smoking, especially for binge/purge subtypes of eating disorders. This increased smoking was also related to impulsivity. Furthermore, patients with BN have been found to smoke significantly more than those with the eating disorder anorexia nervosa (AN) (George and Waller, 2005). This is important, as restricted and disinhibited eating, as measured by the RS, captures eating patterns more analogous to BN (in terms of binging) than AN (Lowe & Thomas, 2009). Although restrained eating is not considered as severe as eating disorders such as BN or AN, it is a risk factor for developing these disorders and associated impairments in many domains of life. It appears that detrimental eating patterns serve to maintain smoking behavior in a large portion of restrained eaters, in addition to predisposing them to more severe eating pathology, increased risk for substance abuse, and negative affect (Tiggemann, 1994).

**Restrained eating as a barrier to quit attempts.**

Smokers higher in dietary restraint are reluctant to gain weight post-cessation, and therefore, restrained eating can serve as a barrier to smoking cessation (Addicott, Gray, & Todd, 2009; Pomerleau, & Kurth, 1996). There are several known mechanisms that contribute to smokers weighing less than the general population. Smoking is an appetite suppressant, which increases satiety after a meal (Grunberg & Greenwood, 1992; Perkins, Epstein, Fonte, Mitchell, &

Grobe, 1995). In addition, implicit and explicit expectancies about nicotine's expected role in appetite and weight control influence smokers perceptions of cigarette's weight suppressing effects (Grunberg & Greenwood, 1992; White, McKee, & O'Malley, 2007; Copeland & Carney, 2003). Additionally, the rate of smoking may be elevated in this sub-population partly due to the concept of self-control (Muraven, & Baumeister, 2000). For instance, depriving oneself of both nicotine and food (as opposed to nicotine alone), may deplete self-control resources and increase smoking behavior (Leeman, O'Malley, White, & McKee, 2010; Muraven, & Baumeister, 2000). Moreover, depletion of self-control can lead to increased consumption of food, and/or cigarettes (Heckman, Ditre, & Brandon, 2012; Leeman, et al., 2010; Shmueli & Prochaska, 2009). It is also possible that smoking may restore self-control (Heckan, Ditre, & Brandon, 2012) that has been depleted by dieting restraint.

Despite these broad associations between eating and smoking, it is important, for at least three reasons, to parse out the acute situations and variables that contribute to the maintenance of smoking in the population of restrained eaters. First, as demonstrated, restrained eating is futile (i.e. it does not result in the desired weight loss over time that is usually the goal of restrained eaters). Next, restrained eating is detrimental, and impairing to quality of life (it is associated with higher levels of negative affect and can lead to more serious eating disorders). Finally, smoking to maintain such futile and detrimental behaviors compounds health risks incurred by disordered eating, by using a dangerous and life threatening product to maintain an already dangerous and life-threatening behavior.

Although research on the effects of cigarettes on weight is relatively robust, there is less known about specific and transient patterns of cigarette use for eating and/or weight control purposes. Because females who are restrained eaters smoke more than the general population, it is logical to combine paradigms from these two research areas. This leads to the research question: Does restrained eating, and the priming effect in particular, influence momentary smoking motivation and behavior?

**The Current Study**

The overarching aim of the current study was to examine the relationship between eating and smoking behavior when both options were available simultaneously. The study attempted to elucidate patterns that occurred in two different scenarios regarding smoking and eating, utilizing a two-arm (Prime/No-Prime) between-subjects design. Importantly, we simulated patterns that occur in natural situations as females make decisions about smoking and eating. Participants were either primed with a preload (an ostensibly high fat, high caloric vanilla milkshake), or received no preload. Next, participants had the opportunity to eat as much food as they liked in a specified amount of time, with the additional option to smoke. We expected participants (particularly those high in eating restraint) in the condition receiving a food prime (Prime), to smoke more than participants not receiving a food prime (No-Prime). We hypothesized that this option to smoke after eating a small amount of food should produce a disruption in the typical disinhibition seen in restrained eaters after a food prime. We also expected the former group to eat less than the participants in the latter condition. That is, we expected that the violation of eating restraint would be re-directed from food to cigarettes, when the latter were available. We postulated that these findings would further elucidate the situations and patterns in which the relationship between food and smoking is evident, particularly when momentary motivation to smoke is affected.

**Specific Aim 1: Testing the effect of a food prime on craving and smoking behavior**

**Hypothesis 1A:** We hypothesized participants in the condition receiving a food prime would smoke more than those in the condition with no food prime. Actual or perceived dietary violations (such as eating a small amount of a perceived “bad” food) disrupt the strict regulation of restrained eaters, leading to more food intake (Stroebe, 2008). In the presence of cigarettes, we expected such smokers to opt to smoke rather than eat.

**Hypothesis 1B.** We expected this effect to be moderated by level of restrained eating.

**Hypothesis 1C.** We expected this effect to be moderated by expectancies regarding smoking’s weight-control properties.

**Hypothesis 1D.** We expected similar main effects and interactions, for craving to smoke.

**Secondary Aim 1: Examination of differences in amount of food consumed between restrained eaters in the Prime vs. No-Prime conditions.**

**Secondary research question 1A.** Previous research on restrained eaters has found that a food prime procedure leads to disinhibited eating and increased food consumption. We examined whether this pattern occurred in the proposed study. However, because we expected smoking to interrupt this disinhibition, we hypothesized that it may negate the priming effect.

**Secondary Aim 2: Examination of the role of negative affect and impulsivity on the priming effects of food.**

**Secondary research question 2A.** Because negative affect and impulsivity have each been associated with increased craving to smoke and higher body dissatisfaction, *trait* negative affect and impulsivity were hypothesized to moderate the effects predicted in the specific aims, with greater negative affect and/or impulsivity associated with greater effects of the food prime. We planned to examine whether any moderator effects were independent of the hypothesized moderator effects of restrained eating.

**Secondary research question 2B.** We also planned to examine if *state* negative affect mediated the effects predicted in the specific aims.

## Method

### Experimental Design and Overview

Female smokers were randomly assigned to one of the two conditions (Prime or No-Prime). Participants were compensated with either course credit (for Psychology classes at USF), or $25 (for participants recruited from non-psychology courses or campuses other than USF).

### Participants

Participants were told that the study was about smokers' taste preferences for foods. Individuals were recruited through the undergraduate psychology research participant pool at USF (SONA), classes at the University of South Florida (USF) (with permission of the instructor), the USF student newspaper (The Oracle), recruitment databases in our lab, and listservs. In addition, fliers recruiting participants were placed around campus at USF. Participants were also recruited through Craigslist's help wanted section, and via posting fliers in community areas in businesses around the Tampa area. All individuals were screened prior to enrollment. They were informed that the study would last about 1.5 hours, and given a brief overview of the tasks they should expect to complete. No appointments were made before 11am. Participants were instructed to smoke a cigarette 3 hours before their appointment and to abstain thereafter. In addition, they were instructed to eat a normal breakfast, and then abstain from eating 3 hours prior to the study. These criteria were confirmed upon arrival at their appointment.

Sample size analyses were conducted using G-power (Faul, Erdfelder, Lang, & Buchner, 2007). To achieve power of .80 for detecting a population group difference with a medium sized effect ($d$ = .5) on the smoking-related dependent variables, with a two-tailed alpha level of .05, we required a sample size of 128, or 64 participants per condition. Effect sizes smaller than this are unlikely to have much theoretical or applied significance.

Inclusion criteria for participation in the study included: 1.) Females; 2.) Ages 18-29; 3.) Smoked more than 100 cigarettes lifetime and at least 1 cigarette every day for the past 30 days;

4.) Exhaled carbon monoxide (CO) of at least 6 ppm on the day of the study; 5.) No current engagement in formal smoking cessation treatment (including pharmacotherapies); 6.) Not pregnant; 7.) Not lactose intolerant or vegan.

**Baseline Measures**

**Demographic Questionnaire (DQ).** This form was used to assess participants' age, date of birth, marital status, race, ethnicity, level of education, and household income. Additionally, we added one question regarding start date of participant's menstrual cycle, as this has been found to affect food intake (Buffenstein, Poppitt, Devitt, & Prentice, 1995).

**Positive and Negative Affect Schedule-(PANAS), General and Moment.** The PANAS (Watson, Clark & Tellegan, 1988), can be used to measure positive and negative affect for several time periods. We used the PANAS-General to assess average affect and the PANAS-Moment to measure affect at three time points.

**Questionnaire on Craving for Sweet or Rich Foods (QCSRF)**. We administered 6 items from the "Relief/Control" factor of the QCSRF (Toll, Katulak, Williams-Piehota, & O'Malley, 2008), which represents expectancies of one's ability to control food intake, and of food's ability to alleviate negative affect. It is scored on a 1-7 Likert scale, with higher scores indicative of increased expectancies for negative affect relief and low expectancies for controlling food intake. The QCSRF is an internally consistent scale that demonstrates good convergent validity.

**Questionnaire of Smoking Urges-4 (QSU-4).** This measure is a 4-item abridged version of the 32-item Questionnaire of Smoking Urges, indicating desire to, and intention to smoke (Tiffany, & Drobes, 1991). This scale demonstrated a high level of internal consistency in this study, $\alpha = .89$.

**Restraint Scale (RS).** The RS (Herman & Polivy, 1980) is a commonly used 10-item measure of dietary restraint. Its 10 items load onto two factors, or subscales: "Weight Fluctuation" (WF) and "Concern for Dieting" (CD). The RS has a maximum score of 35, with the median in the 14-15 range. An individual who scores above the median is thought to exhibit restrained eating. Overall, when used on normal weight individuals, without a diagnosis of eating disorder, the

reliability of the RS is α = .75, indicating good reliability (Lowe, & Thomas, 2009). This measure demonstrated good reliability in the current study, α = .77.

**Smoking Consequences Questionnaire (SCQ).** This scale is a measure of smoking-related expectancies and consists of 10 subscales, of which we included two: Negative Affect Reduction, and Weight Control (Brandon, & Baker, 1991). Participants rated statements on a scale from 0 (“completely unlikely”) to 9 (completely likely).

**Smoking Form (SF).** The Fagerström Test for Nicotine Dependence (FTND; Heatherton, Kozlowski, Frecker, & Fagerstrom, 1991), which reliably measures nicotine dependence, is incorporated in this measure of current and past smoking history. A measure to gauge readiness to consider quitting smoking, the Contemplation Ladder (Beiner, & Abrams, 1991), was also included

**Smoking Related Weight Concern (SRWC).** We used the following question used to assess participants’ concern over post-cessation weight gain: 1.) “On a scale of 1-5 (not at all concerned- extremely concerned), how concerned would you be if you gained weight after quitting smoking?” (Jeffery et al., 2000).

