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The Effects of Attention on Consumption in Restrained and Non-Restrained Eaters

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The Effects of Attention on Consumption in Restrained and Non-Restrained Eaters

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for the degree of Bachelor of Science in Psychology from

The College of William and Mary

by

William Benjamin Schreiber

Accepted for _____

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Running head: ATTENTION AND CONSUMPTION IN RESTRAINED EATERS

The Effects of Attention on Consumption in Restrained and Non-Restrained Eaters

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Advisor: Dr. Catherine Forestell

The College of William and Mary

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Abstract

According to the cognitive capacity theory of attention, individuals have only a limited availability of cognitive resources. Previous research has shown that restrained eaters (i.e., those who typically restrict their intake for weight control) expend a considerable amount of cognitive energy regulating their food intake. As a result, they tend to overeat when these cognitive resources are depleted by engaging in a cognitive task because there are fewer resources available to focus on inhibiting food intake. The purpose of the present study was to test this hypothesis to determine whether the difficulty of a task affected restrained eaters' consumption of a palatable food. We exposed restrained (n=30) and non-restrained (n=23) eaters either to a relatively easy or difficult cognitive computer task. As participants responded to the computer task with their dominant hand, they were exposed to a bowl of chocolate which was placed beside the computer within easy reach of their non-dominant hand. Results indicated that restrained eaters ate significantly less than non-restrained eaters in the heavy cognitive load task, whereas in the light cognitive load task the restrained and non-restrained groups ate similar amounts of chocolate. Thus, contrary to the findings of other studies, restrained eaters were able to continue to control their food intake when exposed to a difficult cognitive task. However, in the easy task food intake may have been disinhibited due to feelings of boredom. These results highlight the importance of future research to further assess models that attempt to explain the effects of boredom on eating behavior.

The Effects of Attention on Consumption in Restrained and Non-Restrained Eaters

In a society inundated with virtually limitless food options, maintaining a healthy diet is a constant struggle for many Americans, both physically and psychologically. As a result, dieting is a multi-billion dollar industry catering to a large percentage of the American population, especially women. According to an estimate by Williamson, Serdula, Anda & Levy (1992), 39% of women and 25% of men in the United States are dieting at any given time with the purpose of losing weight. Unfortunately, negative body image and dieting behavior are not limited to the adult population. Research by Grogan and Wainwright (1996) indicates that girls as young as 8 years old experience body dissatisfaction similar to that of adult women, and up to 70% of adolescent girls are dissatisfied with their body size or are dieting at any given time (Contento, Zybert, & Williams, 2005).

Despite the national obsession with dieting, obesity is one of the biggest public health problems the United States faces. According to the Center of Disease Control, more than one third of U.S. adults (i.e., more than 72 million people) are obese. Since 1980, obesity rates for adults have doubled (Centers for Disease Control and Prevention, 2009). The Surgeon General's Call to Action to Prevent and Decrease Overweight and Obesity (U.S. Department of Health and Human Services, 2004) suggested several action steps to help curb the rise of obesity, aiming to balance calories consumed with the number of calories used by the body over the long term. Unfortunately, rather than adopting these lifestyle changes, many people enlist their faith in fad diets that promise fast results. Despite the enormous commercial interest and the vast numbers of people engaged in dieting behavior, many diets fail, even when individuals are provided with ample incentive to lose weight (Garner & Wooley, 1991).

Restrained Eating as a Psychological Variable

Restrained eating, which refers to the conscious effort to restrict intake of certain types and amounts of foods in order avoid weight gain (Lowe & Kral, 2005), was first investigated as a psychological variable by Herman and Polivy (1975). This study pioneered the idea that the mental processes inherent in restrictive eating may explain why some people are motivated to control their food intake despite the fact that they do not have a weight problem. According to the boundary model of restrained eating, both physiological and psychological factors play a role in driving restrained eating (Herman & Polivy, 1983). Because restrained eaters impose cognitive rules to limit their caloric intake, they eventually become less sensitive to their body's hunger and satiety cues. Therefore, although their body may be in need of calories, their food intake will be driven by their cognitions about the caloric and fat content of the food available.

There are many conditions under which the psychological state necessary for maintaining restrained eating can be destabilized. Triggers of overeating are referred to as disinhibitors because they undermine the individual's ability to continue to inhibit their food intake. One example of this is imposed food consumption (i.e., exposure to a preload of food). Herman and Mack (1975) demonstrated that restrained eaters consumed more food after drinking milkshakes than they did if they had not eaten anything prior. This phenomenon, known as "counterregulatory eating", appears to occur only with good tasting food (Woody *et al.*, 1981). These findings suggest that there is an emotional basis to dietary disinhibition where desire may supersede the restrained eaters' physiological responses. Research has shown that women tend to be more vulnerable to emotional eating than men (Larsen, Strien, Eisinga, & Engels, 2006) and possess a greater desire for forbidden foods linked to guilt, anxiety, and depression (Fletcher, Pine, Woodbridge, & Nash, 2007). Moreover, laboratory research has suggested that when restrained eaters experience strong negative emotions, they may be at increased risk for binge-eating episodes because they become temporarily incapable of maintaining strict dietary self-

control (Schotte, Cools, & McNally, 1990). Schotte *et al.* (1990) demonstrated that restrained eaters ate more popcorn during exposure to a horror film than a neutral film, suggesting the negative affect induced by the frightening condition was a cause of dietary disinhibition. In addition to dysphoric mood, negative affect and consumption of alcohol are also implicated in dietary disinhibition in restrained eaters (Herman & Mack, 1975; Heatherton, Herman and Polivy, 1983; Polivy & Herman, 1991; Polivy, Heatherton, & Herman, 1988; Polivy, 1976; Polivy, Herman, & McFarlane, 1994).

Because one of the distinguishing factors of restrained eating is that it requires focus and willpower to limit food intake, another possible condition which might induce disinhibited eating is distraction. According to the Cognitive Capacity Theory of Attention, restrained eaters' ability to successfully allocate sufficient attention to limiting their food intake may depend on the presence of other factors in their environment.

