RETRAINING THE BRAIN TO PREVENT DISORDERED EATING: APPROACH VERSUS AVOIDANCE

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Retraining the brain to prevent disordered eating: Approach versus avoidance

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ABSTRACT

Emerging adult college women are at particular risk for developing unhealthy eating habits. Despite this, methods of intervention in this population are understudied. This study sought to test whether an implicit, cognitive retraining program could alter how women approach foods. Specifically, the researcher wanted to determine if the Behavioral Activation System (BAS), which encourages individuals to approach positive goals, and the Behavioral Inhibition System (BIS), which helps individuals avoid negative outcomes, could be manipulated. Thus, this study examined whether a dot-probe retraining program could significantly alter women's approaches to healthy foods. Dot-probe programs present two pictures side-by-side; when the pictures disappear, a stimulus, in this case a "+", appears where one of the pictures was previously located. In this project, participants assigned to an experimental training program would have the "+" located under healthy foods most of the time, in order to encourage BAS activation and approach behaviors. In addition, because it is imperative to understand how women's families affect their thin ideal internalization (i.e., drive for thinness and restraint) and their approach/avoidance habits, the quality of past and current parent-daughter relationships were examined. Indeed, no known research has examined how the parent-child relationship may affect BAS/BIS usage. Forty emerging adult women were recruited; half were assigned to an experimental training group, while the other half completed a sham training group, in which they equally reacted to all foods. Participants were asked to complete five sessions on their own devices, in their chosen environment. By the final training sessions, those in the experimental group (n = 15) reacted to healthy foods two times faster than those in the sham group (n = 15). In addition, a series of moderation analyses found that, even when participants had high levels of thin ideal internalization, positive parenting characteristics such as a current high-quality mother-

daughter relationship and past low paternal control improved participants' reaction times to healthy foods. These findings suggest that a combination of both a biologically-based method of intervention and a family systems intervention may lead women to have healthier approaches to foods, thereby potentially preventing the development of unhealthy eating habits.

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INTRODUCTION

Eating disorders, which are "characterized by a persistent disturbance of eating or eating-related behavior that results in the altered consumption or absorption of food and that significantly impairs physical health or psychosocial functioning" (American Psychiatric Association, 2013), are growing in prevalence among both child and adult populations. For instance, a recent large-scale study found that approximately 2.2% of men and almost 5% of women in the United States will meet the criteria for a diagnosed eating disorder, including Anorexia Nervosa (AN), Bulimia Nervosa (BN), Binge Eating Disorder (BED), and Otherwise Specified and Feeding Disorder (OSFED), at some point in their lifetime (Duncan, Ziobrowski, & Nicol, 2017). These numbers may be even higher, as Eating Disorder not Otherwise Specified and/or Other Specified Feeding and Eating Disorder, which include atypical diagnoses that still significantly impair life functioning, were not studied. Such high rates of clinically diagnosable eating disorders are concerning, as they have the highest frequency of mortality of any mental illness; for instance, those with AN are over five times more likely to die than those without an eating disorder (Fichter & Quadflieg, 2016).

Symptoms of eating disorders range from lanugo, or the development of downy hair to keep in body heat, to decaying teeth, more breakable bones, kidney malfunctions, and heart failure. Furthermore, those with eating disorders often have other comorbid psychiatric illnesses, such as depression and anxiety disorders. Comorbidity dramatically increases rates of mortality; for example, one study showed an increase in natural and non-natural deaths in patients with AN versus AN with another comorbid diagnoses from 5.9 to 23.5, compared to someone with no diagnoses (Kask et al., 2016).

While these numbers are troubling, women in college are at even greater risk for the development of eating disorders, and therefore their potentially deadly side effects. For example, while 5% of the general female population may suffer from an eating disorder at some time in their lives, 13.5% of college women have been found to have a diagnosable disorder (Eisenberg, Nicklett, Roeder, & Kirz, 2011). In addition, rates of subclinical disorders may be even higher; 40-49% of one Midwestern female college sample endorsed using at least one disordered behavior at least once per week (e.g., vomiting, excessive exercising, fasting; Berg, Frazier, & Sherr, 2009). Therefore, women in college may be in particular need of intervention, given the high proportion of those engaging in unhealthy, dangerous behaviors.

However, eating disorders may also begin earlier in childhood; Deleel and colleagues (2009) found that not only were 35% of 9- and 10-year-old girls unhappy with their body sizes, but 7 to 11% of those girls already met diagnostic criteria for AN. Furthermore, children are even more likely to suffer from subclinical levels of disordered eating. This means that they have eating habits that are maladaptive and detrimental to both their physical and mental well-being, such as restrictive dieting, emotional eating, and purging, but which do not fully meet the criteria for an eating disorder. For instance, Evans, Tovee, Boothroyd, and Drewett (2013) found that a normative sample of girls ages 7 to 11 already exhibited subclinical disordered eating habits; similarly, 17% of a sample of 8- to 12-year-old girls were found to have such habits (Erickson & Gerstle, 2007). This is problematic, as disordered eating habits may lead to more severe symptomology later in life.

Indeed, body dissatisfaction and drive for thinness begin developing even before subclinical disordered eating habits, which is concerning, as they are also linked to the development of more enduring, severe eating disorder symptomology even in children (e.g.,

Deleel et al., 2009; Erickson & Gerstle, 2007; Evans et al., 2013). For instance, by ages 4 to 6, girls already suggest that being or becoming fat would be unacceptable (Musher-Eizenman, Holub, Edwards-Leeper, Persson, & Goldstein, 2003); this indicates that they are experiencing thin ideal internalization, meaning that they believe societal messages regarding the idea that slimmer body types are the most desirable. Indeed, in interviews with 5- to 6-year-old children, they already emphasized wanting to be thinner and associated negative qualities (e,g., being mean) with those who were overweight (Birbeck & Drummond, 2006). Furthermore, not only do 46.7% of 6-year-old girls already indicate that they want to be thinner, almost half of girls ages 5 to 8 indicate that they would make active changes to their eating habits (e.g., diet) if they started gaining weight (Dohnt & Tiggemann, 2006). Relatedly, body esteem, or one's positive feelings about one's body, decreases as body size dissatisfaction increases from ages 5 to 8 (Dittmar, Halliwell, & Ive, 2006). These numbers increase dramatically throughout adolescence and emerging adulthood; for instance, over 70% of young women have indicated that they wanted to be thinner (Schneider et al., 2013). It is the escalation of such beliefs about the body from childhood and on that may play a pivotal role in creating an environment for college women in which new, normative college stressors (e.g., stress, lack of feeling in control) may lead to the use of unhealthy coping mechanisms to regain control or a sense of emotional relief.

Consequently, it is imperative to understand what childhood factors may be strongly related to young adult disordered habits, as such childhood factors are malleable and amenable to change; intervention and treatment in adulthood are often more challenging. As such, while this study focused on intervening in the eating habits of college women, who are uniquely at risk for disordered eating, it also examined both current and past (i.e., during childhood) familial factors. By examining both current and past relationships, it may be possible to better understand what

familial patterns can provide a barrier against disordered eating, and what current relationship types aid in promoting healthier eating habits.

While it is true that younger children may have more flexible eating habits, this study focused on college students ages 18-25 for two main reasons. As previously stated, college students are at a uniquely high risk of developing an eating disorder compared to the general population (e.g., Eisenberg et al., 2011), indicating that they are in particular need of effective preventive and interventive methods. In addition, emerging adults' frontal lobes are still developing, in particular their prefrontal cortex, meaning the areas in which decision making and planning are controlled are still growing and malleable (e.g., Sowell, Thompson, Holmes, Jernigan, & Toga, 1999). Therefore, testing this model with emerging adult college students is crucial as this population is in high need of effective, noninvasive intervention and prevention strategies, while simultaneously endowed with the requisite brain plasticity to still be relatively amenable to change. In fact, college-attending emerging adults have been specifically highlighted by the field as a group who are in need of intervention, located in an easily accessible environment, yet surprisingly unstudied (Nelson, Story, Larson, Neumark-Sztainer, & Lytle, 2008).

Finally, while it will eventually be important to test preventative and interventive models with men, even girls as young as 3 to 5 show a differentially larger concern about body image than boys at that age (Tremblay, Lovsin, Zecevic, & Lariviere, 2011). Indeed, regardless of whether girls and boys ages 5 to 12 are underweight, average, or overweight, girls continue to display higher levels of body dissatisfaction than boys (Duchin et al., 2014). Furthermore, even though college men are more likely to suffer from eating disorders than the general male adult population at a rate of 3 to 4%, almost one in seven college females have a clinical disorder

(Eisenberg et al., 2011). These findings suggest that women may be in particular need of the development of interventive methods that take into account the lifelong factors that may leave them at such greater risk.

A Biologically-Based Intervention Method

It is possible that such a preventative method may be best based within individuals' biological and cognitive systems. Such a potentially successful method would allow for dissemination regardless of age, gender, sociodemographic status, and ethnicity. This is important, as factors such as education and ethnicity are rarely, if ever, significant predictors of eating disorder development (Mitchison & Hay, 2014); this means that eating disorder development cannot be predicted by someone's wealth, the color of his/her skin, or level of education. Therefore, this project proposed that a biologically-based method, specifically one that trains or retrains the Behavioral Activation and Inhibition Systems, may be used to reach those in need.

The Behavioral Activation and Behavioral Inhibition Systems. Gray (1970) first posited the existence of two brain-behavior systems that affect individuals' reactions to stimuli: the approach system, referred to as the Behavioral Activation System (BAS), and the avoidance system, referred to as the Behavioral Inhibition System (BIS). The BAS activates behavior towards both conditioned and unconditioned incentives, meaning it influences individuals' inclination to approach desirable stimuli. The BAS pathway in the brain is not clearly defined, though dopamine pathways are hypothesized as an important part of this system (Gray & McNaughton, 2000); increased dopamine levels can lead to feelings of happiness, pleasure, and even euphoria, meaning that approaching desired stimuli would become increasingly rewarding.

As such, the BAS responds to signs of reward (e.g., pleasure), and activity in the BAS increases movement towards positive goals (Gray, 1990).

Conversely, the BIS looks for conflict in the environment, directs attention towards it, and facilitates defensive behavior away from the negative occurrences (Gray, 1970; Gray & McNaughton, 2000). This means that the BIS is sensitive to signals of punishment or nonreward; it encourages individuals to avoid stimuli that would lead to negative feelings, such as fear and anxiety. Unlike the BAS, the BIS functions through several different areas of the brain, such as the frontal lobe (Gray, 1990). Overall, the BAS regulates the use of approach strategies, whereas the BIS controls avoidance strategies.