**The Barratt Impulsiveness Scale Version 11 (BIS-11).** The BIS-11 (Patton, Stanford, & Barratt, 1995) is a widely used, internal consistent measure of impulsivity. Its scales load onto three factors: “Motor Impulsiveness”, “Nonplanning Impulsiveness”, and “Attentional Impulsiveness.”

**Washout Task.** Utilizing a task modified from Roehrig (2008), participants had 5 minutes to imagine and list vacation destinations that they had heard about but never been to. This type of task is intended to reduce cognitive and affective consequences of completing baseline questionnaires. This task was administered after the baseline questionnaires, but before the experimental (prime/no-prime) phase.

**Weight-Control Smoking Scale (WCSS).** This scale was originally contained in the Reasons for Smoking Scale. It is a three item measure, with responses ranging from 0-3 on each item, and total scores ranging from 0-9 (Pomerleau et al., 1993). The WCSS demonstrates good

reliability (α = .83). It demonstrates good concurrent validity and also correlates with self-efficacy to relapse after weight gain, and body dissatisfaction (Pomerleau, & Snedecor, 2008).

**Dependent Measures**

**Eating behavior.** A digital food scale was used to measure standardized portions of food before and after the taste test, allowing for calculation of food consumption. Additionally, we video recorded participants during the "taste test" and coded their latency to first bite of food in seconds. Thus, latency to eat, total weight and total calories consumed were our measures of food intake.

**Smoking behavior.** This was measured by video recording participants during the "option to smoke" phase of the experiment and later coding the number of puffs smoked, in addition to latency to first puff. We also measured cigarette weight before and after the experiment and CO levels pre- and post-experiment.

**Visual Analogue Scales (VAS).** Participants rated the following variables on a scale from 0mm-100mm: cravings for/ desire for food, desire to smoke a cigarette, subjective fullness and subjective hunger. In addition, participants completed taste test rating forms. To enhance the taste test cover story, participants were instructed to fill out a separate taste test form for each food item they consumed on a 0mm-100mm VAS scale for four categories of taste: sweetness, saltiness, sourness, and how much they liked each one. (See Appendices M-Q).

**Procedure**

See Table 1 for an outline of the study procedure. Session length was about 70-90 minutes.

**Consent.** Participants first heard a brief overview of the study, and then were asked to sign an informed consent form. The great majority of participants brought a pack of cigarettes with them to the session; however, in the event that they failed to bring cigarettes they had opportunity to use cigarettes provided by the experimenter.

**Administration of Baseline Questionnaires.** After providing consent, participants completed baseline measures, which took about 20 minutes. All participants completed measures in the following order: Demographic Questionnaire (DQ), Exhaled Carbon Monoxide (CO), Questionnaire on Craving for Sweet or Rich Foods (QCSRF), Questionnaire of Smoking Urges-

Brief (QSU-4), PANAS- General and Moment, Smoking Form (SF), Smoking Consequences Questionnaire, Smoking related weight concern, Restraint Scale (RS), Weight Control Smoking Scale (WCSS) the BIS-11, and VAS for hunger and cravings for food and cigarettes in the "present moment." These questionnaires were followed by the 5-minute washout task of generating vacation destinations.

**Randomization and Prime/No-Prime Manipulation**

Next, participants were randomly assigned to one of the two experimental conditions using a random number sequence generator (www.random.org). Based on this sequence, the assignment for each participant was put into a sealed envelope which was opened by the experimenter after consent to participate was attained and baseline measures were administered.

Participants in the No-Prime condition were instructed to wait five minutes while we prepared the next phase of the experiment. They were given the option to read magazines with food and smoking cues removed while they were waiting. Participants in the prime condition received the food preload at this time and had 5 minutes to consume a 10oz vanilla milkshake of approximately 240 calories. The milkshake was prepared at the lab, using ice cream and 1% milk, which we prepared and poured into disposable drink cups. These procedures are typical of milkshake preparation and instructions in previous literature utilizing milkshakes as food primes for restrained eaters (Jansen, Nederkoorn, van Baak, Keirse, Guerrieri, & Havermans, 2009; Mills, & Palandra, 2008; Stroebe, 2008).

**Taste Test Phase**

Next, all participants received ad-lib food, with the option to smoke, for 20 minutes. A glass of water and pre-measured portions of the following four types of foods was placed on a table in front of the participant: potato chips, cookies, candy/chocolate, and cheese cubes. These types of foods have been ranked highly as "comfort foods" for women (Wansink, Cheney, Chan, 2003) and have been used in past priming studies for research purposes (Ogden, 1994; Urbszat, Herman, & Polivy, 2002). Both groups were also presented with their cigarettes and lighters at this time, which were left on a table in the experimental room with an ashtray. They were asked to complete a taste test rating form for each food item they tasted. Afterwards, all food was removed

and placed in a separate room with a scale to weigh it immediately after the participant left the lab.

**Post-session Measures**

Next, immediate measures of hunger and cravings for food and cigarettes (VAS scales) "during the taste test" were taken, followed by VAS for hunger and cravings for food and cigarettes in the "present moment," QCSRF, CO level, PANAS-Moment, and finally BMI measurement (taking of height and weight).

**Compensation and Debriefing**

Lastly, all participants were asked to complete a post-participation survey and a receipt of payment (if applicable). At this time, participants were debriefed.

Table 1.

*Outline of Procedure*

---

**Part I: Recruitment and Screening of Participants**

- Individuals recruited via:
    - SONA
    - Fliers
    - Classrooms
    - Recruitment databases in lab
    - Listservs
    - Student newspaper (the Oracle)
    - Craigslist
- Participants were screened and informed over the phone.
- Instructions and details of the study were given.
- Sessions were scheduled (for 11am or later).

**Part II: Consent (10 minutes)**

**Part III: Baseline Questionnaires completed by all participants (20 minutes)**

- Demographic Questionnaire (DQ)
- Exhaled Carbon Monoxide (CO)
- Questionnaire of Smoking Urges- Brief (QSU-4)
- PANAS- General and Moment
- Restraint Scale (RS)
- Smoking Form (SF)
- Smoking Consequences Questionnaire
- Smoking related weight concerns
- The Barratt Impulsiveness Scale, Version 11 (BIS-11)
- QCSRF
- VAS for hunger, cravings for food and cigarettes
- Weight Control Smoking Scale (WCSS)
- Compensation of $5 if participant disqualified at TRIP
- After questionnaires were completed, experimenter checked to make sure all questions were filled out and in the proper manner and allowed participants to fill in missed questions if they chose.

Table 1, Continued

**Part IV: Wash-out period (5 minutes)**
- Participants listed vacation destinations for 5 minutes.

**Part V: Randomization and prime/no prime manipulation (5 minutes)**
- Participants were assigned to one of two conditions.
- Prime condition was given food prime and told it is was a regular vanilla milkshake which participants receive in order to prepare for the taste-test.
- No-Prime condition read magazines with smoking and food cues removed for 5 minutes.
- QSU-4 and PANAS-moment.

**Part VI: Taste Test Phase (20 minutes)**
- All participants received ad-lib food and cigarettes for 20 minutes.

**Part VII: Post- session Measures (10 minutes)**
- Food was removed.
- Immediate measures of hunger and cravings for food and cigarettes (VAS scales) “during the taste test”
- VAS for hunger and cravings for food and cigarettes in the “present moment”
- Exhaled Carbon Monoxide (CO)
- PANAS- Moment
- Body Mass Index (height and weight)
- QCSRF
- QSU-4

**Part VIII: Compensation and Debriefing (5 minutes)**
- Post-Participation survey
- Receipt of payment (for participants not recruited via SONA)
- Debriefing

**Part IX: Weighing of food and cigarettes consumed**
- Participant left lab
- Experimenter weighed food and cigarettes
- Experimenter or research assistant entered participant’s experimental data.

## Results

To verify group equivalence on demographics, nicotine dependence, and other baseline variables, a series of independent samples t-tests and Chi-square analyses were conducted. A significant difference emerged for only one variable- CPD ($p$ = .033). Because CPD was correlated with two dependent variables (total weight of cigarette and number of puffs), results with these variables were conducted both with and without CPD as a covariate. Unless the covariate CPD produced different significance levels, the results are reported without CPD as a covariate. Additionally, variables were checked for outliers and parametric assumption violations. To conform to normality, three variables were log-transformed (latency to first puff, latency to first bite of food, and number of puffs).

### Participant Characteristics

Average age of participants ($N$ = 128, 64 in each group) was $M$ = 22.13, $SD$ = 3.16. In this sample, 85.2% percent of participants were Caucasian, and 10.9% were African American. Additionally, 15.6% of the sample were Hispanic. Participants smoked an average of 10.35 cigarettes per day ($SD$ = 6.12), with a mean FTND score of 3.11 ($SD$ = 2.43). Additional demographic and smoking variables are presented in Table 2.

### Specific Aim 1: The effect of a food prime on smoking behavior and craving

#### Smoking behavior.

We hypothesized that participants receiving a food prime would smoke more than those in the No-Prime condition and that this effect would be moderated by level of restrained eating and expectancies related to the weight-control properties of smoking. Contrary to hypotheses, no main effects for the Prime condition were found on any of the three smoking variables: log-transformed latency to first puff (in seconds), log-transformed number of puffs, and total weight of cigarette smoked (in grams), (see Table 3).

Between-group differences in smoking behavior were next examined using level of restrained eating (as measured by the RS) as a moderator. We first treated dietary restraint as a continuous variable because of the statistical advantages of this approach. However, we also tested moderation effects by dichotomizing the sample into restrained and non-restrained eaters based on the sample's median restraint score which is consistent with previous research in this area. Currently, it is thought that scores in the 12-14 range or above on the RS are indicative of restrained eaters (Lowe & Thomas, 2009). Therefore, a majority of the sample exhibited high dietary restraint.

First, linear regression analyses were run with a continuous measure of restraint using the total RS score as the moderator, condition as the focal predictor, and smoking variables as the DV's. All linear regressions were run using a specialized macro (Modprobe) for linear and logistic regression in SPSS (Hayes & Matthes, 2009). Plots and means were examined to determine direction of effect after all regressions were run.