Cognitive Capacity Theory of Attention and Ironic Processes

According to some cognitive theorists, attention is a limited resource and is allocated according to the demands of a situation (e.g. Kahneman, 1973; Norman & Bobrow, 1975; Wickens, 1984). This has become known as the "capacity theory" in cognitive psychology, and it suggests that human beings are limited in the amount of attention they can devote to any one task based on the presence of other factors that demand their attention. For example, given two sources of cognitive stimulation in the environment, it is only possible for an individual to attend to each with a fraction of the attention that might have otherwise been devoted to either stimulus individually. Thus, it is impossible to attend to either stimulus in its entirety without in some way being affected by the other. Strangely enough, the fixed capacity of the human mind can sometimes cause people to behave in opposition to their intentions, a phenomenon described as "ironic processes" (Wegner, 1994). In the case of restrained eating, individuals need to be aware

of their personal goals and standards for consumption (i.e., their diet) while self-monitoring their food intake (Baumeister, Heatherton, & Tice, 1994). Therefore, when people are exposed to distractions, they cease to be self-aware and fail to monitor intake, thereby increasing the probability of disinhibited eating.

According to Wegner's Ironic Process Theory (1994), an individual's deliberate attempt to suppress or avoid certain thoughts can cause these thoughts to become more persistent. This theory contends that whenever we attempt to intentionally regulate or suppress our thoughts, an operating process that directs conscious attention is initiated. For example, restrained eaters may try to avoid thinking about food in order to suppress their intake. These operating processes are accompanied by an ironic monitoring process that looks for the failure of or weaknesses in intention. These two processes compete for mental capacity (Navon & Gopher, 1979), and because the operating processes require more cognitive effort, they are more easily undermined than the ironic monitoring processes. In other words, the struggle for cognitive capacity is not necessarily fair. While there is competition between different mental processes for the limited cognitive resources, the high-demand operational processes are the most fragile and the first to suffer. Disinhibited eating in restrained eaters fits this model because limiting food intake demands high levels of mental control. For restrained eaters, operational processes might involve looking for other thoughts to distract them from food, while ironic monitoring processes focus attention on food stimuli. Thus, when restrained eaters are placed under situations where stimuli compete for attention, their most demanding processes (food regulation) are the first to suffer. This, in turn, leads to the expression of counterproductive behaviors (such as unhealthy eating habits).

In a study designed to address this issue, Ward and Mann (2000) administered a "high" and "low" cognitive load to restrained and non-restrained eaters in a laboratory experiment. In the high cognitive load, participants were asked to remember a set of art slides that were

presented, while at the same time responding to an auditory stimulus as quickly as possible. In the low cognitive task, they were simply asked to respond to the auditory stimulus. Throughout the task, both groups were exposed to Doritos chips, M&M's candies, and chocolate chip cookies. They found that restrained eaters ate more in the high cognitive load condition than in the low cognitive load condition, whereas non-restrained eaters did the opposite. The authors attributed the differences in consumption observed in the high cognitive load condition to disinhibited eating in the restrained eaters. This presumably occurred because the restrained eaters were focusing on the task rather than monitoring their eating behavior.

A similar pattern of results were found by Boon *et al.* (2002) in a study where participants engaged in a "taste-test" of ice cream while counting the instances of animal words in a radio conversation or sitting in silence. In addition to manipulating cognitive load, Boon *et al.* also manipulated the participants' beliefs about the caloric content of the ice cream. To do this, they told half of the participants that the ice cream was made by a special company with 30% fewer calories than normal ice-cream. Similar to Ward and Mann (2000), they found that restrained eaters in the high calorie condition ate more than non-restrained eaters while distracted. There were, however, no significant differences between restrained and unrestrained eaters while not distracted. Moreover, no significant differences between restraint groups was observed in the low calorie condition, suggesting that foods that are not perceived as "dangerous" to restrained eaters do not illicit the ironic effects of dietary restraint.

Current Study

As we can see, current research proposes that restrained eaters use attention processes that non-restrained eaters do not to regulate their food intake. These processes should function less effectively if they are executed in the presence of a heavy cognitive load task. The purpose of the present study was to further test this theory in the context of heavy and light cognitive load

computer tasks that were matched in the type and number of stimuli presented. By recording participants' response times throughout the tasks, we were able to make detailed observations not only on patterns food consumption, but performance throughout the heavy and light cognitive load exercises. These additional measures allowed us a better understanding of the manner in which participants' attention was allocated over the course of the task, and assessment of whether the cognitive load was indeed garnering attention from restrained eaters' food regulation as we expected. Additionally, we measured the mood of the participants before and after the task to determine if variations in emotional state mediated the relationship between cognitive load and food consumption.

We hypothesized that in a heavy cognitive load task, women who were restrained eaters would eat more food than they would during the light cognitive load. In the light cognitive load, we expected to see the opposite effect: restrained eaters would eat significantly less than non-restrained eaters. Thus, we did not expect to see any significant differences between the amounts of food consumed by non-restrained eaters in either the light or heavy cognitive load tasks, as non-restrained eaters are not prone to employ the same cognitive restraints on food intake present in dieters.

Methods

Participants. Our sample of N = 61 females, mean age 19.26 (±0.54), came from the population of the introductory psychology classes at the College of William & Mary and from the general university population. All participants were scheduled to be tested in the early afternoon and were instructed to refrain from eating for at least two hours prior to the experiment. They were told that the purpose of this experiment was to test the effect of sweet taste on reaction time. All participants either received a small monetary sum ($10) or earned credit towards their introductory psychology course for participation in the study. All

experimental procedures were approved by the Protection of Human Subjects Committee at the

College of William & Mary and informed consent was obtained from each participant.

Apparatus

Computer Task. The cognitive load task in this study was programmed using SuperLab®

4.0 (Cedrus Corporation, 2010) stimulus presentation software. There were two designations of

cognitive load in this study, "light" and "heavy". The "light" cognitive load consisted of random

white letters appearing in the center a black screen at 1-second intervals. Participants sat at a

computer with a plastic touchpad containing four rectangular buttons colored red, blue, green,

and yellow, with a smaller white circular button in the center. Participants were instructed to hit

the white button whenever they saw an "X" appear in the sequence of letters. The "heavy"

cognitive load consisted of different colored letters appearing in various positions across the

screen. In this condition, participants were instructed to hit the color of the letter that

immediately preceded the presentation of an "X" on their response pad, using the colored

buttons. Both tasks lasted approximately 21 minutes, and included 1192 stimuli, 200 of which

were an "X" and demanded a response.

Chocolate. The chocolate used in this study was Cadbury™ brand milk chocolate bars.

Each serving consisted of one bar, broken into 18 equal-sized pieces weighing 150g total.