In general, studies show that individuals who approach tasks in a positive, adaptive manner achieve more for their efforts, whereas those who perform in ways that avoid negative judgments are not as successful (Dweck, 1986). This means that those who have an intrinsic desire to do well tend to have higher levels of success and motivation, for example, in regards to educational achievement. Such findings can be directly linked to approach/avoidance and BAS/BIS activity. Indeed, it has been found that those who employ the BAS and approach orientations move towards desirable goals and strive to achieve those goals, such as wanting a good grade on an exam. In contrast, individuals with an avoidance orientation focus on undesirable outcomes and seek to move away from those outcomes, such as studying to avoid doing poorly on an exam in comparison to peers (Darnon, Butera, Mugny, Quimzade, & Hulleman, 2009; Elliot & Church, 1997).

There is ample evidence that maladaptive BAS/BIS activation is associated with a wide range of negative behaviors and beliefs. For instance, Rinck and Becker (2007) found that those with ingrained fears towards spiders avoided images of spiders more rapidly than those without

such fears. This suggests that their BIS may be overly reactive towards such stimuli. Similarly, there is evidence that those with depression may be overly focused on negative affect. Indeed, Nasrin and colleagues (2017) found that even a single training session that encouraged those with depression to focus on images of faces displaying positive affect (e.g., smiling) had significantly lower levels of depression than those who did not receive such training. This indicates that an overly reactive approach system to negative stimuli influences maladaptive feelings and beliefs, whereas healthier approaches (e.g., towards positive stimuli) leads to healthier attitudes.

In addition, approach/avoidance mechanisms have been studied in the context of smoking and alcohol use cessation. In general, avoidance training programs seek to alter BAS/BIS activity, such that individuals who have an overly reactive BAS towards unhealthy stimuli are trained to approach alternative stimuli. This may be done by drawing participants' attention away from unhealthy stimuli, towards either neutral or more adaptive stimuli, such that BAS activity is altered through cognitive retraining. For instance, in those attempting to recover from alcohol addiction, a retraining program, in which participants were trained to focus on non-alcoholic stimuli over alcohol drinks, was found to successfully reduce rates of relapse both in the short term, and a year into recovery (Eberl et al., 2013). Therefore, their BAS' were no longer as automatically reactive towards alcohol. It has also been shown that those who are current smokers have strong approach tendencies towards smoking related stimuli, even compared to those who used to smoke but quit (Wiers et al., 2013); studies have indicated that training smokers to avoid smoking-related stimuli has subsequently been associated with less cigarette use (e.g., Wittekind, Feist, Schneider, Moritz, & Fritzsche, 2015). These studies provide ample evidence for use of BAS/BIS retraining in changing maladaptive behaviors.

The approach/avoidance paradigm may also be theoretically applied to eating habits. For instance, those with maladaptive eating habits may have an overly reactive BAS in relation to unhealthy foods; they could experience increased dopamine levels when viewing or ingesting unhealthful foods, which would lead to increased approach strategies towards such foods. Conversely, those with an overly reactive BIS in relation to foods could have strong avoidance tendencies towards foods in general, such that they find eating to lead to anxiety or fear of gaining weight. Indeed, there is a burgeoning field of research regarding the BAS/BIS and approach/avoidance habits with food, and specifically, with retraining such habits to encourage healthy behaviors.

The BAS/BIS and food. Limited preliminary evidence for the translation of the previous training studies to the domain of healthy and unhealthy eating indeed exists. For instance, there is some research establishing the presence of dysregulated BAS/BIS usage and eating disorders. Those with BED, characterized by the compulsion to overeat, have been shown to overly value (or approach) high caloric food in self-reports (Leehr et al., 2016). In addition, a modified dot-probe task (described below) has been used to show that adult patients with BED continue to focus their attention on food stimuli throughout a singular testing period, compared to healthy patients who initially focus on food, but quickly devalue it (Deluchi, Costa, Friedman, Goncalves, & Bizarro, 2017). While these studies are not causational, they provide evidence for the idea that those who compulsively overeat may have overly reactive approach strategies towards all foods, particularly those foods that are high in calories; such individuals may therefore benefit from avoidance training to implicitly change their reactions to unhealthy foods.

Conversely, AN is partially characterized by an aversion (or avoidance) to eating foods. Indeed, in a study with healthy individuals versus those hospitalized due to AN, while healthy

control patients showed a natural approach bias towards foods in general, those with AN did not (Paslakis et al., 2016). In addition, adolescent patients with AN have demonstrated avoidance biases with most foods, though interestingly, Neimeijer and colleagues found that AN patients did have an approach bias towards low calorie foods before approach/avoidance training (Neimeijer, de Jong, & Roefs, 2015; Veenstra & de Jong, 2011). Put together, these findings indicate that while those with BED overly approach all foods, those with AN tend to overly avoid most foods. Therefore, training individuals suffering from maladaptive approach/avoidance tendencies, such that those with restrictive tendencies are implicitly taught to approach a wider variety of foods while those with overeating are taught to approach healthier foods and avoid unhealthy foods more, may benefit eating disorder recovery.

BAS/BIS training and retraining with foods. Given the above evidence, as well as the success of BAS/BIS training in other domains, there has been a recent burgeoning of research into training and retraining approach/avoidance strategies. Unfortunately, little of this research has been done with subclinical or clinical eating disorder populations, despite the serious health consequences associated with such disorders. However, what limited research is available shows promise. For instance, in a small sample of nine adults, Boutelle and colleagues (2016) found that training participants to avoid the names of high caloric food (e.g., cake) and approach neutral words (e.g., pencil) resulted in reductions, both short-term and at two-month follow-up, in emotional eating, binge eating, and global disordered eating symptoms, though not in bulimic symptomology. In addition, Brockmeyer and researchers (2015) found that, among adults with subclinical bulimic symptomology, a five week training program using pictures, not words, was effective in changing participants' unhealthy approach strategies with high caloric food, such that most not only approached those foods less, but even began to avoid them. These studies

suggest that BAS/BIS retraining can effectively counteract the unhealthy approach/avoidance habits of those with disordered eating and clinical eating disorders.

While these results are certainly encouraging, it is imperative to understand how to best prevent the development of disordered habits that negatively affect individuals' mental and physical health. As a result, there has been a greater focus in the field on eating habits and approach/avoidance retraining in general, particularly for adult populations. These studies generally employ three strategies for training implicit responses to foods: 1. Approach Avoidance Tasks (AAT), 2. Go/no-go and stoplight paradigms, and 3. dot-probe tasks.

AAT. The AAT is one of the most frequently used approach/avoidance paradigms. In AAT tasks, participants use either a joystick or a mouse to avoid (push the joystick/mouse away from their bodies) or approach (pull the joystick/mouse towards their bodies) an image, based on a benign characteristic of the image unrelated to the study objective. For example, participants may be told to make landscape-oriented pictures smaller until they disappear, and portrait-oriented pictures larger, or make pictures of food on a round plate smaller and pictures of food on a square plate larger. Making the picture smaller until it disappears would represent avoidance, whereas making the picture bigger until it takes over the screen would represent approach. In terms of approach/avoidance training, such benign characteristics will be purposefully aligned with the characteristic of interest. For instance, if the goal is to train participants to avoid unhealthy foods, participants might be told to make pictures with a landscape orientation smaller, which will actually be all unhealthy foods, and make pictures with portrait orientations larger, which will be all healthy foods. Therefore, participants are not explicitly focusing on the variable of interest (healthy versus unhealthy foods), but on a neutral characteristic. Conversely, for patients with overly strong, maladaptive food avoidance

tendencies (e.g., those with AN), participants might be told to make pictures larger, or approach, images of foods that are on a square plate versus a round plate; foods would be located on the square plate, while non-food stimuli would be on the round plate.

One recent, extensive test of approach/avoidance food behavior with female college students failed to conclusively prove that the AAT could change avoidance behavior. In this study, three separate trials of the AAT were completed, with the protocol altered each time in the hopes of developing a successful food training paradigm. In the first trial, Becker and colleagues (2015) compared the effects of a training program to encourage avoidance of unhealthy foods versus a sham trial (in which participants equally avoided healthy and unhealthy foods). While there was limited success (e.g., participants in the experimental trial reported eating less frozen foods after a week versus those that were in the sham trial), findings were mostly inconclusive. Therefore, they repeated this protocol with a larger sample size in the second study, but found no differences at all between the experimental and sham groups in terms of food choices. Finally, in the third study, they attempted to create a more specific training program, such that only chocolate was used as the unhealthy stimulus, versus a non-food stimulus (e.g., pencils). While those high in self-control did exhibit more avoidance tendencies to chocolate after training, those in the experimental condition actually ate more chocolate than those in the sham condition. Therefore, despite their efforts, no significant, long-lasting differences in avoidance behaviors or amount of food consumed after training were found. Importantly, they did not attempt to train these behaviors over time, but instead had single-session trainings, in which participants were only taught to avoid chocolate or unhealthy foods.

Subsequently, another study by Dickinson, Kavanagh, and MacLeod (2016) sought to expand upon their findings by teaching college students to either avoid (push the joystick away

from them 90% of the time) or approach (pull the joystick towards them 90% of the time) chocolate, unlike Becker and colleagues (2015) who only compared the training to a sham (approach/avoid equally) group. Participants were told to push or pull the joystick depending on whether the images were portrait- or landscape-oriented. Dickinson and colleagues (2016) found that participants were learning to avoid chocolate faster than participants were learning to approach chocolate, but still found no differences in amount of chocolate consumed after training; those in the avoidance group actually consumed slightly more chocolate than those in the approach group. However, it is important to note that this was also a single training session. In addition, those in the avoidance training group had a higher initial approach bias to chocolate at pre-test than the approach group.

Conversely, Schumacher, Kemps, and Tiggemann (2016) found that a single AAT session did successfully train emerging adult women in the avoidance group to approach chocolate less, as well as consume less chocolate after training. However, Shumacher and colleagues (2016) used non-chocolate sweet foods as alternative stimuli, rather than non-food stimuli. In addition, Kakoschke, Kemps, and Tiggemann (2017) completed a study with undergraduate women in which they compared the AAT to a Go/no-go task (discussed below), using multiple food stimuli, not just chocolate. They found that, while both the AAT and the Go/no-go tasks taught participants to avoid unhealthy foods, only the AAT significantly predicted food choice, such that those in the AAT training group made healthier food choices than both the Go/no-go group and the control group. In contrast to the previous studies, which used a taste test and measured amount of foods consumed, the food choice test involved simply choosing a snack from a variety of available healthy or unhealthy options. This indicates that

training may be effective in altering choices in real world settings, compared to the more inconsistent results with the forced food taste tests.

In summary, there is limited support for the use of the AAT in the food training domain. It is possible that the use of chocolate in the first studies may have limited the applicability of the program to eating in general, as chocolate may not be generalizable to unhealthy eating. Indeed, this may explain the comparative success of those studies that used a wider variety of foods (e.g., Kakoschke et al., 2017; Shumacher et al., 2016). Chocolate, in moderation, is not necessarily unhealthy, and therefore may not have elicited the desired response. In addition, these studies were limited to one session; it is possible that the unsuccessful studies may have been effective if training sessions were repeated. Despite the success of those studies that used a wider variety of training stimuli, more research is needed in order to determine if the AAT can successfully retrain approach/avoidance habits; multi-session studies in particular are necessary. However, a different training paradigm may provide more optimal results in terms of assisting individuals in leading healthier lives.