As seen in table 4, the hypothesized interaction between RS and smoking appeared on two of the smoking variables (log-transformed latency to first puff and total weight smoked). This interaction is also displayed in Figure 1 for log-transformed latency to first puff and Figure 2 for total weight smoked. RS was also a significant predictor of smoking variables with these regression models[1].

ANOVA's were run next, to examine group differences between smoking variables using the sample's RS median split as a moderator. As expected, for log-transformed latency to first puff, there were main effects of the RS median split $F(1,119) = 7.68$, $p = .006$ (participants above the RS median had a shorter latency to fist puff; see Figure 3), and an interaction between the RS median split and condition $F(1,119) = 7.12$, $p = .009$, such that those in the Prime condition above the median RS score began smoking sooner. Contrary to what was expected, for log-transformed number of puffs, there were no main or interaction effects of condition or RS median split (*p's* >

[1] When CPD was included as a covariate for total weight smoked, this result became marginally significant, $p = .065$.

.05) [2]. For total weight of cigarette smoked, however, there was an interaction between condition and RS median split such that those who were above the median in the Prime condition smoked significantly more $F(1,120) = 6.12$, $p = .015$. There were no main effects of condition or restraint on total weight smoked (*p's* > .05).

**Craving.**

To test Hypothesis 1D, that craving would show main effects of the priming manipulation and interactions with the RS, we first tested the QSU-4 scores from Time 2. ANOVA revealed no significant main effects of condition ($p = .50$) or interaction between condition and RS median split ($p = .13$) on craving after the manipulation. Continuous results similarly revealed no main effect by condition ($p = .37$) or interaction between RS and condition ($p = .19$). We then tested the VAS item that was administered after the taste test to assess participants' retrospective craving during the taste test. We found no main effect of the priming manipulation upon craving, but the RS median split significantly moderated the priming effect upon craving, consistent with the behavioral results, such that those scoring above the median of 15 in the Prime group, endorsed the highest craving to smoke ($M = 71.13$, SD = 18), $F(1,123) = 6.7$, $p = .011$. Continuous results revealed that there were significant main effects by condition and an interaction between RS total and condition (see Figure 4). Moreover, craving measured by the QSU-4 was negatively correlated with latency to first puff, and positively correlated with number of puffs, total weight smoked, and VAS desire to smoke (see Table 5).

Mediation by craving analyses revealed no direct or indirect effects of condition through QSU-4 (time two) to predict latency to first puff (effect = .059, $SE = .085$, 95%CI [-.11, .23]), number of puffs (effect = -.02, $SE = .27$, 95%CI [-.08 , .03]), or total weight smoked (effect = -.02, $SE = .02$, 95%CI [-.08 , .03]. Moderated mediation of the interaction between restraint and condition upon all three smoking variables by craving was also non-significant.

[2] When CPD was included as a covariate, group differences in log-transformed number of puffs by RS median split status were marginally significant, $p = .06$

Based on these results, both continuous and categorical measures of restraint shared moderating effects of the priming condition upon smoking behavior. Those highest in restraint and in the prime group had the shortest latency to first puff, and tended to take more puffs.

Table 2.

*Sample Demographic and Smoking Variables*

| Variable | Prime | No-Prime | Overall | *p* |
|---|---|---|---|---|
| N | 64 | 64 | 128 | |
| Age (mean) | 21.81 (2.99) | 22.44 (3.31) | 22.13 (3.17) | 0.27 |
| Race (%) | | | | 0.39 |
| American Indian/Alaska Native | 1.6 | 0 | 0.8 | |
| Asian | 3.1 | 0 | 1.6 | |
| Native Hawaiian or Other Pacific Islander | 1.6 | 1.6 | 1.6 | |
| Black or African American | 7.5 | 14.1 | 10.9 | |
| White | 85.9 | 84.4 | 85.2 | |
| Hispanic (%) | 14.1 | 17.2 | 15.6 | 0.53 |
| Marital Status (%) | | | | 0.73 |
| Single | 90.6 | 92.2 | 91.4 | |
| Married | 3.1 | 3.1 | 3.1 | |
| Separated | 4.7 | 1.6 | 3.1 | |
| Divorced | 1.6 | 1.6 | 1.6 | |
| Widowed | 0 | 1.6 | 0.8 | |
| Education (%) | | | | 0.59 |
| Did Not Graduate High School | 4.7 | 9.4 | 7.0 | |
| High School Graduate | 12.5 | 7.8 | 10.2 | |
| Some College | 48.4 | 46.9 | 47.7 | |
| Technical School/ Associates Degree | 20.3 | 20.3 | 20.3 | |
| 4-year College Degree | 6.3 | 10.9 | 8.6 | |
| Beyond 4-year College Degree | 6.3 | 1.6 | 3.9 | |
| Professional Degree (eg. MD, JD, PhD) | 1.6 | 3.1 | 2.3 | |

Table 2, Continued

| | | | | |
|---|---|---|---|---|
| Income (%) | | | | 0.48 |
| Under $10,000 | 34.4 | 43.8 | 39.1 | |
| $10,000-$19,000 | 18.8 | 20.3 | 19.5 | |
| $20,000-$29,000 | 20.3 | 7.8 | 14.1 | |
| $30,000-$39,000 | 3.1 | 6.3 | 4.7 | |
| $40,000-$49,000 | 10.9 | 9.4 | 10.2 | |
| $50,000-$59,000 | 3.1 | 3.1 | 3.1 | |
| $60,000-$69,000 | 1.6 | 3.1 | 2.3 | |
| $80,000-$89,000 | 1.6 | 3.1 | 2.3 | |
| Over $90,000 | 6.3 | 1.6 | 3.9 | |
| Years of Daily Smoking (Mean/SD) | 4.61 (3.73) | 5.10 (3.69) | 4.86 (3.69) | 0.46 |
| Cigarettes Per Day (Mean/SD) | 11.5 (6.63) | 9.20 (5.37) | 10.35 (6.12) | 0.03 |
| FTND Score (Mean/SD) | 3.39 (2.37) | 2.84 (2.47) | 3.11 (2.43) | 0.42 |
| CO (Mean/SD) | 15 (12.71) | 13.45(12.04) | 14.23 (12.36) | 0.48 |

Table 3.

*Between Group Smoking Variables (Means/Standard Deviations)*

| Variable | Prime | No-Prime | Overall | *df* | *F* | *p* |
|---|---|---|---|---|---|---|
| Log-transformed latency to first puff | 4.10 (1.63) | 4.23 (1.46) | 4.17 (1.55) | 1, 122 | 0.22 | 0.64 |
| Log-transformed number of puffs | 2.98 (0.44) | 3.01 (0.46) | 2.99 (0.45) | 1, 221 | 0.15 | 0.70 |
| Total cigarette weight smoked | 0.83 (0.30) | 0.80 (0.35) | .82 (.33) | 1, 123 | 0.21 | 0.65 |

Table 4.

*Regression of Smoking Variables by Restraint and Condition*

| Dependent Variable | Predictor | *B* | *t* (*df*) | *p* |
|---|---|---|---|---|
| Log-Transformed Latency to First Puff | | | | |
| | Condition | -2.28 | -3.3(119) | 0.001 |
| | Restraint Scale | | | |
| | Total | -0.30 | -4.5(119) | 0.00 |
| | Interaction | 0.16 | 3.8(119) | 0.0003 |
| Log-Transformed Number of Puffs | | | | |
| | Condition | 0.24 | 1.1(118) | 0.27 |
| | Restraint Scale | | | |
| | Total | 0.03 | 1.4(118) | 0.16 |
| | Interaction | -.014 | -1.0(118) | 0.31 |
| Total Weight Smoked | | | | |
| | Condition | 0.29 | 1.9(120) | 0.05 |
| | Restraint Scale | | | |
| | Total | 0.03 | 2.2(120) | 0.03 |
| | Interaction | -0.02 | -2.3(120) | 0.02 |

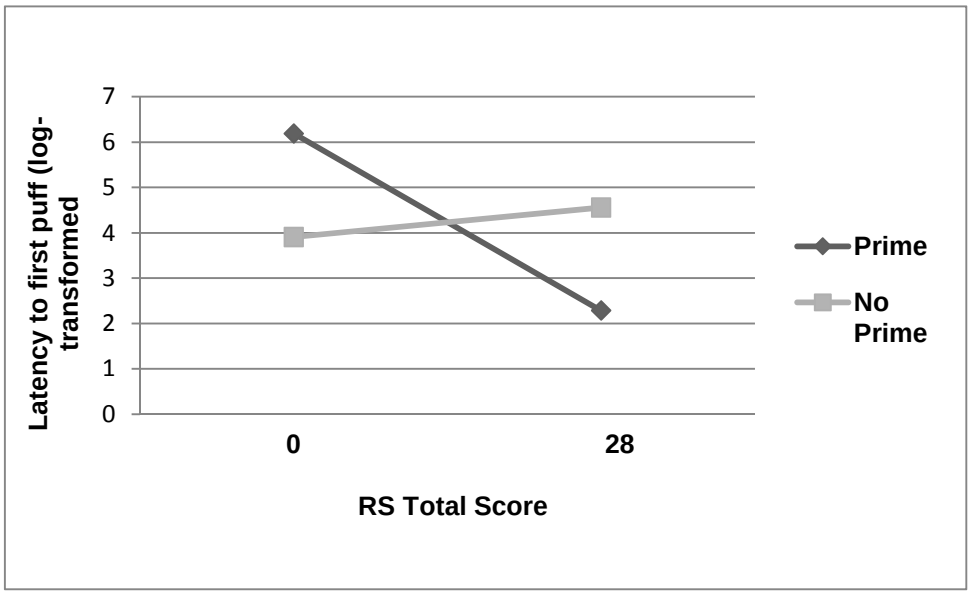



*Figure 1.* Plot of interaction between the Restraint Scale (RS) total score and condition to predict latency to first puff. Interaction is significant, $p < .001$. Range of participant scores on the RS was 0-28.