Questionnaires. All participants completed a demographic questionnaire to determine

their age, and race/ethnicity (Appendix A). Additionally, the current mood state of all of the

participants was measured in the present study to check for mood differences between restrained

and non-restrained eaters and to determine whether participants' mood was related to their

chocolate consumption. To measure mood, we asked participants to complete the Positive Affect

and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988), which is a Likert

scale designed to measure positive and negative affect before and after the computer task (see

Appendix B). Additionally, visual analogue scales which asked for participants to indicate their feelings of alertness, stress, hunger, and chocolate-liking, as well as how easy, boring and pleasant the computer task was. Each scale was 103 mm long and was anchored by descriptors such as "very easy" and "very difficult" for questions such as "How would you rate the computer task?" (see Appendix C).

The participants were also asked to complete modified version of the Three-Factor Eating Questionnaire (TFEQ; Stunkard & Messick, 1984). This is a standardized questionnaire used for assessing restraint, disinhibition and hunger. For the purposes of this experiment, participants completed questions that were pertinent only to restrained eating (see Appendix D).

Procedure

Participants were randomly assigned to either a light or heavy cognitive load condition prior to their arrival at the lab. Upon arrival, each participant signed an informed consent form and proceeded to fill out the demographic and the PANAS questionnaires. Before beginning the computer task, the participants were asked to report what they had eaten most recently and how long it had been since they ate this food and their height and weight were measured by the experimenter. Participants were instructed to eat a piece of chocolate and then fill out several scales indicating their levels of attentiveness and hunger. They were then briefed on the instructions for computer task and told they could consume as much or as little chocolate during the course of the experiment as they wanted. The researcher then left the laboratory for 15 minutes, returning with approximately 5 minutes remaining on the computer task.

After the task was complete, participants were then instructed to eat another piece of chocolate and rate it again. They were also asked to rate how difficult they perceived the computer task to be. Participants filled out a second copy of the PANAS to determine whether their mood had changed over the course of the experiment. Once the PANAS was complete,

participants were administered the modified TFEQ. Upon completion of the final questionnaire, the participant was questioned as to whether or not they knew the true purpose behind the experiment, following which they were debriefed and dismissed from the testing area.

Results

Participant Characteristics

At the beginning of the experimental session, 8 of the 61 participants indicated that they disliked chocolate on the visual analogue scale (i.e., scored less than 52 on the 103 mm scale). As a result, these participants were excluded from all subsequent data analyses. The remaining 53 participants consisted of 74% White, 9 % Asian, 7% Black, 4% Hispanic, and 6% mixed (more than one race/ethnicity) women who were on average 18.68 ($\pm$0.17) years old and had a BMI of 22.21 ($\pm$ 0.67).

These participants were divided into restrained and non-restrained groups based on research by Stunkard and Messick (1984), who found an overall mean restraint score of 10 for the restraint portion of the TFEQ for all participants. Therefore, those who scored 10 or above were designated as "restrained eaters", while those who scored less than 10 were classified as "non-restrained eaters". Of the 30 restrained eaters, 12 were randomly assigned to the heavy cognitive load alongside 14 of the 23 non-restrained eaters.

As shown in Table 1, the mean restraint scores for the restrained eaters were significantly higher than those of non-restrained eaters ($t(51) = 11.3$, $p < 0.001$) and were in line with those originally reported by Stunkard and Messick (1984). Independent samples t-tests failed to find group differences in BMI, chocolate liking, alertness, or positive and negative affect between the restrained and non-restrained eaters, all $p > 0.05$ (see Table 1). There were no significant differences between the restraint groups for racial/ethnic background, indicating that no one ethnic group in our sample was more or less disposed to restrained or non-restrained eating.

However, there was a marginally significant difference in the amount of time since the restrained and non-restrained eaters last ate ($t(51) = 1.837$, $p = 0.072$).

Chocolate Consumption

To determine whether restrained and non-restrained eaters differed in their chocolate consumption as a function of the computer task, a univariate Analysis of Covariance (ANCOVA) was conducted, using cognitive load (heavy *vs.* light) and restraint group (restrained *vs.* non-restrained) as independent variables. The total amount of chocolate consumed was the dependent variable, and hunger levels reported before the task was used as a covariate. This analyses revealed a main effect of restraint group ($F(1, 48) = 5.19$, $p < 0.03$), with restrained eaters consuming less chocolate overall than non-restrained eaters. Although there was not a significant cognitive load x restraint group interaction ($F(1, 48) = 2.17$, $p = .148$), planned comparisons were conducted in which we assessed whether the restraint groups differed in their chocolate consumption in the heavy and light cognitive loads, respectively (see Figure 1). These analyses indicated that restrained eaters who were in the heavy cognitive load condition ate significantly less than the non-restrained eaters ($t(24) = -2.26$, $p < 0.05$). However, there was no difference between the restraint groups in the light cognitive load, $p > 0.05$.

Mood

In addition to measuring chocolate intake, we also measured participants' positive and negative mood states before and after the computer task to determine whether restrained and non-restrained eaters were differentially affected by the experimental paradigm. A series of mixed univariate ANOVAs, which included restraint group as a between-subjects independent variable and time (before or after the task) as a within-subjects variable, were conducted on the positive and negative moods measures from the PANAS questionnaire. Additionally, stress,

hunger, and alertness were measured before and after the task. These analyses revealed that there was a significant decrease in participants' scores on the PANAS questionnaire for both positive affect ($F(1, 49) = 23.82$, $p < 0.001$), and negative affect ($F(1, 49) = 5.20$, $p < 0.03$), indicating that after the task, participants experienced less emotional affect regardless of their restrained eating status. Participants also felt significantly less alert after the task ($F(1,49) = 3.95$, $p = 0.05$), and all participants labeled themselves as significantly less hungry after the task ($F(1,49) = 9.20$, $p < 0.01$).

Reaction Time Data

The reaction times were divided into ten blocks of twenty responses each. To determine whether restrained and non-restrained eaters' response times differed in the heavy and light cognitive load tasks, we used a repeated measure ANOVA with the independent variables of restraint group and cognitive load and the dependent variable of response time. As shown in Figure 2, these analyses revealed a main effect of experimental block on response time ($F(9, 441) = 5.76$, $p < 0.001$), indicating an overall decrease in response times for participants. There was also a significant main effect for group on reaction time ($F(1, 49) = 331.21$, $p < 0.001$), with responses in the light condition being shorter overall than those in the heavy condition. These findings were consistent with those from the analogue questionnaire in which participants in the heavy cognitive load rated the task as more difficult than those in the light cognitive load ($F(1,49) = 81.0$, $p < 0.01$) and those in the light cognitive load indicated that the task was more boring than those in the heavy cognitive load ($F(1, 49) = 10.45$, $p < 0.005$). These main effects were qualified by a significant experimental block x group interaction ($F(9, 441) = 13.82$, $p < 0.001$). Simple main effects analyses indicated that although reaction times decreased significantly over the course of the test trial for this who participated in the heavy cognitive load

task ($F(9, 225) = 9.92$, $p < 0.001$), there was an increase in reaction times for those who

participated in the light cognitive load task ($F(9,234) = 9.03$, $p < 0.001$).

