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The effectiveness of mindful eating in a student population

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Abstract

Eating while distracted (television, conversation, etc.) or under cognitive stress (studying, reading, writing) has shown to increase food consumption, which can result in overeating. Frequent overeating is a major factor in the development of obesity, a serious health concern. The current study examined the potential benefits of mindful eating in a university setting where student eating habits are constantly influenced by environmental distractions and cognitive stress. Eighty undergraduate students were randomly assigned to either a mindful eating condition or control condition, followed by either a high or low cognitive stress condition. Cognitive stress was manipulated using frequent (low cognitive stress) and infrequent word (high cognitive stress) anagram tasks, during which participants were given two bowls of food to snack on; grapes and Smarties. Participants in the mindful eating condition ate significantly less food overall than participants in the control condition. However, the negative effects of cognitive stress on eating were not demonstrated.

The Effectiveness of Mindful Eating in a Student Population

Despite the increasing trend to eat well, exercise regularly and live a healthier lifetsyle, obesity is a still a growing problem in Canada. Obesity rates have roughly doubled over the past 30 years, with one in four Canadians currently suffering from obesity (Public Health Agency of Canada, 2011). A number of comorbid diseases have been linked to obesity such as type II diabetes, asthma and several types of cancers, supporting the claim that it is a serious health concern (Public Health Agency of Canada, 2011). Increased consumption of high-fat, high-sugar, and high-salt foods are dietary changes that have been linked to the increased prevalence of obesity (Stevenson, Doherty, Barnett, Muldoon & Trew, 2007). North American culture has become increasingly engaged in the indulgence and overeating of these unhealthy foods, and this trend has spread throughout workplaces, cafeterias, homes, social occasions and schools (Stevenson et al., 2007).

High school and university are critical periods in which individuals develop long term eating habits, both healthy and unhealthy (Stevenson et al., 2007). The development of unhealthy long term eating habits places students at risk to overeat and become obese in the future (Ha & Caine-Bish, 2009). For university students, transitioning to life away from home often contributes to this dietary decline, as students are no longer under the supervision of parents and make independent decisions regarding their food intake (Richards, Kattelmann & Ren, 2006; Perera & Madhujith, 2012). Students living in a university residence have access to cafeteria food, while those living off-campus are more likely to make their own meals, but unfortunately cooking is a skill not commonly taught while living at home (Unusan, 2006). University exposes students to an increased level of cognitive stress, and extended hours of sedentary activities such as studying and writing essays can result in weight gain and a decline in diet quality (Moor,

Scott, & McIntosh, 2013). During the hours spent studying and reading, snacking is commonplace. Chaplin and Smith (2011) found that there is a general consensus about snack foods being a major contributor to the increase in obesity prevalence. For 80% of people, snacking occurs at least once per day, and the quantity and quality of food consumed during snacking is affected by external influences such as studying, driving, and watching television (Chaplin & Smith, 2011). Snacking while reading, writing, and studying is a common occurrence for students, placing them at an increased risk of making unhealthy eating choices.

External Influences

A variety of external environmental influences can hinder students' ability to make healthy eating choices (Robinson, Aveyard, Daley, Jolly, Lewis, Lycett, & Higgs, 2013; Moor, Scott & McIntosh, 2013; Kennedy-Hagan, Painter, Honselman, Halvorson, Rhodes & Skwir, 2011; Geier, Wansink & Rozin, 2012; Wansink & Sobal, 2007; Hetherington, Anderson, Norton & Newson, 2006; Vartanian, Herman & Wansink, 2008). Automatic eating behaviours, such as snacking while studying, can lead to overeating due to poor awareness of satiety (Moor, Scott & McIntosh, 2013). There are a number of external influences that draw attention away from eating and satiety cues, and have been shown to increase food consumption. Kennedy-Hagan et al. (2011) conducted a study examining the effect of visual cues on food consumption. Workers were provided with pistachios to snack on during a workday. Some workers had their empty shells removed every two hours, while other workers had their shells on their respective desks all day. Those whose shells were routinely removed ate roughly 20% more calories during the workday than those who could continually see their shells pile up (Kennedy-Hagan et al., 2011). By leaving the shells to pile up, workers were made more aware of their pistachio intake during the workday, decreasing the likelihood of overeating. A study conducted by Geier, Wansink and

Rozin (2012) involved participants watching a movie while eating chips provided for them, but for some participants the chips were segmented so that every seventh or fourteenth chip was red. This chip segmentation brought attention to the participants' eating, resulting in the intake of fewer chips, and more accurate estimates of their chip intake during the film (Geier, Wansink, & Rozin, 2012). Those who did not receive red segmented chips tended to underestimate their chip intake during the film, suggesting that their eating was automatic and inattentive (Geier, Wansink, & Rozin, 2012). This inattentive, mindless chip eating is comparable to the pistachio study, in that both groups who were made aware of their food intake were less likely to overeat, suggesting that eating awareness plays a role in food intake.

