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Smoking by Restrained Eaters Following a Food Prime in the Context of an Alternative Distractor

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by

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Abstract

Prior research found that female smokers with elevated dietary restraint ("high-restrainers") smoked more after a disinhibiting food event (Kovacs, Correa, & Brandon, 2014). The current study aimed to determine if high-restrainers smoked merely to distract themselves from eating, or if the appetite/weight-control aspects of smoking played a role. Female smokers (N = 128) attended a laboratory session and were randomized to receive a milkshake prime (Prime condition) or not (No-Prime condition). All participants then received ad-lib access to tempting foods, cigarettes, and a computer tablet with internet access. Our main aims were to test the effect of the prime on smoking and eating behavior in the presence of an alternative distractor (i.e. the tablet). We expected high-restrainers in the Prime condition to demonstrate preference for cigarettes even in the presence of an alternative distractor. Primary analyses utilized hierarchical regression models with condition and several moderators as predictors of consumption behavior. Condition was predictive of total cigarette smoked (p's <.02), indicating that those in the Prime condition smoked more. Regardless of condition, several expectancy measures predicted cigarette consumption (p's < .05), and higher level of dietary restraint predicted shorter latency to smoke (p = .017). Additionally, lower levels of trait mindfulness were associated with elevated dietary restraint, cigarette craving at baseline and expectancies about cigarettes' weight control properties. Importantly, latency to use the tablet was not predicted by level of dietary restraint or expectancies. Although dietary restraint and expectancies did not interact with condition to predict levels of smoking, the overall findings suggest that: 1. The traditional priming effect was apparently mitigated in the presence of appealing distracting stimuli; and 2. Dietary restrainers attempt to prevent food consumption by turning to cigarettes, choosing to utilize cigarettes above and beyond preference for other salient distracting stimuli. Therefore, smoking appears to be more than just a distractor from eating, and is also associated with

strong beliefs about weight and appetite control. These findings may inform interventions aimed at the high-risk population of young adult female smokers, and mindfulness-based strategies may prove especially useful.

Smoking by Restrained Eaters Following a Food Prime in the Context of an Alternative Distractor

Smoking is the leading cause of preventable death in the U.S., and smoking prevalence continues to hover around 17% (Jamal et al., *MMWR*, 2015). Females have a lower smoking prevalence than males (14.8% vs. 18.8%, respectively); yet, female smokers are at higher risk for what is termed "weight-control smoking," both the expectancy that smoking suppresses one's weight, and increased smoking for this purpose (Pomerleau, et al., 1993; Pomerleau & Snedecor, 2008; Klesges & Klesges, 1988). In fact, smoking does suppress weight (Lycett, Munafo, Johnstone, Murphy, & Aveyard, 2011); however, smokers tend to gain only about five lbs. on average, after cessation (Flegal, 2012; Hudmon, Gritz, Clayton, & Nisenbaum, 1999). Young adult female smokers appear to be an especially vulnerable population for the dual risks associated with disordered eating (Striegel-Moore, & Smolak, 2001) and smoking to control food intake or to influence weight and shape. For instance, when men and women were surveyed on their thoughts regarding weight gain after smoking cessation, young females (under age 25) were most likely to report that no amount of weight gain would be acceptable (Pomerleau, & Kurth, 1996).

Underlying this disparity of smoking for weight control purposes between males and females may be the increase in disordered eating in the U.S. that has disproportionally affected women (Neumark-Sztainer, et al., 2011). Sociocultural standards of beauty have increasingly emphasized a thin-body ideal that is unrealistic or unhealthy for many women to obtain (Gordon, 2000; Striegel-Moore, & Smolak, 2001). This influence has likely contributed to the increased rates of smoking for weight control among women. Additionally, expectancies about the weight-control properties of cigarettes are strongly associated with concerns about weight, shape, and food intake (White, McKee, & O'Malley, 2007).

As such, it is important to identify the situations that influence and exacerbate the relationship between smoking and unhealthy weight control behaviors in this population, to ultimately address both maladaptive behaviors. One subgroup that is particularly prone to smoke to control weight comprises female "restrained eaters" (Pomerleau, Ehrlich, Tate, Marks, Flessland, & Pomerleau, 1993).

Restraint Theory and Restrained Eaters

According to Restraint Theory (Herman & Polivy, 1975; Spoor, Stice, Bekker, Van Strien, Croon, & Van Heck, 2006), restrained eaters are dieters who, out of concern about weight gain or weight maintenance, abandon physiologically dictated cues (i.e. hunger and satiation) to initiate and end eating episodes. Instead, they adopt cognitive or externally controlled cues and rules (e.g. caloric content, time of day) to regulate food intake. Restrained eaters are susceptible to vacillation between periods of restraint and "disinhibited eating," whereby an emotional, environmental or external cue leads the eater to abandon restraint and eat in an out-of-control, binge-like manner, again ignoring physiological cues for food regulation. After a disinhibited eating episode, the restrained eater will then attempt to restore dietary restraint and the cycle will repeat. Restrained and disinhibited eating are associated with adverse mental health outcomes, including mood disturbances such as anxiety and negative affect (Lattimore & Caswell, 2004; Lopez, Litvin, & Brandon, 2009), comorbid substance use disorders (Addicott, Gray & Todd, 2009; Hudmon et al., 1999; Stewart, Angelopoulos, Baker & Boland, 2000), and increasingly severe eating pathology such as eating disorders (Ruderman & Grace, 1987; Ruderman & Grace, 1988).

Disinhibition of restraint can be experimentally manipulated by "priming" restrained eaters with a palatable food prime or preload (e.g. a milkshake) and then providing them access to ad-libitum food (e.g. Herman & Mack, 1975; Stroebe, 2008). Once restrained eaters (as measured by the Restraint Scale, RS; Herman & Polivy, 1980; Polivy, Herman, & Howard, 1988) have been primed, they experience a hypothesized abstinence-violation whereby their cognitive rules about food intake have been violated, resulting in increased ad-libitum food intake compared with those who are not restrained eaters. Non-restrained eaters tend to moderate their food intake according to physiological cues and typically eat in an opposite manner to restrainers after a prime. That is, they eat less after a food prime (as discussed in

Stroebe, 2008). This effect has been replicated many times and the catalyst of disinhibition has been extended from a food prime to demanding cognitive tasks (Lattimore & Caswell, 2004), the presence of appetizing food (Rogers, & Hill, 1989), and a placebo "vitamin" that was purported to induce hunger in participants (Heatherton, et al., 1989). In all of these scenarios, disinhibition of restraint occurred, leading restrained eaters to eat more ad-libitum food than non-restrainers. These studies reinforce the evidence that restrained eaters either have a difficult time attending to, or they ignore, physiological regulatory signals for food intake.

It should be noted that the RS is not intended to assess *successful* dietary restraint, or the ability to restrict caloric intake, with subsequent negative energy balance (see Stice, Sysko, Roberto, & Allison, 2010). Instead, the RS is able to identify dieting, overeating, and weight fluctuation patterns (Lowe & Thomas, 2009). In fact, a construct validity analysis of the RS determined that it is capable of measuring disinhibited eating, attempts at dieting or restraint, and body dissatisfaction (van Strien, Herman, Engels, Larsen, & van Leeuwe, 2007). Thus, the RS is likely better at predicting *unsuccessful* dieters, i.e. those that are prone to disinhibited eating, than it is at predicting pure restraint from food intake (as discussed in van Strien et al., 2007; Lowe & Thomas, 2009).

Smoking Among Restrained Eaters

Although many smokers are aware of long-term risks associated with tobacco use (Bansal, Cummings, Hyland, Bauer, Hastrup, & Steger 2004), these risks may be outweighed by the perceived short-term gains of smoking by weight-control, restrained eating, smokers. For example, restrained eaters report smoking specifically for weight control purposes to a greater extent than non-restrained eaters (McKee, Nhean, Hinson, and Mase, 2006).

Traditionally, the food priming effect in restrained eaters has been thought to occur due to an abstinence-violation, as mentioned above, also colloquially referred to as the "what the hell effect." That is, restrained eaters were thought to have increased motivation to consume food after a food prime, which led to the increased food consumption found in laboratory manipulations of food cues in restrained eaters. However, recent research has described the "why bother effect" (Sin & Vartanian, 2012). As

opposed to the "what the hell effect," the "why bother effect" suggests that restrainers may simply lose their motivation to continue dieting after a food prime. From this standpoint, restrained eaters could potentially continue to hold dietary restraint as a goal even when engaging in disinhibited eating; however, this goal becomes difficult to achieve in food rich environments (Sin & Vartanian, 2012; Strobe, van Koningsbruggen, Papies, & Aarts, 2013). In either theoretical scenario, cigarettes may be used to redirect individuals to their goal of dietary restraint, despite the effects of the food prime on motivation to consume food or uphold dietary rules. In the case of an abstinence-violation effect, cigarettes may be working to suppress appetite, "undo" an eating episode, and/or distract individuals from further food consumption (and then realign individuals with their dietary goal of restraint). If individuals simply lose motivation to uphold their dietary restraint in food rich environments, cigarettes may be used to restore this motivation.

Recently, Kovacs, Correa, and Brandon (2014) employed an altered version of the food prime procedure described above to investigate the momentary mechanisms underlying the relationship between increased smoking in female restrained eaters. In a randomized, two-arm design, half of the participants were primed with a standard milkshake prime, whereas a control group read magazines. All participants were then presented with ad-lib food for a twenty minute period, which was termed a "taste test" phase. However, unlike the classic food prime procedure, an option to smoke was also allowed during this period. It was hypothesized that participants who were primed and high in dietary restraint (as measured by the RS) would choose to smoke rather than eat, theoretically to suppress appetite and further eating, and/or to restore their dietary restraint after the food prime. As expected in our initial study, level of restraint moderated both food intake and smoking in the experimental group, whereby those with elevated dietary restraint ("high-restrainers") waited longer to consume food and consumed more cigarettes (and had a shorter latency to their first cigarette, which corresponds with increased motivation to smoke; e.g. Shiffman et al., 2013), than those lower in restraint who received the same food prime. This study provided evidence for a mechanism underlying the increased smoking seen in female restrained eaters: smoking as a substitution for eating. In addition, this study found that expectancies about smoking as a

weight control mechanism moderated smoking behavior after a food prime, such that those endorsing these beliefs had shorter latencies to their first puff from a cigarette.

Although this initial study was a first examination of the momentary smoking patterns of females with high dietary restraint, we were unable to test whether participants' smoking behavior was driven primarily by factors associated with smoking cigarettes per se (e.g. expectancies of weight control or physiological appetite suppression associated with tobacco use) versus merely smoking as an alternative and available distractor in the presence of tempting food. Furthermore, although this study was able to achieve a high level of internal validity, its external validity was limited by the fact that people have a wide-range of available distractions and behavioral alternatives other than cigarettes with which to engage in their natural environments. Therefore, it is particularly important to continue investigating the mechanisms underlying dietary restrainers' apparent preference for smoking after a food prime. A crucial question remains to be answered: is there something unique about cigarettes, as compared with alternative behaviors that people may engage in when at risk for disinhibited eating? As smoking serves as a potent reinforcer, delivering nicotine to the brain within seven seconds and providing a multifaceted sensory experience (Maisto, Galizio, & Connors, 2011), we postulated that it is likely cigarettes are more than simply a distraction. That is, we would expect the same effect of decreased latency to smoke, and increased latency to eat, to occur even when an alternative behavior is provided for participants to engage with after a disinhibiting food prime.

The Current Study

The primary aim of the current study was to extend previous research that found that female restrained eating smokers substituted their normal excessive eating behavior with increased smoking after consumption of a food prime (Kovacs, et al., 2014). In the current study, we employed the same two-arm (Prime/No-Prime) experimental design utilized in our prior study, by either "priming" participants with a small amount of a vanilla milkshake (Prime condition), or instructing them to read magazines for several minutes (No-Prime condition). We then allowed all participants ad-lib access to food and cigarettes during a mock "taste test" phase. However, we also introduced a third behavioral option during the taste

test phase: granting ad-libitum access to web browsing on an electronic tablet. We expected that after a food prime, participants high in dietary restraint would be inclined to smoke instead of eat to: prevent further food consumption; realign their behavior with their goals of dietary restraint; and/or "undo" a perceived overeating episode. Importantly, with the introduction of a third behavioral alternative, we were able to test if smoking after a food prime was merely used as a distraction from further food intake. That is, despite having another behavioral option with which to engage (one that is less detrimental than cigarette smoking and is also quite engaging and familiar), we still expected participants to smoke at higher rates if they had been primed and were high in dietary restraint. In addition to ruling out smoking as a distraction method from continued food intake, we probed alternative underlying mechanisms and motivations involved with behavioral decisions in the current study.

Specific Aim 1: To test the effect of a food prime on smoking behavior in the presence of an alternative distractor, and the effects of expectancies and dietary restraint as moderators.