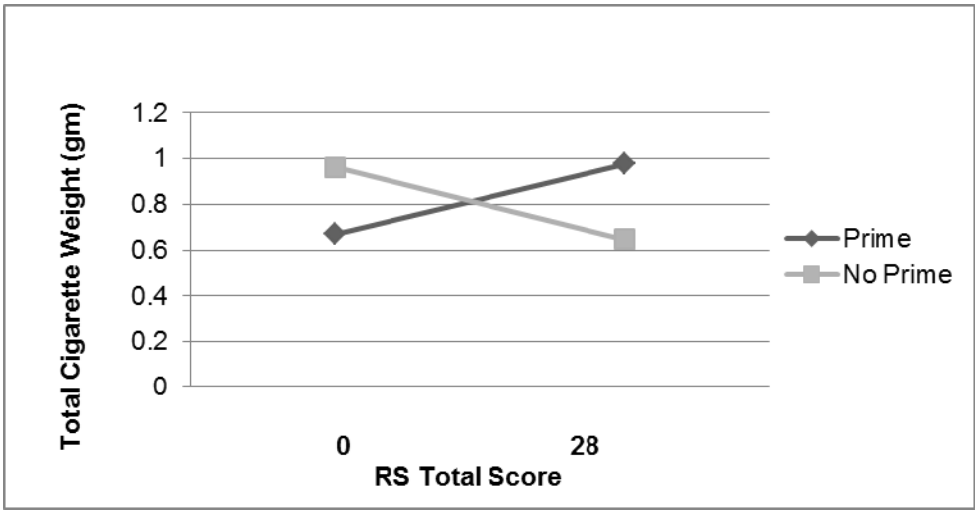



*Figure 2.*
Plot of interaction between the Restraint Scale (RS) total score and condition to predict total cigarette weight smoked. Interaction $p = .02$.

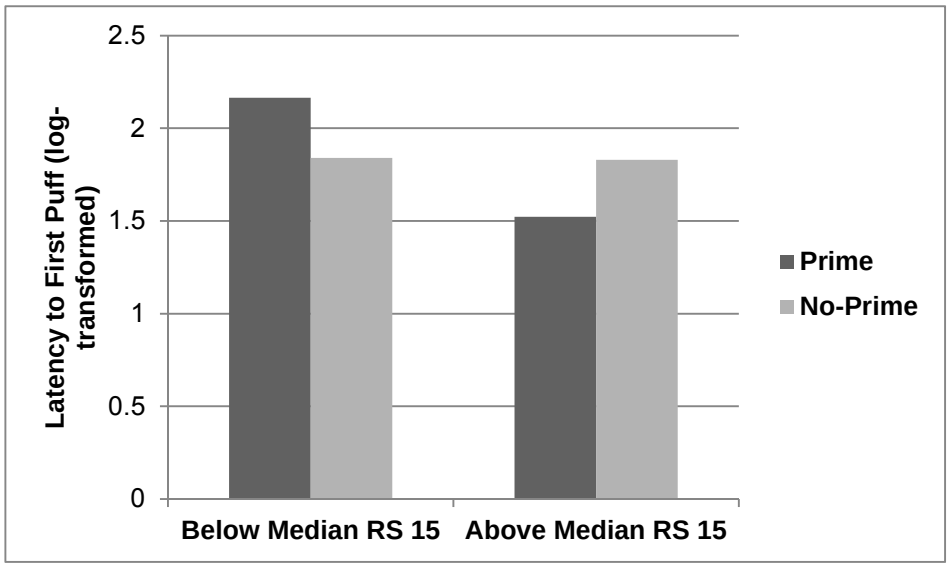



*Figure 3.* Plot of interaction between the Restraint Scale (RS) total score and condition to predict latency to first puff. Interaction $p$ = .006.

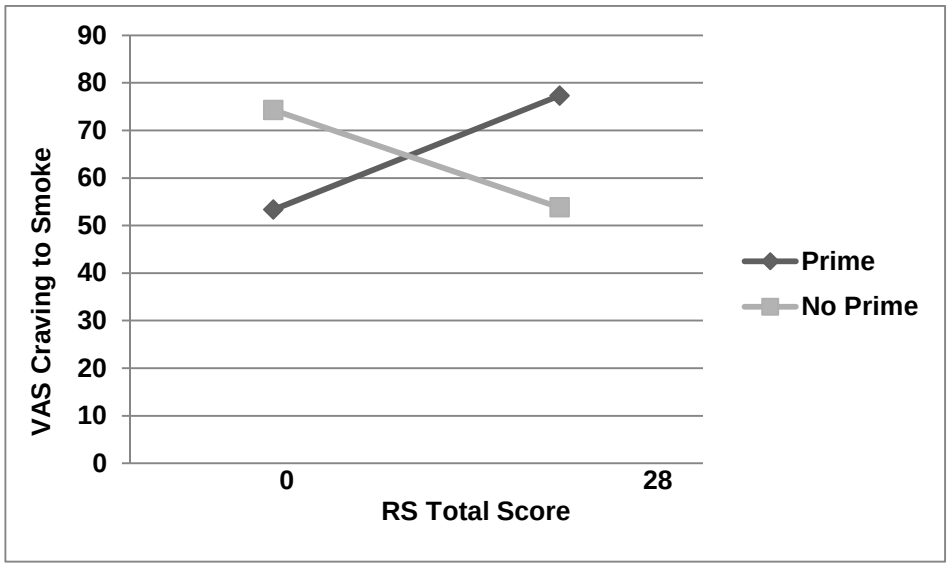



*Figure 4.* Plot of the interaction between the Restraint Scale (RS) and condition to predict craving to smoke on the VAS "during the taste test". Main effect of condition ($p$ = .025), RS total ($p$ = .009) and the interaction ($p$ = .007).

**Moderation by expectancies.**

Moderation of condition effects on smoking variables by expectancies of smoking as a weight control strategy was examined next, using linear regressions. Expectancies were measured with the WCSS, SCQ Weight Control Scale, and the SRWC, which were all positively correlated with each other, as well as with RS Total (see Table 6).

.Table 5.

*Correlations Between Craving and Smoking*

| Variable | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 1. Log-transformed Latency to First Puff | 1 | -.450** | -.423** | -.309** | -.297** |
| 2. Log-transformed Number of Puffs | | 1 | .733** | 0.164 | 3.12** |
| 3. Total Weight Smoked | | | 1 | .362** | .459** |
| 4.Visual Analogue Scale (Desire to Smoke)[a] | | | | 1 | .496** |
| 5. QSU Time 2 Total | | | | | 1 |

*Notes:*[a]Indicates rating during the taste test. **Correlation significant at the .01 level (2-tailed)

Table 6.

*Correlations Between Expectancy Measures and Restraint*

| Measure | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 1. Smoking Related Weight Concerns | - | .504** | .460** | .558** |
| 2. Weight Control Smoking Scale | | - | .744** | .455** |
| 3. SCQ Weight Control Scale | | | - | .415** |
| 4. Restraint Scale Total | | | | - |

*Notes:*[a]Indicates rating during the taste test. **Correlation significant at the .01 level (2-tailed).

One of the three measures of smoking behavior, log-transformed latency to first puff, was predicted by all three measures of expectancies. More importantly, there were interactions with all three measures of expectancies by condition to predict log-transformed latency to first puff (see Table 7). These interactions indicated that those with elevated expectancies of smoking to control weight (or higher concerns about gaining weight after cessation) who were in the Prime group began smoking quicker than those who were not primed. Because both RS and the expectancy measures had separately moderated the effect of condition upon latency to first puff, we ran dual moderation analyses in which both moderators were tested at once to test whether the moderators predicted independent variance in latency. Similar results were obtained for each expectancy measure, so Table 8 illustrates the regression results with WCSS only. As shown,

when both moderators were entered simultaneously, only RS was retained as a significant moderator.

**Secondary Aim 1: Differences in Food Consumption by Group and Restraint Status**

Next, group differences in amount of food consumed (g), total calories consumed, and log-transformed latency to first bite were examined (see Table 9). For amount of food and calories consumed, participants in the Prime group ate less than those in the No-Prime group. Log-transformed latency to first bite of food (in seconds) did not demonstrate group differences.

Group differences in food consumption, with RS score as a moderator, were investigated through both continuous (using RS total) and categorical (using the sample median split of 15) procedures, as described above. See Table 10 for results from the continuous analyses. Using linear regression, amount of food and total calories consumed were predicted by RS total score, but not by condition. Log-transformed latency to first bite of food was predicted both by RS total score and condition, as well as an interaction between the two predictors, such that those in the Prime condition highest in restraint waited the longest to eat (see Figure 5). For weight and calories consumed, interactions did not reach significance (*p's* < .10).

A somewhat different pattern of results emerged for the categorical analysis of restraint by condition to predict food consumption. For total grams consumed, there was no main effect by RS median split, $F(1,123) = 2.32$, $p = .130$. However, as predicted, the interaction between RS median split and condition was significant $F(1,123) = 5.11$, $p = .025$, such that those in the Prime condition who were above the RS median split ate the least (see Figure 6).

Table 7.

*Regression of Smoking Variables by Expectancy Measures and Condition*

| Dependent Variable | Predictor | *B* | *t* (*df*) | *p* |
|---|---|---|---|---|
| Log-Transformed Latency to First Puff | WCSS Total Score | -0.75 | -3.34 (112) | 0.001 |
| | Interaction (WCSS by Condition) | 0.40 | 2.88 (112) | 0.005 |
| | SCQ Weight Control Scale | -0.10 | -3.00 (120) | 0.003 |
| | Interaction (SCQ Weight Control Scale by Condition) | 0.05 | 2.40 (120) | 0.018 |
| | SRWC | -0.84 | 2.38 (120) | 0.007 |
| | Interaction (SRWC by Condition) | 0.47 | 2.38 (120) | 0.02 |
| Log-Transformed Number of Puffs | WCSS Total Score | 0.01 | .11 (111) | 0.92 |
| | Interaction (WCSS by Condition) | 0.02 | .55 (111 | 0.58 |
| | SCQ Weight Control Scale | 0.003 | .38 (119) | 0.70 |
| | Interaction (SCQ Weight Control Scale by Condition) | 0.002 | .38 (119) | 0.71 |
| | SRWC | -0.06 | -.68 (119) | 0.50 |
| | Interaction (SRWC by Condition) | 0.05 | .87 (119) | 0.38 |
| Total Weight Smoked | WCSS Total Score | 0.05 | 1.1 (113) | 0.28 |
| | Interaction (WCSS by Condition) | 0.03 | -.80 (113) | 0.42 |
| | SCQ Weight Control Scale | 0.009 | 1.31 (121) | 0.19 |
| | Interaction (SCQ Weight Control Scale by Condition) | -0.003 | -.64 (121) | 0.52 |
| | SRWC | 0.027 | 0.41 | 0.68 |
| | Interaction (SRWC by Condition) | -0.01 | -.30 (121) | 0.76 |

Table 8.