Go/no-go and stoplight tasks. Go/no-go and stoplight tasks have been used most extensively in studies to train participants to inhibit their responses to unhealthy foods. In such tasks, participants are given cues (e.g., a green versus red stoplight) about whether or not to respond to stimuli. When given a green light, participants indicate whether or not the indicated stimulus (e.g., healthy food) is on the right or left side of the screen, compared to a control stimulus. However, if a red light is present, participants must refrain from pushing a button. To train inhibitory responses, red lights may be paired with unhealthy foods, so that participants are trained not to respond to such foods. In addition, auditory cues (e.g., a tone played through

headphones) may be used to indicate that participants should refrain from responding to the stimuli.

Houben (2011) used such a task to train female undergraduates not to respond to certain types of high caloric foods; specifically, in the food inhibition trial, participants were told to press left on a keyboard if food-related images appeared (e.g., nuts, M&Ms), and right if neutral stimuli appeared (e.g., chairs). However, auditory stop signals would occur before food pictures, indicating that participants should refrain from responding to the image. This study found that, for participants who initially struggled to inhibit their desire for foods, the training task significantly reduced the amount of unhealthy foods consumed in a bogus taste test. Similar studies with chocolate and unhealthy foods revealed comparable inhibitory training, such that participants avoided those foods more, and consumed less, even when they had stronger appetites, high Body Mass Indices (BMIs), but no strong dieting goals (e.g., Houben & Jansen, 2015; Veling, Aarts, & Stroebe, 2013; Veling, van Koninsbruggen, Aarts, & Stroebe, 2014). Indeed, such tasks have been shown to reduce measured weight two weeks after training and self-reported weight after six months in adult men and women when compared to a control group, as well as been associated with consuming healthier foods outside of the lab (Blackburne, Rodreiguez, & Johnstone, 2016; Lawrence, Verbruggen, Morrison, Adams, & Chandler, 2015).

One study found that, when female student participants were trained to avoid eight images of crisps (chips) and eight other food images (e.g., pasta), avoidance training effects were strong, such that all participants in the stop-signal avoidance group ate less crisps (Study 1; Lawrence et al., 2015). Conversely, when more mixed unhealthy stimuli were included (e.g., eight images each of: crisps, chocolate, pasta, and pancakes) and the taste test included both crisps and chocolate, the avoidance training was most evident for those who already exhibited

dietary restraint (Study 2; Lawrence et al., 2015). While this could imply that selecting a limited number of foods may be more effective, it is also possible that training to avoid a single unhealthy food (e.g., chips), may not generalize to unhealthy foods overall, but instead just to the chosen unhealthy food.

While these tasks show promise, not all studies have been successful. For example, Allom and Mullan (2015) found that a stop signal task completed online, in-home, in which undergraduate participants were taught to inhibit their reactions to unhealthy foods (e.g., an auditory tone would occur after unhealthy images, indicating that participants should not respond) did not produce significant differences in self-regulation at one-week follow-up. Generally, however, go/no-go and stoplight tasks do provide evidence for the success of approach/avoidance retraining programs with food stimuli. Despite some mixed evidence for the number of food stimuli used and the long-term effectiveness of such programs, overall, efforts to train adults have been fairly successful, despite individual differences (e.g., BMI).

Dot-probe tasks. Finally, dot-probe tasks have been used somewhat infrequently for training approach/avoidance techniques with food. In such tasks, two images appear next to each other on a computer screen (e.g., a picture of a "healthy" food like broccoli appears next to a picture of an "unhealthy" food like cake). When those images disappear, a plus sign (+) is revealed, located where one of the previous images was (e.g., if participants were being trained to approach healthy foods and the healthy food was on the right side of the screen, the "+" would be oriented on the right side of the screen as well). The participants are instructed to simply click the "+" once it appears. If participants use avoidance techniques towards unhealthy foods, they may then take longer to click on the "+" when it appears under unhealthy stimuli. Conversely, if they are using approach strategies towards healthy foods, they will more rapidly click on "+"

that appear where healthy foods were located. Training programs can be created that purposefully place the signs under particular types of stimuli, in order to implicitly train participants to begin to look for the "+" under those types of images. For example, if the goal is to train participants to approach healthy foods, all or a majority of "+" will appear oriented on the side of the screen that the healthy food appeared.

In one example, Kakoschke, Kemps, and Tiggemann (2014) used a dot-probe training task (healthy versus unhealthy food stimuli, or neutral versus neutral stimuli) to teach undergraduate women to either approach healthy foods or approach unhealthy foods. Specifically, a healthy food (e.g., fruit) would appear next to an unhealthy food (e.g., chips), or two non-food images would appear next to one another (e.g., a giraffe and a koala). A "+" would appear where one of the pictures was previously located; for those taught to approach healthy foods, the "+" appeared where the healthy food was located 90% of the time. In contrast, for those taught to approach unhealthy foods, the "+" appeared where the unhealthy food was 90% of the time. While the unhealthy training task group did not show significant differences from baseline to follow-up, those in the healthy training task did. Participants in the healthy approach group were also significantly more likely to choose healthy snacks over unhealthy snacks. This suggests that training participants to approach healthy foods (and subsequently avoid unhealthy foods) may be a particularly useful method of cognitive retraining.

Similarly, Kemps, Tiggemann, and Elford (2015) found that five weekly training sessions led to increased avoidance of chocolate-related stimuli, though a single training session did not. A related study found that, despite the fact that obese participants showed an initial attentional bias towards food when compared to average weight participants, an avoidance dot-probe training paradigm was still successful in altering their reactions to food. Importantly, these

findings went beyond just the retraining program. Participants in the avoidance training were also significantly less likely to think of food-related words at post-test, when given word stems and asked to complete the words (Kemps, Tiggemann, & Hollitt, 2014). Kemps, Tiggemann, and Hollitt (2016) then sought to generalize these findings to a wider variety of foods, as well as neutral stimuli, and tested to see if training effects were still evident after a week. They found that food avoidance training was still indeed effective among overweight adults, and training effects were maintained over time. Therefore, while there are only a limited number of studies on dot-probe training, those studies suggest that it is relatively successful in altering motivations towards foods. Therefore, this study utilized a dot-probe paradigm, given its relative rate of success in comparison to the other methods.

Limitations. While the previous studies show promise, there are several notable flaws. First, a recent metaanalysis by Jones, Hardman, Lawrence, and Field (2017) found that the majority of studies do not include control groups, use only single session training paradigms, and do not take place in realistic, at-home settings. These limitations have led to an overall uncertainty regarding the effectiveness of such programs (Jones et al., 2017). Indeed, this is problematic when considering that emerging adult college students are at particular risk for the development of disordered eating habits (Berg et al., 2009; Eisenberg et al., 2011); it is unlikely that a single session would be effective, particularly long-term. In addition, college students frequently transition between dorm/off-campus housing to at-home housing; it is imperative that training is applicable to a variety of real-world settings, not only in-lab. Furthermore, because college students exhibit particularly high levels of disordered eating (Berg et al., 2009; Eisenberg et al., 2011), it is possible that simple exposure to healthy and neutral foods may alter their approach/avoidance strategies.

Therefore, the current study included two groups: one that completed an active training program, and one that completed a sham program that neutrally trained both approach and avoidance. In addition, those studies that did incorporate multiple training sessions into their design had participants complete sessions over several weeks; none tested the effectiveness of an intensive training protocol, meaning none had multiple sessions that occurred in rapid succession (e.g., multiple days in a row, versus once a week, multiple weeks in a row). This is imperative, as those who are suffering from high levels of disordered eating, as a large portion of female college students do (Berg et al., 2009; Eisenberg et al., 2011), may require a more intensive protocol. Indeed, it is possible that a higher dosage of trainings, such as several sessions within a week, may have a more pronounced effect on retraining implicit reactions. Thus, in the present study, participants were asked to complete five training sessions, one each day for five days, in order to determine if a short, intensive program may be more beneficial to participants than a single session paradigm, or an extended paradigm.

Second, the previous studies may be flawed in terms of their chosen stimuli. For instance, the majority of studies used a 100-0 distribution, such that participants would approach healthy foods 100% of the time, and avoid unhealthy foods 100% of the time. While this theoretically makes sense, this pattern allows for an easier recognition of the training program, meaning that participants may more easily guess the goal of the program. Indeed, Folkvord and colleagues (2016) found that when participants could guess the goal of the program, the training was not effective. It is crucial to consider that many emerging adult college students have taken research methods and psychology courses, and therefore may similarly be able to determine the purpose of a 100-0 distribution.

As a result, the present study employed an approximately 90-10 distribution, in order to make the goal of the training less obvious (Schoenmakers, Wiers, Jones, Bruce, & Jansen, 2007). In addition, all of the prior studies reviewed earlier involved either healthy, unhealthy, or neutral non-food stimuli. None have explored the role of "neutral" foods, meaning those that are rated as neither healthy nor unhealthy. Because moderation is key to a healthy diet, this study proposes that approaching neutral foods is also important. Specifically, this study led participants to approach healthy foods a majority of the time, followed by neutral foods, and unhealthy foods a minority of the time. The goal was to create an implicit bias towards a balanced diet, without potentially engaging in the "good" versus "bad" food narrative that is present in dieting culture, as college women are already particularly prone to such maladaptive beliefs (Berg et al., 2009; Eisenberg et al., 2011).

Third, the above-mentioned studies used the neutral versions of the training tasks (e.g., 50-50 distribution) to measure changes from baseline to follow-up. This is problematic, as completing such a program after training may serve to undo that training. Therefore, instead of risking undoing beneficial training, this study measured participants' baseline reaction times to foods, to their final training session reaction times. Given that emerging adult college women are already likely to suffer from high levels of disordered eating (Berg et al., 2009; Eisenberg et al., 2011), it is imperative that any benefits from the study are retained.

Finally, none of the current studies discussed the importance of family systems, or how individuals within a family affect one another. There has been increased interest in the field of family studies in looking at the presenting problem, in this case body dissatisfaction and disordered eating, as a whole. Researchers are increasingly noting the value of not only examining family dynamics, but the underlying biological factors that affect the disorder as well

(Campbell, 2004). Therefore, to develop the most effective prevention and intervention programs, it is imperative to understand what external factors (e.g., relationships with family members) may combine with the BAS/BIS to help promote or deter positive change. As such, a goal of this study was to understand how current and past supportive relationships, either via general parenting characteristics or lack of unhealthy modeling and pressures, may assist women in leading healthier lives.

A Brief Overview of Family Systems

This study focused not only on intervening in the eating patterns of women, but sought to understand how current and past maternal and paternal relationships may affect women's eating habits. Research has consistently shown that mothers and fathers both directly (e.g., through controlling food) and indirectly (e.g., through the parent-child relationship) affect girls' eating behaviors. For instance, when mothers restrain children's eating, even girls as young as 4 begin to associate positive characteristics with thin figures (Damiano et al., 2015), and when fathers and mothers make negative comments about adolescent girls' weight, girls are more like to have higher body dissatisfaction, drive for thinness, and bulimic symptoms (Rodgers, Faure, & Chabrol, 2009). Finally, low levels of family social support have been specifically associated with greater disordered eating, above and beyond peer support, for early emerging adults (Kirsch, Shapiro, Conley, & Heinrichs, 2016).