Hypothesis 1A: We planned to examine overall simple main effects for differences in smoking behavior (i.e. latency to smoke, number of puffs, and total weight smoked) for those in the Prime/No-Prime conditions and for those who were high/low in dietary restraint. As our previous study (Kovacs et al., 2014) did not find overall differences by condition, we did not expect to find group differences upon our smoking variables. However, we did expect to find overall main effects by dietary restraint, such that those who endorsed high levels of dietary restraint would smoke more than those lower in restraint.

We also hypothesized an interaction effect, such that participants who received the milkshake food prime would continue to demonstrate greater smoking behavior, as moderated by self-reported level of dietary restraint, despite the introduction of an alternative distracting variable (i.e. the computer tablet).

Alternative hypothesis 1A. As an alternative to the above hypothesis, it was possible that the availability of the alternative distractor (the tablet) would eliminate the effect of elevated dietary restraint upon smoking behavior as well as the moderation of conditional effects upon smoking behavior by dietary restraint. This would suggest that the tablet could compete with smoking as an alternative to eating. That is, smokers with elevated dietary restraint may merely use cigarettes as one of many possible

distractors when they are tempted to eat, rather than as a unique mechanism to control appetite, body-image, or weight. Therefore, we planned to measure latency to engagement with our distracting alternative behavior (i.e. use of the computer tablet). We postulated that if participants who received the food prime, *and* were higher in dietary restraint, had shorter latencies to use of the tablet, this would indicate that the tablet was a desirable alternative distractor to increased food intake (similar to cigarettes).

Hypothesis 1B: We predicted that expectancies regarding cigarette's weight control properties would moderate the effect of the food prime on cigarette consumption. As in our prior study (Kovacs et al., 2014), we expected to find main effects of expectancies upon smoking behavior. We also predicted an interaction between condition and expectancies such that participants in the Prime group would engage in greater cigarette consumption, as moderated by expectancies regarding cigarettes' weight control effects.

Additionally, to further explore the driving mechanisms involved in the greater smoking we expected, we planned to parse out different aspects of weight-related expectancies of cigarettes. We planned to separate expectancies into both immediate and distal outcomes associated with smoking. Immediate outcome expectancies included appetite suppression and the expectancy that smoking is a distraction from eating. Distal outcome expectancies included beliefs that cigarettes influence weight, more broadly.

Specific Aim 2: To test the effect of a food prime on eating behavior in the presence of a distractor, moderated by dietary restraint.

Hypothesis 2A: Previous research (Kovacs et al., 2014) demonstrated that the priming effect of food was reversed among restrained eating smokers when cigarettes were available. That is, rather than consuming more food after receiving a tempting food prime, participants high in dietary restraint ate less in the presence of both food and cigarettes. In the current study, we expected to find main effects of condition, with those in the Prime condition consuming less food, as well as to replicate our previous finding of an interaction between condition and restraint. Specifically, we expected to find that those in the Prime condition, with higher levels of dietary restraint, would smoke faster, and smoke more overall.

Secondary Aim: To explore the effects of key variables upon craving to smoke.

We expected to find main effects of both dietary restraint and condition upon craving to smoke during and after the taste test. Specifically, we expected participants in the Prime condition, and participants higher in dietary restraint, to endorse greater craving. We also hypothesized an interaction between dietary restraint and condition such that participants with elevated levels of dietary restraint in the Prime condition would rate their craving to smoke higher. This interaction between dietary restraint and condition was expected to predict craving at three time points: first, immediately after administration of the food prime, secondly, during the taste test, and finally, immediately after the taste test.

Exploratory Aims

First, as a higher level of trait mindfulness has been associated with less severe eating pathology (Adams et al., 2012) we planned to examine relationships among our DV's and trait mindfulness. Secondly, internalization of the thin ideal, i.e. high value placed on appearance-related societal norms, with subsequent modification of behaviors (e.g. food restriction) to achieve corresponding goals, is a risk factor for body image disturbances and eating pathology (e.g. Thompson & Stice, 2001). Thus, we included a measure of thin-ideal internalization an exploratory predictor of smoking and eating outcomes.

Third, because in our previous study we found a negative relationship between smoking and eating behavior, we planned to examine relationships between the three behavioral options during the "taste test"- i.e. smoking, eating, and browsing the internet.

Fourth, we planned to examine relationships between dietary restraint and several variables to which this construct is theoretically related, including: consumption variables, craving, mindfulness, our measure of thin-ideal internalization, and expectancies.

Finally, we planned to conduct analyses of participants' responses on a Post Participant Questionnaire, including: 1. reasons for choosing to smoke, eat, and/or use the tablet during the taste test; 2. expectancies as predictors of reasons for smoking; and 3. participants' perceptions of the milkshake food prime (e.g. taste, belief that the milkshake was or was not a "tempting" food).

Method

Experimental Design and Overview

Participants were randomized into one of two conditions (Prime or No-Prime) in a between-subjects design. All participants who were consented completed baseline measures. Those in the Prime condition then received a milkshake food prime and were instructed to drink it in its entirety. Those in the No-Prime condition read magazines instead. Afterwards, both conditions began an ad-lib "taste test" during which they had the option to eat, use a computerized tablet, and/or smoke cigarettes they brought with them to the session. Lastly, participants filled out post-session measures, height and weight were measured, and participants were debriefed. For participation in the 1.5 hour study session, participants received a $25 payment or extra credit through USF Psychology classes.

Participants

Female smokers were informed that they would be participating in a study designed to learn more about the relationship between smoking and other variables, such as the taste of food. Most participants were recruited through fliers at USF, in addition to recruitment databases within the lab, fliers placed in the Tampa Bay community, advertisements placed online on Craigslist and Facebook, and the USF undergraduate research participant pool in psychology (SONA). Individuals recruited through Craigslist had the option to complete online pre-screening questions linked through SurveyMonkey or to call the lab directly to be screened. SONA participants were deemed eligible based on their responses to pre-screening questions. All other participants were screened upon calling the lab, before they scheduled and attended a lab session.

During the screening process, participants were informed that their appointment would be an individual session, lasting about 1.5 hours, and that the session would entail filling out questionnaires, participating in a taste test, and having the option to smoke during the study. We restricted our

appointment times to 11am or later in the day, to facilitate participants' compliance with the instruction to not eat or smoke for three hours before their appointment. We also confirmed these criteria upon participant arrival at the appointment.

A power analysis was conducted utilizing G-power (Faul, Erdfelder, Lang, & Buchner, 2007). To achieve power of .80 for detecting group differences with medium effect sizes (d = .50), we required a sample size of 128 participants total, or 64 participants per condition (Cohen, 1988). Additionally, we calculated that based on this sample and effect size, we would have power of .80 to detect moderation with three predictors in each proposed model.

The following inclusion criteria were required: 1. female gender; 2. age 18-29; 3. smoked 100 or more lifetime cigarettes and at least 1 cigarette each day for the last 30 days; 4. expired carbon monoxide (CO) reading of at least 6 parts per million after consenting to the study; 5. not currently engaged in any formal smoking cessation treatment or programs; 6. not currently or potentially pregnant; 7. not lactose intolerant or vegan.

Measures[1]

Baseline measures.

Demographic Questionnaire (DQ). We collected demographic information including gender, age, marital status, race/ethnicity, education level, and income.

Baseline measures of cigarette use and dependence.

Exhaled Carbon Monoxide (CO). Participants were asked to provide a breath sample, to confirm their smoking status, into a CO monitor via a disposable mouthpiece. The cutoff of at least 6 parts per million (ppm) upon arrival for their appointment was utilized, which verifies smoking status within light smokers (Kendzor et al., 2008).

[1] Additional measures of self-control, affect, and BMI were included; however, since they were not analyzed for this main report, they are not included in the method section.

Smoking Form (SF). We assessed nicotine dependence with the Fagerström Test of Nicotine Dependence (FTND; Heatherton, Kozlowski, Frecker, & Fagerstrom, 1991), which was imbedded in a larger set of questions within the SF. Additionally, readiness to quit smoking was assessed via the Contemplation Ladder (Biener & Abrams, 1991.

Baseline measures of dietary restraint and mindfulness.

Restraint Scale (RS). (Herman & Polivy, 1980). We measured level of dietary restraint with the 10-item RS. The RS has good psychometric properties; in the current study it demonstrated adequate reliability, $\alpha = .72$. Those who score higher in dietary restraint on the RS have a heightened *desire* to restrict food but also a higher likelihood to overeat or eat in a disinhibited manner. Scores on this measure range from 0-35 and a scores ranging from 12-15 have been suggested as cut-points to distinguish high vs. low levels of dietary restraint .

Five Facet Mindfulness Questionnaire. (FFMQ; Baer et al., 2006). We administered this questionnaire to assess trait level of mindfulness, which has been associated with body image and eating style (Adams et al., 2012). This measure demonstrates good reliability and validity and consists of 39 questions that load onto five factors of mindfulness including: "non-reactivity," which is the act of accurately perceiving one's thoughts and emotions without reacting to them; "observing," or tuning into external/internal signals and sensations; "acting with awareness," purposefully focusing only on the present moment; "describing," which entails accurately identifying and labeling one's emotions and cognitions; and "non-judging," or accepting one's cognitions and emotions with a sense of detachment or a non-judgmental/evaluative stance (Baer et al., 2006). Adams et al. (2012) determined that certain inherent aspects of trait mindfulness (specifically the describing, non-judging, and acting with awareness domains measured with the FFMQ) in female smokers were predictive of less severe eating pathology and poor body image. Consequently, we included only these three factors in our questionnaire, and examined the total scale score including all three factors. In the current study the FFMQ demonstrated excellent internal consistency, $\alpha = .93$.

Baseline measures of weight-control expectancies of cigarettes.

Smoking Consequences Questionnaire-Adult: Weight Control Smoking (SCQ-Weight Control) and Negative Affect Reduction Subscales. The Weight Control Smoking subscale is one of 8 subscales from the Smoking Consequences Questionnaire-Adult, a measure of expectancies in nicotine-dependent adult smokers (SCQ-A; Copeland, Brandon, & Quinn, 1995). We utilized this subscale to examine both main and moderation effects upon our dependent variables. Additionally, we developed two exploratory items that were added to this scale to measure participants' beliefs about smoking as a distraction from eating. We further categorized the subscale into weight-related and appetite-related expectancies. Overall, the SCQ-A Weight-Control Smoking subscale demonstrated good internal consistency ($\alpha = .77$). We also included the Negative Affect Reduction subscale from the SCQ-A, for the purpose of imbedding the weight related questions; the Negative Affect Reduction subscale was not utilized in the final analysis.

Smoking-Related Weight and Eating Episodes Test (SWEET). This psychometrically sound 10-item measure (Adams, Baillie, & Copeland, 2011), is intended to assess smoking for appetite control and other weight-related concerns. In the current study it demonstrated good reliability ($\alpha = .89$). This measure is ideal for parsing out expectancies regarding smoking and food intake; specifically, it loads onto four separate factors, categorized into *"smoking to suppress appetite," "smoking to prevent overeating," "smoking to cope with body dissatisfaction,"* and *"withdrawal-related appetite increases."* We included the SWEET total score and each of these factors as predictors or correlates of smoking and food outcomes.

Weight-Control Smoking Scale (WCSS). (Pomerleau et al., 1993). This three-item scale was adapted from the Reasons for Smoking Scale and included as a measure of expectancies for smoking's weight control properties. In the current study it demonstrated good internal consistency ($\alpha = .77$).

Measures of craving.

Questionnaire of Smoking Urges-Brief (QSU-Brief). (Cox, Tiffany, & Christen, 2001). We administered this 10-item questionnaire at several points throughout the study (baseline, $\alpha = .93$; post-manipulation, $\alpha = .93$; post taste-test, $\alpha = .92$) to obtain a total score for level of state urge and intention to smoke.

Visual Analogue Scales (VAS). At multiple time points throughout the study (i.e. at baseline, and after the taste test) participants rated their cravings for food in the present moment, desire to smoke a cigarette in the present moment, and subjective fullness and hunger in the present moment on a scale from 0-100mm. After the taste test, they were also asked to rate these items based on how they felt during the taste test. Participants also completed taste test rating forms during the taste test, in an effort to enhance the validity of the taste test cover story, similar to procedures in previous research (Kovacs, et al., 2014; Ogden, 1994), (see Appendices J-N).

Washout task. To decrease any unintended effects of completing baseline questionnaires, immediately after filling out baseline questionnaires but before the Prime manipulation, participants were instructed to engage in this five minute task adapted from Roehrig (2008). Specifically participants were asked to think of and describe (in writing) vacation destinations that they have not previously experienced.

Dependent measures.

Smoking behavior, eating behavior, and engagement with the tablet. A video recording of each participant during the taste test phase was saved and coded to determine behavior during this phase. The following latency variables were coded, based on the time the taste began: latency to first puff of a cigarette, latency to first bite of food, and latency to engage with the computerized tablet. These latency variables were included as measures of motivation to engage with a specific item. Additionally, number of puffs were counted for each cigarette participants smoked during the taste test. Finally, total weight of both food and cigarettes were determined based on pre-post weight of participants' cigarettes and pre-

portioned food. We measured food and cigarette weight with a digital scale. Total calories consumed were calculated for each participant, based on the pre-post weight of food consumed.