Students often live in an environment where eating awareness is reduced by the distraction of friends and entertainment. Research suggests that eating while watching television leads to an increase in consumption compared to eating while not watching television (Hetherington et al., 2006). Those who eat while not watching television spend more time looking at their food, suggesting an increased awareness of their eating (Hetherington et al., 2006). Similar to the effects of visual cues, television draws attention away from eating, increasing the likelihood of overeating. Eating with friends has also been shown to increase consumption, as attention is shifted from food to conversation (Vartanian, Herman & Wansink, 2008). Consumers are often unaware of this influence as they attribute their increased consumption to hunger and taste, and reject the notion of the presence of others as the cause (Vartanian, Herman & Wansink, 2008). In the cafeteria or with roommates, eating in the presence of friends is common in university, suggesting that social eating effects play a role in students' food consumption.

A larger serving size can also increase consumption due to poor eating awareness, which was emphasized in an eating study that gave participants a larger than average bowl of soup (Wansink & Sobal, 2007). Consumers with the larger bowl ate an average of 31% more soup than the control group with a regular sized bowl, while 73% of those with larger bowls believed they ate as much as they normally would (Wansink & Sobal, 2007). As many as 21% of consumers in the large bowl condition denied eating more than usual, and only 4% believed the increase intake was due to the size of the bowl (Wansink & Sobal, 2007). The influences of visual cues and poor awareness on eating were demonstrated in this study, as participants ate more or less due to the size of the bowl, rather than eating to reach satiety.

Visual cues, serving size, distractors and social gatherings are all factors that increase food intake during meal and snack periods. Research suggests that these factors increase food intake by drawing attention away from satiety cues and the food itself, increasing the likelihood for an individual to eat automatically. This inattentive eating can cause an individual to overeat beyond satiety which may lead to weight gain. In contrast, if attention is focused on a student's food and eating habits, they should be more likely to eat until satisfied and may be able to attenuate the negative effect of external influences on eating habits.

Healthy eating is an important skill for students to develop in order to avoid preventable future health problems. Healthy eating can be approached using the Information-Motivation-Behavioural Skills (IMB) Model which is used for health-related interventions, such as quitting smoking and overcoming alcoholism (Harman & Amico, 2009). Following the IMB Model, to overcome a health problem an individual requires information on why this change is important for their health, the motivation to make the change, and the skills to make the change for themselves (Harman & Amico, 2009). Students tend to be well informed about the benefits of

healthy eating and which foods are unhealthy and should be avoided (Story & Resnick, 1986). Many students are also highly motivated to eat healthily, due to body image beliefs and the desire to feel better as a result of better eating decisions (Share & Stewart-Knox, 2012). However, many students lack the behavioural skills required to eat in a healthy manner. University often requires students to cook for themselves, and select their own groceries; two skills that must be learned. Along with the absence of these skills, students are not typically taught to recognize the negative effects that external influences can have on eating. Research indicates that students and adults both lack the ability to recognize how certain external factors draw their attention away from satiety cues (Hetherington et al., 2006). This skill, generally referred to as mindful eating, is neither typically taught, nor commonly recognized by students as a healthy eating skill. Awareness of these external factors could decrease the likelihood of an individual to overeat and decrease the risk of becoming overweight or obese.

Mindful Eating

Mindful eating stems from the overarching concept of mindfulness. Mindfulness can be described as maintaining full non-judgemental awareness of internal and external influences, fixating strongly on a subject, and upholding tranquility, reflectivity and concentration in the present moment (Gethin, 2011). Mindful eating is simply the application of this attentive awareness while eating a meal or a snack. Those who eat mindfully are able to direct attention towards sensory modalities while eating, are able to recognize cues that determine the initiation and cessation of eating, and are aware of the causes and consequences of mindless eating (Fletcher, 2010). A meta-analysis of 24 studies examining mindfulness and attention during eating showed that mindful eating can improve healthy eating behaviours and reduce the risk of overeating (Robinson et al. 2013). Given the range of activities that students engage in while

eating (e.g., studying, television, hanging out with friends, etc.), mindful eating may be a beneficial skill for students to develop in order to be aware of satiety cues and avoid overeating. One study examined the link between student Body Mass Index (BMI) and mindfulness. BMI scores were used to classify obese, overweight and normal-weight individuals, and mindfulness was found to be negatively correlated with BMI, indicating that those who are more mindful in daily life tend to be of healthier weight (Moor, Scott, & McIntosh, 2013). A study conducted by Beshara, Hutchinson and Wilson (2013) revealed a close relationship between general mindfulness and mindful eating, indicating that those who are generally mindful tend to be mindful while eating. Mindful eaters are also more likely to know appropriate serving sizes, even for unhealthy foods, including common snack foods like chips and cookies (Beshara, Hutchinson, & Wilson, 2013). The research suggests that this is due to the increased awareness of mindful eaters, which allows them to better recognize when they are full. Mindful eating is associated with lower BMI scores and lower snack serving size estimates, indicating that mindful eaters are of a healthier weight and make healthier snack decisions than those who are mindless eaters.