*Regression of Smoking Variables by Interactions Between WCSS by Condition and Restraint Scale by Condition*

| Dependent Variable | Predictors | *b* | *t* (*df*) | *p* |
|---|---|---|---|---|
| Log-Transformed Latency to First Puff | Condition | 0.23 | .81 (114) | 0.42 |
| | RS Total | -.51 | -1.95 | 0.054 |
| | WCSS | -.06 | -.71 | 0.48 |
| | WCSS by Condition | 0.18 | 1.20 (114) | 0.23 |
| | Condition by RS | 0.14 | 2.81 (114) | 0.0006 |

*Note.* Variables entered into the regression model: Condition, Restraint Scale Total, Weight Control Smoking Scale, Weight Control Smoking Scale by Condition, Condition by Restraint Scale Total.

Table 9.

*Between Group Food Consumption Variables (Means/Standard Deviations)*

| Variable | Prime | No-Prime | Overall | *df* | *F* | *p* |
|---|---|---|---|---|---|---|
| Amount of Food Consumed | 49.74 (30.35) | 67.70 (34.99) | 58.73 (33.85) | 1, 126 | 9.62 | 0.002 |
| Total Calories Consumed | 224.83 (138.29) | 309.23 (158.17) | 267.03 (154.18) | 1, 127 | 10.3 | 0.002 |
| Log-Latency to First Bite | 1.29 (0.77) | 1.32 (0.63) | 1.3 (0.70) | 1, 123 | 0.05 | 0.821 |

Table 10.

*Regression of Food Consumption Variables by Restraint and Condition*

| Dependent Variable | Predictor | *B* | *t* (*df*) | *p* |
|---|---|---|---|---|
| Amount of Food Consumed (in gms.) | | | | |
| | Condition | -6.79 | -.45 (123) | 0.66 |
| | Restraint Scale | | | |
| | Total | -2.95 | -1.9(123) | 0.05 |
| | Interaction | 1.62 | 1.6 (123) | 0.09 |
| Total Calories Consumed | | | | |
| | Condition | -30.19 | -0.4 (123) | 0.66 |
| | Restraint Scale | | | |
| | Total | -13.57 | -1.9(123) | 0.05 |
| | Interaction | 7.52 | 1.7 (123) | 0.09 |
| Log-Transformed Latency to First Bite | | | | |
| | Condition | 0.64 | 1.9(120) | 0.05 |
| | Restraint Scale | | | |
| | Total | 0.071 | 2.2(120) | 0.03 |
| | Interaction | -0.04 | -1.9(120) | 0.05 |

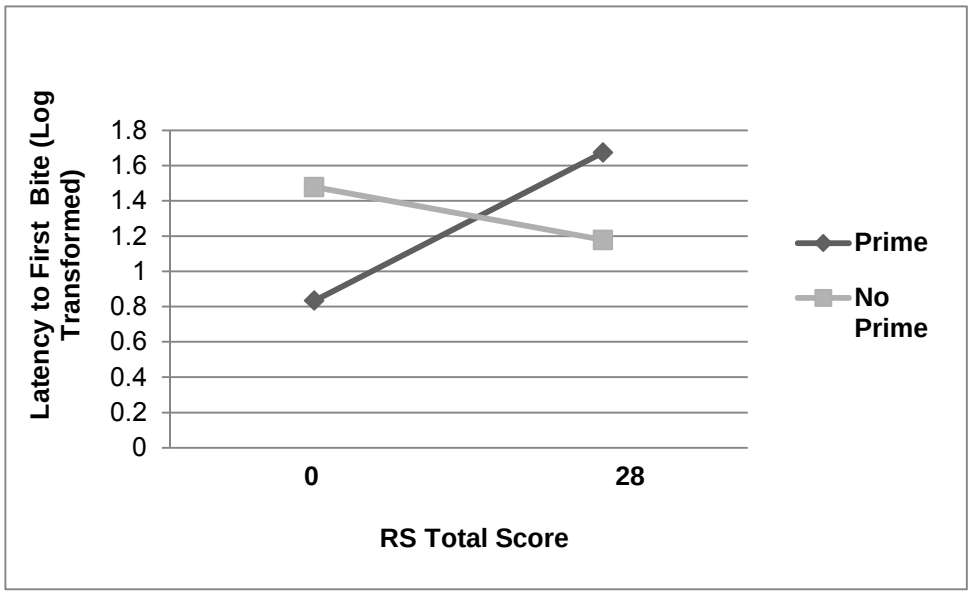



*Figure 5.* Plot of interaction between the Restraint Scale (RS) total score and condition to predict latency to first bite. The interaction is significant at $p = .05$. Range of participant scores on the RS was 0-28.

Similarly, for total calories consumed, there was no main effect by RS median split $F(1,123) = 2.48$, $p = .118$, however the interaction between RS median split and condition was significant $F(1,123) = 5.20$, $p = .024$. Log-transformed latency to first bite did not demonstrate main effects of the RS median split $F(1,120) = 2.61$, $p = .109$, however there was an interaction between the RS median split and condition $F(1,120) = 6.27$, $p = .014$, such that those in the Prime condition above the median RS score waited the longest to eat their first bite of food.

Based on these results, both continuous and categorical measures of restraint indicated that predictions of eating behavior could be made based on where participants fell on the RS and which condition they were in. Those who were highest in restraint, in the Prime condition, ate the least and had the longest latency to first bite of food. Additionally, correlations between eating and smoking variables (see Table 11) further support the premise that participants were substituting immediate cigarettes for food. Specifically, as latency to first puff decreased, there was a longer latency to first bite and greater food and caloric consumption.

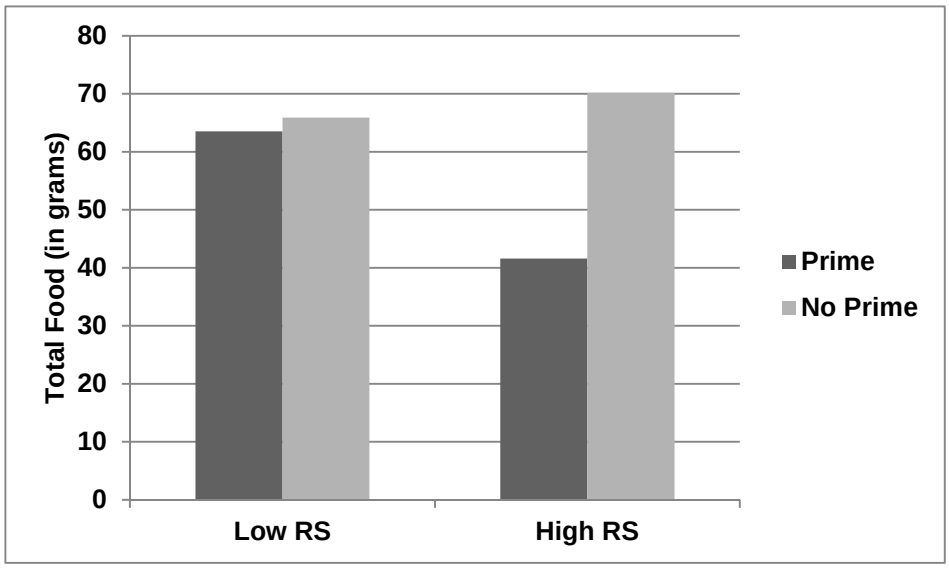



*Figure 6.* Plot of the interaction between RS median split and condition on total food consumed in grams. The interaction is significant ($p$ = .025).

Table 11.

*Correlations Among Smoking and Food Variables*

| Variable | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1. Log-Number of Puffs | 1 | -.450** | .733** | 0.153 | -.037 | -.20 |
| 2. Log-Latency to First Puff | | 1 | -.423** | -.571** | .214* | .209* |
| 3. Total Cigarette Weight | | | 1 | 0.074 | 0.002 | 0.015 |
| 4. Log-Latency to First Bite | | | | 1 | -208* | -.205* |
| 5. Total Weight of Food Consumed | | | | | 1 | .997** |
| 6. Total Calories Consumed | | | | | | 1 |

*Notes:* *Correlation significant at the .05 level (2-tailed). **Correlation significant at the .01 level (2-tailed).

**Secondary Aim 2: The Role of Negative Affect and Impulsivity on the Priming Effects of Food**

As a secondary aim, moderation of condition effects on smoking and food variables by level of trait negative affect endorsed on the PANAS was assessed using linear regressions. Contrary to predictions, all main and interaction effects of trait negative affect and interaction effects of trait negative affect and condition were non-significant predictors of all smoking and

food variables (all *p*'s > .05). However, there was a significant interaction between RS total and condition to predict state negative affect at time 2, i.e. immediately after the manipulation (see Table 12 and Figure 7).

Table 12.

*Regression of Time 2 Negative Affect by Restraint and Condition*

| Dependent Variable | Predictor | *B* | *t* (*df*) | *p* |
|---|---|---|---|---|
| PANAS-Negative Affect (time 2) | | | | |
| | Condition | 4.39 | 2.0 (122) | 0.043 |
| | Restraint Scale Total | 0.47 | 2.2 (122) | 0.031 |
| | Interaction | -.26 | -1.9 (122) | 0.055 |

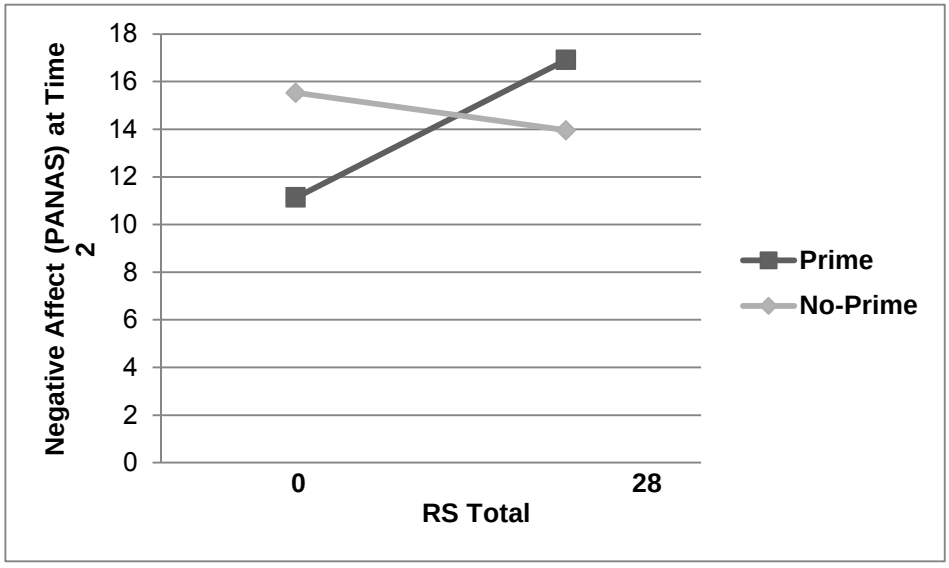



*Figure 7.* Plot of the interaction between RS total and condition on negative affect experienced after the experimental manipulation. The interaction is significant (*p* = .055).