Post-session measures. Subsequent to the taste test phase, participants were immediately administered VAS forms to rate their hunger and craving (for both food and cigarettes) "during the taste test," as well as "in the present moment." Additionally, they completed time three measures of cigarette craving (QSU-brief). Other measures administered at this time included the Internalization: Thin/Low Body Fat subscale from the Sociocultural Attitudes Towards Appearance Scale-4 (SATAQ-4; Schaefer et al., 2015). This measure was analyzed as an exploratory predictor of cigarette and food consumption, as well as a correlate of other baseline measures. Additionally, participants completed a Post-Participation Questionnaire that was developed to elucidate participant motivations to engage with the three behavioral options during the taste test, and their perceptions of the food prime.

Procedure

Table 1 summarizes the procedure of the experimental session, which lasted an average of 90 minutes.

Table 1.
Outline of Procedure

Part I: Recruitment and Screening of Participants
- Individuals recruited via:
    - SONA
    - Fliers on campuses and in the community
    - Classrooms
    - Craigslist
    - Databases at the lab
- Participants were screened over the phone and/ or online at surveymonkey.com.
- Instructions/details of the study were provided.
- Session scheduled (for 11am or later).

Part II: Consent and randomization (10 minutes)
- Exhaled Carbon Monoxide (CO)
- Compensation of $5 or chance to reschedule one time, if participant disqualified at lab.

Part III: Baseline Questionnaires completed by all participants (15-20 minutes)
- Demographic Questionnaire (DQ)
- Five Facet Mindfulness Questionnaire (FFMQ)
- Questionnaire of Smoking Urges- Brief (QSU-brief)
- Restraint Scale (RS)
- Smoking Form (SF)
- Smoking Consequences Questionnaire (SCQ-A)

Table 1. Cont.

- Smoking-Related Weight and Eating Episodes Test (SWEET)
- VAS for hunger, cravings for food and cigarettes
- Weight Control Smoking Scale (WCSS)
- After questionnaires were completed, experimenter verified that all questions were filled out properly and allowed participants to fill in missed questions.

Part IV: Wash-out period (5 minutes)

- Participants described vacation destinations for 5 minutes.

Part V: Prime/no prime manipulation (5 minutes)

- Prime condition received vanilla milkshake food prime; were told that participants receive the milkshake in order to prepare for the taste-test; were instructed to try to drink the entire milkshake.
- No-Prime condition read magazines with smoking and food cues removed for 5 minutes.
- Immediately after manipulation, all participants received QSU-brief.

Part VI: Taste Test Phase (20 minutes)

- All participants were introduced to the taste test. Received their pack of cigarettes, a lighter, ad-lib food and a tablet with internet access. Instructions were provided:
    - All participants told to remain in room with no other distractions for 20 minutes, were provided instructions for use of tablet, told they were allowed to smoke, eat and/or use the tablet as much or as little as they would like, and were asked to fill out a taste test rating form for each food item that they ate.

Part VII: Post- session Measures (10 minutes)

- Food 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"
- QSU-brief
- SATAQ-4
- Post-Participation Questionnaire

Part VIII: Compensation and Debriefing (5 minutes)

- Post-Participation lab Survey
- Receipt of payment (when applicable)
- Debriefing

Part IX: Weighing of food and cigarettes

- Participant exited lab.
- Experimenter weighed remaining food/cigarettes

Consent. Upon arrival at the lab, participants were provided with an overview of the study and were asked to read and sign an informed consent document.

Randomization. A pre-determined randomization order was generated from www.random.org, and condition and participant number were then placed in a sealed envelope in each participant's folder. Immediately after the participant was consented, group assignment was revealed to the experimenter.

Administration of baseline questionnaires. Participant CO level and time of last meal/cigarette were verified immediately after randomization. They were then provided with a packet of baseline questionnaires (described above). Participants were informed that the questionnaires would take about 15-20 minutes to complete, and the experimenter exited the room. Afterwards, the experimenter returned and administered the five-minute washout-task.

Prime manipulation. Following the washout task, participants entered into the Prime vs. No-Prime phase, which lasted 5 minutes. Those in the No-Prime condition were asked to wait several minutes while the experimenter prepared for the next stage of the experiment. They were given the option to read through magazines while waiting. Care was taken to remove all smoking and food cues from these magazines. Participants assigned to the Prime condition received the food prime. The prime was an 8 oz. vanilla milkshake, blended by the experimenter from Edy's brand vanilla ice cream and 1% milk. The milkshake contained approximately 240 calories; however, participants were not informed about the nutritional content of the prime (and none of the participants asked about nutritional content). Instead, they were informed that it was a "regular vanilla milkshake." Ostensibly, the milkshake would be perceived as high in fat and calories. Similar primes have been used in previous research paradigms as a tempting food (see Stroebe, 2008 for a comprehensive list of such studies). Participants were later given the opportunity to provide feedback about the milkshake (e.g. whether or not they thought it was "healthy" or "tempting"). Participants in the Prime condition were provided with a vague rationale for being asked to drink the milkshake; they were informed it was administered to participants to prepare them for the taste test. All but one participant complied with the instruction to drink most of the milkshake; that participant was excluded from data analysis. These procedures are analogous to those employed in prior food prime studies (e.g. Kovacs, et al., 2014; Jansen, Nederkoorn, van Baak, Keirse, Guerrieri, & Havermans, 2009; Mills, & Palandra, 2008).

Immediately following the manipulation, materials (i.e. the magazines or the milkshake) were removed from the table in front of the participant, and the QSU-brief was administered to assess craving.

Taste test phase. Immediately after completing time-2 measures of craving and mood, participants entered the 20-minute taste test phase. They were presented with pre-measured portions (three serving sizes each) of potato chips, cookies, chocolate, cheese cubes, and water. These types of food have been used in previous food priming research (e.g. Kovacs, et al., 2014; Ogden, 1994), and have been validated as tempting "comfort foods" for women (Wansink, Cheney, & Chan, 2003). Additionally, participants were provided with their own pack of cigarettes and a lighter, an ash tray, taste test rating forms, and a pen. Lastly, particpants were introduced to the option to use a computerized tablet equipped with wi-fi to browse the internet, watch videos, play games etc., ad lbitum, and they were also provided brief instructions about how to use the tablet. All participants noted previous use of, or familiarity with, similar technology.

Participants were instructed to avoid all other distractions (e.g. reading, sleeping, drawing, checking their phone etc.) for the 20 minute taste-test period. Specifically, they were told: "You have the option to smoke, eat, and/or use the provided tablet to browse the internet as much or as little as you would like, but you do not have to participate in any of these options. However, for any *food* that you do try, please rate it on the taste test forms in front of you." Immediately after the 20 minutes, the experimenter returned to the room and cleared the table of all taste test items. Leftover food and cigarettes were removed from the room and weighed at the completion of the study.

Post-session measures, compensation and debriefing. Finally, participants completed post-session measures (as described above) and a post-participation survey, were debriefed, and received their monetary compensation (when applicable).

Results

Preliminary Analyses

Before analyses were conducted, group equivalence (Prime vs. No-Prime) of categorical and continuous baseline and demographic variables was examined through a series of chi-square and t-tests. The following variables differed between groups: age, race, two measures of expectancies (the WCSS and SCQ-A weight control subscale), and the cigarettes per day (CPD) item from FTND. Correlations were then conducted between the WCSS, SCQ-A Weight Control subscale and CPD variables, and each of the consumption variables (smoking, eating, and tablet use). Of these variables, there were significant correlations only between age and food consumption, and between the SCQ-A Weight Control subscale and total cigarette weight smoked. Additionally, race did not predict any of the consumption variables in an ANOVA analysis. Therefore, for analyses of priming effects on food consumption, age was entered as a covariate, and for analyses of priming effects on total cigarette smoked, SCQ-A Weight Control was entered as a covariate. Results that differed based on inclusion of these covariates are included in footnotes; otherwise results are presented without covariates included.

Additionally, parametric assumptions were checked, and several dependent variables demonstrated significant kurtosis and/or positively skewed distributions. Therefore, log transformations were performed for the following continuous dependent variables: total weight and calories of food consumed, total number of puffs smoked, and all three latency values (i.e. latency to first cigarette puff, tablet use, and first bite of food). After transforming these variables, dependent variables were examined for outliers. There remained only one outlier, for number of puffs. Primary analyses were conducted with and without this outlier and all findings remained consistent. Therefore, this data point is included in all analyses.

Three participants were excluded from the final data analysis for non-compliance: two were excluded for smoking cigarillos during the taste test, and one was excluded for failing to drink the milkshake food prime.

Interrater reliability analyses were conducted for variables that were coded from video recordings (number of puffs, latency to first puff, latency to eat, and latency to first use of the tablet). A sample of 20% of the video recordings was selected at random and scored by a second rater. Correlations between the two independent raters were conducted and high levels of reliability were achieved (*r*'s ranged from .84 - .99).

Finally, several participants did not smoke (n = 4), eat (n = 1), or use the tablet (n = 1) during the taste test. All participants engaged in at least two of these choices. For the purposes of obtaining a latency value for engagement with each of these behaviors, participants were assigned a maximum latency value (1200 seconds, i.e., the duration of the taste test) for those behaviors they did not engage in. Analyses were conducted with and without these maximum latency values. With maximum values included, all results, except for one outcome (noted in a footnote) did not differ for any of our primary outcomes. Therefore maximum latency values were not included in the final analyses.

Participant Characteristics

Our final sample size, excluding the three participants who were non-compliant with instructions, comprised 128 participants (64 in each condition). Of these 128 participants, we were missing some topography data for four participants, and missing all topography data for eight participants, as we experienced intermittent technical difficulties with our video recording system. Mean age of participants was 22.87 years (SD = 3.57). The sample included 73% Caucasian and 22% Black/African American individuals, with 13% reporting Hispanic ethnicity. On average, participants smoked about 10 cigarettes per day and were considered low-dependence smokers. See Table 2 for sample demographic variables and Table 3 for sample baseline and smoking variables.

Specific Aim 1: The effect of a food prime on smoking behavior in the presence of an alternative distractor, and the effects of dietary restraint and expectancies as moderators.

For Hypothesis 1A, we conducted both hierarchical linear regressions with condition as the focal predictor and with RS used as a continuous moderator of smoking outcomes, and 2x2 factorial ANOVA's, dichotomized by the sample's Restraint Scale (RS) median of 16. We predicted a main effect of dietary restraint such that participants with elevated dietary restraint would demonstrate greater smoking behavior, based upon our prior findings (Kovacs et al., 2014).

Table 2.
Sample Demographic Variables

Variable	Prime	No-Prime	Overall	*p*
N	64	64	128	
Age (mean)	22.02 (3.46)	23.72 (3.50)	22.87 (3.57)	**<.01**
Race (%)				**0.05**
American Indian/Alaska Native	0	1.6	0.8	
Asian	0	6.3	3.1	
Native Hawaiian or Other Pacific Islander	1.6	0	0.8	
Black or African American	20.3	23.4	22	
White	78.1	67.2	73.2	
Hispanic (%)	12.5	14.1	13.3	0.79
Marital Status (%)				0.70
Single	89.1	89.1	89.1	
Married	4.7	6.3	5.5	
Separated	0	1.6	0.8	
Divorced	6.3	3.1	4.7	
Education (%)				0.69
Did Not Graduate High School	4.7	3.1	3.9	
High School Graduate	18.8	23.4	21.1	
Some College	53.1	43.8	48.4	
Technical School/ Associates Degree	15.6	17.2	16.4	
4-year College Degree	3.1	9.4	6.3	
Beyond 4-year College Degree	3.1	1.6	2.3	
Professional Degree (eg. MD, JD, PhD)	1.6	1.6	1.6	
Income (%)				0.99
Under $10,000	39.1	29.7	34.6	
$10,000-$19,000	7.8	17.2	12.6	
$20,000-$29,000	10.9	12.5	11.8	

Table 2. Cont.

$30,000-$39,000	7.8	9.4	8.7
$40,000-$49,000	4.7	9.4	7.1
$50,000-$59,000	9.4	4.7	7.1
$60,000-$69,000	6.3	4.7	5.5
$70,000-$79,000	3.1	3.1	3.1
$80,000-$89,000	3.1	1.6	2.4
Over $90,000	6.3	7.8	7.1

We did not expect to find a main effect of condition upon smoking behavior. We also expected to find an interaction between condition and dietary restraint, whereby those higher in dietary restraint and in the Prime condition would demonstrate greater smoking behavior.

For the continuous regression models, as expected, restraint was predictive of smoking behavior. Specifically only latency to first puff (and not total cigarette smoked, or number of puffs) was predicted by dietary restraint, whereby higher restraint predicted shorter latency to first puff, $p = .017$. Additionally, unexpectedly there was a main effect of condition upon one of our smoking variables. Specifically, participants in the Prime condition smoked more than those in the No-Prime condition, in terms of total weight ($p = .013$; see Table 4 for M/SD's and table 5 for the regression models). Furthermore, we did not find evidence of an interaction between condition and restraint for any of our three smoking variables.