Mindful eating can also help picky eaters overcome their poor eating by helping them enjoy more nutritious foods. In a study conducted by Hong et al. (2011) participants engaged in a mindful eating task with raisins, then rated their perceptions of food-liking for other foods. Those engaging in the mindful eating task were more likely to believe they would enjoy a variety of other foods, especially foods that were initially disliked such as anchovies and tofu (Hong et al., 2011). In this study mindful eating instruction had an impact on participants' eating behaviours immediately after one session, however, the study by did not examine how mindful eating

influenced subsequent food consumption. This study suggests that mindful eating is a skill that can be effectively taught in order to make individual's more aware of their eating behavior.

Cognitive Stress

While it may be possible to improve student eating habits by teaching mindful eating, the cognitive stress students experience has been shown to increase unhealthy eating behaviours (Oaten & Cheng, 2005; Royal & Kurtz, 2010; Zellner et al., 2006). A study by Oaten and Cheng (2005) examined levels of self-control among students during examination periods. During weeks of heightened cognitive stress due to exams, students exhibited an increased perception of stress, an increase in smoking and caffeine use, and a decrease in healthy eating (Oaten & Cheng, 2005). This combination of decreased self-control, cognitive stress, snacking, and sedentary activity places university students at a high risk to overeat.

Students spend a great deal of time studying, writing tests, taking notes, or brainstorming ideas, all of which expose the students to high levels of cognitive stress. To examine the effects of cognitive stress, one study gave students an impossible anagram task and snacks to eat during the task, while a control group was given solvable anagrams. The students attempting to complete impossible anagram tasks were subjected to a greater deal of cognitive stress, and as a result consumed significantly more snacks during the task (Royal & Kurtz, 2010). In a similar anagram-stress study, students were given the choice between healthy and unhealthy snacks while performing the tasks. Students subjected to high levels of cognitive stress were more likely to consume the unhealthy high-fat foods (M&Ms), while those in the low cognitive stress condition were more likely to eat the healthy option provided (grapes) (Zellner et al., 2006). Higher levels of cognitive stress are associated with greater food intake, and also more unhealthy eating choices, placing university students at risk to make poor eating decisions.

Present Research

Two factors likely to contribute to overeating for university students are cognitive stress and mindless eating due to external factors and distractors (Royal & Kurtz, 2010; Zellner et al., 2006; Geier, Wansink & Rozin, 2012; Moor, Scott & McIntosh, 2013; Kennedy-Hagan et al., 2011; Wansink & Sobal, 2007; Hetherington et al., 2006; Vartanian, Herman & Wansink, 2008). If an individual is mindful while eating, s/he may be able to recognize fullness and mitigate overeating due to external distractors. However, the relationship between mindful eating and cognitive stress requires further exploration, as the application of mindful eating has not been examined in a cognitively demanding environment.

The goal of the current study was to examine how the benefits of mindful eating can be applied in a university setting, where students frequently experience cognitive stress. To test this, participants engaged in a mindful eating activity or a mindless eating control, followed by a high or low cognitive stress task. It was hypothesized that (1) participants in the mindfulness condition would consume less food overall than participants in the control condition, (2) participants in the high stress condition would consume more food overall, and (3) more unhealthy food than participants in the low stress condition, and (4) participants in the mindfulness condition will resist the negative influence from high cognitive stress on food consumption compared to participants in the control condition. Support for these hypotheses would suggest that the benefits of mindful eating would be effective in a university setting, demonstrating that mindful eating may be a useful skill to teach university students in order to reduce the likelihood of overeating and obesity prevalence.

Method

Participants

The sample consisted of 80 undergraduate students (29 men, 51 women, M_{age} = 19.2 years, SD_{age} = 1.38 years, age range: 18-24 years) at King's University College. The sample contained 64 undergraduate Psychology students recruited through the undergraduate participation school (SONA). Participants received a course credit for participating. The remaining 16 participants were student volunteers who were recruited on campus via posters, and were entered into a draw for a $20 Tim Hortons gift card for participating. The participants were informed that the study was on "awareness and cognitive stress in university students" to avoid revealing the nature of the hypotheses. In order to control for potential differences in the appetite of participants, they were instructed to refrain from eating anything for two hours prior to participation. All participants provided written consent before participating. Participants were randomly assigned to one of four conditions; mindful-low stress, mindful-high stress, control-low stress, or control-high stress.