Family Systems Theory provides a potential explanation for such relationships. Specifically, it is believed that family members do not act as individual units, but instead as dyads (e.g., mother and daughter, father and daughter, mother and father) that interact to affect the family, or system, as a whole (Whitchurch & Constantine, 2004). One of the basic tenets of Family Systems Theory is holism, or the belief that individual factors must not and cannot be

examined or understood in isolation; a phenomenon will only be understood when all of its components are examined as a whole. Indeed, families experience patterns of redundant activities, or transactions, which lead to the entrenchment of behaviors, both positive and negative (Whitchurch & Constantine, 2004).

Therefore, intervening in girls' eating habits and beliefs about the body may be more effective, particularly in the long-term, if the impact of family unit relationships are understood. The most effective training method may likely involve the family as a whole, but before relationships may be appropriately altered, it is first imperative to understand how family relationships affect women's habits. Emerging adult women, therefore, may best illuminate how both current and past family relationships affect both healthy and unhealthy eating, while younger samples may not be able to appropriately convey such effects, particularly the impact of indirect effects such as warmth and control.

Parental factors impacting girls' body satisfaction and eating. There is ample research showing the impact that women's environments can have on their eating habits and beliefs about the self. Sources in the environment range from girls' and women's families, to their friends and peers, to media, and an overall culture present in the Western world that emphasizes thinness over health (e.g., Culbert, Racine, & Klump, 2015; McCabe & Ricciardelli, 2001). Though an internalized, healthy approach towards food as described above may counteract these external influences, it is undoubtedly important to build the healthiest environment possible for girls and women. Therefore, this study examined maternal and paternal relationships with their children, both in general and in terms of eating and body image. While it would be ideal to include all family members, parents were chosen for this study as research suggests that they may have the strongest overall impact on girls' body image and eating habits

(e.g., compared to siblings; Rodgers & Chabrol, 2009). Indeed, while Family Systems Theory suggests that all units within a family work together as an integrated system, it is also true that certain dyads within each system may be more strongly linked (Cox & Paley, 2003). Research indicates that this may be the case for women; while siblings affect girls' body image, the mother-daughter and father-daughter dyads most strongly influence body satisfaction (Rodgers & Chabrol, 2009).

Such strong parental effects may be explained by the nature of the parent-daughter relationship. In general, children who are raised by parents who are warm (i.e., responsive to children's thoughts and emotions) and who express moderate levels of control (i.e., set realistic boundaries and rules that they then discuss with their children) grow up to experience less mental health difficulties than children with parents without those characteristics (Baumrind, Larzelere, & Owens, 2010). This type of parenting can be referred to as authoritative parenting (Baumrind, 1971). Conversely, parenting characterized by low warmth and high control, known as authoritarian parenting, and parenting characterized by high warmth and no control, known as permissive parenting, have been associated with more maladaptive behaviors and beliefs (Baumrind, 1971, Baumrind et al., 2010).

Indeed, body satisfaction and healthier eating habits have specifically been associated with authoritative parenting. For instance, Haycraft and Blisset (2010) found that authoritarian and permissive parenting were associated with the development of disordered eating symptoms, poor body image, and particularly an internalization of the thin ideal in young girls (average age of 11), while authoritative parenting was not associated with such symptoms. This pattern holds true for women with clinical eating disorders, as their most commonly perceived type of early parenting style (e.g., before age 16) was authoritarian parenting (Jauregui Lobera, Bolanos Rios,

& Garrido Casals, 2011). In addition, college-age women's body satisfaction was significantly, negatively predicted by high levels of parental control (Sira & White, 2010).

There is even evidence that generational maladaptive parenting habits affect eating disorder development. Specifically, Canetti and colleagues (2008) found that not only did those suffering from AN indicate that their parents were low in warmth, but individuals had more disordered symptoms if there was also an uncaring relationship between their parents and the maternal or paternal grandmother of the individual. Furthermore, Jones, Blodgett Salafia, and Hill (2019) found that having two parents high in warmth protected women from developing high DFT, even when girls also experienced parental pressure to be thin. It is therefore imperative to acknowledge and address the potential effects of the parent-daughter relationship when attempting to alter women's beliefs and habits.

Parental modeling and direct commenting. Research has demonstrated clear links between both actual and perceived parental body dissatisfaction and drive for thinness, and girls' levels of these factors during childhood, adolescence, and emerging adulthood. For instance, when girls perceive their mothers and fathers to be concerned about their own weights, girls are more likely to restrain their own eating (Anschutz, Kanters, Van Strien, Vermulst, & Engels, 2009; Neumark-Sztainer et al., 2010). This may be because, as children, parents are the primary source of socialization (Furman & Buhrmester, 1992), meaning that children internalize parental beliefs and habits, including those regarding body dissatisfaction and eating. For instance, girls as young as five whose mothers were currently or had recently dieted were more likely to understand the concept of dieting to control weight than girls whose mothers did not report recent dieting behavior (Abramovitz & Birch, 2000). Importantly, this was true for both mothers who used modified (e.g., eat more vegetables and fruits) and restrictive behaviors (e.g., do not

eat even when they cook for family) to lose weight, suggesting that even maternal diet goals that appear healthy may still communicate unhealthy messages regarding thinness to children (Abramovitz & Birch, 2000). Conversely, Lam and McHale (2012) found that it was fathers' concerns about their weight, not mothers', that predicted adolescents' own concerns longitudinally. However, overall, these findings highlight that parental concerns about their own weights impact girls' beliefs about their bodies.

Parents' own body satisfaction also affects their restrictive tendencies with their children (e.g., what they actually feed to or encourage their children to eat), which in turn affects how girls diet. Indeed, mothers who are more concerned about their own shape, as well as those who adhere more strongly to societal body type ideals, are more likely to restrict their children's intake of unhealthy foods, encourage them to monitor their intake, and encourage them to eat specific types of foods (Damiano, Hart, & Paxton, 2016; Musher-Eizenman et al., 2003; Schreiber et al., 2014). Similarly, fathers who strongly adhere to beliefs about the thin ideal are more likely to have daughters who engage in bulimic behaviors (Dixon, Gill, & Adair, 2010). Parents with an internalized fear of being fat or gaining weight may be especially concerned about their child's own weight, leading to restrictive feeding habits. Daughters, in turn, are not only more likely to engage in the suggested restrictive tendencies, but to have lower levels of body satisfaction (Anschutz et al., 2009), as they begin to equate certain foods as being good versus bad, and internalize biases against being overweight.

Such restrictive tendencies are not only harmful to girls' body image, but often do not result in weight loss. In fact, when parents restrict access to certain foods, children are more likely to eat a significantly larger portion of that food later on, particularly when those children already displayed approach tendencies towards that food (Rollins, Loken, Savage, & Birch,

2014). This is because denying one's desire to eat a craved food often leads to increased cognitive desire of that food, which in turn increases the likelihood of binge eating of that food once cravings become too strong to deny, rather than eating foods in moderation when initially desired. One of the most common explanations for this phenomenon is the Ironic Processes Theory, originally proposed by Wegner (1994), which states that attempts to suppress certain thoughts actually lead to a rebound effect, during which those thoughts increase. For instance, in an experimental study, Anschutz, Engels, and Van Strien (2010) found that girls who indicated that their mothers encouraged them to be thin actually ate more snack foods after being exposed to both low and high calorie food commercials, not non-food commercials; this finding was particularly strong for low calorie, diet foods. The authors proposed that not only was there a rebound effect when children attempted to suppress desires for unhealthy foods, but that overencouragement to eat healthy, low calorie foods led to increased overconsumption of such foods; children had overly reactive approach strategies towards diet foods. This suggests that maternal encouragement of thinness may lead to more uncontrolled eating in children, as increased restriction of desirable foods may lead to binge eating of "forbidden" foods, while encouragement from parents to eat healthy, diet foods may lead children to perceive such foods as acceptable to eat in larger quantities. Indeed, both maternal and paternal encouragement to diet was related to increases in dieting for 11-year-old girls, such that they were twice as likely to restrict their intake than girls who were not receiving encouragement (Balantekin, Savage, Marini, & Birch, 2014).

Interestingly, when mothers rated low on intuitive eating (e.g., they eat for emotional reasons, not because of physical hunger cues), they were more likely to restrict their children's food intake (Tylka, Lumeng, & Eneli, 2015). One possible reason for this finding is that when

mothers do not trust their own internal hunger cues, they in turn do not trust their children's natural approaches towards foods, leading them to overly restrict unhealthy foods, as well as control the quantity of foods eaten. This is problematic, as it teaches children to ignore internal hunger cues. Both maternal and paternal emotional eating have also been associated with adolescent emotional eating (Snoek, Engels, Janssens, & Van Strien, 2007). Similarly, maternal and paternal external eating, defined as eating for reasons other than intrinsic hunger, such as smell, appearance, boredom, or negative affect, has been associated with children's increased desire to eat more foods in general and overweight, as well as their own later levels of emotional eating (Elfhag, Tynelius, & Rasmussen, 2010; Morrison, Power, Nicklas, & Hughes, 2013; Rodgers et al., 2013).

It is possible that parents may unintentionally model using food as a coping mechanism, in turn leading children to use the same strategies when experiencing negative affect. For example, higher levels of mothers' maladaptive eating behaviors have been associated with higher levels of girls' disordered eating, above and beyond girls' own body dissatisfaction (Gonçalves, Silva, Gomes, & Machado, 2012). Mothers who had eating disorders were also even more likely than their maternal counterparts to be concerned about their daughters' weight, which was associated with the increased prevalence of girls' disordered eating symptomology across time (Allen, Gibson, McLean, Davis, & Byrne, 2014). In addition, when fathers express concern about their daughter's weight, girls are more likely to engage in severe restriction (Vincent & McCabe, 2000). This emphasizes the importance of addressing parental beliefs about the body when developing interventions, to counteract the development or continued use of unhealthy tendencies, such as emotional eating.

These patterns continue into adulthood. For instance, parental childhood feeding practices such as pressure to eat continued to affect college age women's emotional eating, intuitive eating, and disordered eating (Ellis, Galloway, Webb, Martz, & Farrow, 2016; Galloway, Farrow, & Martz, 2012). In addition, parents restriction of food intake in childhood was significantly associated with emotional eating in college, such that higher levels of disordered eating were associated with students' recalled use of parental coercive feeding strategies (Williams, Dev, Hankey, & Blitch, 2017). Therefore, there is limited evidence that maladaptive childhood feeding strategies continue to affect adults' ability to eat healthily and feel confident with their bodies.