State negative affect (at Time 2, post-manipulation) as a potential mediator of conditional effects on smoking variables was also examined, using the bootstrapping approach (Hayes & Preacher, 2012; Mallinckrodt, Abraham, Wei, & Russell, 2006; Shrout, & Bolger, 2002). Although we had not found any direct effects of the prime manipulation upon smoking variables, mediation

(i.e., indirect effects) may nevertheless occur despite the lack of detectable main direct effects (Hayes, 2009). However, the relationships between the experimental manipulation and participants' log-transformed latency to smoke (effect = -.02, *SE* =.08, 95%CI [-0.17,0.16]) and log-transformed number of puffs (effect = .009, *SE* =.031, 95%CI [-.06, .07]) were not indirectly mediated by state negative affect. Additionally, all food variables were non-significant for mediation. Moderated mediation of the interaction between restraint and condition upon all three smoking variables by negative affect was also non-significant.

Trait level of impulsivity as a secondary aim (as measured by the BIS) was expected to moderate conditional effects on smoking and food variables, independent of the moderating effects of restrained eating. Linear regressions were conducted and contrary to what was expected, none of the smoking or food consumption DV's were predicted by total BIS score or by an interaction between condition and BIS. However, it was found that those below the RS median, *M* = 64.68, SD = 11.19, were less impulsive that those above the RS median, *M* = 68.75, SD = 11.37. *F* (1,121) = 3.99, *p* = .048.

## Discussion

The primary goal of this study was to determine momentary patterns that manifest in the relationship between elevated levels of smoking exhibited by restrained eaters. Although hypothesized main effects on smoking variables did not differ by priming condition, results indicated that group differences in smoking behavior and craving were moderated by participants' restrained eating status, as predicted. Additionally, the priming effect usually found in laboratory manipulations of food cue presentation to restrained eaters was reversed in this study. That is, when cigarettes were presented as an option to high restrainers, rather than continue to eat, they apparently chose to smoke. Overall, participants who endorsed high levels of restraint and were primed with a milkshake smoked faster, smoked more, waited longer to eat, and ate less than those who were not primed or those who were non-restrainers.

### Effects of a Food Prime on Smoking and Eating Behavior

As mentioned, there were no significant group differences in smoking behavior, but there was significant moderation by restraint status; i.e. it was not the food prime specifically that elicited differences in craving, smoking, and eating; rather, it was participants' level of eating restraint combined with a food prime. Our results suggest that cigarettes may substitute for eating among weight control smokers after they experience a food prime that would normally disinhibit their eating restraint.

Our result that those higher in restraint who were primed ate *less* than those who were not primed is inconsistent with a body of research that indicates high restrained eaters tend to eat *more* after a food prime, albeit without the option of smoking (Strobe, 2008; Urbszat, Herman, & Polivy, 2002). However, we believe these results are consistent with Restraint Theory. As Herman and Polivy (1993) posit, to be successful at restraining one's food intake, one must successfully avoid interactions with food or food-related stimuli. There is evidence that restrained eaters are able to control their attention to avoid food-related stimuli (Hotham, Sharma, &

Hamilton-West, 2012). Attentional control would prove useful in situations when food stimuli would increase likelihood of unintended food consumption (which is goal-incongruent with restrained eaters' desire to control food intake, lose weight, etc.). The current study provides behavioral evidence that cigarettes are acting as a distractor, or a way to avoid/ replace subsequent disinhibited eating when confronted with food stimuli, for restrained eaters. Over time, frequent pairing of successful avoidance of food intake and smoking may create a conditioned relationship, which would support the effect we found of shorter latency to smoke only in those who were primed with the milkshake.

Besides re-establishing attentional control for goal-congruent behaviors, it is possible that weight-control smokers are using cigarettes to control their appetite, due to the appetite-suppressant and satiety-enhancing effects of nicotine (Grunberg & Greenwood, 1992; Perkins, Epstein, Fonte, Mitchell, & Grobe, 1995). As will be discussed below, there was in fact an association with participants' endorsement of expectancies of smoking as an appetite and weight-control mechanism and their actual smoking behavior. Additionally, it is possible that since there was a negative relationship between smoking and eating behaviors, participants redirected their primed eating to smoking behavior. Furthermore, weight-control smokers may be seeking to restore self-control resources that have been depleted through active restraint (Heckman, Ditre, & Brandon, 2012).

Additionally, it is well-known that food priming is but one of many occasions that high-restrainers abandon control of their food intake. For example disinhibited eating has been demonstrated following a demanding cognitive task (Lattimore & Caswell, 2004), when appetizing food is present (Rogers, & Hill, 1989), and when perceptions about amount of preceding food consumption are altered (Polivy, & Herman, 2010). It is still unknown whether smoking would substitute for further food consumption for high-restrainers primed in any of the alternative ways.

Overall, the main findings of this study: a) provide robust evidence that weight-control smokers turn to cigarettes in moments of perceived lost control over food intake, and b): establish at least one trigger for smoking in high restrainers (i.e. a violation of eating control).

**Moderation by Expectancies**

Delving deeper into the underlying mechanisms that elicited our main findings, moderation results revealed that participants in the Prime condition, with higher expectancies of cigarettes to control weight and appetite, had shorter latencies to smoke. This further supports past research indicating that a subset of smokers use cigarettes for weight control (Pomerleau & Snedecor, 2008; Klesges & Klesges, 1988), and extends this finding by elucidating how this occurs in the moment. A reasonable postulation is that when weight control smokers are primed with food stimuli, they are reminded to employ a distractor or a replacement to avoid either the temptation to consume food or the unpleasant feelings associated with goal incongruent behaviors. As such, when cigarettes are readily available, the weight control smoker chooses to smoke to prevent dishinhibtion of restraint, as they are reminded of cigarette's weight control properties. Furthermore, those with stronger convictions about cigarette's weight control properties would likely choose this option above all others if readily available. Of note, however, is that when moderation by restraint was tested with moderation by weight-control expectancies, only the former retained predictive significance. Together with the high correlations between the two measures, the results suggest that expectancies about weight-control by smoking are subsumed under the broader umbrella of dietary restraint.

**Moderation and Mediation by Negative Affect**

Contrary to what was expected we did not find moderation of the smoking and food dependent variables by participants' general level of negative affect, or mediation for smoking behavior by state negative affect after the experimental manipulation. However, we did find an interaction between condition and restraint, such that primed participants high in restraint experienced the highest levels of negative affect. These findings are consistent with previous literature that indicates elevated levels of negative affect mediate the relationship between body dissatisfaction and urge to smoke (Lopez Khoury, Litvin, & Brandon, 2009). Further, we know that negative affect induction increases craving to smoke in general (Heckman at al., 2013) and among restrained eaters (Addicott, Gray, & Todd, 2009). Taken together, these results may indicate that weight control smokers are seeking to re-establish control over food intake after a

perceived dietary violation, but are also looking to improve their negative affect that was exacerbated by the dietary violation.

**Role of Impulsivity**

Contrary to another secondary aim, impulsivity was not found to moderate the relationship between increased restraint and smoking and food outcomes although participants above the RS median split were significantly more impulsive than those below the median split. This latter result is consistent with previous findings that demonstrated increased rates of smoking and impulsivity in persons with disordered eating (Anzengruber et al., 2006). An increased propensity for sensation-seeking coupled with a strong desire to control one's weight could potentially undermine the motivation to avoid aversive consequences associated with cigarette smoking in weight-control smokers.

**Limitations**

There are several limitations to the current study that should be addressed. First, although this study employed a commonly used food prime paradigm procedure, we altered this paradigm by introducing cigarettes as a second option along with food, and did not attempt to replicate the priming effect without cigarettes. Being that the food prime procedure has produced consistent results across many different contexts (Lattimore & Caswell, 2004; Rogers, & Hill, 1989; Polivy, & Herman, 2010; Heatherton, Polivy, & Herman, 1991) we opted for the simpler design in this initial study. We found the opposite of the priming effect (i.e. primed restrained eaters ate *less* in our study, whereas they reliably eat *more* after a food prime using the traditional paradigm). However, without including the usual prime/no-prime conditions without cigarettes, we cannot rule out the possibility that our sample or methodology contributed to this reverse finding, rather than the availability of cigarettes, per se, during the taste test. For example, it is possible that restrained eaters who are smokers do not show the usual priming effect upon eating, regardless of whether cigarettes are available. Future research will need to verify that our effect was indeed caused by the allowing participants the option to smoke in addition to eating.

Secondly, our study made use of self-report measures for our moderation analyses. Although the RS and other measures used demonstrate adequate to high levels of reliability,

there is always a risk of demand or reactivity effects with these types of assessments. However, it is unlikely that demand effects could account for the hypothesized, but non-obvious, interaction effects found. Third, our study was highly controlled and internally valid, but generalization to a real-world context is unknown. We instructed participants to refrain from any other distractors, such as writing, reading, sleeping etc. during the taste test. However, in a naturalistic setting people have a wider range of distractors available to them and therefore may not turn to smoking as an alternative to eating as readily as they did in the current study.

A strength of the current study was that, although we restricted gender and age, our sample was made up of a heterogeneous population of smokers who were recruited through various sources including a university and a community population. However, future research should examine if the effects found in this study occur to the same extent in male smokers, and also how the effects manifest in older populations. Although the rate of smoking for weight control purposes is lower in males (Pomerleau & Snedecor, 2008; Klesges & Klesges, 1988), it is necessary to determine how the patterns of the relationship between smoking and weight control manifest in males other populations of weight control smokers.