Discussion

Based on previous research which showed that restrained eaters tend to disinhibit their

food intake when they are distracted (Boon *et al.*, 2002, Ward & Mann, 2000), we hypothesized

that relative to non-restrained eaters, restrained eaters in the current study would consume more

chocolate while engaging in a heavy cognitive load task. Contrary to our predictions, restrained

eaters in the present study ate significantly less chocolate during the heavy cognitive load than

non-restrained eaters, whereas in the light cognitive load, both restraint groups ate similar

amounts of chocolate.

If we consider the participants in the heavy cognitive load first, it appears that we

underestimated the ability of the restrained eaters to ignore the chocolate stimulus. There is

research to suggest that restrained eaters may exhibit attenuated physiological responses to food

stimuli under certain conditions. Kemmotsu and Murphy (2006) used olfactory event-related

potentials (OERPs) to demonstrate a significant difference in brain responses to the smell of

chocolate between restrained eaters and controls. In an experimental paradigm in which they

were asked to either attend to or ignore the presence of chocolate, they found that restrained

eaters in both conditions exhibited smaller OERPs than controls to food odors, suggesting

abnormal cognitive suppression to food odors in restrained eaters. Likewise, similar research

done by Piacentini *et al.* (1993) showed decreased skin conductance to food odors in restrained

eaters compared to non-restrained eaters. Kemmotsu and Murphy suggested that perhaps the

restrained eaters in their study were low in disinhibition and thus had learned to use techniques,

either consciously or unconsciously, to suppress thoughts about and attention to the food stimuli,

which would allow them to continue to restrict their food intake in the face of significant distracters. These findings have been supported by research done by Oliver and Huon (2001), which showed that low dishinhibitors were better at suppressing thoughts about food and eating. These combined studies suggest that restrained eaters learn ways to block food stimuli without giving way to the ironic processes we predicted would cause them to disinhibit. Whether restrainers' overall level of disinhibition explains our present results is a topic for future research, as disinhibition was not a measure included in the present experiment.

In order to understand why our findings are in direct opposition to those currently reported in the literature (Boon *et al.*, 2002, Ward & Mann, 2000), we will examine some of the differences between their studies and ours. The first and most profound difference between our study and that of Ward and Mann is the nature of our cognitive load stimuli. In Ward and Mann's study, participants in the heavy cognitive load condition were instructed to memorize art slides in conjunction with responding to an auditory cue with a foot-pad, allowing their hands to be completely free for the duration of the test session. In the light cognitive load condition, the participants simply responded to the auditory cues and had no visual cues to which they were asked to attend. While the heavy cognitive load tasks employed in Ward and Mann and the present study primarily engaged visual sensations (i.e., art slides and letter sequences), Ward and Mann's task differed from ours in that it additionally required responses to an auditory stimulus. Because our participants had to both attend and respond to the letter stimuli in both conditions, we avoided the possibility that they would selectively ignore the stimulus to which they were asked to attend (i.e., the art slides in Ward & Mann) and instead focus exclusively on the stimulus that demanded a response (i.e., the auditory cue). This ensured that there were processing differences between the heavy and light cognitive loads in our study. Moreover, our task required participants to use their hand to respond to the stimuli, and it is possible that having their hands occupied with the computer task may have led to decreased eating behavior.

Therefore, in comparison to Ward and Mann, it is possible that as the task progressed our participants became engaged to the point that they eventually forgot about the food. Although it is possible that our experimental design attenuated intake, the amount of chocolate participants consumed was still well above floor (25-30 g). Thus, most of the intake may have occurred at the beginning of the heavy cognitive load, when participants were not as engaged in the task. Future research could address this possibility by videotaping the participants to analyze patterns of eating behavior throughout the task.

Another study structured similar to ours conducted by Boon *et al.* (2002) found that restrained eaters ate more ice cream than non-restrained eaters while distracted. In this study, participants were instructed to consume ice cream as they either attended to a radio conversation (distracted) and write down instances in which an animal word was mentioned in the conversation, or sat in silence (not distracted). Thus, Boon *et al.*'s task, like Ward and Mann, involved audition as a response-based stimulus as opposed to a visually-based stimulus, the implications of which have already been discussed. Because participants were told to count the number of animal words occurring in the radio conversation, it is also unlikely that their hands were engaged in a similar manner to ours, leaving them free to consume the chocolate.

Compared to Boon *et al*. (2002), our tasks differed in the amount of attention required on a per-second basis. The act of listening to a conversation for key words is less demanding than paying attention and responding to rapidly presented visual stimuli. While the Boon *et al.*'s task demands that participants acknowledge a stimulus that occurs in the course of conversation, our task demands a quick and accurate response that is based on information that is re-evaluated in working memory on a second-by-second basis. Citing Wegner (1994), Boon *et al.* claimed that the operant process of restrictive eating would be undermined in their distracting situation, implicating simple distraction as an adequate form of cognitive load. In both Boon *et al.* and Ward and Mann (2000), "cognitive load" was manipulated by simply including the presence of

an additional stimulus in the "distracting" condition, rather than varying stimuli of different intensities to induce different cognitive loads.

Rather than use a control condition with no stimulation at all, we elected to use a condition which we considered to be significantly less difficult than the heavy cognitive load task, which was confirmed to be correct by a combination of self-reports and reaction time data. It should be noted that neither Ward and Mann (2000) nor Boon *et al*. (2002) tested the validity of their tasks. Therefore, it is difficult to say with any certainty the degree to which participants in these studies were paying attention to the distracter cues, as the authors did not assess the accuracy of the participants' responses. Without such measures, it is impossible to say for sure whether the heavy cognitive load task held attention over the course of the experiment, nor can there be established any sense of relative difficulty between the manipulation and control conditions.