In addition, while there is also limited available research on concurrent parent-child relationships and women's disordered eating and body image, there is some evidence available that parents also simultaneously impact their daughters during emerging adulthood. For instance, when adult women feel pressured by family to change their weight, women are more likely to experience body dissatisfaction (Green & Pritchard, 2003). Indeed, receiving both positive and negative comments about weight from parents has been associated with levels of body dissatisfaction, particularly for college age women, which in turn is associated with higher levels of drive for thinness and bulimic symptomology (Rodgers, Paxton, & Chabrol, 2009). Finally, Abraczinskas and colleagues (2012) found that modeling of dieting behaviors by parents, in addition to direct comments, was also significantly associated with poor body image and disordered symptomology in college women.

Overall, these findings suggest that maternal and paternal beliefs about their own and their daughters' bodies are crucial when considering preventative efforts against the development of body dissatisfaction and disordered eating. Indeed, because families work as a system, it is

crucial to ensure that that system is healthy overall; without understanding parental impacts on women's approach and avoidance behaviors, future intervention efforts may fail to properly assist in the development of healthy eating. Indeed, even when mothers emphasize the importance of making positive comments about their daughters' appearance, they still frame comments about the body in terms of concern about girls' weight (McCabe et al., 2007). Therefore, including parenting measures when attempting to understand how to intervene in women's eating habits and beliefs about the body is imperative; failing to accurately incorporate family measures into future preventative efforts may leave women vulnerable to increased levels of dieting, body dissatisfaction, disordered eating, and potentially clinical eating disorder development.

Study Goals

This study sought to examine the effect of a dot-probe training program on the eating habits of women. The first goal of the study was to determine whether approach training towards healthful foods changed automatic reactions to food stimuli (i.e., after completing training sessions, do participants naturally focus on healthful foods over unhealthy foods?). As such, an experimental and sham training group were created, to control for natural fluctuations in approach/avoidance behavior over time.

The second goal of the study was to determine how parents impact their daughters' approach/avoidance habits with food. Specifically, would paternal and maternal habits such as their parenting styles, modeling of behaviors and beliefs regarding body dissatisfaction and eating, or parental comments and control over girls' eating potentially alter the effectiveness of such a program?

METHOD

Participants

Forty English-speaking 18- to 25-year-old women were recruited from the North Dakota State University student body. Participants had to have one of the following pieces of electronics, with access to the internet: a desktop computer, a laptop, or a tablet with a keyboard. A smartphone was not acceptable, as the pictures of food stimuli used in the project's training task would have been too small for participants to accurately observe. In addition, an on-screen keyboard could have obscured the photos, as such keyboards typically appear over a portion of the screen, and could therefore cover important parts of the stimuli. The above criteria were determined during the initial email eligibility discussion. Participants were recruited through listserv advertisements at NDSU.

The majority of participants identified as straight (n = 38; 95%), single (n = 26; 65%), and White (n = 36; 90%). Two participants (5%) identified as Asian/Asian American, one participant (2.5%) as Hispanic, and one participant (2.5%) as an ethnicity not named (other). The majority (n = 27; 67.5%) of participants were of average weight according to their BMI; one participant (2.5%) was underweight, eight were overweight (20%), and three (7.5%) were considered obese. One participant did not provide their weight and height. Two participants indicated that they currently or in the past suffered from an eating disorder, Binge Eating Disorder and Anorexia Nervosa.

Five participants (12.5%) either did not complete a training session, or no training sessions were eligible. Two (5%) participants completed one eligible session, three (7.5%) completed two sessions, four (10%) completed three sessions, nine (22.5%) completed four sessions, and seventeen (42.5%) completed all five sessions.

Procedure

After participants were screened in order to ensure that they meet the above criteria, they were assigned into either the experimental or sham training group. The first five participants were assigned to the experimental group, the second five to the sham training group, and so on, until 40 total participants were recruited. This strategy was employed in lieu of random assignment given the limitations of the software used for the training sessions; both the actual training and sham training could not be run at the same time. Both groups completed a short set of surveys, after which they were sent instructions for the training program. Once the training program was complete, a second set of surveys was emailed. All surveys and training sessions, experimental or sham, took place on participants' own devices, in their own location of choice.

Survey set one. After the initial screening, participants were sent a secure Qualtrics link to the first group of surveys. The first page was the consent form, and participants were not able to continue until they marked that they consented. If they chose no, they did not see any survey questions and were sent to a page thanking them for their time. If consent was given, participants completed demographic questions and a series of surveys, including the BIS/BAS scale, BIS/BAS food scale, and the parent-child relationship (past and current). Instructions for the online training were sent upon survey completion. Participants had their name entered once into a giftcard drawing for completing this stage. They were able to win one of two $50 or two $25 giftcards to Amazon.

Training. Participants were asked to complete the assigned program at least five out of seven days. For each training session completed, participants had their name entered one more time into the drawing (e.g., if they complete five sessions, their names were entered five more times).

Survey set two. After a week, the researcher sent the second set of surveys, which asked about issues related to body image and eating. At this time, the participants had their name entered into the drawing one more time, and, if they completed all five training sessions, became eligible to win an additional $100 giftcard.

Measures

Body mass index (BMI). BMI was computed for each participant, based on self-reported weight and height from the demographic data obtained in the first set of surveys. BMI was calculated using the formula: BMI = [Weight in pounds/(height in inches)^2] * 703 (Center for Disease Control). According to this formula, if participants have a BMI below 18.5, they are considered underweight. Those that have a BMI between 18.5 and 24.9 are considered to be of average weight, while those that have a BMI above 25.0 are considered overweight. Finally, those with a BMI of 30.0 or higher are considered obese.

Approach/avoidance dot-probe task – training. The training task involved forty-two sets of photos – 14 healthy-unhealthy pairs, 14 healthy-neutral pairs, and 14 unhealthy-neutral pairs. These pictures were taken by the researcher. The food was plated on the same square, white plate. Because the healthiness or unhealthiness of food can be considered subjective, a pilot survey was sent out through the NDSU listserv. In this survey, participants were asked to rate the perceived healthiness or unhealthiness of each food on a scale of 1 (very unhealthy) to 5 (very healthy). Furthermore, a Health Nutrition and Exercise Science faculty member was consulted in order to ensure that these foods were objectively healthy or unhealthy.

In the experimental version, a "+" appeared under the healthy pictures approximately 90% of the time, and the other pictures approximately 10% of the time; when neutral-unhealthy pairs were presented, the sign appeared under the neutral stimuli approximately 90% of the time,

and unhealthy stimuli approximately 10% of the time. Participants were instructed to press either a button on the left of the keyboard (i.e., E) or the right of the keyboard (i.e., I), depending on whether or not the + appeared under the left or right picture. However, the "+" was purposefully placed under healthy pictures the majority of the time, with the intention of implicitly training individuals to focus on the healthy stimuli. Because these pictures only appeared for 1,000 milliseconds, sets of photos were repeated twice, with 84 sets total; 28 healthy-unhealthy pairs, 28 healthy-neutral pairs, and 28 unhealthy-neutral pairs. For the sham training task, the same procedure was followed, except the "+" appeared equally under the types of pictures (e.g., for the healthy-unhealthy pairs, the "+" was under the healthy picture 50% of the time, and the unhealthy picture the other 50%).

Inquisit software by Millisecond was used for the tasks. This software allowed for data collection during the training sessions to occur online, on participants' own technology, in order to best mimic real world usage of the program. It asked users to download a small app, Inquisit 5 Player, to ensure that the program ran as smoothly as possible on each individual's own device; this is more effective than the use of just a web app, which could be prone to delays and malfunctions depending on the quality of the user's technology and internet connection. This technology also allowed the researcher to choose to make pictures a percentage of the screen size, rather than one standard size, so that they adapted to the size of the participants' devices. Importantly, this software provided a way for participants to complete the study at home (or in their environment of choice), on their own devices, and have that data saved in a way that was accessible by the researchers.

The software also came with a free library of premade scripts for those with a license, which could be altered for specific research purposes. It contained a generic dot probe task script

(see user manual at http://www.millisecond.com/download/library/v5/dotprobe/genericdotprobe_images/genericdotprobe_images.manual for more information), based on Miller and Fillmore (2010), that was adapted for this project. This script already contained the appropriate coding for a dot-probe task, as well as a user manual for how to edit it for the purpose of this study. This meant that, instead of having to develop a script specifically for this study, an empirically validated script was used and slightly altered to include the food picture stimuli. Daily reminders to complete this training program were sent to participants via email, text, or phone call, as per their choice; all participants chose to be reminded via email.

Parent-daughter relationship – current. The Parent-Adolescent Relationship Quality Scale (Moller & Stattin, 2001) was used to examine the quality of the current parent-daughter relationships. This scale consists of two subscales, one for each parent. Each subscale consists of six items. Item responses range on a scale from 1 to 5, but vary depending on the item. For instance, an example item and response set would be "How much does your *mother/guardian* mean to you?" on a scale of 1 (*nothing at all*) to 5 (*very much*). Another example item is "If you need advice on important questions, how often do turn to your *father/guardian*?" with items ranging from 1 (*almost never*) to 5 (*almost always*). The full composite scale has been shown to have good reliability with early emerging adult women ($\alpha = .92$; Moller & Stattin, 2001). This scale was administered with the first set of surveys.

Parent-daughter relationship – past. The maternal and paternal warmth and control subscales of The Sibling Inventory of Differential Experiences –Revised (SIDE-R; Barret-Singer & Weinstein, 2000) were used to examine components of the past mother-daughter and father-daughter relationships. There are 18 items total (9 per parent). Item response options range from

0 (*almost never*) to 3 (*almost always*). Example items include, "My mother/guardian has tended to favor me" and "My father/guardian has been strict with me." Subscales have been shown to have good validity and reliability with emerging adults (α's > .76; Barret-Singer & Weinstein, 2000). This survey was administered in the first survey set.

Approach/avoidance behavior. The BIS/BAS subscales (Carver & White, 1994) was utilized in order to measure approach and avoidance behavior among participants. This scale consists of four subscales: BIS (7 items), BAS Reward Responsiveness (5 items), BAS Drive (4 items), and BAS Fun Seeking (4 items). Items have response options ranging from a scale of 1 (*very false for me*) to 4 (*very true for me*), such that higher scores indicate higher levels of each behavior. An example item for the BIS scale is "I feel pretty worried or upset when I think or know somebody is angry at me." Example items for the BAS subscales, respectively, are "When I'm doing well at something I love to keep at it," "I go out of my way to get things I want," and "I'm always willing to try something new if I think it will be fun." These scales have been shown to have acceptable to good reliability in adult women (BIS α= .81; BAS Reward Responsiveness α= .67; BAS Drive α= .86; BAS Fun Seeking α= .81; Harrison, Treasure, & Smillie, 2011). These scales were administered in the first survey set.