Materials

Mindful Eating Instruction. The mindful eating instruction was adapted from Johnson and Pelican's (2008) *The Last Orange on Earth: An Activity to Teach Mindful Eating*, and can be found in Appendix A. The mindful eating instruction was used to create sensory-awareness, perceptual-awareness and self-awareness for the participants engaged in the task. Clementines were used in place of oranges due to seasonal variations and to minimize influences on participants' appetites since clementines are smaller than oranges. The task instructions were modified to match the process of eating a clementine as opposed to an orange. The response sheet for the mindful eating instruction was modified to fit the modified instructions and can be found in Appendix B.

Control Condition. The video used in the control condition was "Cooking as Alchemy" (Cantu & Roche, 2011). The video was nine minutes and 30 seconds long, and was selected to match the length of the mindful eating task, as well as the focus on food. The video was used as a control because participants do not engage in mindful behaviours while watching it. Participants watched the video on a laptop computer and answered questions on a response sheet (see Appendix C) that matched the response sheet given in the mindful eating task.

Low and High Cognitive Stress Anagram Tasks. High and low cognitive stress conditions were created by administering an anagram task to participants. The low-cognitive-stress anagram task contained 10 scrambled seven-letter words that are encountered frequently, including balloon (BOLANLO) and library (LBARIYR). The high-cognitive-stress anagram task contained 10 scrambled seven-letter words that are not encountered frequently, including juniper (IUJRPEN) and venison (ENINVOS). Both anagram tasks were pilot tested to confirm the difficulty of the frequent and infrequent tasks. The low-cognitive-stress anagram task can be found in Appendix D and the high-cognitive-stress anagram task can be found in Appendix E.

Cognitive Stress Manipulation Check. In order to measure the effectiveness of the anagram tasks for inducing corresponding levels of cognitive stress, a 10-item manipulation check was created. The questions were statements that required responses on an 11-point Likert-type scale, ranging from highly disagree to highly agree. Only question eight (*I found the anagram task in this study to be quite stressful*) was examined to measure perceived cognitive stress, while the other nine questions were used as masking questions. The masking questions were focused on memory, word task skills and general stress so that participants were unaware of the purpose of the questionnaire. The cognitive stress manipulation check can be found in Appendix F.

Food and Apparatuses. Each participant was given a clementine. Two white identical bowls were used, one filled with green grapes and the other filled with Smarties, a peanut-free food to avoid the risk of potential allergies. An electronic scale was used to weigh the food bowls before and after each participant.

Procedure

Before the participant arrived. Two coins were flipped to randomly assign the participant to one of four conditions (mindful-low stress, mindful-high stress, control-low stress, control-high stress). Both food bowls were sufficiently filled to avoid self-presentation bias, so that each participant could eat from them without it appearing as if they had eaten the entire bowl. Both food bowls were weighed and the weights were recorded. The food bowls weighed 250 grams with 300-350 grams of food in each, and were placed on a desk at the back of the room.

While the participant was present. Upon arrival, the researcher asked the participant if they had any food-related allergies. No food related allergies were reported. Participants assigned to the mindful eating condition were seated at a desk next to the researcher and were given a clementine. The researcher instructed them through the task while they answered the questions on the response sheet provided to them. This mindful eating task took roughly eight to ten minutes to complete for each participant. A participant assigned to the video control condition was seated at a desk with a laptop computer and a response sheet relating to the video. Each participant in the video control condition was instructed to answer the questions as the video played and were offered a clementine while they watched the video. The researcher told each participant that the clementines were left over from a faculty meeting. Upon completion of the mindful eating task or video control task, the participant was moved to a desk at the back of the

room which had one of the two anagram tasks (low or high cognitive stress) and two food bowls (grapes and Smarties). In order to avoid participant suspicions about the hypothesis of the study, the researcher told them that the food was also leftover from a faculty meeting. Each participant was told they were free to eat as much as they would like to. The researcher also told the participant that they would be given 10 minutes to unscramble as many of the anagrams as they could, and that the researcher would be out of the room during this time. When the 10 minutes were up the researcher returned and instructed the participant to stop writing. At the completion of the anagram task, the participant was moved to a different desk to complete the cognitive stress manipulation check so that they no longer had access to the food bowls. Upon completion of the cognitive stress manipulation check, each participant was thanked and debriefed. Each participant had the option to complete an assignment based on the study in order to receive up to 2.5% bonus marks for their final Psychology 1000 grade.

After the participant left. Once the participant had left the room, the researcher weighed each food bowl using the electronic scale and recorded the change of weight for each bowl.