In our experiment, participants' reaction times indicated that although our heavy and light cognitive load tasks were both engaging throughout the course of the experiment and they required different levels of cognitive processing, which helps to legitimize our manipulation. First, there was a distinct and statistically significant downward slope in reaction times that occurred for the participants overall in the heavy cognitive load. This suggests that participants were paying attention to the task and improving their performance. Thus, the task was indeed stimulating enough to engage and hold the attention of the participants, such that they could improve over the course of the experiment. Secondly, the response times of the participants in the heavy cognitive load were significantly longer than those in the light cognitive load. In other words, participants in the heavy cognitive load required more mental processing than those in the light cognitive load, as indicated by slower reaction times. These finding were confirmed by the reported task difficulty in the visual analogue questionnaires, in which participants in the heavy cognitive load rated the task as more difficult than those in the light cognitive load. Because of

these findings, we are confident in the legitimacy of our manipulation and our data's implication

that even on the subconscious level, dietary restraint may indeed be strong enough an influence

to thwart the ironic processes described by Wegner (1994) that would lead to disinhibition.

Future research would be well-suited to contain similar confirmations to ensure the experimental

validity of their tasks.

Another significant difference between our study and others (Boon *et al*., 2002; Ward &

Mann, 2000) was the type of food used. While we offered our participants only one food option

(Cadbury™ brand milk chocolate bars), Ward and Mann used a variety of different foods

(Doritos, M&M's, and chocolate-chip cookies) and Boon *et al*. used three different flavors of ice

cream (strawberry, chocolate, and vanilla). For the purposes of their studies, this appears

advantageous in that it allowed participants with a severe dislike of any one particular food the

option of consuming another more favorable option. In our study, participants who did not like

chocolate had to be excluded on the grounds that their personal inclinations towards our

dependent variable undermined the true purpose of the experiment. However, using chocolate

bars exclusively in our study was a decision reached based on previous research suggesting that

chocolate was the best candidate to observe disinhibited eating. Wansick *et al.* (2003) discovered

that chocolate appears to be a preferable and comforting food for women, even though it induces

feelings of guilt. Other research which presented female dieters and non-dieters with either

chocolate stimuli or non-food stimuli found that dieting women scored higher on chocolate

craving questionnaires following the presentation of chocolate stimuli, suggesting that

presentation of forbidden foods leads to cravings for these foods in dieters (Fletcher *et al.*, 2007).

The combined results of these studies allowed us to reasonably suspect that dietary disinhibition

would reliably dispose dieting women to consume chocolate, based on their desire-oriented

eating patterns and emotions. Thus, having chocolate as the only food stimulus precluded the

possibility of overall consumption being affected by the presence of other foods for which the motives behind consumption have not been as thoroughly investigated in the literature.

Alternatively, it is possible that the variety of food stimuli presented in the previous studies differentially affected the amount of total food consumed by restrained and non-restrained eaters. Research has indicated that satiety can be specific to foods that have already been eaten (Rolls, Rolls, Rowe, & Sweeny, 1981). This phenomenon, referred to as sensory specific satiety, refers to a temporary decline in pleasure derived from consuming a certain food in comparison to other unconsumed foods. Because our experiment involved using a single food stimulus, participants may have experienced sensory specific satiety for the chocolate as the task progressed. Differences between restrained and non-restrained eaters' responsiveness to sensory specific satiety might have contributed to differences in consumption of the chocolate. However, although very little is known about the nature of the relationship between dietary restraint and responsiveness to sensory-specific satiety, two studies (Mok, 2010; Tepper, 1992) have shown that restrained and non-restrained eaters tend to display the same sensitivity to sensory-specific satiety.

There were a few additional small differences between our study and previous studies. One distinction between Boon *et al*. (2002) and our research was the time at which participants were weighed. In Boon *et al.,* participants were weighed and measured immediately before debriefing, whereas in our study all participants had their height and weight taken before the cognitive load task. This was done in hopes that raising awareness of their weight would prime restrained eaters to be cognizant of their restrained eating practices. One final difference between our task and that of Boon *et al.* and Ward and Mann (2000) was length. Whereas our task was 20 minutes long, the tasks in the other studies were 15 minutes long (Boon *et al*.) or less (i.e., 10 minutes long in Ward and Mann). The length of our tasks was meant to allow participants ample time to eat as much chocolate as they would like, fearing that only administering a 10-minute

long task would result in small and immeasurable amounts of chocolate consumption. One of the effects of having a longer task was, however, that there were measurable levels of boredom that became evident in the light cognitive load.

In this condition, we saw no significant difference between chocolate consumed between restrained and non-restrained eaters, which was inconsistent with our predictions that there would be significantly less chocolate consumed by restrained eaters. Our hypothesis was made under the assumption that only in the light cognitive load would restrained eaters be granted full use of their cognitive faculties to inhibit their eating behavior, and ironic processes would not have a chance to express themselves. However this hypothesis was also issued under the assumption that we would see similar trends in reaction time data as we saw in the heavy cognitive load condition (with reaction times decreasing over experimental blocks). On the contrary, we found an opposite effect for restrained and non-restrained eaters in the light cognitive load: reaction times increased over the course of the experiment, suggesting that as the task progressed participants were paying less attention. This, combined with the results from the self-report analogue scales, indicate the presence of boredom, a variable we had not planned to measure.

Based on these findings for the light cognitive load, it is possible that boredom caused restrained eaters to disinhibit their eating behavior so that they consumed similar amounts of food as the non-restrained eaters. Relatively little research has looked at the relationship between boredom and eating behavior, which is especially surprising given that people anecdotally complain that they eat more when they're bored. Abramson and Stinson (1977) conducted research to investigate whether obese and non-obese participants' eating behaviors differed when bored, finding that all participants consumed more food when they performed a boring task compared to an interesting task, regardless of their BMI. Although restrained eating is not the equivalent to obesity, these results support the theory that boredom may indeed be responsible

for increases in chocolate consumption in restrained eaters. That is, perhaps restrained eaters in the light cognitive load ate to satiety, just like the non-restrained eaters. Therefore, boredom may have incurred the ironic processes of disinhibition we suspected distraction would.

Research by Finkelstein (2003) highlights the development of food as a form of entertainment, suggesting that eating may serve as an escape from the unpleasantness of boredom. This lends support to the model of eating as an operational response to dealing with boredom; participants were able to thwart increases in negative affect that would have come from being bored by occupying themselves with chocolate consumption. However, these self-correcting processes of mood control were examined by Wegner (1994), who claimed that monitoring mood during a distracting mental task (in his case, rehearsing a number) often lead to the expression of the opposite mood in the participant. Thus, in an effort to sustain a positive mood in the boring condition by consuming chocolate, the ironic processes predicted by Wegner may account for the overall decreases in positive affect displayed in our results. Further research is necessary to adequately explain the effects of boredom on eating behavior.