Approach/avoidance with food. The 12-item Planning of Eating Behaviors Scale (Otis & Pelletier, 2008) was used to measure approach (6 items) and avoidance (6 items) behaviors specific to food. Items are scored on a scale of 1 (*Never*) to 7 (*Always*), such that higher total scores indicate higher approach or avoidance planning behaviors. Examples of approach items are, "I think about new and healthy recipes I want to try" and "I think about new fruits and vegetables to introduce into meals." Avoidance subscale example items are, "I think about ways to avoid temptations" and "I think about not looking at the dessert selection at restaurants."

Confirmatory factor analysis indicates that the approach and avoidance subscales represent two distinct types of food planning, and both subscales had good reliability with adult women, α's = .82, .84, respectively (Otis & Pelletier, 2008). This scale was administered in the first survey set

Drive for thinness. Women's DFT was measured using the Drive for Thinness Subscale from the Eating Disorder Inventory (Garner, Olmstead, & Polivy, 1983). This scale contains seven items which are scored on a six-point scale, ranging from 0 (*Never*) to 5 (*Always*), such that higher total scores represent higher levels of DFT overall. Sample items from the scale are, "I am terrified of gaining weight" and "If I gain a pound, I worry that I will keep gaining." This scale has been shown to have high reliability with adult women (e.g., α = .93; Lev-Ari & Zohar, 2013). This scale was administered in the second set of surveys.

Body dissatisfaction. The Body Dissatisfaction Subscale of Eating Disorder Inventory (Garner et al., 1983) was used to measure body dissatisfaction. This measure includes nine items, such as "I think that my stomach is too big" and "I think my buttocks are too large." Items are measured on a scale ranging from 1 (*Never*) to 5 (*Always*). Higher total scores indicate higher levels of body dissatisfaction. This scale has been shown to have high reliability with adult women (e.g., α= .90; Lev-Ari & Zohar, 2013). This scale was administered in the second set of surveys.

Dieting. The Dutch Eating Behavior Questionnaire (DEBQ) Restraint subscale (Van Strien, Frijters, Bergers, & Defares, 1986) was used to measure levels of dietary restraint. This scale consists of 10 items, scored on a scale of 1 (*never*) to 5 (*very often*), plus an additional 6 (*non-relevant*) option on 2 of the items. Higher scores indicate higher levels of restraint behavior. Example items are, "Do you deliberately eat foods that are slimming?" and "Do you deliberately eat less in order not to become heavier?" This subscale has been shown to have high factorial

validity using confirmatory factor analysis both in women with and without disordered eating (Wardle, 1987). It also has been shown to have high reliability with adult women (e.g., α= .92; Stepoe, Pollard, & Wardle, 1995). This scale was administered in the second set of surveys.

Parental impact on body image and eating habits. Maternal and paternal items were created based on the Perceived Sociocultural Pressure Scale (Stice, Ziemba, Margolis, & Flick, 1996) to examine parental pressures regarding thinness (Schaefer & Salafia, 2014). There are six items total; three per parent (the original scale only had items for "parent" in general). The three items are: "I've felt pressure from my mother to lose weight," "I've noticed a strong message from my mother to have a thin body," and "My mother teases me about my weight or body shape." Items are repeated for fathers. Response options range from 0 (*none*) to 4 (*a lot*). The overall scale has also been shown to have good validity, as well as reliability when used with adolescents (α = .80; Stice & Agras, 1998; Stice & Bearman, 2001; Stice, Spangler, & Agras, 2001). This scale was administered during the second set of surveys.

Parental modeling of eating behaviors. Maternal and paternal items were created based on the Bulimic Modeling Scale to examine how parents model poor eating habits (Stice, 1998). There are 10 items total; five per parent (the original scale only had items for "parent" in general). The five items are: "My mother has fasted, exercised excessively, or used laxatives or diuretics to lose weight," "My mother has dieted to lose weight," "My mother has felt bad about herself because of her weight," "My mother has gone on out-of-control eating binges (eaten huge amounts of food in a short period)," and "My mother has vomited to lose weight." Items are repeated for fathers. Response options range from 1 (*never*) to 5 (*often*). This overall scale has been shown to have good validity and reliability in young adult and adolescent females (α = .78; Stice, 1998). This scale was administered during the second set of surveys.

Analysis Plan

Training data were first cleaned. Incorrect trials (e.g., indicated that the "+" was on the left when it as on the right, or vice versa) were excluded. In addition, correct trials that took an unusually long time were excluded, by examining z-scores. Any responses that fell outside of two standard deviations were deleted. Finally, if a participant incorrectly chose under which picture the "+" appeared more than 25% of the time, that entire session was not included in analyses. This cleaning occurred in order to ensure that the data reflect the potential effectiveness of the program when participants were focused and adhering to instructions (e.g., not distracted by environmental noise, not just choosing randomly to get through the program, etc.).

Study 1. In order to determine if the training program trained women to have healthier approaches to food, whether or not participants clicked on healthy foods more quickly at their final training than the first training was examined. Only participants who completed at least three (i.e., a majority of sessions) were included. This resulted in 30 remaining participants, split evenly between the two training groups. Two paired sample *t*-tests were conducted in order to determine if there were significant differences in approach/avoidance behaviors between the initial training task and the final training task for participants in both the experimental group and the sham training group. In addition, an independent samples *t*-test was conducted in order to examine differences in approach and avoidance behaviors between the first and last training task, and between the experimental and sham training groups. All analyses were conducted using SPSS 25.0.

Study 2. Reaction times were created from the first testing session for all participants who completed at least one training session (n = 35). Missingness was examined and dealt with appropriately. For example, if a participant missed a survey item, and missingness appeared to be

completely random (e.g., there was no pattern to the missingness), pairwise deletion was used. Several analyses were run in order to determine the potential impact of familial factors on women's approach avoidance behaviors.

For the primary focus of Study 2, a series of hierarchical regressions were conducted in order to determine if familial variables significantly altered (i.e., moderated) the impact of women's own body dissatisfaction, dieting, and DFT on their approach/avoidance habits. For example, the effect of women's body dissatisfaction on their approach/avoidance with food, as impacted by perceived maternal high or low levels of bulimic modeling, was examined. Similarly, the effect of women's restrained eating on their difference scores, as impacted by parental warmth, was examined. All analyses were conducted using SPSS 25.0.

RETRAINING THE BRAIN: THE EFFECTIVENESS OF AN ONLINE APPROACH/AVOIDANCE FOOD TRAINING PROGRAM IN COLLEGE WOMEN

Abstract

Despite the abnormally high rates of clinical and subclinical disordered eating among college women, interventive methods continue to be understudied in this population. This study proposed that a biologically based, cognitive restructuring method may best assist women in developing healthier eating habits. Specifically, we sought to determine if a simple, online training task could teach women to more rapidly, yet implicitly, approach healthy foods, compared to unhealthy foods. In addition, while previous studies have used a variety of training paradigms, this study sought to further examine the effectiveness of the dot-probe task. Therefore, participants (*n = 30)* were asked to complete five training sessions, done over seven days; half of the participants were trained to approach healthy foods, while the other half were not trained to approach or avoid any food type. Compared to those in the sham training group, those in the experimental group reacted faster to healthy foods at the end of their training. This study suggests that, overall, the dot-probe training paradigm is effective in altering women's approaches to foods, and specifically that such a training task may be useful in intervening in or preventing unhealthy habits.

Introduction

Rates of eating disorders continue to grow among women in the United States; for instance, almost 5% of women will meet the criteria for a clinically diagnosable disorder at some point in their lifetime (Duncan, Ziobrowski, & Nicol, 2017). Interestingly, women in college are at particularly high risk of developing such disorders. For instance, Eisenberg and colleagues (2011) found that 13.5% of college women had a diagnosable disorder, and Berg, Frazier, and

Sherr (2009) found that up to 49% of college females identified as using at least one disordered behavior each week.

Such high rates of eating disorders and disordered eating behavior are concerning. Women who have eating disorders are at the greatest risk of death out of any mental illness, such that they are up to five times more likely to die, compared to those without an eating disorder (Fichter & Quadflieg, 2016). When women experience other comorbid disorders such as depression, mortality rates increase rapidly; for instance, an individual with both Anorexia Nervosa and another comorbid mental illness is 23.5 times more likely to die than someone with no disorders (Kask et al., 2016). Given the deadly consequences of eating disorders and disordered eating, in addition to the particularly high rates of such behaviors among college women, it is imperative that intervention methods for emerging adult women be examined. Indeed, despite a general overreliance upon college students in research in general due to their highly accessible location, researchers have identified college-attending emerging adults as not only in great need of intervention, but surprisingly unstudied in the area of health promotion and weight-related behavior change (Nelson, Story, Larson, Neumark-Sztainer, & Lytle, 2008).

One particularly understudied method of intervention is implicit, cognitive restructuring. While those interventions that do exist tend to focus on education or directly discussing eating habits and body image, it is important to address women's implicit reactions to foods. Emerging adult women's brains may be particularly malleable to implicit training programs, as important areas of the brain, such as the prefrontal cortex, are still developing at this time (e.g., Sowell, Thompson, Holmes, Jernigan, & Toga, 1999). Therefore, the current study sought to examine the effectiveness of an implicit intervention program with college-age women. Specifically, this intervention focused on retraining women's approaches towards healthy foods, by altering their

usage of the Behavioral Activation System (BAS) and Behavioral Inhibition System (BIS), and therefore how they approach and avoid foods.

A brief overview of the BAS/BIS. The BAS and the BIS are two brain-behavior systems that affect how individuals approach and avoid stimuli. Specifically, the BAS responds to desirable stimuli and rewards, hypothetically through the use of dopamine pathways, leading people to move towards positive goals (Gray, 1990; Gray & McNaughton, 2000). Activation of the BAS can be referred to as utilizing approach strategies. Conversely, the BIS encourages behavior away from negative occurrences and feelings, punishment, or nonreward, and theoretically operates via areas of the brain such as the frontal lobe (Gray, 1990; Gray & McNaugton, 2000). BIS activation is referred to as using avoidance strategies.

Maladaptive approach/avoidance strategies have been studied in a variety of contexts. For instance, those who fear spiders avoid images of spiders more rapidly than those who do not, whereas those who smoke and drink excessively react more rapidly to pictures of those stimuli than those who do not smoke or drink (Eberl et al., 2013; Rinck & Becker, 2007; Weirs et al., 2013). These studies show the effects of overstimulation of the BAS and BIS; such individuals are overly approaching unhealthy stimuli, and excessively avoiding fear-related stimuli.

Interestingly, these studies have also indicated that simple training programs may correct such maladaptive behaviors and guide participants towards implicit, healthier reactions. For instance, when participants were trained to focus on non-alcoholic stimuli compared to alcoholic stimuli, researchers found that participants had more successful rates of recovery (Eberl et al., 2013). Similarly, participants suffering from depression were trained to approach images of happy people, which led to lower rates of depression than those who did not receive such training (Nasrin, Rimes, Reinecke, Rinck, & Barnhofer, 2017). These studies indicate that

training programs may successfully alter the over usage of approach and avoidance strategies. Theoretically, this paradigm may then be applied to eating behaviors; those with unhealthy eating habits may have an overly reactive BAS when presented with unhealthy foods, or strong BIS reactions towards foods in general.