For our 2x2 factorial models, level of dietary restraint was examined as a categorical variable. On the Restraint Scale, level of restraint at or above a total score of 14 is indicative of eating pathology. Therefore, our sample exhibited somewhat high levels of dietary restraint on average. Participants above the median of 16 were coded as "high restrainers" and those below this cutoff were coded as "low restrainers." Similar to the continuous results, no main effects of restraint were found upon our three smoking variables, although there was a trend toward shorter latencies to first puff (log-transformed)

among high restrainers (M = 4.33, SD = 1.46), compared to low restrainers (M = 4.80, SD = 1.41), $F(1,114) = 2.97$, $p = .088$.[2]

Consistent with our continuous results, main effects emerged for condition upon total weight of cigarette smoked, whereby those in the Prime condition smoked more (M = .87, SD = .32) than those in the no-prime condition (M = .73, SD = .31), $F(1,124) = 5.83$, $p = .017$. No other main effects by condition or restraint were found (all *p's* >.05). Finally, no interactions were found between categorical dietary restraint and condition.

As an alternative to Hypothesis 1A, we speculated that those higher in dietary restraint could potentially demonstrate no increased smoking behavior when in the presence of an alternative distractor (the tablet), and that an interaction between condition and dietary restraint would not be found to predict any smoking outcomes. The failure to reject the null hypothesis is consistent with the notion of cigarettes being viewed as simply an alternative distractor, rather than having unique appetite or weight control motivational influences in this context.

However, and importantly, latency to use of the computer tablet, $F(1,118) = 1.09$, $p = .29$; Prime (M = 3.14, SD = 1.91), No-Prime (M = 3.50, SD = 1.87), was also not predicted by any variable, including condition, dietary restraint, or an interaction between these two predictors (all *p's* > .05; see Table 6).

Expectancies. To test Hypothesis 1B, we utilized three expectancy measures regarding cigarettes' influence on weight/appetite/body-image control in the current study. We hypothesized that we would find main effects of expectancy measures (but not condition) upon smoking behavior, and that these measures would moderate the effect of the food prime on cigarette consumption. See Table 7 for total and subscale descriptive statistics.

[2] When maximum value for latency to smoke was imputed for participants who did not smoke (n = 4), this result became significant $F(1,118) = 4.05$, $p = .047$; high restrainers (M = 4.37, SD = 1.49), low restrainers (M = 4.91, SD = 1.47).

Table 3.

Baseline Variables (Means/Standard Deviations)

Variable	Prime	No-Prime	Overall	*t(df)*	*p*
Cigarettes Per Day	11.20 (5.93)	9.22 (5.47)	10.21 (5.77)	1.96(126)	**0.05**
FTND Score	3.08 (2.14)	2.91 (2.17)	2.99 (2.14)	.45(126)	0.65
CO	15.41 (14.62)	17.31 (17.43)	16.36 (16.05)	-67(126)	0.50
QSU Total Score	43.39 (14.11)	40.39 (15.11)	41.90 (14.63)	1.15(123)	0.25
Body Mass Index (BMI)	26.64 (7.15)	28.47 (8.29)	27.56 (7.77)	-1.3(126)	0.19
Restraint Scale (RS) Total Score	15.84 (5.19)	16.77 (6.38)	16.30 (5.81)	-.89(126)	0.37
Smoking Related Weight and Eating Episodes Test (SWEET)	25.84 (8.51)	23.56 (8.45)	24.96 (8.52)	1.51(125)	0.13
Smoking Consequences Questionnaire (Weight Control)	32.81 (16.42)	23.16 (17.21)	27.98 (17.44)	3.25(126)	**<.01**
Weight Control Smoking Scale	3.29 (2.09)	2.44 (2.14)	2.87 (2.15)	2.30(126)	**0.02**
Five Facet Mindfulness Questionnaire (FFMQ) Total Score	83.6 (16.47)	84.05 (16.46)	83.82 (16.39)	-.15(124)	0.88

Note. FTND = Fagerström Test of Nicotine Dependence; CO = Carbon monoxide level; QSU = Questionnaire of Smoking Urges-Brief

Table 4.

Between Group Smoking Variables (Means/Standard Deviations)

Variable	Prime	No-Prime	Overall	*df*	*F*	*p*
Log-transformed latency to first puff	4.58 (1.53)	4.49 (1.37)	4.54 (1.45)	1, 116	0.09	0.76
Log-transformed number of puffs	2.87 (0.45)	2.73 (0.51)	2.80 (0.48)	1, 114	2.38	0.13
Total cigarette weight smoked	0.87 (0.32)	0.73 (0.31)	.80 (.32)	1, 126	5.89	**0.017**

Table 5.

Hierarchical Regression of Smoking Variables by Restraint and Study Condition

Dependent Variable: Latency to First Puff (log-transformed)					
Step	Predictor(s) Included	β	t (df)	R^2	p
1				.00	
	Condition	-0.03	-.31 (117)		.78
2				.05	
	Condition	-0.01	-.12 (117)		.91
	Restraint Scale Total	-0.22	-2.43 (117)		**.02**
3				.05	
	Condition	-0.03	-.12 (117)		.90
	Restraint Scale Total	-0.25	-.80 (117)		.42
	Interaction (Condition by Restraint)	0.04	.09 (117)		.93
Dependent Variable: Number of Puffs (log-transformed)					
Step	Predictor(s) Included	β	t (df)	R^2	p
1				.02	
	Condition	-0.14	-1.54 (115)		.13
2				.03	
	Condition	-0.15	-1.56 (115)		.11
	Restraint Scale Total	-0.08	.81 (115)		.42
3				.00	
	Condition	-0.33	-1.69 (115)		.25
	Restraint Scale Total	-0.13	-.41 (115)		.68
	Interaction (Condition by Restraint)	0.29	.68 (115)		.49

Table 5. Cont.

Dependent Variable: Total Cigarette Smoked					
Step	Predictor(s) Included	β	t (df)	R^2	p
1				.05	
	Condition	-0.21	-2.43 (127)		**.02**
2				.06	
	Condition	-0.22	-2.52 (127)		**.01**
	Restraint Scale Total	0.101	1.16 (127)		.25
3				.06	
	Condition	-0.28	-1.06 (127)		.29
	Restraint Scale Total	0.03	0.09 (127)		.92
	Interaction (Condition by Restraint)	0.10	0.25 (127)		.80

Note: Standardized Coefficients included

No main effects of our three expectancy measures' total scale scores upon our three smoking outcomes (total cigarette smoked, latency to first puff, number of puffs) were found when all predictors were entered into the model (condition, expectancy measure, and the interaction term). Furthermore, no interactions between condition and any of our expectancy measures (total scores and subscale scores) were found on our three smoking variables (all *p's* > .05; see Tables 8 through 10. Therefore, we did not test for interactions between subscales of these expectancy measures and condition.

Table 6.

Regression of Latency to Log-Transformed Tablet Use by Condition and Restraint

Step	Predictor(s) Included	β	t (df)	R^2	p
1				0.00	
	Condition	0.096	1.05 (119)		0.29
2				0.01	
	Condition	0.098	1.06 (119)		0.29
	Restraint Scale Total	-0.028	-.30 (119)		0.76
3				0.013	
	Condition	0.218	.79 (119)		0.43
	Restraint Scale Total	0.114	.36 (119)		0.72
	Interaction	-0.197	-.46 (19)		0.65

Note: Standardized Coefficents included

Table 7.

Descriptives for Expectancy Variables- Total Scores and Subscales

Variable	Overall Mean/SD	n
SWEET Total Score	24.69 (8.52)	127
SWEET Suppression of Appetite	6.91 (2.70)	128
SWEET Control of Overeating	7.59 (3.44)	128
SWEET Cope With Body Dissatisfaction	4.37 (2.39)	127
SWEET Withdrawal Related Appetite Increases	5.85 (2.28)	128
SCQ Weight Control Total Score	27.98 (17.44)	128
SCQ Weight-Related Expectancies	6.73 (5.35)	128
SCQ Appetite-Control Expectancies	12.72 (7.71)	128
SCQ Distraction from Eating	8.53 (5.57)	128
WCSS Total Score	2.87 (2.15)	128

Instead, we explored main effects of expectancy subscale scores (from the SWEET and SCQ-A) upon our three smoking outcomes, via simple linear regressions. Total weight smoked was consistently predicted by several subscales, whereas number of puffs and latency to puff were not; these analyses are reported in Table 11. Overall, by parsing out the contributions of the different expectancy subscales from the SWEET and SCQ-A, we found a pattern in which proximal, or immediate expectancies related to smoking's effects (i.e. suppression of appetite, control of overeating, and coping with body

dissatisfaction) were predictive of increased total weight smoked. In contrast, distal expectancies (related to weight and withdrawal) did not predict total weight smoked. Finally, the subscale created from items we added related to smoking to distract oneself from eating was marginally predictive of smoking behavior. Expectancy variables and sub-scales were highly correlated with one another (see table 12 for correlation matrix).

Specific Aim 2: The effect of the food prime on eating behavior.

We expected to find main effects of the food prime, such that those in the Prime condition would eat less. We also expected to find an interaction effect between condition and dietary restraint, such that those in the Prime condition who were higher in dietary restraint would eat less.

We first entered condition and dietary restraint (measured continuously) into regression models to predict both log-transformed total calories consumed, and log-transformed latency to first bite of food. Main effects upon latency to consume food emerged for level of dietary restraint (p = .03) and as a trending effect for condition (p = .06). See table 13 for descriptive statistics, and table 14 for the regression model. Specifically, primed participants consumed food quicker[3] than those who did not receive a food prime, and participants with higher levels of dietary restraint avoided food for longer. When all three predictors (condition, restraint, and the interaction term) were entered into these models, interactions were not detected.

Next, as proposed, we entered condition and dietary restraint (measured dichotomously based on a median split) into 2x2 factorial ANOVA models. Analogous to the categorical analyses conducted for Hypothesis 1A, participants' level of dietary restraint was categorized into "high restrainers" and "low restrainers" based on the sample median of 16. Similarly to our continuous results, no main effects of condition or restraint were found to predict total calories consumed.

[3] Effect of condition upon latency was no longer trending when controlling for age, p = .12.

Table 8.

Hierarchical Regression of Smoking Variables by SWEET Total Score and Study Condition

Dependent Variable: Latency to First Puff (log-transformed)

Step	Predictor(s) Included	β	*t* (*df*)	R^2	*p*
1				.00	
	Condition	-0.035	-.37 (116)		.71
2				.01	
	Condition	-0.04	-.46 (116)		.64
	SWEET Total	-0.08	-.81 (116)		.42
3				.02	
	Condition	0.27	.91 (116)		.37
	SWEET Total	0.24	.79 (116)		.43
	Interaction (Condition by SWEET)	-0.43	-1.14 (116)		.27

Dependent Variable: Number of Puffs (log-transformed)

Step	Predictor(s) Included	β	*t* (*df*)	R^2	*p*
1				.02	
	Condition	-0.14	-1.47 (114)		.15
2				.02	
	Condition	-0.13	-1.37 (114)		.17
	SWEET Total	0.05	0.57 (114)		.57
3				.02	
	Condition	-0.24	-.79 (114)		.43
	SWEET Total	-0.05	-.17 (114)		.86
	Interaction (Condition by SWEET)	0.14	0.38 (114)		.71

Dependent Variable: Total Cigarette Smoked

Step	Predictor(s) Included	β	*t* (*df*)	R^2	*p*
1				.04	
	Condition	-0.204	-2.33 (126)		**.02**
2				.07	
	Condition	-0.182	-2.08 (126)		**.04**
	SWEET Total	0.164	1.88 (126)		.06
3				.68	
	Condition	-0.171	-.63 (126)		.53
	SWEET Total	0.175	0.63 (126)		.53
	Interaction (Condition by SWEET)	-0.015	-.04 (126)		.97

Note: Standardized Coefficients included

Table 9.

Hierarchical Regression of Smoking Variables by WCSS Total Score and Study Condition

Dependent Variable: Latency to First Puff (log-transformed)					
Step	Predictor(s) Included	β	*t* (*df*)	R^2	*p*
1				.00	
	Condition	-0.29	-.31 (117)		.76
2				.00	
	Condition	-0.40	-.42 (117)		.68
	WCSS Total	-0.60	-.62 (117)		.54
3				.01	
	Condition	0.09	.53 (117)		.60
	WCSS Total	0.22	.72 (117)		.48
	Interaction (Condition by WCSS)	-0.29	-.96 (117)		.34

Dependent Variable: Number of Puffs (log-transformed)					
Step	Predictor(s) Included	β	*t* (*df*)	R^2	*p*
1				.02	
	Condition	-0.14	-1.54 (115)		.13
2				.00	
	Condition	-0.14	-1.45 (115)		.15
	WCSS Total	0.03	0.31 (115)		.76
3				.00	
	Condition	-0.26	-1.62 (115)		.11
	WCSS Total	-0.24	-.80 (115)		.42
	Interaction (Condition by WCSS)	0.29	.95 (115)		.35

Dependent Variable: Total Cigarette Smoked					
Step	Predictor(s) Included	β	*t* (*df*)	R^2	*p*
1				.05	
	Condition	-0.21	-2.43 (127)		**.02**
2				.05	
	Condition	-0.20	-2.21 (127)		**.03**
	WCSS Total	0.073	.82 (127)		.41
3				.05	
	Condition	-0.19	-1.29 (127)		.20
	WCSS Total	0.08	.29 (127)		.77
	Interaction (Condition by WCSS)	-0.01	-.037 (127)		.97

Note: Standardized Coefficients included

Table 10.