Directions for Future Research

Although there were differences between the tasks in the amount of boredom induced in the participants, no other task related differences in mood were observed. Instead, lower levels of positive and negative affect were found following both heavy and light cognitive load conditions. This "affective-numbing" is significant because it indicates that our tasks did not incur emotional arousal, either positive or negative, that may have affected chocolate consumption. Ward and Mann (2000) were able to illustrate their tasks were rated by participants as more relaxing than stressful, allowing the authors to claim that the load, not stress, was responsible for restrained eaters disinhibition in their study. Research by Lattimore and Maxwell (2004) sought to measure whether an ego-threatening cognitive distraction would cause restrained eaters to eat more than

unrestrained eaters. They found that restrained eaters consumed more snack food when the heavy cognitive load was ego-threatening, indicating that the affective nature of a particular task can have a profound influence on resultant eating behavior. The fact that participants did not indicate any significant increase in emotional arousal after the task lends validity to our findings insofar as they truly reflected cognitive load, not emotional affect.

Although our design had many strengths compared to those previously conducted, one limitation of our study was the composition and size of our sample. A vast majority of our sample was taken from the Introductory Psychology Classes as the College of William & Mary. Time constraints and a desire to maintain control of the experiment by having the same researcher run every participant individually only allowed us to acquire a sample of 61 students overall, 8 of which had to be excluded because of their severe dislike of chocolate. Of those, an overwhelmingly large portion of these students were white (74%), fairly consistent with the demographics of the institution itself. We failed to find differences in the ethnic breakdown of restrained and non-restrained eaters. This finding was advantageous for the purposes of this study, which was to measure the effects of attention rather than ethnicity on food consumption. However, there is justifiable skepticism that our population was truly representative of the United States population as a whole.

Research has shown that citizens of different races and ethnicities vary greatly in their disposition to restrained eating. Stevens, Kumanyika, & Keil (1994) found that compared to overweight White women, overweight Black women were less likely to feel guilty after overeating, consider themselves overweight, or diet. Overweight Black women were also more likely to be satisfied with their weight and consider themselves attractive. This research suggests that Black women are considerably less disposed towards restrained eating given that they are less likely to recognize the threat of being overweight as a problem, as we see in restrained eaters. Further research done by Story *et al.*(1995) found that Black and American Indians show

higher levels of body satisfaction compared to White women. This research also confirmed that, contrary to popular belief, weight control behaviors are not limited to high socioeconomic status White women, indicating higher uses of diuretics in Hispanics, binge eating in Asians, and vomiting in Blacks when compared to Whites. These studies indicate that there are a number of sociological variables that cause women of different ethnic and racial groups to diet which are not clearly indicated in our data. So, while our results may be pertinent to the interaction of cognitive processes in white, young adolescent women, to apply these findings on a broader scale would require a sample with more ethnic diversity to be representative sample of the U.S. population as a whole, as well as a wider range of socioeconomic groups. Future research would benefit from a sample that contains greater socioeconomic, racial, and ethnic diversity, allowing it to indicate patterns of restrained eating among different demographics consistent with previous research.

Concluding Thoughts

Recognizing the importance of psychological variables in dieting by investigating the phenomenon of restrained eating has wide-reaching implications for the millions of women in the United States who struggle with maladaptive eating behaviors. Independent of the obesity epidemic that manifests itself presently in the United States, restrained eating has vast psychological implications for women of all ages, including guilt and depression associated with cravings for forbidden food (Fletcher *et al.*, 2007; Macht & Mueller, 2007). This study also highlights the relatively uninvestigated phenomenon of whether boredom can lead to disinhibited food consumption in restrained eaters. This line of inquiry holds profound implications, especially for the American lifestyle in which people find themselves with ample leisure time and may fall victim to trying to escape their boredom with food stimulation. A better

understanding of the mind's methods of coping with a lack of mental stimulation may indeed be just as important as understanding how the brain copes with sensory overload.

Understanding the nature of restrained eating and its weaknesses helps researchers to recognize the mechanisms involved in dieting behavior and the circumstances in which they are undermined. As Wegner (1994) suggests, the true root of the problem may be in restrictive eating itself as an operational process. Further research that aims to understand how ironic processes undermine cognitive directives will benefit both the restrained eating and cognitive psychology research communities.

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Appendix A

Confidential Questionnaire

What is your age? _____   What is your gender?   Male   Female (Circle one)

What year of school are you in?   Freshman   Sophomore   Junior   Senior (Circle one)

What year do you expect to graduate? _____

What is your ethnic category?

- ❑   Hispanic or Latino
- ❑   Not Hispanic or Latino

What is your racial background? (Check all that apply)

- ❑ White/Caucasian/European
- ❑ Black/African American
- ❑ American Indian or Alaskan Native
- ❑ Asian Indian
- ❑ Chinese
- ❑ Filipino
- ❑ Japanese
- ❑ Korean
- ❑ Vietnamese
- ❑ Other Asian (please specify)_____
- ❑ Native Hawaiian or other Pacific Islander
- ❑ Guamanian or Chamorro
- ❑ Samoan
- ❑ Other (please specify) _____

Appendix B

Positive Affect and Negative Affect Scale (PANAS)

Directions

This scale consists of a number of words that describe different feelings and emotions. Read each item and then circle the appropriate answer next to that word. Indicate to what extent you have felt this way <u>at this moment</u>.

	Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
1. Interested	1	2	3	4	5
2. Distressed	1	2	3	4	5
3. Excited	1	2	3	4	5
4. Upset	1	2	3	4	5
5. Strong	1	2	3	4	5
6. Guilty	1	2	3	4	5
7. Scared	1	2	3	4	5
8. Hostile	1	2	3	4	5
9. Enthusiastic	1	2	3	4	5
10. Proud	1	2	3	4	5
11. Irritable	1	2	3	4	5
12. Alert	1	2	3	4	5
13. Ashamed	1	2	3	4	5
14. Inspired	1	2	3	4	5
15. Nervous	1	2	3	4	5

16. Determined	1	2	3	4	5
17. Attentive	1	2	3	4	5
18. Jittery	1	2	3	4	5
19. Active	1	2	3	4	5
20. Afraid	1	2	3	4	5
21. Discouraged	1	2	3	4	5
22. Content	1	2	3	4	5
23. Frustrated	1	2	3	4	5
24. Anxious	1	2	3	4	5
25. Happy	1	2	3	4	5
26. Nervous	1	2	3	4	5
27. Sad	1	2	3	4	5
28. Angry	1	2	3	4	5

Appendix C

Visual Analogue Scales

How alert are you?

|———————————————————————————————|
Alert   Not Alert

How stressed are you?

|———————————————————————————————|
Extremely Stressed   Extremely Relaxed

How hungry are you?

|———————————————————————————————|
Extremely Hungry   Extremely Full
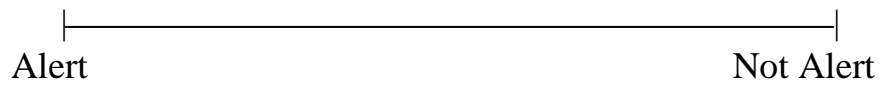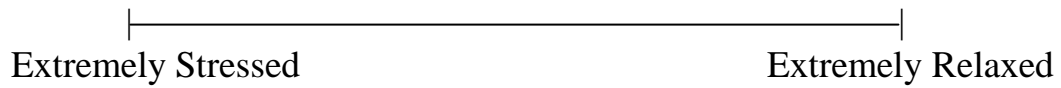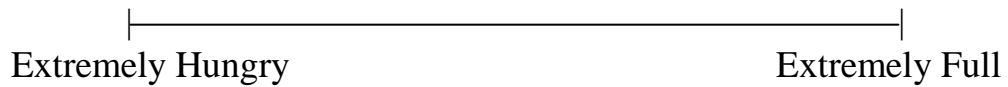
How much do you like chocolate?

|———————————————————————————————|
Extremely Like   Extremely Dislike
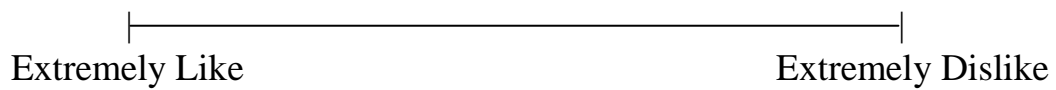
How would you rate the computer task (not including the chocolate) on the following scales?

|⊢————————————————————————————⊣|
Extremely Easy   Extremely Hard

|⊢————————————————————————————⊣|
Extremely Boring   Extremely Stimulating

|⊢————————————————————————————⊣|
Extremely Pleasant   Extremely Unpleasant

Appendix D

Three Factor Eating Questionnaire (Restraint Only)

Please answer true the following questions by circling the response that best applies to you.

When I have eaten my quota of calories, I am usually good at not eating any more.   T   F

I deliberately take small helpings as a means of controlling my weight.   T   F

Life is too short to worry about dieting.   T   F

I have a pretty good idea of the number of calories in common food.   T   F

While on a diet, if I eat food that is not allowed, I consciously eat less for a period of time to make up for it.   T   F

I enjoy eating too much to spoil it by counting calories or watching my weight.   T   F

I often stop eating when I am not really full as a conscious means of limiting the amount that I eat.   T   F

I consciously hold back at meals in order not to gain weight.   T   F

I eat anything I want, any time I want.   T   F

I count calories as a conscious means of controlling my weight.   T   F

I do not eat some foods because they make me fat.   T   F

I pay a great deal of attention to changes in my figure.   T   F

How often are you dieting in a conscious effort to control your weight?

1	2	3	4
rarely	sometimes	usually	always

Would a weight fluctuation of 5 lbs. affect the way you live your life?

1	2	3	4
not at all	slightly	moderately	very much

Do your feelings of guilt about overeating help you control your food intake?

1	2	3	4
never	rarely	often	always

How conscious are you of what you're eating?

1	2	3	4
not at all	slightly	moderately	extremely

How frequently do you avoid 'stocking up' on tempting foods?

1	2	3	4
almost never	seldom	usually	almost always

How likely are you to shop for low calorie foods?

1	2	3	4
unlikely	slightly unlikely	moderately likely	very likely

How likely are you to consciously eat slowly in order to cut down on how much you eat?

1	2	3	4
unlikely	slightly unlikely	moderately likely	very likely

How likely are you to consciously eat less than you want?

1	2	3	4
unlikely	slightly likely	moderately likely	very likely

On a scale of 0 to 5, where 0 means no restraint in eating (eating whatever you want, whenever you want it and 5 means total restraint (constantly limiting food intake and never 'giving in'), what number would you give yourself? Please circle the choice that applies to you.

0 – eat whatever you want, whenever you want
1 – usually eat whatever you want, whenever you want it
2 – often eat whatever you want, whenever you want it
3 – often limit food intake, but often 'give in'
4 – usually limit food intake, rarely 'give in'
5 – constantly limiting food intake, never 'giving in'

Table 1. Participant Characteristics

Restraint Group	Restrained	Non-Restrained
Participants, *n*	30	23
Age, y	18.67 ± 0.28	18.70 ± 0.16
Weight, kg	64.04 ± 2.39	59.43 ± 2.3
Height, m	1.674 ± 0.010	1.671 ± 0.014
BMI, kg/m^2	22.92 ± 0.94	21.29 ± 0.876
Time since last ate (min.)	275.9 ± 51.068	165.39 ± 16.189**
Initial chocolate liking (Range: 1-103)	86.03 ± 2.547	87.61 ± 3.071
Restraint score (TFEQ; range: 0-21)	13.37 ± 0.473	5.39 ± 0.517*
PANAS		
Positive Affect	25.17 ± 1.336	24.04 ± 1.125
Negative Affect	12.63 ± 0.397	12.04 ± 0.385

*Indicates significant differences between restrained and non-restrained groups, $p < 0.05$.