The BAS/BIS and disordered eating. There is some evidence linking maladaptive approach/avoidance behaviors to the regulation of eating disorders. For example, those with Binge Eating Disorder (BED) have been shown to overly approach high caloric foods, and maintain their focus on foods longer than those without BED (Deluchi, Costa, Friedman, Goncalves, & Bizarro, 2017; Leehr et al., 2016). Conversely, those with Anorexia Nervosa have been shown to both avoid foods in general (Paslaskis et al., 2016) and to overly approach low calorie foods (Neimeijer, de Jong, & Roefs, 2015; Veenstra & de Jong, 2011). These findings indicate not only that those who suffer from disordered eating exhibit improper usage of the BAS/BIS, but that those who restrict may benefit from being taught to approach a variety of foods, while those who overindulge may benefit from training to approach healthier foods.

A small number of studies have provided evidence for the feasibility of such retraining programs in the context of eating disorders. For instance, two separate studies have found that, among those with subclinical symptomology, training participants' focus away from unhealthy foods led to reductions in bulimic symptomology, emotional eating, and binge eating (Boutelle, Monreal, Strong, & Amir, 2016; Brockmeyer, Hahn, Reetz, Schmidt, & Friederich, 2015). While these findings are encouraging, it is imperative to understand how to use such training strategies to prevent the development of maladaptive habits, before they can begin to form.

Training BAS/BIS usage with foods in general. Several different training paradigms have been utilized to examine and train approach/avoidance strategies with food. The three most

commonly used strategies are 1. Approach Avoidance Tasks (AAT), 2. Go/no-go and stoplight paradigms, and 3. Dot-probe tasks.

AAT. When participants complete an AAT training program, they use a joystick or mouse to avoid (push away from themselves) or approach (pull towards themselves) an image, based on a characteristic unrelated to the study goal. If the study goal is to teach participants to approach healthy foods, they would pull the joystick towards them if foods are, say, on a square plate (healthy foods), and push it away from them if the foods are on a round plate (unhealthy foods).

Unfortunately, Becker and colleagues (2015), after three separate trials, did not find any meaningfully significant results of training towards healthy foods or away from unhealthy foods with the AAT. However, their studies involved only single-session trainings, and participants were only taught avoidance strategies. A follow-up study, which added an approach condition, also failed to find any significant results of training (Dickinson, Kavanagh, & MacLeod, 2016). Conversely, Schumacher, Kemps, and Tiggemann (2016) did find that a single-session avoidance training towards chocolate led to decreased consumption; however, they compared the chocolate to other sweet foods, rather than non-food stimuli. Kakoschke, Kemps, and Tiggemann (2017) similarly found that AAT training led participants to choose healthier foods in a follow-up taste test.

Overall, there is limited support for the use of the AAT to alter food preferences. It is possible that the use of a single training session led to less than optimal results. In addition, given the success of those studies that used a variety of foods (e.g., Kakoschke et al., 2017; Shumacher et al., 2016), it may be possible that, rather than focusing on a single food type, studies may benefit more from using a variety of foods; these studies may better reflect real-world eating

habits, or training with multiple types of foods may better alter overall approach/avoidance strategies towards all foods.

Go/no-go and stoplight tasks. In this task, participants respond to cues such as a green versus a red light. If the light is green, they indicate on which side of the screen a stimulus appears, but if it is red, they are not to respond. For a food training paradigm, unhealthy foods would be paired with red lights.

Several studies have indicated that go/no-go studies may not only effectively train participants to avoid unhealthy stimuli, but also to consume less unhealthy foods during taste tests, even when they began with strong appetites (e.g., Houben. 2011; Houben & Jansen, 2015; Lawrence, Verbruggen, Morrison, Adams, & Chambers 2015; Veling, Aarts, & Stroebe, 2013; Veling, van Koninsbruggen, Aarts, & Stroebe, 2014). Such tasks have even been associated with reduced weights at two-week and six-month follow-ups (Blackburne, Rodreiguez, & Johnstone, 2016; Lawrence, Verbruggen, Morrison, Adams, & Chandler, 2015).

While these studies are promising, all training sessions took place in a controlled laboratory. Allom and Mullan (2015) found that, when they asked participants to complete an inhibitory training program online, at home, there were no significant changes in avoidance towards unhealthy foods at a one-week check-up. Therefore, while there has been a relatively large success in using the go/no-go and stoplight tasks, it is possible that such success may not translate to less-controlled environments, such as participants' homes.

Dot-probe tasks. In dot-probe tasks, two pictures appear side-by-side; when they disappear, a stimulus such as an "X" appears on the left or right of the screen, corresponding to one of the two previous pictures. In this case, if a participant had avoidance tendencies towards unhealthy foods, and the "X" appeared where an image of an unhealthy food was located, it

would take them longer to react to the "X." To use this paradigm as a training tool, researchers would purposefully place the "X" underneath the type of stimuli they desire participants to focus on.

For example, Kakoschke, Kemps, and Tiggemann (2014) taught some participants to approach healthy foods, and the others to approach unhealthy foods; a "+" would appear under the desired stimuli 90% of the time. While those that were assigned a task to approach unhealthy foods did not show any differences at follow-up, those that were trained to approach healthy foods not only approached them faster at follow-up, but chose healthier snacks (Kakoschke et al., 2014). These results indicate that the dot-probe paradigm may be particularly useful in training approach strategies.

Interestingly, Kemps, Tiggemann, and Elford (2015) found that five weekly training sessions had significant effects on approach and avoidance activities, such that those trained to approach chocolate sitimuli did so more rapidly by the final training session, though a single session did not. A follow-up study found that these findings were consistent even when a wide variety of foods was utilized (Kemps, Tiggemann, & Hollitt, 2016). As such, while the dot-probe paradigm has not been studied often in the field of approach and avoidance food retraining, what studies have been done have been highly successful. Thus, this study will utilize a dot-probe task.

Present study. In addition to using the dot-probe task, this study will also make several other notable changes. The majority of past studies discussed only trained participants over a single session, occurred in highly controlled environments, and did not include control groups (see Jones, Hardman, Lawrence, and Field [2017] for an overview). Because emerging adult college students have such high rates of disordered eating habits already (e.g., Berg et al., 2009),

it is unlikely that a single training session would have meaningful long-term results. In addition, college students are often switching between various on-campus, off-campus, and at-home locations, meaning that a controlled laboratory environment may not lead to applicability in their real-world settings. Finally, it is possible that simple exposure to healthy foods may temporarily alter their approach strategies; control groups are therefore crucial to testing the effectiveness of an active training program.

Therefore, the current study will include not only an experimental training group, in which participants approach healthy foods 90% of the time, but also a sham training group, in which participants equally approach and avoid all types of foods. Evidence suggests that when a 100-0% distribution is employed, participants more easily identify the goal of the training sessions, which means the training is no longer implicit (Folkvord, Veling, & Hoeken, 2016). Participants will also be asked to complete five trainings in rapid succession (e.g., multiple days in a row), over a seven day period, on their own devices, in their own chosen location.

Method

The present study utilized training data that was collected as part of a larger study, which examined not only the program's effectiveness, but also included surveys on parent-daughter relationships and parental modeling of eating behaviors and beliefs about the body. The university's institutional review board approved the study.

Participants. The present study (original $n = 40$) excluded those that did not complete a majority (i.e., at least three) of the five training sessions. This excluded five (12.5%) participants that either did not complete any training sessions, or whose training sessions were unusable due to inaccurate responses (see below for description of procedures). A further two (5%) participants completed only one eligible session, and three (7.5%) completed only two sessions.

The rationale for this exclusion was that the goal of the study was to determine if a training program including multiple, rapidly (i.e., within 24 hours of one another) completed training sessions could alter implicit reactions; those that completed two or less sessions were not exposed to a series of sessions.

Of the remaining 30 eligible participants, four (10%) completed three sessions, nine (22.5%) completed four sessions, and seventeen (42.5%) completed all five sessions. Participants ranged in age from 19 to 24 (M = 21.17, SD = 1.66), were mostly White (n = 28; 93.3%), were majority heterosexual/straight (n = 28; 93.3%), were single (n =19; 63.3%), and had an average Body Mass Index (BMI) of M = 23.25 (SD = 3.58). BMI was calculated using self-reported weight and height with the formula: BMI = [Weight in pounds/(height in inches)^2] * 703 (Center for Disease Control). Finally, 93.3% (n = 28) of participants indicated that they did not currently or had not in the past suffered from an eating disorder; the two participants that identified as having an eating disorder indicated that they experienced Anorexia Nervosa and Binge Eating Disorder.

Procedure. Participants were recruited via university student email listservs. Potential participants were screened in order to ensure that they met study criteria: they were 18- to 25-year-old English-speaking females, with access to a computer or tablet of their own. The first 40 qualified potential participants were recruited. Participants who qualified were randomly assigned to either the experimental or sham training group. Of the 30 participants, there was an even split among participation types, such that 50% (n = 15) completed the experimental training program, and 50% (n = 15) completed the sham training program.

All participants were asked to complete online surveys on parent-daughter relationships and parental modeling of eating behaviors and beliefs about the body as well as complete the

online training task. While the present study does not include the survey data, the first page of the online surveys was the informed consent document for both the training program and the surveys. Participants could not advance unless they checked a box confirming that they understood the information presented, and consented to the study.

For compensation, participants were entered into a drawing for one $100, two $50, or two $25 giftcards to Amazon. For each step of the study that they completed, they received an entry into the drawing; if they completed both surveys and all five training sessions, they received seven total entries. Only those that completed all seven components were eligible for the $100 giftcard.

Data from training sessions were examined prior to being analyzed, to ensure that participants responded accurately to stimuli for the majority of the session; participants who did not respond appropriately a majority of the time may not have been actively engaged in the session. Therefore, if less than 75% of the session was completed correctly, that session was not included. In addition, z-scores for each response time were examined, and those that took more than two standard deviations in time to respond were individually deleted. Again, this was done to ensure that only responses that were completed while the participant was actively engaged were analyzed.

Measures. ***Approach/avoidance dot-probe task – training*****.** The training task involved forty-two sets of photos: 14 healthy-unhealthy food pairs, 14 healthy-neutral food pairs, and 14 unhealthy-neutral food pairs. These pictures were taken by the researcher; all food appeared on identical white plates for consistency. A list of potential healthy, neutral, and unhealthy foods was created by the researcher, and then sent to a Health Nutrition and Exercise Science faculty member, who refined the list. A pilot survey was then sent to undergraduate students, in which

they were asked to rate the perceived healthiness or unhealthiness of each food, on a scale of 1 (very unhealthy) to 5 (very healthy). Those foods that were rated most strongly as unhealthy, neutral, or healthy were chosen for the training task. Examples of healthy foods were baby carrots, strawberries, and assorted nuts. Some of the neutral foods displayed were goldfish, white rice, and turkey slices. Examples of unhealthy foods were cheesecake, onion rings, and Cheetos.