Hierarchical Regression of Smoking Variables by SCQ-A Weight Control and Study Condition

Dependent Variable: Latency to First Puff (log-transformed)

Step	Predictor(s) Included	β	t (df)	R^2	p
1				.00	
	Condition	-0.03	-.31 (117)		.76
2				.01	
	Condition	-0.05	-.50 (117)		.62
	SCQ-A Weight Control Total	-0.07	-.74 (117)		.46
3				.02	
	Condition	0.17	.90 (117)		.37
	SCQ-A Weight Control Total	0.32	1.05 (117)		.30
	Interaction (Condition by SCQ-A Weight Control)	-0.41	-1.35 (117)		.18

Dependent Variable: Number of Puffs (log-transformed)

Step	Predictor(s) Included	β	t (df)	R^2	p
1				.01	
	Condition	-0.14	-1.54 (115)		.13
2				.01	
	Condition	-0.12	-1.26 (115)		.21
	SCQ-A Weight Control Total	0.08	.80 (115)		.42
3				.04	
	Condition	-0.34	-1.86 (115)		.07
	SCQ-A Weight Control Total	-0.33	-1.08 (115)		.28
	Interaction (Condition by SCQ-A Weight Control)	0.43	1.41 (115)		.16

Dependent Variable: Total Cigarette Smoked

Step	Predictor(s) Included	β	t (df)	R^2	p
1				.05	
	Condition	-0.21	-2.43 (127)		**.02**
2				.06	
	Condition	-0.17	-1.93 (127)		.06
	SCQ-A Weight Control Total	0.14	1.50 (127)		.14
3				.06	
	Condition	-0.24	-1.41 (127)		.16
	SCQ-A Weight Control Total	0.005	0.02 (127)		.99
	Interaction (Condition by SCQ-A Weight Control)	0.14	0.47 (127)		.64

Note: Standardized Coefficients included

Table 11.

Simple Linear Regressions of Smoking Variables by SWEET and SCQ-A Expectancy Measure Subscales

Dependent Variable	Predictor	β	t (df)	R^2	p
Log-Transformed Latency to First Puff					
	SWEET Suppression of Appetite	-.077	-1.56 (117)	.02	.12
	SWEET Control of Overeating	-.002	-.059 (117)	.00	.95
	SWEET Cope With Body Dissatisfaction	-.064	-1.14 (116)	.01	.26
	SWEET Withdrawal Related Appetite Increases	.010	.17 (117)	.00	.86
	SCQ -A Weight-Related Expectancies	-.022	-.87 (117)	.01	.39
	SCQ-A Appetite-Control Expectancies	-.005	-.31 (117)	.00	.76
	SCQ-A Distraction from Eating	-.017	-.71 (117)	.00	.48
Log-Transformed Number of Puffs					
	SWEET Suppression of Appetite	.005	.29 (115)	.00	.77
	SWEET Control of Overeating	.018	.16 (115)	.02	.16
	SWEET Cope With Body Dissatisfaction	.012	.65 (114)	.06	.52
	SWEET Withdrawal Related Appetite Increases	-.003	-.17 (115)	.00	.87
	SCQ Weight-Related Expectancies	.011	1.35 (115)	.02	.18
	SCQ Appetite-Control Expectancies	.008	1.34 (115)	.02	.18
	SCQ Distraction from Eating	.005	.58 (115)	.00	.56
Total Weight Smoked					
	SWEET Suppression of Appetite	.022	2.12 (127)	.03	**.04**
	SWEET Control of Overeating	.018	2.17 (127)	.04	**.03**
	SWEET Cope With Body Dissatisfaction	.026	2.27 (126)	.04	**.03**
	SWEET Withdrawal Related Appetite Increases	.001	.06 (127)	.00	.92
	SCQ Weight-Related Expectancies	.009	1.67 (127)	.02	.10
	SCQ Appetite-Control Expectancies	.008	2.18 (127)	.04	**.03**
	SCQ Distraction from Eating	.010	1.94 (127)	.03	.06

Table 12.

Correlations Between Expectancies Total and Subscale Scores

Variable	1	2	3	4	5	6	7	8	9	10
1. SWEET Total Score	1	.740	.874	.734	.769	.682	.563	.657	.685	.722
2. SWEET Suppression of Appetite		1	.480	.417	.417	.709	.614	.679	.693	.670
3. SWEET Control of Overeating			1	.527	.632	.537	.425	.528	.542	.571
4. SWEET Cope With Body Dissatisfaction				1	.401	.434	.388	.405	.426	.533
5. SWEET Withdrawal Related Appetite Increases					1	.442	.332	.430	.471	.475
6. SCQ Weight Control Total Score						1	.905	.966	.927	.764
7. SCQ Weight-Related Expectancies							1	.816	.744	.682
8. SCQ Appetite-Control Expectancies								1	.859	.740
9. SCQ Distraction from Eating									1	.715
10. WCSS Total Score										1

Note: All correlations significant at the .01 level (2-tailed).

Consistently, a main effect of condition was found to predict latency to first bite (Prime $M = 3.02$, $SD = 1.99$; No-Prime $M = 3.71$, $SD = 1.83$; $F(1, 120) = 4.10$, $p = .045$[4]). Finally, a trending effect was found, such that higher restraint predicted increased latency to first bite (high restraint $M = 3.66$, $SD = 1.88$; low restraint $M = 3.02$, $SD = 1.97$; $F(1, 120) = 3.19$, $p = .077$). No interactions between dietary restraint and condition emerged for our food consumption variables in our categorical analysis. Overall, the continuous and categorical analyses of restraint as a moderator of the food prime upon food consumption variables were consistent.

[4] Effect of condition upon latency was no longer significant when controlling for age, $p = .10$.

Table 13.

Between Group Food Consumption Variables (Means/Standard Deviations)

Variable	Prime	No-Prime	Overall	*df*	*F*	*p*
Amount of Food Consumed	3.94 (.59)	3.99 (.64)	3.97 (.62)	1, 125	.25	0.62
Total Calories Consumed	5.46 (.58)	5.51 (.65)	5.48 (.62)	1, 125	.26	0.61
Latency to First Bite	3.02 (1.9)	3.71 (3.7)	3.35 (1.9)	1, 118	3.90	0.06*

Note: All DV's are Log-Transformed

*Effect of group upon latency to first bite was insignificant when controlling for age, $p = .121$

Table 14.

Hierarchical Regression of Food Consumption by Restraint and Study Condition

Dependent Variable: Total Calories Consumed

Step	Predictor(s) Included	β	*t* (*df*)	R^2	*p*
1				<.01	
	Condition	0.05	.51 (126)		.61
2				<.01	
	Condition	0.05	.50 (126)		.62
	Restraint Scale Total	0.01	.12 (126)		.91
3				<.01	
	Condition	.119	.44 (126)		.66
	Restraint Scale Total	.096	.31 (126)		.76
	Interaction (Condition by Restraint)	-.120	-.29 (126)		.77

Dependent Variable: Latency to First Bite of Food (log-transformed)

Step	Predictor(s) Included	β	*t* (*df*)	R^2	*p*
1				0.03	
	Condition	0.179	1.98 (119)		**.05**
2				0.07	
	Condition	0.169	1.89 (119)		.06
	Restraint Scale Total	0.194	2.17 (119)		**.03**
3				0.07	
	Condition	.295	1.11 (119)		.27
	Restraint Scale Total	.342	1.12 (119)		.27
	Interaction (Condition by Restraint)	-.204	-.505 (119)		.62

Note: Standardized Coefficients included

As discussed in the introduction, the traditional "priming effect" is contingent upon an *interaction* between the food prime and level of dietary restraint. Overall, for Specific Aim 2, contrary to previous research (Kovacs et al., 2014) and our expected results, we did not find evidence that the food priming effect was reversed in this study. To elaborate, in the present study, participants high in dietary restraint did not eat more food after receiving a tempting food prime, as in traditional food prime research, and they also did not eat less food in the presence of cigarettes, although they tended to delay eating compared with low-restrainers. In sum, the priming effect was completely eliminated in the presence of several real-world options with which to engage (i.e. smoking and utilizing a computer tablet).

Craving. To test our secondary aim, we analyzed the interaction between condition and dietary restraint upon craving continuously with hierarchical linear regression models. We expected to find main effects of dietary restraint, as well as condition, and an interaction between these two predictors upon craving to smoke at three time points: 1. craving immediately after the experimental manipulation of the food prime with the QSU-time 2 measure, 2. craving during the taste test, measured with a VAS scale, and 3. craving immediately after the taste test with the QSU-time 3 measure. Results for each model are displayed in Tables 15 through 17. Overall, no main effects of condition were found, whereas a main effect of dietary restraint was found, but only in the presence of food. Specifically, higher level of dietary restraint was predictive of increased craving during the taste test, $p = .023$. Contrary to our hypothesis, craving at all three time points was not predicted by the interaction of condition and level of dietary restraint (all $p's > .05$).

Additionally, we explored the association of expectancies and craving for cigarettes both at baseline and during the taste test. Craving at baseline was measured with the QSU-time 1 measure, and craving during the taste test was measured with a 100-point Visual Analogue Scale (VAS). Overall, craving and expectancies were highly associated. See Table 18 for results.

Table 15.
Hierarchical Regression of Craving After Experimental Manipulation (QSU-Time 2)

Step	Predictor(s) Included	β	*t* (*df*)	R^2	*p*
1				<.01	
	Condition	-0.05	-.50 (127)		.62
2				.02	
	Condition	-0.57	-.64 (127)		.53
	Restraint	0.15	1.69 (127)		.10
3				.03	
	Condition	-0.33	-1.25 (127)		.22
	Restraint	-0.17	-.56 (127)		.58
	Interaction (Condition by Restraint)	0.45	1.10 (127)		.28

Note: Standardized Coefficients included

Table 16.
Hierarchical Regression of Craving Reported During the Taste Test (VAS)

Step	Predictor(s) Included	β	*t* (*df*)	R^2	*p*
1				<.01	
	Condition	-0.023	-.26 (127)		.78
2				.04	
	Condition	-0.04	-045 (127)		.66
	Restraint	0.20	2.30 (127)		**.02**
3				.06	
	Condition	-0.4	-1.50 (127)		.14
	Restraint	-0.21	-.70 (127)		.49
	Interaction (Condition by Restraint)	0.58	1.43 (127)		.15

Note: Standardized Coefficients included

Table 17.

Hierarchical Regression of Craving After the "Taste Test" (QSU-Time 3)

Step	Predictor(s) Included	β	*t* (*df*)	R^2	*p*
1				.01	
	Condition	-0.10	-1.10 (127)		.27
2				.03	
	Condition	-0.11	-1.22 (127)		.22
	Restraint	0.13	1.51 (127)		.13
3				.04	
	Condition	-0.46	-1.71 (127)		.09
	Restraint	-0.26	-.88 (127)		.38
	Interaction (Condition by Restraint)	0.56	1.38 (127)		.17

Note: Standardized Coefficients included

Exploratory Aims

We had several exploratory aims in addition to the specific and secondary aims discussed above. As we did not find evidence of interactions between condition and dietary restraint upon consumption variables (i.e. smoking, eating, use of the tablet), we did not include additional exploratory variables (i.e. trait level of mindfulness or thin-ideal internalization) into regression models including condition. Rather, we examined linear relationships between those individual variables (trait level mindfulness, and thin-ideal internalization) and our consumption dependent variables.

We examined trait mindfulness with the Five-Facet Mindfulness Questionnaire (FFMQ), from which we included three factors ("acting with awareness," "describing," and "non-judging"), combined into one variable. As a continuous predictor in linear regression analyses, the FFMQ was not associated with any of our consumption outcomes (all *p's* > .20). Next, we performed a median split of the FFMQ (*M* = 83.83; Median = 84) to categorize participants into high vs. low in self-reported mindfulness. We examined relationships between mindfulness, consumption variables, expectancies, dietary restraint, craving, and thin-ideal internalization. The categorical analyses revealed that lower levels of mindfulness were associated with higher levels of: dietary restraint, expectancies for weight-control properties of cigarettes, thin-ideal internalization, and higher levels of baseline craving to smoke.

Table 18.