**Future Directions**

Paradoxically, although weight control smokers clearly altered their smoking behavior when primed with food stimuli in this study, presumably in an attempt to avoid further food consumption, restraining food intake is usually ineffective and sometimes counterproductive. Literature indicates that high restrainers (as measured by the RS) are generally not successful at their attempts to restrict food intake (Stroebe, 2008), and that high restraint may actually be a risk factor for weight gain (Lowe, & Kral, 2006). Smoking is widely known to suppress weight and is associated with weight gain upon cessation; however, those who are motivated to smoke for weight control purposes are misinformed to believe that the trade-off for weight control is worth the health risks associated with smoking.

This study demonstrates momentary risk factors that contribute to weight-control smokers' reasons for smoking. It provides support for the causal relationship between the known elevated incidence of smoking amongst persons with disordered eating and demonstrates an

important trigger or cue for weight-control smokers to turn to cigarettes (i.e. a violation of eating restraint). It further suggests that other moderating and mediating factors, such as negative affect and cigarette weight-control expectancies contribute to the behaviors of increased smoking after a violation of eating restraint. Future research should aim to replicate the reversal of the priming effect in high restraint smokers, as this is the first study to demonstrate this outcome. Additionally, although we found that weight-control expectancies predicted smoking behavior, the role of such expectancies could be further investigated by using the balanced-placebo design and denicotinized cigarettes (e.g., Juliano & Brandon, 2002) to parse out the influence of expectancies vs. nicotine pharmacology on any observed priming effects. If similar results are achieved, this information could be used in expectancy challenge intervention studies (e.g., Darkes & Goldman, 1993).

Previous literature has found that restrained eaters have the ability to disengage or not attend to food stimuli, theoretically in order to remain adherent to their goals of restricted food intake. Future research should aim to examine if there are other similarly effective, yet less harm-inducing, distractors that high restrainers could use when attempting to maintain their restraint. As this is more of a “harm-reduction” suggestion (i.e., it may decrease smoking rates, but it does not address eating pathology), it is also important to explore interventions that target both goals of smoking cessation and normal eating.

One important fact to consider when designing interventions for this population is that weight-control smokers are less likely to comply with smoking cessation interventions (Meyers, Klesges, Winders, Ward, Peterson, & Eck, 1997). For this reason, it may be especially important to develop interventions specifically targeted to weight-control smokers. However, clinical interventions that address both smoking cessation and post-cessation weight gain have been relatively unsuccessful to date (Flegal, 2012).

**Conclusion**

This study was the first to our knowledge to examine the underlying mechanisms between momentary decisions about eating and smoking in weight-control smokers. The results were consistent with several of the primary hypotheses, mainly that persons high in eating

restraint would choose to smoke more and smoke faster when primed with a small amount of tempting food. We also found that persons higher in restraint who were primed ate significantly less food. These results confirm and expand on the theoretical assumption underlying the study, which postulates that weight-control smokers are able to disrupt the disinhibition of restraint that usually occurs after they receive a tempting food prime, by using cigarettes. Future research should aim to replicate and extend these findings as well as explore potential interventions that address both smoking cessation and weight control simultaneously.

## References

Addicott, A. K., Gray, J. J., & Todd, B. L. (2009). Mood, dietary restraint, and women's smoking and eating urges. *Women Health, 49*, 310-320. doi: 914903026 [pii]10.1080/03630240903158396

Anzengruber, D., Klump, K. L., Thornton, L., Brandt, H., Crawford, S., Fichter, M. M., et al. (2006). Smoking in eating disorders. *Eating Behaviors, 7*, 291-299. doi:10.1016/j.eatbeh.2006.06.005

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

Brandon, T.H., & Baker, T.B. (1991). The Smoking Consequences Questionnaire: The Subjective Expected Utility of Smoking in College Students. *Psychological Assessment: A Journal of Consulting and Clinical Psychology, 3*, 484-491.

Brandon, T.H. (1994). Negative affect as a motivation to smoke. *Current Directions in Psychological Science, 3*, 33-37.fenstein, R.S. Poppitt, S.D., DeVitt, R.M., & Prentice, A.M. (1995). "Food intake and the menstrual cycle: a retrospective analysis, with implications for appetite research." Physiology & Behavior, *58* 1067-1077.

Bulik, C.M., Sullivan, P.F., Epstein, L.H., McKee, M., Kaye, W.H., Dahl, R.E., & Weltzin, T.E. (1992). Drug use in women with anorexia and bulimia nervosa. *International Journal of Eating Disorders, 11,* 213-225.

Centers for Disease Control and Prevention (2010). Adult Cigarette Smoking in the United States: Current Estimate. Retrieved February 15, 2013, from http://www.cdc.gov/tobacco/data_statistics/fact_sheets/adult_data/cig_smoking/index.htm .

Copeland, A. L., & Carney, C. E. (2003). Smoking expectancies as mediators between dietary restraint and disinhibition and smoking in college women. *Experimental and Clinical Psychopharmacology, 11*, 247-251.

Darkes, J., & Goldman, M.S. (1993). Expectancy challenge and drinking reduction: Experimental evidence for a mediational process. *Journal of Consulting and Clinical Psychology, 61*, 344-353.

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*, 175-191.

Flegal, K. M. (2012). The conundrum of smoking cessation and weight gain. *Preventative Medicine, 54*(3-4), 193-194. doi: 10.1016/j.ypmed.2012.01.015

George, A., & Waller, G. (2005). Motivators for smoking in women with eating disorders. *European Eating Disorders Review, 13*, 417-423.

Gordon, R.A. (2000). *Eating disorders: Anatomy of a social epidemic (2nd ed.).* Annandale-on-Hudson, NY: Malden Blackwell Publishing.

Grunberg, N.E. (1992). Cigarette smoking and body weight: A personal journey through a complex field. *Health Psychology, 11*, 26-31.

Grunberg, N.E., & Greenwood, M.R.C. (1992). Task force 1: Mechanisms relevant to the relations between cigarette smoking and body weight. *Health Psychology, 11,* 4-9.

Hayes, A. F., & Matthes, J. (2009). Computational procedures for probing interactions in OLS and logistic regression: SPSS and SAS implementations. *Behavior Research Methods*, *41*, 924-936.

Hayes, A. F., & Preacher, K., J. (2012). Statistical mediation analysis with a multicategorical independent variable. *Manuscript submitted for publication.*

Heatherton, T.F., Kozlowski, L.T., Frecker, R.C., & Fagerstrom, K.O. (1991). The Fagerstrom Test for Nicotine Dependence: a revision of the Fagerstrom Tolerance Questionnaire. *British Journal of Addiction, 86*, 1119-1127.

Heatherton, T. F., Polivy, J., & Herman, C. P. (1991). Restraint, weight loss, and variability of body weight. *Journal of Abnormal Psychology, 100*, 78-83.

Heckman, B.W., Ditre, J.W., & Brandon, T.H. (2012). The restorative effects of smoking upon self-control resources: A negative reinforcement pathway. *Journal of Abnormal Psychology,* Advance online publication. doi: 10.1037/a0023032

Herman, C. P., & Polivy, J. (1975). Anxiety, restraint, and eating behavior. *Journal of Abnormal Psychology, 84*, 66-72.

Herman, C. P., & Polivy, J. (1993). Mental control of eating: Excitatory and inhibitory food thoughts. In D. M. Wegner & J. W. Pennebaker (Eds.), Handbook of mental control (pp. 491–505). Englewood Cliffs, NJ: Prentice Hall.

Herman, C.P., & Polivy, J. (1980). Restrained eating. In A.J. Stunkard (Ed.), *Obesity,* pp. 208-225. Philadelphia: Saunders.

Hotham, S., Sharma, D., & Hamilton-West, K. (2012). Restrained eaters preserve top-down attentional control in the presence of food. *Appetite, 58*(3), 1160-1163. doi: 10.1016/j.appet.2012.03.011

Hudmon, K.S., Gritz, Ellen R.; Clayton, S.,& Nisenbaum, R. (1999). Eating orientation, postcessation weight gain, and continued abstinence among female smokers receiving an unsolicited smoking cessation intervention. *Health Psychology, 18*, 29-36.

Jansen A, Nederkoorn C, van Baak L, Keirse C, Guerrieri R, Havermans R. (2009). High-restrained eaters only overeat when they are also impulsive. *Behaviour Research and Therapy, 47,* 105-110.

Jeffery, R. W., Hennrikus, D. J., Lando, H. A., Murray, D. M., & Liu, J. W. (2000). Reconciling conflicting findings regarding postcessation weight concerns and success in smoking cessation. *Health Psychology, 19*, 242-246.

John, U., Hanke, M., Rumpf, H. J., & Thyrian, J. R. (2005). Smoking status, cigarettes per day, and their relationship to overweight and obesity among former and current smokers in a national adult general population sample. *International Journal of Obesity, 29*, 1289-1294. doi: 10.1038/sj.ijo.0803028

Juliano, L.M., & Brandon, T.H. (2002). Effects of nicotine dose, instructional set, and outcome expectancies on the subjective effects of smoking in the presence of a stressor. *Journal of Abnormal Psychology, 111*, 88-97. doi: 10.1037///0021-843X.111.1.88

Klesges, R.C., & Klesges, L.M. (1988). Cigarette smoking as a dietary strategy in a university population. *International Journal of Eating Disorders, 7*, 413-419.

Kendzor, D.E., Baillie, L.E., Adams, C.E., Stewart, D.W, & Copeland, A.L. (2008). The effect of food deprivation on cigarette smoking in females. *Addictive Behaviors, 33*, 1353-1359.

Lattimore, P., & Caswell, N. (2004). Differential effects of active and passive stress on food intake in restrained and unrestrained eaters. *Appetite, 42*, 167-173. doi: 10.1016/j.appet.2003.09.002S0195666303001570

Leeman, R. F., O'Malley, S. S., White, M. A., & McKee, S. A. (2010). Nicotine and food deprivation decrease the ability to resist smoking. *Psychopharmacology, 212*, 25-32. doi: 10.1007/s00213-010-1902-z

Lopez Khoury, E. N., Litvin, E. B., & Brandon, T. H. (2009). The effect of body image threat on smoking motivation among college women: mediation by negative affect. *Psychology of Addictive Behaviors, 23*(2), 279-286. doi: 10.1037/a0014291

Lowe, M.R., & Kral, T.V.E. (2006). Stress-induced eating in restrained eaters may not be caused by stress or restraint. *Appetite, 46*, 16–21.

Lowe & Thomas (2009). Measures of restrained eating: Conceptual evolution and psychometric update. Handbook of Assessment Methods for Eating Behaviors and Weight Related Problems, 2nd edition.