**Indicates marginal differences between restrained and non-restrained groups, $p = 0.072$.

Figure Caption

Figure 1. Means of chocolate consumed between restrained (dark grey bars) and

non-restrained (light grey bars) eaters in the Light and Heavy cognitive loads.
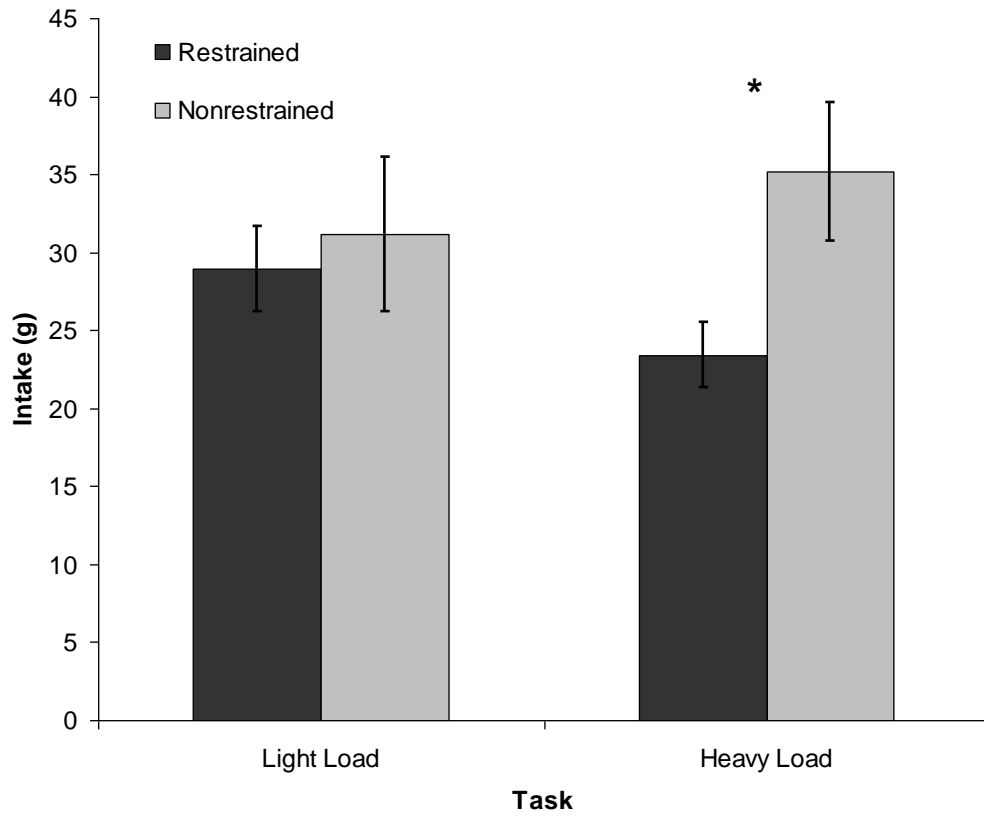
*Indicates significant difference at $p < 0.05$.

Figure 1

Figure Caption

Figure 2. Means reaction times as a function of the 10 experimental blocks for Restrained eaters (Square) and Non-restrained eaters (Triangle) in Heavy (dotted line) and Light (solid line) cognitive loads.
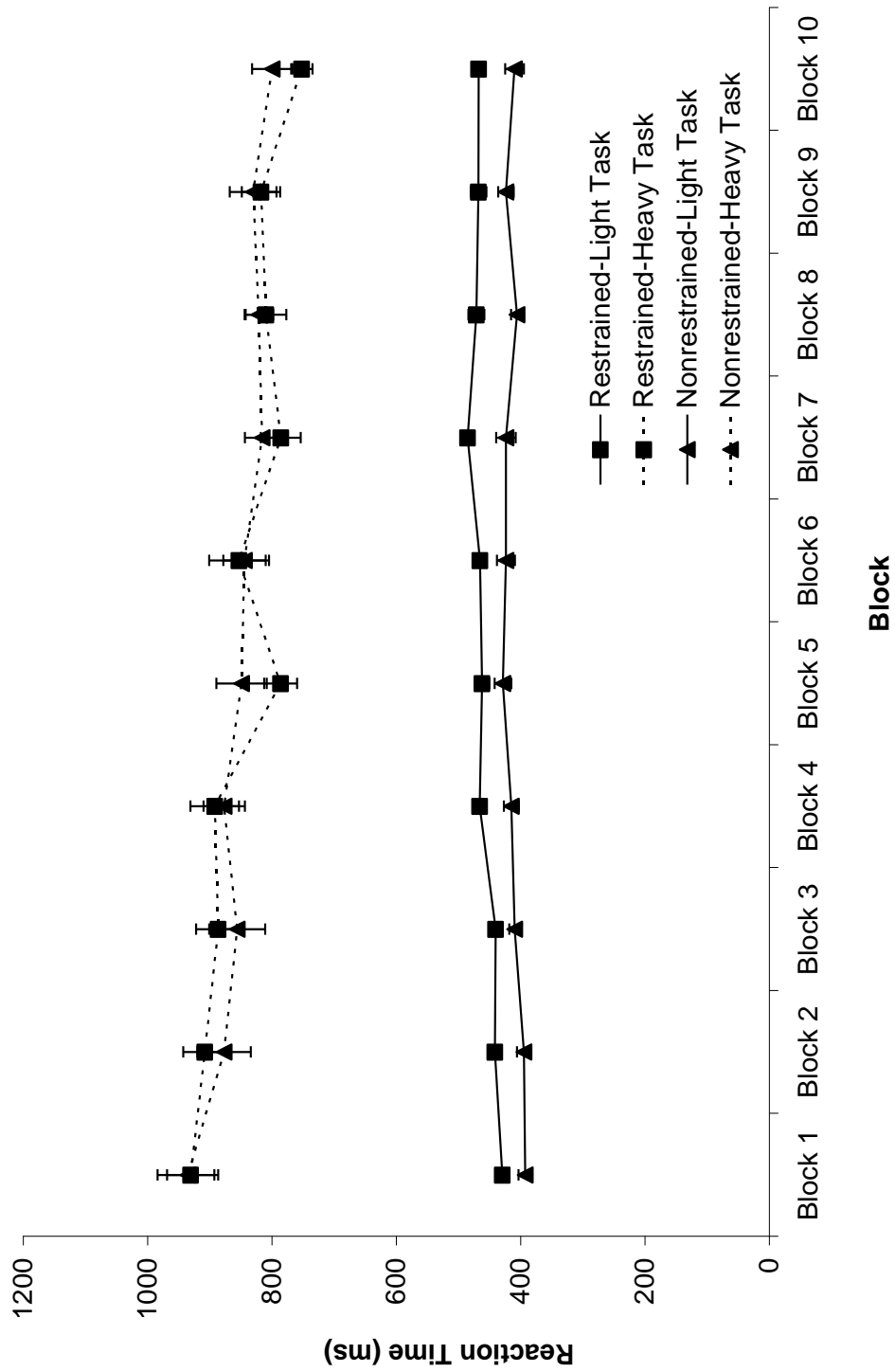
Figure 2