Simple Linear Regressions of Craving Variables by Expectancy Measures and Subscales

Dependent Variable	Predictor	*B*	*t* (*df*)	R^2	*p*
Baseline Craving (QSU)	SWEET Total Score	.687	4.84 (123)	.110	**<.001**
	SWEET Suppression of Appetite	1.406	2.97 (124)	.067	**.004**
	SWEET Control of Overeating	1.523	4.27 (124)	.129	**<.001**
	SWEET Cope With Body Dissatisfaction	2.014	3.89 (123)	.333	**<.001**
	SWEET Withdrawal Related Appetite Increases	2.012	3.63 (124)	.097	**<.001**
	SCQ Weight Control Total Score	.230	3.13 (124)	.074	**.002**
	SCQ Weight-Related Expectancies	.612	2.54 (124)	.050	**.012**
	SCQ Appetite-Control Expectancies	.533	3.22 (124)	.078	**.002**
	SCQ Distraction from Eating	.663	2.86 (124)	.062	**.005**
	WCSS Total Score	1.003	1.63 (124)	.021	.105
Craving During Taste Test (VAS)	SWEET Total Score	.807	3.92 (126)	.109	**<.001**
	SWEET Suppression of Appetite	1.856	2.79 (127)	.058	**.006**
	SWEET Control of Overeating	1.983	3.89 (127)	.107	**<.001**
	SWEET Cope With Body Dissatisfaction	1.827	2.20 (126)	.044	**.018**
	SWEET Withdrawal Related Appetite Increases	2.229	2.82 (127)	.060	**.006**
	SCQ Weight Control Total Score	.306	2.98 (127)	.066	**.003**
	SCQ Weight-Related Expectancies	.872	2.58 (127)	.050	**.011**
	SCQ Appetite-Control Expectancies	.731	3.16 (127)	.073	**.002**
	SCQ Distraction from Eating	.798	2.453 (127)	.214	**.016**
	WCSS Total Score	1.906	2.26 (127)	.039	**.026**

Note: Unstandardized Coefficients included

Lower levels of trait mindfulness were also marginally predictive of higher total smoking consumption during the taste test (See Table 19). Finally, we examined thin-ideal internalization with the SATAQ-4; internalization was also not predictive of any of the consumption variables (all *p's* > .22).

Associations between smoking, use of the tablet, and eating. In our previous research (Kovacs et al., 2014), we found a negative relationship between smoking and eating behavior. Thus, we planned to conduct correlations between our three behavioral options during the "taste test"- i.e. smoking, eating, and use of the tablet. These correlations are reported in Table 20. As predicted, we found negative relationships between latency to first bite and latency to first puff of a cigarette, indicating that these two behaviors competed for participants' behavioral choices. Latency to first bite and latency to use of the tablet were also negatively correlated. Furthermore, amount of food consumed was negatively associated with desire to smoke during the taste test.

Table 19.

Categorical Analysis of FFMQ Trait Level Mindfulness (M/SD)

Dependent Variable	Low Mindfulness	High Mindfulness	*t(df)*	*p*
Log-Transformed Latency to First Puff	4.44 (1.40)	4.65 (1.51)	-76(115)	.447
Log-Transformed Number of Puffs	2.82 (.56)	2.78 (.39)	.49(100)	.627
Total Cigarette Smoked	.86 (.32)	.75 (.29)	1.93(124)	.056
Log-Transformed Latency to First Bite	3.51 (1.84)	3.26 (2.04)	.70(116)	.487
Log-Transformed Total Food Consumed	3.99 (.60)	3.93 (.62)	.57(123)	.573
Log-Trasformed Latency to Tablet	3.56 (1.87)	3.07 (1.88)	1.40(116)	.163
Restraint Scale (RS) Total Score	18.02 (5.51)	15.00 (5.56)	3.06(124)	**.003**
WCSS Total	3.23 (2.29)	2.52 (1.91)	2.14(124)	**.034**
SCQ Weight Control	30.97 (16.49)	25.91 (17.83)	1.65(124)	.101
SWEET Total	27.38 (8.50)	22.45 (7.82)	3.38(123)	**.001**
SATAQ-4	18.5 (4.10)	14.73 (4.10)	5.09(120)	**.000**
QSU Total (Baseline)	46.0 (13.45)	38.20 (14.86)	3.06(122)	**.003**
VAS Craving to Smoke (During Taste Test)	69.26 (21.30)	65.58 (19.37)	1.02(124)	.312
QSU Time Three (After Taste Test)	23.80 (10.13)	20.57 (12.59)	1.58(124)	.116

Table 20.

Correlations Between Consumption Variables

Variable	1	2	3	4	5	6	7
1. Latency to First Puff	1	-.379**	-.370	-.508**	.026	.018	.084
2. Number of Puffs		1	.620**	.133	-.093	-.111	.147
3. Total Weight Smoked			1	.050	-.119	-.122	.091
4. Latency to First Bite				1	-.302**	-.294**	-.204*
5. Total Calories Consumed					1	.997*	.040
6. Total Food Consumed						1	.033
7. Latency to Tablet							1

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

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

Note: All variables log-transformed except Total Weight Smoked

The order in which participants chose to utilize the three behavioral options during the taste test (i.e. cigarettes, food, and the tablet) was also coded to determine if choice to first option was predicted by either restraint or condition; however, no significant differences emerged (all *p's* > .10).

Additional dietary restraint analyses. We also examined correlations between dietary restraint and several variables. First, restraint was positively correlated with all three measures of expectancies related to weight-control properties of cigarettes (see table 21). We also examined the relationship between dietary restraint and all of our consumption variables (i.e. smoking, eating, and latency to tablet). A negative relationship was found between dietary restraint and latency to first puff, $r(116) = -.222$, $p = .016$, while a positive association was found between restraint and latency to first bite of food, $r(118) = .203$, $p = .026$. No other associations between restraint and consumption were detected (*p's* all > .05). Additionally, we examined the relationship between restraint and the SATAQ-4, our measure of thin-ideal internalization, and we detected a positive relationship, $r(124) = .372$, $p < .001$.

Post-Participation Questionnaire. Finally, we conducted analyses regarding the reasons participants provided for their decisions to smoke, eat, and/or use the tablet during the taste test on a Post-Participation Questionnaire (PPQ). Participants answered multiple choice questions at the conclusion of the study regarding their behaviors after the taste test.

Table 21.

Correlations Between Dietary Restraint and Expectancies

Variable	1	2	3	4
1 SWEET	1	.682**	.722**	.361**
2. SCQ Weight Control		1	.764**	.273**
3. WCSS			1	.317**
4. Restraint Scale				1

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

Using chi-square and Fisher's Exact Test analyses, categorical dietary restraint was entered as a predictor for the following dichotomous (yes/no) variables that evaluated: reasons for smoking during the taste test, including to distract oneself from eating; to control appetite; and to control weight gain after consuming a milkshake; reasons for eating during the taste test including not being able to resist eating, and because of craving a cigarette; reasons for utilizing the tablet during the taste test including to distract oneself from eating, due to craving a cigarette, to control appetite, and to control weight gain after a milkshake. Overall, the cell sizes for each response type were very small, and no significant differences emerged between high versus low dietary restrainers. There were some trends whereby high-restrainers were more likely to endorse that the milkshake was tempting, and that they used the tablet to distract themselves from eating, compared to low-restrainers. See table 22 for a summary of results.

Additional exploratory analyses were conducted between two of our three expectancy measures (the SWEET and the SCQ-A Weight-Control scale) and responses on the PPQ. These expectancy measures were included as predictors of reasons for smoking, eating, and tablet use during the taste test. Both of these expectancy variables were split at their median, to dichotomize participants into high vs. low in their endorsement of expectancies regarding cigarettes' weight, appetite and body-image control properties (SCQ-A Weight-Control Median = 27, SWEET Median = 24).

Table 22.

Post-Participation Questionnaire Responses Predicted by Categorical Level of Dietary Restraint

Dependent Variable	High Restraint Circled yes (*n*)	Low Restraint Circled yes (*n*)	X^2	*df*	*p*
Reason For Smoking					
To Distract from Eating	8	4		1	.30
To Control Appetite	6	2		1	.21
Reason for Eating					
Craved a Cigarette	5	1		1	.16
Could Not Resist Eating	5	4		1	.63
Reason for Using Tablet					
Craved a Cigarette	5	3		1	.47
To Distract from Eating	24	12	2.88	1	.09
To Control Appetite	4	1		1	.25
Perception of Milkshake					
It was Healthy	1	3		1	.22
It was Tempting	18	9		1	.06

In sum, just as with our analysis of high vs. low dietary restraint, each of our cell sizes for endorsement of responses based on participant's grouping into high vs. low expectancies were small. Overall, participants who endorsed high expectancies on the SCQ were more likely to endorse smoking to distract themselves from eating or to control their appetite. They were also more likely to report using the tablet because they craved a cigarette or were attempting to control their appetite. Participants who endorsed high expectancies on the SWEET were more likely to report smoking to distract themselves from eating, and to use the tablet because they craved a cigarette. No other response options related to the perception of the milkshake or reasons for smoking, eating, or using the tablet were significant based on endorsement of expectancies. See Tables 23 and 24 for results.

Finally, we examined multiple choice and open-ended responses regarding participants' perceptions of the milkshake food prime (which applied only to participants in the Prime condition). None of the participants, of the 64 who received the milkshake, endorsed smoking or using the tablet to control weight gain after the milkshake.

Table 23.

Post-Participation Questionnaire Responses Predicted by Categorical Level of SCQ Weight-Control Scale

Dependent Variable	High Expectancies Circled yes (*n*)	Low Expectancies Circled yes (*n*)	X^2	*df*	*p*	ϕ
Reason For Smoking						
To Distract from Eating	10	2		1	**.02**	.208
To Control Appetite	7	1		1	**.04**	.188
Reason for Eating						
Craved a Cigarette	5	1		1	.12	
Could Not Resist Eating	6	3		1	.22	
Reason for Using Tablet						
Craved a Cigarette	7	1		1	**.04**	.187
To Distract from Eating	23	13	3.05	1	.08	
To Control Appetite	5	0		1	**.03**	.197
Perception of Milkshake						
It was Healthy	3	1		1	.53	
It was Tempting	18	9		1	.40	

Table 24.

Post-Participation Questionnaire Responses Predicted by Categorical (High vs. Low) Level of SWEET

Dependent Variable	High Expectancies Circled yes (*n*)	Low Expectancies Circled yes (*n*)	X^2	*df*	*p*	ϕ
Reason For Smoking						
To Distract from Eating	10	2		1	**.03**	.186
To Control Appetite	7	1		1	.06	
Reason for Eating						
Craved a Cigarette	4	2		1	.44	
Could Not Resist Eating	3	6		1	.16	
Reason for Using Tablet						
Craved a Cigarette	8	0		1	**.01**	.236
To Distract from Eating	24	12	2.69	1	.10	
To Control Appetite	4	1		1	.25	
Perception of Milkshake						
It was Healthy	1	3		1	.17	
It was Tempting	18	9		1	.19	

Of the 64 participants who received the milkshake, 47% (*n* = 30) reported that they thought the milkshake was a tempting or unhealthy food, and 28% (*n* = 18) did not endorse that the milkshake was tempting but described it as enjoyable (e.g. with free-responses such as “delicious,” “good,” and “tasty”). Several participants felt the milkshake was “neutral,” that is, neither tempting or healthy (*n* = 9, 14%), and 3 participants reported that they did not like the milkshake (5%). We include a summary table of our main findings from the current study (see Table 25, below).

Table 25.

Summary of Findings

Hypothesis	Primary Findings
Hypothesis 1A: •No prediction of main effects by condition. •Prediction that higher level of dietary restraint would result in greater smoking behavior. •Prediction of interaction between condition and dietary restraint whereby food Prime condition would demonstrate greater smoking, moderated by level of dietary restraint.	• Main effect of condition on smoking behavior on one of three smoking variables (total cigarette weight smoked). Those in the Prime condition smoked more. •Main effect of dietary restraint on one of three smoking variables (latency to first puff). Those higher in dietary restraint had shorter latency to initiate smoking. • No evidence of interactions between condition and dietary restraint for any of our smoking outcomes.
Alternative Hypothesis 1A: • Participants in food Prime condition and higher in dietary restraint, may instead demonstrate shorter latencies to use of the tablet.	• Alternative hypothesis not supported; latency to use of computer tablet was not predicted by condition, dietary restraint or an interaction between these two variables.
Hypothesis 1B: • Main effects of elevated expectancies upon elevated smoking behavior, and interaction between condition and expectancies. Specifically, participants in the Prime group would engage in greater cigarette consumption, moderated by expectancies regarding cigarettes' weight control effects.	• Expectancy total scale scores did not predict smoking outcomes and no interactions between expectancies and condition were found. • When examined by subscale, proximal measures of expectancies (suppression of appetite, control of overeating, and coping with body dissatisfaction) were predictive of increased total cigarette smoked (but not latency to first puff or number of puffs). Distal expectancies (related to weight gain and withdrawal) were not predictive of smoking behavior.
Hypothesis 2A: •Prediction of main effects of condition, with those in the Prime condition consuming less food, as well as an interaction between condition and restraint. Those in the Prime condition, with higher levels of dietary restraint, would avoid food longer, and eat less overall.	• Trending main effect of condition predicted shorter latency to first bite of food but not total food consumed. Those in the prime condition ate faster; this effect was no longer trending when controlling for age. • Main effect of dietary restraint on latency to first bite of food but not total food consumed. Those higher in dietary restraint avoided food longer. • No evidence of interactions between condition and dietary restraint to predict eating behavior outcomes.