Results

The dependant variable, number of pieces of food consumed, was measured by dividing the weight of food that each participant consumed by the average weight of the grapes and Smarties. With number of food pieces consumed as the dependent variable, a 2(mindful eating: mindful, control) x 2(cognitive stress: low, high) x 2(food choice: healthy, unhealthy) repeated measures factorial ANOVA was performed with mindful eating and cognitive stress as between subjects variables. A repeated measures factorial ANOVA was also conducted with grams of food consumed as the dependant variable, and the results produced the same levels of significance.

Hypothesis 1: Participants in the mindfulness condition would consume less food overall than participants in the control condition.

As shown in Figure 1, consistent with Hypothesis 1, participants in the mindful eating condition consumed significantly less food overall (M = 1.7 pieces, SD = 4.97) than participants in the control condition (M = 4.2 pieces, SD = 4.97), $F(1,76) = 5.19$, $p = .03$, $\eta^2 = .06$, power = .61. The positive effect of mindful eating was not significantly different for healthy and unhealthy foods, $F(1,76) = 1.50$, $p = .224$, $\eta^2 = .02$, power = .23.

Hypothesis 2: Participants in the high cognitive stress condition would consume more food overall than participants in the low cognitive stress condition.

An independent samples t-test confirmed that participants in the high cognitive stress condition experienced significantly higher levels of cognitive stress (M = 6.6, SD = 2.38) than participants in the low cognitive stress condition (M = 5.4, SD = 1.93), $t(78) = -2.47$, $p = .016$. Contrary to hypothesis 2, participants in the high cognitive stress condition did not consume significantly more food overall (M = 3.7 pieces, SD = 4.97) than participants in the low cognitive stress condition (M = 2.1 pieces, SD = 4.97), $F(1,76) = 2.09$, $p = .152$, $\eta^2 = .03$, power = .30. Although not at a significant level, Figure 1 shows that cognitive stress influenced food consumption in the predicted direction.

Hypothesis 3: Participants in the high cognitive stress condition would consume more unhealthy food than participants in the low cognitive stress condition.

Contrary to hypothesis 3, the negative effect of cognitive stress was not significantly greater for unhealthy food than for healthy food, $F(1,76) = 1.15$, $p = .286$, $\eta^2 = .02$, power = .19. However, as shown in Figure 2, participants ate significantly more pieces of unhealthy food (M =

4.5 pieces, *SD* = 9.48) than healthy food (*M* = 1.4 pieces, *SD* = 2.23), $F(1,76) = 8.88$, $p = .004$, $\eta^2 = .11$, power = .84.

Hypothesis 4: Participants in the mindful eating condition would resist the negative influence from high cognitive stress on food consumption compared to participants in the control condition.

Contrary to hypothesis 4, the negative effect of high cognitive stress did not influence participants in the mindful eating condition significantly less than it influenced participants in the control condition, $F(1,76) = 0.11$, $p = .746$, $\eta^2 < .01$, power = .06. Although not at a significant level, Figure 1 shows that the negative influence of high cognitive stress was more prevalent for participants in the control condition than participants in the mindful eating condition. The three way interaction between mindful eating, cognitive stress and food choice was not significant, $F(1,76) = 0.19$, $p = .666$, $\eta^2 < .01$, power = .07.

Discussion

This study examined the effect of participation in a mindful eating activity on snacking behaviours in the presence of cognitive stress. The results showed that mindful eating caused individuals to consume less food during cognitive stress tasks. However, mindful eating did not allow participants to resist the negative effects of high cognitive stress more than low cognitive stress. Unlike previous studies (Royal & Kurtz, 2010; Zellner et al., 2006), in the current study cognitive stress did not significantly increase food consumption, nor did it significantly increase consumption of unhealthy food.

Similar to a study by Hong and colleagues (2011), the effects of engaging in a mindful eating activity were exhibited immediately following the single session. The study by Hong and colleagues (2011) found that participants perceived greater enjoyment for a variety of foods

following a mindful eating task, while the current study found a decreased consumption of snacks following a mindful eating task. Both studies demonstrated an instantaneous behavioural change from a single mindful eating task, whether decreasing the likelihood of automatic snacking or improving the likelihood of trying certain foods. It is also possible that the nature of the mindful eating task in the current study caused participants to be more relaxed and/or more focused than participants who watched the video in the control condition, which may have influenced subsequent food consumption.

Participants in the current study consumed significantly more Smarties than grapes, which may have several explanations. Participants in both the low and high cognitive stress conditions experienced moderate levels of cognitive stress, which may be able to explain the preference for Smarties consistent with previous research (Zellner et al., 2006). It is also possible that the use of clementines made the taste, smell, texture and succulence of fruit salient, decreasing grape consumption during the snacking period. Alternatively, Smarties may have been perceived as a novel food after exposure to fruit in the previous task, or that participants may have simply had a greater initial preference for Smarties than for grapes.