Lycett, D., Munafo, M., Johnstone, E., Murphy, M., & Aveyard, P. (2011). Associations between weight change over 8 years and baseline body mass index in a cohort of continuing and quitting smokers. *Addiction, 106*(1), 188-196.

Mallinckrodt, B., Todd Abraham, W., Wei, M., & Russell, D.W. (2006). Advances in testing the statistical significance of mediation effects. *Journal of Counseling Psychology, 53,* 372-378. doi: 10.1037/0022-0167.53.3.372.McKee, S.A., Nhean, S., Hinson, R.E., & Mase, T. (2006). Smoking for weight control: Effect of priming for body image in female restrained eaters. *Addictive Behaviors, 31*, 2319-2323.

Meyers, A. W., Klesges, R. C., Winders, S. E., Ward, K. D., Peterson, B. A., & Eck, L. H. (1997). Are weight concerns predictive of smoking cessation? A prospective analysis. *Journal of Consulting and Clinical Psychology, 65*, 448-452.

Mills, J.S., & Palandra, A. (2008). Perceived caloric content of a preload an disinhibition among restrained eaters. *Appetite, 50*, 240-245. doi: 10.1016/j.appet.2007.07.007

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

Ogden, J. (1994). Effects of smoking cessation, restrained eating, and motivational states on food intake in the laboratory. *Health Psychology, 13*, 114-121.

Patton, J. H., Stanford, M. S. and Barratt, E. S. (1995). Factor structure of the Barratt Impulsiveness scale. *Journal of Clinical Psychology, 51,* 768-774.

Perkins, K.A., Epstein, L.H., Fonte, C., Mitchell, S.L., & Grobe, J.E. (1995).Gender, dietary restraint, and smoking's influence hunger and the reinforcing value of food. *Physiology & Behavior, 57*, 675-680. doi: 0031-9384(94)00320-3

Polivy, J., Herman, C. P., & Deo, R. (2010). Getting a bigger slice of the pie. Effects on eating and emotion in restrained and unrestrained eaters. *Appetite*. doi: S0195-6663(10)00463-0 [pii]10.1016/j.appet.2010.07.015

Pomerleau, C. S., and C. L. Kurth. (1996). Willingness of female smokers to tolerate postcessation weight gain. J Subst Abuse 8:371–8. doi: 10.1016/S0899-3289(96)90215-1

Pomerleau, C. S., Ehrlich, E., Tate, J. C., Marks, J. L., Flessland, K. A., & Pomerleau, O. F. (1993). The female weight-control smoker: a profile. *Journal of Substance Abuse, 5*, 391-400.

Pomerleau, C.S., & Snedecor, S.M. (2008). Validity and reliability of the weight control smoking scale. *Eating Behaviors, 9*, 376-380.

Rogers, P. J. & Hill, A. J. (1989). Breakdown of dietary restraint following mere exposure to food stimuli: interrelationships between restraint, hunger, salivation, and food intake. *Addictive Behaviors 14*, 387-397.

Roehrig, M. (2008). An experimental study of pro-dieting and anti-dieting psychoeducational messages: Effects on immediate and short-term psychological functioning and weight control practices in college women. *Dissertation Abstracts International, 68*, Retrieved from EBSCO*host*.

Ruderman, A. J., & Grace, P. S. (1987). Restraint, bulimia, and psychopathology. *Addictive Behaviors, 12*, 249-255. doi: 0306-4603(87)90035-9 [pii]

Saarni, S. E., Silventoinen, K., Rissanen, A., Sarlio-Lahteenkorva, S., & Kaprio, J. (2004). Intentional weight loss and smoking in young adults. *International Journal of Obesity, 28*, 796-802. doi: 10.1038/sj.ijo.08026270802627

Shmueli, D., & Prochaska, J.J. (2009). Resisting tempting foods and smoking behavior: Implications from a self-control theory perspective. *Health Psychologyogy, 28*, 300-306.

Shrout, P. E., & Bolger, N. (2002). Mediation in experimental and nonexperimental studies: New procedures and recommendations. *Psychological Methods, 7,* 422–445.

Spoor, S.T.P., Stice, E., Bekker, M.H.J., Van Strien, T., Croon, M.A., Van Heck, G.L. (2006). Relations between dietary restraint, depressive symptoms, and binge eating: A longitudinal study. *International Journal of Eating Disorders*, *39*, 700–707.

Stewart, S. H., Angelopoulos, M., Baker, J. M., & Boland, F. J. (2000). Relations between dietary restraint and patterns of alcohol use in young adult women. *Psychology of Addictive Behaviors, 14*, 77-82.

Strobe, W. (2008). Restrained eating and the breakdown of self-regulation. Dieting, overweight and obesity10.1016/j.appet.2009.12.009

Tiffany, S. T., & Drobes, D. J. (1991). The development and initial validation of a questionnaire on smoking urges. *British Journal of Addiction, 86*, 1467-1476.

Tiggemann, M. (1994). Dietary restraint as a predictor of reported weight loss and affect. *Psychological Reports, 75*, 1679-1682.

Toll, B.A., Katulak, N.A., Williams-Piehota, P., O'Malley, S. (2008). Validation of a scale for the assessment of food cravings among smokers. *Appetite, 50*, 25-32.

Urbszat, D, Herman, C.P., Polivy, J. (2002). Eat, drink, and be merry for tomorrow we diet: Effects of anticipated deprivation on food intake in restrained and unrestrained eaters. *Journal of Abnormal Psychology, 111*, 296-401.

Wansink, B., Cheney, M.M., Chan, N. (2003). Exploring comfort food prefernces across age and gender. Physiology & Behavior *79*, 739– 747.

Watson, D., Clark, L.A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology, 54*, 1063-1070.

White, M. A., McKee, S. A., & O'Malley S, S. (2007). Smoke and mirrors: magnified beliefs that cigarette smoking suppresses weight. *Addictive Behaviors, 32*, 2200-2210. doi: 10.1016/j.addbeh.2007.02.011

# Appendices

## Appendix A: Moffitt SRC Approval Letter


August 30, 2011

Michelle Kovacs
H. Lee Moffitt Cancer Center & Research Institute
University of South Florida
12902 Magnolia Drive
Tampa, FL 33612

Dear Ms. Kovacs:

The Behavioral Subcommittee of the Scientific Review Committee (SRC) has reviewed your response for your research protocol entitled, **"The Effects of Caloric Preload and Dietary Restraint on Smoking and Eating Behavior"** (MCC 16759). The revised protocol version 3 dated 08/29/2011 is approved as written for use at the Moffitt Cancer Center pending approval of the Institutional Review Board (IRB) and satisfaction of institutional operational and financial review requirements.

Please be aware that after you receive IRB approval, you must request study activation before you commence any study activities. Please contact Diane Martinez, Manager at The Office of Protocol Review and Monitoring to request study activation, at (813) 745 8349. That office will ensure that all applicable institutional reviews have been completed. You will then be issued an automated activation notification by email.

It is your responsibility to ensure that all Moffitt staff (nursing, pharmacy, data management, etc.) are informed and aware of the details of the project. The committee encourages the use of in-services for those projects that are complex or require special attention.

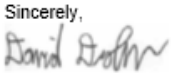
All changes made to protocols approved by the SRC must be submitted to the Protocol Review and Monitoring System office. Changes made to the protocol document require SRC review and approval. Minor changes (i.e. changes to personnel, non-scientific changes, changes that do not affect patient participation) will be expedited through the SRC review process.

**Appendix A, Continued**

If this project is not being managed by the Clinical Trials Office or Clinical Research Unit, then it is your responsibility to follow through with all requirements for submission to the IRB. All IRB approvals are required to be documented in Oncore, and all associated regulatory documentation (signed applications, IRB approval letters and IRB approved consent forms, etc.) are to be saved in the appropriate study folder in the e-binders directory at J:\ebinders.

Oncore is the Cancer Center's mechanism for submission and review of materials requiring Scientific Review (SRC) and Protocol Monitoring (PMC). If you need access to Oncore, please contact Jeryl Madden, Oncore Administrator, at 745-6964 for assistance.

Sincerely,



David Drobes, PhD
Chair, Behavioral Subcommittee
Scientific Review Committee

## Appendix B: USF IRB Approval Letter

USF
UNIVERSITY OF SOUTH FLORIDA

DIVISION OF RESEARCH INTEGRITY AND COMPLIANCE
Institutional Review Boards, FWA No. 00001669
12901 Bruce B. Downs Blvd., MDC035 • Tampa, FL 33612-4799
(813) 974-5638 • FAX (813) 974-5618

10/6/2011

Michelle Kovacs
Psychology
14733 Turtle Creek Circle
Apt. 104

RE: **Expedited Approval** for Initial Review
IRB#: Pro00005668
Title: The Effects of Caloric Preload and Dietary Restraint on Smoking and Eating Behavior

Dear Ms. Kovacs:

On 10/5/2011 the Institutional Review Board (IRB) reviewed and **APPROVED** the above referenced protocol. Please note that your approval for this study will expire on 10/5/2012.

Approved Items:

**Protocol Document(s):**
Protocol 3_Clean Copy_without highlights.doc_eIRB 9_2011.doc 0.02

**Consent/Assent Documents:**
Kovacs Informed Consent.pdf 0.01

**Please use only the watermarked/stamped consent form(s) found under the "Attachment Tab" in the recruitment of participants.**

It was the determination of the IRB that your study qualified for expedited review which includes activities that (1) present no more than minimal risk to human subjects, and (2) involve only procedures listed in one or more of the categories outlined below. The IRB may review research through the expedited review procedure authorized by 45CFR46.110 and 21 CFR 56.110. The research proposed in this study is categorized under the following expedited review category:

(4) Collection of data through noninvasive procedures (not involving general anesthesia or sedation) routinely employed in clinical practice, excluding procedures involving x-rays or microwaves. Where medical devices are employed, they must be cleared/approved for marketing.

**Appendix B, Continued**

(6) Collection of data from voice, video, digital, or image recordings made for research purposes.

(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

Please note, the informed consent/assent documents are valid during the period indicated by the official, IRB-Approval stamp located on the form. Valid consent must be documented on a copy of the most recently IRB-approved consent form.

As the principal investigator of this study, it is your responsibility to conduct this study in accordance with IRB policies and procedures and as approved by the IRB. Any changes to the approved research must be submitted to the IRB for review and approval by an amendment.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,

John A. Schinka, Ph.D.

John A. Schinka, Ph.D., Chairperson
USF Institutional Review Board

Cc: Christina Calandro
USF IRB Professional Staff