Table 25 Cont. **Hypothesis**	**Primary Findings**
Secondary Aim: •Main effects of dietary restraint and condition upon craving to smoke during and after the taste test (High-restrainers and Prime condition would endorse greater craving). •Interaction between dietary restraint and condition to predict craving at three time points.	• No main effects of condition upon craving at any time point in the study (i.e. after manipulation, during the taste test, after the taste test). • Main effect of dietary restraint upon increased craving, only during the taste test. Those higher in restrained eating endorsed higher levels of craving. • No evidence of interactions between condition and dietary restraint for craving at any time point. • Craving at baseline and during the taste test, and expectancy total and subscale scores were highly and positively correlated.
Exploratory Aims:	
1. Mindfulness would be associated with consumption (smoking, eating, tablet) and other variables (e.g. dietary restraint, thin-ideal internalization, craving to smoke).	• Mindfulness not predictive of consumption variables when measured continuously. Dichotomized in a median split, low level of mindfulness was marginally predictive of greater total cigarette smoked, but no other consumption variables. Participants low in mindfulness demonstrated higher levels of dietary restraint, expectancies for weight-control properties of cigarettes, thin-ideal internalization, and baseline craving to smoke.
2. Examination of relationships between consumption variables to determine competing behaviors during the taste test.	• Negative correlations were found between latency to first bite of food and latency to first puff of a cigarette, and between latency to first bite and latency to use of the tablet. Total food consumed was negatively correlated with desire to smoke during the taste test.
3. Exploration of additional relationships with dietary restraint.	• Dietary restraint was positively correlated with expectancies related to weight-control properties of cigarettes, and positively correlated with thin-ideal internalization.
4. Examination of participant responses on Post-Participation Questionnaire (perception of the food prime; reasons for choosing to smoke, eat, and or use the tablet). Examination of expectancies as predictor of reasons for smoking.	• Small cell sizes for responses to Post-Participation Questionnaire. Most participants who received the milkshake food prime described it as tempting, unhealthy, or enjoyable. Trend for those with elevated dietary restraint to be more likely to endorse milkshake as tempting and use of tablet to distract self from eating. •Those with elevated expectancies related to weight control properties of cigarettes more likely to endorse smoking to distract from eating or control appetite, during the taste test. Also more likely to endorse use of tablet due to craving for cigarette or attempt to control appetite.

Discussion

The primary aim of this study was to replicate and extend prior research that indicated female smokers with elevated dietary restraint smoke at higher levels after a disinhibiting food event (Kovacs et al., 2014). Specifically, we aimed to determine whether cigarettes are utilized as a simple distraction technique (as opposed to their use for specific purposes associated with tobacco/nicotine, such as suppression of appetite), by those with elevated dietary restraint. With this aim in mind, we attempted to probe underlying mechanisms in the relationship between dietary restraint and elevated smoking on a momentary basis, by exploring the roles of craving, expectancies, and trait level of mindfulness. Overall, our primary hypotheses were not supported as we did not find evidence of an interaction between dietary restraint and condition upon smoking or eating behavior. However, main effects of dietary restraint upon smoking and food consumption, and several secondary analyses were indicative of interesting outcomes that have the potential to inform development of interventions.

First, high-restrainers demonstrated decreased latency to smoke, and increased latency to eat, indicating both higher levels of motivation to smoke, and to avoid food. Importantly, restraint was not similarly predictive of engagement with an alternative distractor. Second, expectancies about smoking as a weight control mechanism were explored in depth and were related to both craving and total smoking consumption. Taken together, these results indicate that persons with disordered eating habits may in fact prefer cigarettes above other appealing stimuli to suppress their appetite, control overeating, and cope with body dissatisfaction, *as well as* to distract themselves from food intake. To our knowledge, this is the first experimental study that parsed the different contributing aspects of expectancies of smoking related to appetite, weight, body-image, and distractibility from further food intake, in order to predict in-vivo smoking behavior in a laboratory setting.

Primary Findings Related to Smoking and Eating Behavior

As mentioned, we did not find support for an interaction between administration of a tempting food prime and dietary restraint upon either smoking or eating behavior.
Theoretically, failure to detect such interactions between condition and dietary restraint might be explained by the presence of our alternative distractor (i.e. the computer tablet).

We also did not find support for main effects of dietary restraint upon total cigarette consumption. Nonetheless, we found a main effect of dietary restraint upon one aspect of smoking behavior; that is, females who were higher in dietary restraint choose to smoke sooner. This finding is indicative of a higher level of motivation to smoke among these individuals, and is consistent with our prior study of smoking behavior among young adult female smokers (Kovacs et al., 2014). Additionally, dietary restraint was predictive of latency to food intake. Here, high-restrainers waited longer to initiate food intake during the taste test (although, they ultimately did not eat any less than those lower in dietary restraint). Importantly, latency to use the tablet was *not* similarly predicted by dietary restraint. These overall findings associated with latency behavior offer some very preliminary support for our hypothesis that high-restrainers attempt to prevent themselves from food consumption in the moment, by turning to cigarettes, and that they prefer cigarettes to other salient distracting stimuli. This interpretation is somewhat bolstered by our findings related to expectancies, discussed separately below.

Moreover, the traditional priming effect did not occur as prior studies have demonstrated numerous times (e.g. Polivy & Herman, 1991; discussed extensively in Stroebe, 2008), nor was it reversed in the presence of cigarettes, as our prior study found (Kovacs et al, 2014). High-restrainers did demonstrate motivation to avoid food intake, as evinced by their longer latency to first bite of food and shorter latency to smoking. However, despite their apparent motivation to avoid food, high-restrainers were ultimately unable to avoid eating, as they consumed equal amounts of food (in calories), compared with low-restrainers.

To speculate, the computerized tablet may have served as an immediate distracting activity, drawing participants' attention away from cognitive control over eating and smoking behavior. Research

indicates that distracting activities contribute to "mindless eating" (e.g. Ogden et al., 2013), a tendency to eat in an automatic manner, without attention to self-monitoring of food consumption, which leads to overeating (Wansink & Sobal, 2007). Additionally, it is also possible that eating in the presence of distractors is habitual for many individuals (see Wansink et al., 2007 for a review of environmental factors associated with eating behavior). This may explain why we did not detect interactions between condition and dietary restraint upon smoking or eating behavior. Perhaps the "mindless" activity of using the tablet rendered the ability to tune into interoceptive cues of hunger/fullness more difficult among those lower in dietary restraint (e.g. "normal" eaters), and it prevented high-restrainers from achieving sustained focus on their goal to restore dietary restraint in the moment (through use of cigarettes). Paradoxically, restrained eaters may be searching for a distraction from eating, but distraction has been shown to actually induce overeating among restrained eaters (Boon, Stroebe, & Ijntema, 2002). This phenomenon, combined with the robust literature on the priming effect, leads us to speculate that if cigarettes were not present in the current study, restrained eaters would have overate; the presence of cigarettes may have tempered their tendency to overeat after a disinhibiting event, in the presence of the distracting tablet. In the end, we see any effect of the food prime washed away.

Relatedly, attentional control could have been diminished in the presence of this third distracting behavioral option. From this point of view, our findings remain consistent with Restraint Theory. In order to control food intake, one must be able to direct attention and effort toward the goal of food avoidance. High-restrainers do this repeatedly, as they frequently pair smoking with attempts to avoid food consumption; however, attention may have been pulled away from this goal in the presence of the tablet. Perhaps this study mimicked one such real-life scenario in which high-restrainers struggled to focus their attention upon their goal of restraint.

Smoking Expectancies Related to Weight, Appetite, Body-Image, and Distraction

As described, a key purpose of this study was to examine underlying mechanisms for increased smoking behavior in those with disordered eating patterns. Consistent with the results described above related to dietary restraint, we did not detect interactions between condition and expectancies. Still, we

found support for main effects of weight, appetite, body-image and distraction-related expectancies of cigarettes upon craving and smoking behavior.

This additional evidence reinforces the notion that the traditional priming effect was mitigated in the presence of several real-world options with which to engage.

To reiterate, we intentionally measured a wide-range of expectancies regarding cigarette's ability to regulate appetite, weight, and body image, and found that higher expectancies predicted increased total cigarette consumption. We also included two exploratory questions to learn about beliefs of cigarettes' ability to distract from food consumption. These beliefs were similarly found to predict cigarette consumption, as well as craving both at baseline and during the taste test. This indicates that cigarettes' use as a distraction from food intake is part, but certainly not all, of the impetus for higher smoking rates among those with disordered eating.

Of note, one of our three expectancy measures, the WCSS total scale, did not predict any smoking behavior, and neither did the SWEET "withdrawal-related appetite increases" subscale. It seems as though more immediate expectancies related to weight-control properties of cigarettes drive the increased smoking behavior we found. That is, weight-related expectancies, as measured with the WCSS, are more distal in nature and did not predict smoking. However, appetite, body dissatisfaction, and prevention of overeating can all be expected to be immediately impacted by smoking and therefore, endorsement of these expectancies did predict smoking behavior.

Overall, taken with our primary findings, these expectancy results underscore the conclusion that young adult female smokers actually do consider cigarettes a tool to distract themselves from eating, but they also believe there are unique properties associated with cigarettes' ability to control their food intake that make cigarettes more appealing/desirable than another distracting alternative. Therefore, as we hypothesized, cigarettes may not simply be a distracting behavior, and they are associated with strong beliefs about weight and appetite control.

The Role of Craving

Consistent with our primary findings, we did not find the hypothesized interaction between condition and dietary restraint to predict craving at any of the three time points (after the food prime, during the taste test, or after the taste test) for which we expected to find elevated craving among high-restrainers in the Prime condition. Elevated craving was associated with elevated dietary restraint, but only while these participants were in the presence of food, during the taste test. This finding, in conjunction with the positive relationship that craving demonstrated with expectancies in this study, suggests that high-restrainers have potentially come to associate tempting foods with smoking behavior to suppress appetite, distract themselves from eating, and cope with body dissatisfaction; hence, their increased desire to smoke when faced with the decision to eat.

The Role of Mindfulness

It has previously been established that lower levels of mindfulness are associated with elevated craving to smoke (Adams et al., 2013), higher nicotine dependence, withdrawal sensitivity, and lower efficacy about quitting smoking (Vidrine et al., 2009), as well as increased body image disturbances (Adams et al, 2012). It the current study, when participants were categorized into "high" vs. "low" in trait mindfulness, we found lower levels of mindfulness to be associated with elevated dietary restraint and expectancies about cigarettes' weight control properties, as well as thin-ideal internalization. Consistently, lower levels of mindfulness were associated with elevated craving at baseline.

Scoring lower on trait mindfulness also marginally predicted increased cigarette consumption during the taste test. This finding underscores the importance of assessing trait level of mindfulness for young adult female smokers who present for smoking cessation treatment.

Limitations

Several critical limitations to the current study must be addressed. Traditional food priming studies entail providing a tempting food prime and measuring subsequent eating behavior (see Stroebe, 2008 for a list of such studies). In the current study, we significantly altered the traditional food prime paradigm by including only smokers, and by presenting two other behavioral options (i.e. smoking, use of

the tablet) in addition to food. Again, just as in our previous study (Kovacs et al., 2014), we did not include two additional groups to allow us to replicate the traditional priming effect in conditions without cigarettes. Instead, we opted for a simpler design, as prior food priming research has established robust effects across different contexts (e.g. Lattimore & Caswell, 2004; Rogers, & Hill, 1989; Polivy, & Herman, 2010; Heatherton, Polivy, & Herman, 1991). This trade-off in our study design allowed for a more externally valid experience for participants, which mimicked a real-world scenario in which people have many different behavioral options with which to engage.

Second, our primary moderator variables (dietary restraint, craving, and expectancies) were derived from self-report measures. Therefore, participants may have experienced reactivity to questions in these measures. However, we attempted to mitigate any such effects via use of a washout task. Furthermore, the measures we selected demonstrated good to excellent reliability. Third, we lost a small amount of important behavioral data (latency variables) due to problems with several video recordings, as well as some participants' failure to comply with directions. The resulting loss of statistical power may have limited our detection of some other effects. Fourth, our manuscript included a large number of variables and analyses, which ultimately resulted in complex, inconsistent and marginal findings upon many of our dependent variables. However, we conceptualized this initial study as largely exploratory, so replication and more systematic testing of specific hypotheses is needed.