The results of the current study showed that participants under high cognitive stress consumed more unhealthy food and food overall than participants under low cognitive stress, although not at a significant level. However, similar previous studies (Royal & Kurtz, 2010; Zellner et al., 2006) found significant support for these hypotheses. The manipulation check from the current study revealed that the frequent and infrequent anagrams induced significantly different levels of cognitive stress, but the difference may have not been substantive as both scores are comparable. The studies by Royal and Kurtz (2010) and Zellner and colleagues (2006) both used solvable and unsolvable five-letter anagrams to induce different levels of cognitive

stress, and these appeared to be more effective than the frequent and infrequent seven-letter anagrams in the current study. All participants in the current study appeared to experience moderate cognitive stress, indicating that five-letter solvable and unsolvable anagrams may have been more effective at inducing differing levels of cognitive stress. Quantity of food consumed under cognitive stress in the current study was in the predicted direction, but a more adequate cognitive stress manipulation may have increased the effect size of cognitive stress, leading to the consumption of significantly more food overall and significantly more unhealthy food in the high cognitive stress condition.

Further steps could have been taken in attempt to reduce variability in the sample. Participants were required to refrain from eating for two hours prior to the experiment to control for appetite effects, but the study took place at various times throughout the morning, afternoon and evening, which may have unintentionally created an appetite effect on food consumption, lowering internal validity. Additionally, dieting and eating habits among participants were not measured, and these individual differences may have influenced food consumption during the experiment as some participants may have been refraining from eating high-fat or processed foods. Pre-testing participants on dieting and eating attitudes may have produced a more homogenous sample. Future studies should attempt to improve internal validity and minimize variability by running the experiment during consistent times each day, and by measuring eating habits of participants prior to running the experiment.

The hypotheses related to cognitive stress for the current study produced results in the predicted direction but at a non-significant level; however, this may have been due to a lack of power. Power for the latter three hypotheses was low and could have been increased by using a larger sample size. Reducing participant variability, increasing sample size, and increasing the

effect size of cognitive stress could have increased power for these analyses, and potentially attained significance for the hypotheses related to cognitive stress.

In order to better understand the extent to which mindful eating can control snacking behaviours under cognitive stress, an experiment could be conducted in a natural setting. While participants in the current study perceived moderate levels of cognitive stress, the laboratory setting may not be comparable to a natural university setting such as the library. In reality, university students experience frequent cognitive stress paired with high stakes (examinations, essays, grades, graduation, etc.). Though it is possible that participants felt added pressure in the laboratory setting, the task was only 10 minutes long with nothing at stake. Additionally, a 10 minute cognitive stress task is not equivalent to a normal university work session, as students may experience cognitive stress for up to several hours. The artificial laboratory setting and minimal time for cognitive stress exposure limit the generalizability of the current study. A future study could organize independent study sessions, provide students with snacks, and measure perceived cognitive stress and food consumption during the study sessions.

Although the current study showed food consumption during a task can be decreased immediately following a brief mindful eating activity, there are several questions about mindful eating that this study was unable to answer. The current study was short-term and did not examine how long the effects of the mindful eating activity influenced participants' eating habits, as they may have left the experiment with the same eating intentions as when they arrived. Future studies should also investigate how mindful eating can affect eating behaviour during meals, and how multiple mindful eating sessions may influence an individual's eating habits. Aside from cognitive stress, research suggests that other common student behaviours such as eating while watching television (Hetherington et al., 2006) and eating in the presence of friends

(Vartinian, Herman & Wansink, 2008) can also increase food consumption, which yields opportunity for future research on the effectiveness of mindful eating in a university setting. The exclusive focus on mindful eating under cognitive stress, and the short-term nature of this study both limit the generalizability of how mindful eating operates in a real university setting.

This study examined the effectiveness of mindful eating as a skill for university students to control eating habits in the presence of cognitive stress. Although beyond the scope of this study, future research should investigate the effectiveness of mindful eating as a skill for university students to control eating in the presence of negative influences aside from cognitive stress from studying and writing, such as distracted eating and eating in the presence of others. The current study showed that engaging in a mindful eating activity can increase awareness of automatic eating behaviours, although the effect of cognitive stress requires further exploration. Regardless, this study and previous research indicate that mindful eating can be taught, and is an effective skill for increasing awareness of sensory and bodily sensations while eating, and reducing the tendency to overeat.

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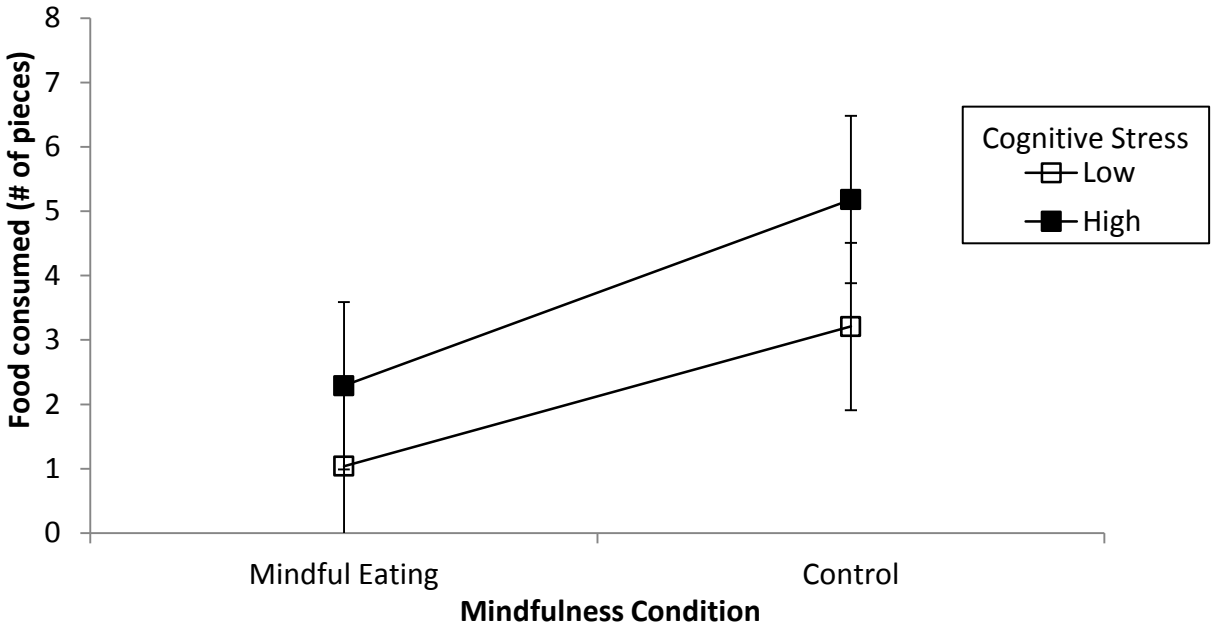
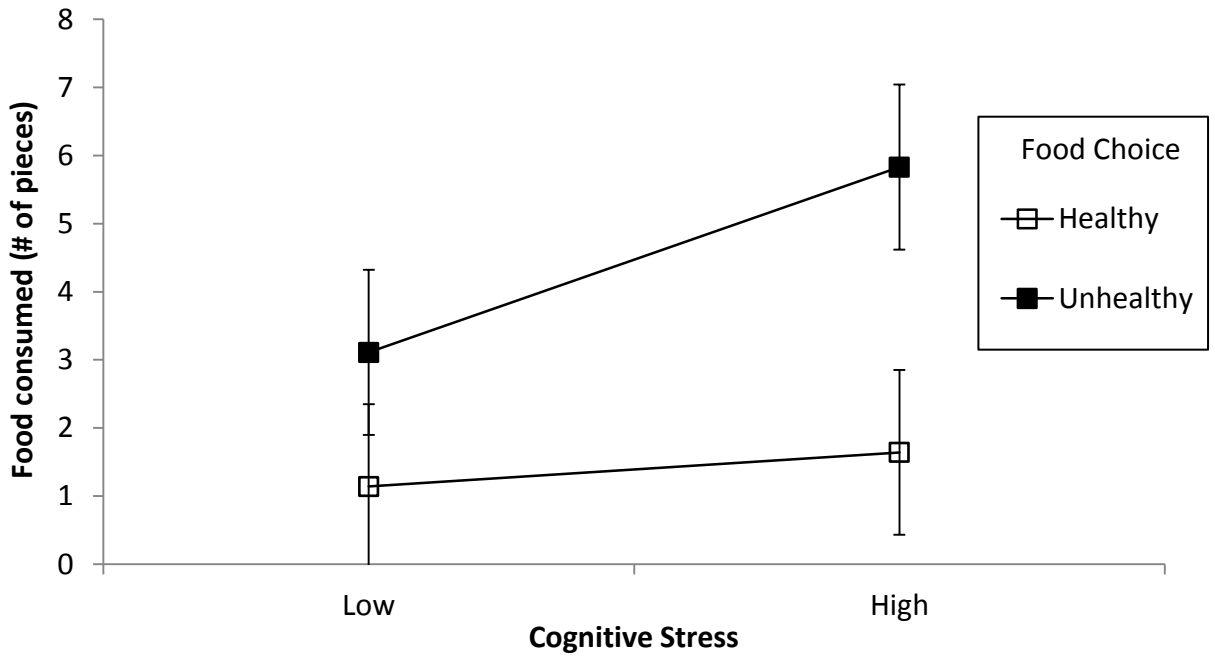
Figure 1. Mean number of pieces of food consumed for mindful eating and control conditions, under low and high cognitive stress conditions.