Finally, we had the opportunity to address a limitation of our previous study (Kovacs et al., 2014), by including a post-participation questionnaire that asked participants about their perceptions of the milkshake food prime. Although only 10% of participants who received the milkshake considered it healthy, or reported that they did not like how it tasted, this may be a limitation of our experimental manipulation, since less than half of participants explicitly described the milkshake as tempting. We chose this food prime as previous research has validated that milkshakes are viewed as tempting; in fact one study established that participants rated a vanilla milkshake as one of the top rated "forbidden" foods out of a list of 149 foods (Knight & Boland, 1989). However, this research was conducted several decades

ago. This potential limitation should be considered when designing future priming research (e.g. perhaps there are other foods that are now considered more universally "tempting").

Future Directions

Despite our lack of support for our primary aims, this study contributes to the existing literature on the relationship between smoking and disordered eating, and provides some implications for smoking cessation treatment of individuals with weight concerns. Specifically, our findings regarding the roles of dietary restraint, expectancies, and mindfulness suggest that these variables are determinants of young adult female smokers' decisions about smoking.

Broadly, restrained eaters report smoking for weight control to a greater extent than non-restrained eaters (e.g. McKee, Nhean, Hinson, & Mase, 2006). They also demonstrate increased smoking behavior after receiving a tempting food prime (Kovacs et al., 2014), and the current study found evidence that they continue to experience elevated urge and motivation to smoke even in the presence of an appealing alternative distractor. Unfortunately, disordered eating appears to be a barrier to smoking cessation for some individuals with weight concerns. Furthermore, current clinical guidelines stipulate that smokers should approach smoking cessation first, before attempting to address weight concerns, as concomitant weight control attempts may undermine smoking cessation efforts (as discussed in a recent Cochrane Review; Farley, Hajek, Lycett, & Aveyard, 2012). However, research indicates that when guided by clinicians, and approached in a sequential manner, weight management in the context of smoking cessation is not contraindicated, and in fact can mitigate health risks associated with excessive post-cessation weight gain (Farley et al., 2012; Spring, 2009; Spring et al., 2009; also see Audrain-McGovern, & Benowitz, 2011).

Nonetheless, young adult females may be deterred from smoking cessation attempts unless they are assured that their weight concerns will be addressed. Our findings offer implications for the assessment and treatment of young adult females who present for smoking cessation treatment. First, dietary restraint, expectancies, and mindfulness should be assessed when young adults present for smoking cessation treatment. Secondly, this information should be used to inform tailored interventions.

For example, mindfulness-based treatment approaches (e.g. Acceptance and Commitment Therapy), and psychoeducation to challenge expectancies about the relationship between smoking and weight should be considered in this population during treatment.

Conclusion

This study builds upon previous research (Kovacs et al., 2014) that examined underlying mechanisms for momentary decisions to smoke among young adult female smokers. We specifically aimed to replicate the effect of increased smoking after a tempting food prime, among high-restrainers, while in the presence of an appealing alternative distractor. Overall, our main hypothesized interactions between condition and dietary restraint were not upheld, and several important limitations and inconsistent findings hinder our ability to draw conclusive interpretations regarding our results. Yet, this was the first study that examined choices young adult female smokers made among several real-world behavioral options: to smoke, to eat, and/or to use a smartphone tablet, after receiving a temping food prime. Several main effects of craving, smoking, and eating behavior by restrained eating received support. That is, we found evidence that suggests that even in the presence of an appealing alternative distractor, high-restrainers continue to demonstrate higher craving to smoke, increased motivation to smoke, and increased avoidance of food consumption. Importantly, neither condition, dietary restraint nor an interaction between these variables predicted engagement with our alternative distractor. Essentially, the traditional priming effect was apparently mitigated in the presence of an alternative distractor. Overall, we found partial support for the theory and hypothesis that smoking is preferred above alternative appealing/distracting stimuli as a strategy to avoid food intake, among those with higher levels of dietary restraint. Additional relationships between expectancies, mindfulness, craving and smoking behavior emerged. These relationships provide implications that should inform assessment and treatment approaches for young adult female smokers with weight concerns.

References

Adams, C.E., Apperson, McVay, M., Kinsaul, J., Benitez, L., Vinci, C., Stewart, D.W., & Copeland, A.L. (2012). Unique relationships between facets of mindfulness and eating pathology among female smokers. *Eating Behaviors, 13*, 390-393.

Adams, C.E., Baillie, L.E., & Copeland, A.L. (2011). The Smoking-Related Weight and Eating Episodes Test (SWEET): Development and preliminary validation. *Nicotine and Tobacco Research, 13*, 1123-1131.

Adams, C. E., et al. (2013). "Effects of brief mindfulness instructions on reactions to body image stimuli among female smokers: an experimental study." *Nicotine and Tobacco Research, 15*, 376-384.

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.

Audrain-McGovern, J., & Benowitz, N.L. (2011). Cigarette smoking, nicotine, and body weight. *Clin Pharmacol Ther, 90*, 164-168.

Baer, R.A, Smith, G.T., Hopkins, J., Krietemeyer, J., & Toney, L. (2006). Using self-report assessment methods to explore facets of mindfulness. *Assessment, 13*, 27-45.

Bansal, M.A., Cummings, K.M., Hyland, A., Bauer, J.E., Hastrup, J.L., & Steger, C. (2004). Do smokers want to know more about the cigarettes they smoke? Results from the EDUCATE study. *Nicotine & Tobacco Research, 6*, 289-302.

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

Boon, B., Stroebe, W., Schut, H. & Ijntema, R. (2002), Ironic processes in the eating behaviour of restrained eaters. *British Journal of Health Psychology, 7,* 1–10.

Centers for Disease Control and Prevention- CDC (2015). Current cigarette smoking among adults in the United States. Retrieved December 15, 2015 from: http://www.cdc.gov/tobacco/data_statistics/fact_sheets/adult_data/cig_smoking/

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences (2nd Ed.).* Hillside, NJ: Erlbaum.

Copeland, Brandon, & Quinn (1995). The Smoking Consequences Questionnaire-Adult: Measurement of smoking outcome expectancies of experienced smokers. *Psychological Assessment, 7*, 484-494.

Cox, L.S., Tiffany, S.T., & Christen, A.G. (2001). Evaluation of the brief questionnaire of smoking urges (QSU-brief) in laboratory and clinical settings. *Nicotine and Tobacco Research, 3,* 7-16.

Farley AC, Hajek P, Lycett D, Aveyard P (2012). Interventions for preventing weight gain after smoking cessation. *Cochrane Database of Systematic Reviews Issue 1*.

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*,193-194.

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

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. (1989). Restraint and internal responsiveness: Effects of placebo manipulations of hunger state on eating. *Journal of Abnormal Psychology, 98*, 89-92.

Herman, C.P., & Mack, D. (1975). Restrained and unrestrained eating. *Journal of Personality, 43*(4), 647-660.

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

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

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.

Jamal, A., Homa, D.M, O'Connor, E., Babb, S.D., Caraballo, R.S., Singh, T., et al. (2015). Current cigarette smoking among adults – United States, 2005-2014. *Morbidity and Mortality Weekly Report (MMWR)*. Retrieved December 15, 2015, from: http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6444a2.htm?s_cid=mm6444a2.

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.

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.

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.

Knight, L. J., & Boland, F. J. (1989). Restrained eating: An experimental disentanglement of the disinhibiting variables of perceived calories and food type. *Journal of Abnormal Psychology, 98*, 412–420.

Kovacs, Correa, & Brandon (2014). Smoking as an alternative to eating among restrained eaters: Effect of food prime on young adult female smokers. *Health Psychology, 33*, 1174-1184.

Lattimore, P., & Caswell, N. (2004). Differential effects of active and passive stress on food intake in restrained and unrestrained eaters. *Appetite, 42*, 167-173.

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*, 279-286.

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,*188-196.

Maisto, S.A., Galizio, M., & Connors, G.J. (2011). *Drug use and abuse, sixth edition*. Belmont, CA: Wadsworth, Cengage Learning.

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.

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

Neumark-Sztainer, D., Wall, M., Larson, N.I., Eisenberg, M.E., & Loth, K. (2011). Dieting and disordered eating behaviors from adolescence to young adulthood: Findings from a 10-year longitudinal study. *Journal of the American Dietetic Association, 111*, 1004-1011.

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

Ogden, J., Coop, N., Cousins, C., Crump, R., Field, L., Hughes, S., & Woodger, N. (2013) Distraction, the desire to eat and food intake: Towards an expanded model of mindless eating. *Appetite, 62,* 119- 126.

Polivy, J., & Herman, C. P. (1991). Good and bad dieters: Self-perception and reaction to a dietary challenge. International Journal of Eating Disorders, 10, 91–99.

Polivy, J., Herman, C., & Howard, K. (1988). The restraint scale: Assessment of dieting. In M.Herson, & A.S. Belack (Eds.), *Dictionary of behavioral assessment techniques* (pp. 377-380).

Pomerleau, C. S., and C. L. Kurth. (1996). Willingness of female smokers to tolerate postcessation weight gain. J Subst Abuse 8:371–8.

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.

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*.

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.

Ruderman, A. J., & Grace, P. S. (1988). Bulimics and restrained eaters: a personality comparison. *Addictive Behaviors, 13*, 359-368.

Ruderman, A. J., & Grace, P. S. (1987). Restraint, bulimia, and psychopathology. *Addictive Behaviors, 12*, 249-255.

Schaefer, L.M., Burke, N.L., Thompson, J.K., Dedrick R.F., Heinberg, L.J., Calogero, R.M., et al. (2015). Development and validation of the Sociocultural Attitudes Towards Appearance Questionnaire-4 (SATAQ-4). *Psychological Assessment, 27*, 54-67.

Shiffman, S., Dunbar, M., Kirchner, T, Li, X., Tindle, H., Anderson, S. et al. (2013). Smoker reactivity to cues: Effects on craving and on smoking behavior. *Journal of Abnormal Psychology, 122*, 264-280.

Sin, N.L.Y, & Vartanian (2012). Is counter-regulation among restrained eaters a result of motivated eating? *Appetite, 59*, 488-493.

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.

Spring, B., Howe, D., Berendsen, M., McFadden, H.G., Hitchcock, K., Rademaker, A.W., et al. (2009). Behavioral intervention to promote smoking cessation and prevent weight gain: A systematic review and meta-analysis. *Addiction, 104*, 1472-1486.

Spring, B. (2009). *Smoking cessation with weight gain prevention.* New York, NY: Oxford University Press.

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.

Stice, E., Sysko, R., Roberto, C.A., & Allison, S. (2010). Are dietary restraint scles valid measures of dietary restriction? Additional objective behavioral and biological data suggest not. *Appetite, 54*, 331-339.

Striegel-Moore, R., & Smolak, L.(2001). *Eating disorders: Innovative directions in research and practice*. Washington, D.C.: American Psychological Association.

Stroebe, W. (2008). Restrained eating and the breakdown of self-regulation. In *Dieting, overweight, and obesity: Self-regulation in a food-rich environment* (pp. 115-139). Washington, DC US: American Psychological Association.

Stroebe, W., van Koningsbruggen, G. M., Papies, E. K., & Aarts, H. (2013). Why most dieters fail but some succeed: A goal conflict model of eating behavior. *Psychological Review, 120*, 110-138.

Thompson, J.K., & Stice, E. (2001). Thin-ideal internalization: Mounting evidence for a new risk factor for body-image disturbance and eating pathology. *Current Directions in Psychological Science, 10*, 181-183.

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.

van Strien, T., Herman, C. P., Engels, R. C., Larsen, J. K., & van Leeuwe, J. F. (2007). Construct validation of the Restraint Scale in normal-weight and overweight females. *Appetite, 49*, 109-121.

Vidrine, J.I., Businelle, M.S., Cinciripini, P., Li, Y., Marcus, M.T., Waters, A.J. et al. (2009). Associations of mindfulness with nicotine dependence, withdrawal, and agency. *Subsatnce Abuse, 30*, 318-327.

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

Wansink, B., & Sobal, J. (2007), Mindless eating: The 200 daily food decisions we overlook. *Environment and Behavior*, *39*, 106-23.

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.

Appendices

Appendix A: USF IRB Approval Letter

USF
UNIVERSITY OF
SOUTH FLORIDA

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)974-7091

June 26, 2014

Michelle Kovacs
Psychology
Tampa, FL 33612

RE: **Expedited Approval for Initial Review**
IRB#: Pro00017792
Title: Smoking by Restrained Eaters Following a Food Prime in the Context of an Alternative Distractor

Study Approval Period: 6/19/2014 to 6/19/2015

Dear Ms. Kovacs:

On 6/19/2014, the Institutional Review Board (IRB) reviewed and **APPROVED** the above application and all documents outlined below.

Approved Item(s):
Protocol Document(s):
Protocol Version 1 Kovacs Dissertation

Consent/Assent Document(s)*:
Adult Consent Minimal Risk SOCIAL BEHAVIORAL USF/Moffitt KovacsDissertation.pdf

*Please use only the official IRB stamped informed consent/assent document(s) found under the "Attachments" tab. Please note, these consent/assent document(s) are only valid during the approval period indicated at the top of the form(s).

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:

Appendix A, Continued

(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.

(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.

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