Error bars represent 95% confidence interval for the interaction.

Figure 2. Mean number of pieces of healthy and unhealthy food consumed under low and high cognitive stress conditions.



Error bars represent 95% confidence interval for the interaction.

Appendix A

Mindful Eating Activity

1. Take 3 deep breaths.

2. Admire the colour, shape, and texture of the clementine. *(record answers to questions 1& 2)*

3. Clementines grow on trees in warm climates. Close your eyes and imagine where this clementine grew. Can you feel the warm sun? Can you smell the blossoms? Can you see the fruit on the trees?

4. Open your eyes and smell the clementine. *(record answer to question 3)*

5. Peel the clementine slowly, taking time to enjoy the aroma, texture and colour. Now smell the peeled clementine. *(record answer to question 4)*

6. Separate a couple segments. Examine their inner structure. *(record answer to question 5)*

7. Place a segment in your mouth, close your eyes, and bite down. Pay attention to how the juice bursts in your mouth and fills it with flavour. (record answer to question 6)

8. Place another segment in your mouth, close your eyes, and bite down. Chew slowly and experience the texture of the membrane. *(record answer to question 7)*

9. Record answers to questions 8 and 9.

Appendix B

Mindful Eating Response Questions

Be sure to be very descriptive in your answers.

1. Appearance	
2. Texture	
3. Smell	
4. Smell after peeling	
5. Inner structure	
6. Flavour	
7. Texture of membrane	
8. Describe this as if it were the last clementine on earth	
9. Do you usually eat your food like this? What would happen if you ate all your food like this?	

Appendix C

Responses to "Cooking as Alchemy"

What was special about the paper they printed and sold with food?	
What was special about the burger they created?	
What food was used to create a food similar to tuna?	
Customers ate a combination of hay and crab apples, what did they think they were eating?	
What was the speakers' long term goal?	
What is one implication of this food research?	

Appendix D

Anagram Word List (Frequent, Low Cognitive Stress)

1. BOLANLO _ _ _ _ _ _ _ *(BALLOON)*
2. OOALHCL _ _ _ _ _ _ _ *(ALCOHOL)*
3. RUTOIEN _ _ _ _ _ _ _ *(ROUTINE)*
4. RSADESD _ _ _ _ _ _ _ *(ADDRESS)*
5. PADTNIE _ _ _ _ _ _ _ *(PAINTED)*
6. SOOFEAD _ _ _ _ _ _ _ *(SEAFOOD)*
7. EDRCKCA _ _ _ _ _ _ _ *(CRACKED)*
8. RTAHEYP _ _ _ _ _ _ _ *(THERAPY)*
9. LBARIYR _ _ _ _ _ _ _ *(LIBRARY)*
10. OELWECM _ _ _ _ _ _ _ *(WELCOME)*

Appendix E

Anagram Word List (Infrequent, High Cognitive Stress)

1. IANUTCL _ _ _ _ _ _ _ *(LUNATIC)*
2. IUJRPEN _ _ _ _ _ _ _ *(JUNIPER)*
3. MSSIHAI _ _ _ _ _ _ _ *(SASHIMI)*
4. LEEKULE _ _ _ _ _ _ _ *(UKELELE)*
5. ENINVOS _ _ _ _ _ _ _ *(VENISON)*
6. COETENA _ _ _ _ _ _ _ *(ACETONE)*
7. RHETHWI _ _ _ _ _ _ _ *(WHITHER)*
8. CINUSIE _ _ _ _ _ _ _ *(CUISINE)*
9. ICRUANM _ _ _ _ _ _ _ *(CRANIUM)*
10. IORNEMB _ _ _ _ _ _ _ *(BROMINE)*

Appendix F

Cognitive Stress Questionnaire

Please answer each question on a scale of 0 – 10.

0 (Highly Disagree) -------- 5 (Neither Agree nor Disagree) -------- 10 (Highly Agree)

1. I am pretty good at word puzzles, such as anagrams and crosswords _____
2. I find it difficult to remember things I have to do, unless I write them down _____
3. I find it easy to remember the names of people I meet _____
4. I get stressed easily when doing a task that is very difficult _____
5. I am good at remembering directions to a new location _____
6. I enjoy doing word puzzles (anagrams, crosswords) _____
7. I remember everything from the first part of this study _____
8. I found the anagram task in this study to be quite stressful_____
9. If a friend told me his/her phone number, I would remember it after hearing it only once _____
10. I am more stressed right now than I usually am _____