In the experimental training, a "+" appeared under the healthy pictures approximately 90% of the time, and the other pictures approximately 10% of the time. When neutral-unhealthy pairs were presented, the "+" appeared under the neutral stimuli approximately 90% of the time, and unhealthy stimuli approximately 10% of the time. For the sham training, the "+" appeared equally under the types of pictures (i.e., for the healthy-unhealthy pairs, the "+" was under the healthy picture 50% of the time, and the unhealthy picture the other 50%).

Participants were instructed to press either a button on the left of the keyboard (i.e., E) or the right of the keyboard (i.e., I), depending on whether or not the "+" appeared under the left or right picture. However, in the experimental group, the "+" was purposefully placed under healthy pictures the majority of the time, with the intention of implicitly training individuals to focus on the healthy stimuli. Because these pictures only appeared for 1,000 milliseconds, sets of photos were repeated twice, with 84 sets total: 28 healthy-unhealthy pairs, 28 healthy-neutral pairs, and 28 unhealthy-neutral pairs. In addition, the program was written such that pictures were pulled from the healthy and unhealthy pools, paired randomly, and did not repeat in a specific order; therefore there was no specific pattern of appearances that would have allowed for rote memorization.

The training program was administered to participants using Inquisit software by Millisecond, an online data collection program that allows for training sessions to occur on

participants' own devices. This required participants to download a small app, Inquisit 5 Player, which adjusted automatically for variables such as screen size and internet speed connection.

Grouping variable. A grouping variable indicating which version of the training program was completed was used for these analyses. A "1" indicated that participants completed the experimental training program, and a "2" indicated that they completed the sham training program. Participants in each group did not vary in age or BMI, though those in the sham training group did complete a slightly higher number of training sessions (see Table 1).

Table 1

Independent Samples T-Test Results Comparing the Experimental and Sham Training Groups

	Experimental			Sham			
	N	M	SD	N	M	SD	*t*-test
Age	15	20.73	1.71	15	21.60	1.55	-1.46
BMI	14	22.51	3.34	15	23.93	3.77	1.53
†Number of sessions	15	4.13	.83	15	4.73	.46	-2.44*

Note. † Equal variances not assumed. *$p < .05$

Reaction times. To create a reaction time variable, the pairs in which healthy and unhealthy foods appeared next to one another were examined, and an average reaction time to healthy foods was created for each participant. Then, their reaction time at their final training session was subtracted from their initial training session reaction time. Therefore, if participants reacted more rapidly to healthy foods when compared to unhealthy foods by their final training session, the reaction time variable would be positive. Only the pairs that compared a healthy to an unhealthy food were included in these analyses.

Analysis. In order to determine if completing the training program significantly altered participants' approaches to healthy foods, three analyses were run. Specifically, two paired sample *t*-tests were conducted to determine if reaction times to healthy versus unhealthy foods significantly changed from the first to the final training session for both groups. In addition, an independent-samples *t*-test was conducted to determine if those who completed the experimental training session improved more by their final session than those that completed the sham training group. IBM SPSS version 25.0 was used for these analyses.

Results

Those who completed the experimental training reacted significantly faster to healthy foods at their final training session, $t(14) = 3.99$, $p = .001$, as did those in the sham training group, $t(14) = 4.81$, $p < .001$. This indicates that, regardless of group, all participants reacted faster to healthy versus unhealthy foods by their final training session.

For the independent-samples *t*-test, the dependent variable was the change in reaction time from the first session to the final session (e.g., session one minus the final session). Levene's Test for Equality of Variances was significant, $F = 16.96$, $p < .001$, and therefore the *t* value that did not assume equal variances was used. The *t* value was trending towards significance, $t(18.50) = 1.89$, $p = .075$. These results suggest that that those who completed at least a majority of the experimental training program reacted faster to healthy foods ($n = 15$; $M = 84.03$; $SD = 81.55$) compared to those who completed the sham training program ($n = 15$; $M = 41.14$; $SD = 33.13$) by the end of the training sessions. However, the effect size for this test was large: cohen's $d = 0.70$, and Glass's Δ (which accounts for large variations in standard deviation) equaling 1.29.

Discussion

Summary and interpretation of findings. The purpose of the present study was to determine if an online dot-probe training program could significantly alter women's approaches to healthy foods, when compared to unhealthy foods. Specifically, the researcher sought to determine if completing multiple training sessions (e.g., at least three) on consecutive days, on participants' own devices, would increase participants' reaction times to healthy foods, compared to those in a sham training group that equally approached and avoided healthy foods.

Encouragingly, despite the low number of participants, those who completed the experimental training sessions did react more quickly to healthy foods by their final training session, indicating that the sessions did implicitly train participants to focus on healthier foods more than the sham training group. Indeed, while both groups of participants responded faster by their final training session, most likely due to habituation, participants in the experimental group reacted over two times faster to healthy foods, indicating the potential retraining of their BAS to approach healthy foods over unhealthy foods.

While the exact neural pathways related to the BAS and BIS have not been definitively determined, the results of this study provide further proof of their existence and malleability (Gray, 1990; Gray & McNaughton, 2000). Specifically, given the evidence of maladaptive BAS and BIS activity in other domains, such as alcohol and smoking (Eberl et al., 2013; Weirs et al., 2013), the researcher theorized in the present study that those with unhealthy eating habits might have an overly reactive BAS towards unhealthy foods, and conversely, high BIS activity when presented with foods in general. Indeed, a limited number of studies examining disordered eating habits supported this hypothesis (e.g., Deluchi et al., 2017; Paslaskis et al., 2016). These findings further confirm that, even in a high risk emerging adult sample (e.g., Berg et al., 2009), BAS and

BIS activity is alterable. Given the high rates of mortality for those suffering from clinically diagnosable eating disorders (e.g., Fichter & Quadflieg, 2016), these findings are particularly exciting, as they suggest that a BAS/BIS retraining program might be used as an effective intervention tool.

The results from this study also provide further evidence for the effectiveness of the dot-probe paradigm in retraining approaches to foods. Given the widespread existence of disordered eating and clinically diagnosable eating disorders (e.g., Berg et al., 2009; Eisenberg et al., 2011), it is imperative that interventive methods are as successful, effective, and efficacious as possible. Therefore, while the AAT has been more widely utilized, the researcher opted not to employ it, as several extensive studies failed to find significant changes in approach/avoidance habits (Becker et al., 2015; Dickinson et al., 2016). In addition, while the go/no-go paradigm has been successful in laboratory settings (e.g., Blackburne et al., 2016; Houben & Jansen 2015; Lawrence et al., 2015; Veling et al., 2014), the lack of effectiveness in a non-laboratory setting was of concern (Allom & Mullan, 2015). As a result, while the dot-probe paradigm had not been as widely studied in the context of eating behaviors, it was chosen by the researcher due to its high level of success in altering participants' actual food choices.

Encouragingly, these findings solidified the dot-probe task as a viable means of altering approach and avoidance habits, consistent with past studies (Kakoschke et al., 2014; Kemps et al., 2015; Kemps et al., 2016). While studies involving all three tasks would need to be completed in order to determine why the dot-probe task appears to be particularly effective, it is possible that this is due to the simplicity of the task. While the AAT involves actively responding to a type of stimuli (e.g., square versus round plates), and the go/no-go requires paying attention to the color of the light, the dot-probe has consistent instructions. This means that, instead of

actively processing extra stimuli (light, tone, plate type), participants only consistently respond to which side of the screen the "X" or "+" falls on. This may allow for better implicit training, as compared to other methods.

This study also provides evidence for the need to include control groups. Even those individuals who completed the sham training sessions improved in their reaction times to healthy foods, indicating that practice in general can lead to the appearance of improvement. Without neutral comparisons, studies may interpret improvements as active training and change, when instead they may simply represent habituation. This is particularly concerning, given that the vast majority of studies completed so far have not included a control group (see Jones et al., 2017). Such past studies should therefore be interpreted with caution, whereas the present study can more strongly suggest that changes in reaction times could be due to the active training component.

Limitations and future directions. Despite the success of this training program, future studies should seek to include a larger sample size. In addition, 25% (n = 10) of the total 40 participants either did not complete enough training sessions, or did not engage with the program (e.g., they opened the program but just let it run; they did not attempt to respond to any stimuli). Future studies should evaluate how to best encourage active participation. Furthermore, while the participants included in these analyses completed at least three training sessions in one week, with the majority completing all five, there was not a long-term follow-up. While it is encouraging that such quick training session repetition led to noticeable change, this study cannot determine if such change is long-lasting. Therefore, future studies should include a measure of participants' reaction times at a later follow-up, such as two weeks or a month after the final training session (Blackburne et al., 2016; Lawrence et al., 2015). In addition, future

studies should seek to include an actual measure of food consumption. Participants may either be invited to the laboratory after training, or in-home measures could be used, such as a diary of foods eaten.

While this study chose to focus on emerging adult college women, due to their particularly high rates of disordered eating and eating disorders as compared to the general population (e.g., Berg et al., 2011; Eisenberg et al., 2011), future endeavors should seek to include men as well. In addition, because those suffering from eating disorders and disordered eating are already prone to severe health risks (Fitcher & Quadflieg, 2016; Kast et al., 2016), it is imperative that this paradigm be tested in younger populations, particularly children, to encourage prevention rather than intervention.

Strengths and contributions. The present study provides evidence that implicit retraining of the BAS/BIS in relation to foods can effectively alter how individuals approach foods, even in a population known for high levels of disordered eating (e.g., Berg et al., 2011). Perhaps this study's greatest strength is that it took place at the participants' place of choice, and on their own devices. Participants were allowed to complete this at any location, regardless of environmental noise, during any time of the day, and on any desktop, laptop, or tablet. Previous studies have almost exclusively taken place in controlled laboratory settings, and those that did take place online, in-home, were not successful (e.g., Allom & Mullan, 2015; Jones et al., 2017). The relative success of this study indicates that retraining may not only be effective in regulated environments, but may be generalizable to women's real-world settings, and therefore meaningfully impact their lives.

In addition, this study utilized multiple training sessions, while the majority of current studies only include a single training session (see Jones et al., 2017). Multiple training sessions

are imperative for long-term cognitive rewiring; the more a behavior is practiced, the better connected the synapses involved in those behaviors become. As women's brains are still developing (e.g., Sowell et al., 1999), practicing healthy behaviors may lead to better long-term function. In addition, because it is likely that women already possess some maladaptive BAS/BIS behaviors related to foods, a single training session is unlikely to lead to significant long-term change.

Finally, two training groups were included: an experimental and a sham training group. Because reaction times may improve simply due to habituation (e.g., participants just get better at reacting to the images and completing the program itself), it was crucial to include a group that was not actively trained towards any food type. Indeed, most studies have included only one training type, or compared approach to avoidance techniques (see Jones et al., 2017). This is problematic, as training avoidance towards healthy foods also potentially worsen women's already disordered behaviors.

Conclusion

The dot-probe paradigm, while still limited in the examination of its usage, has demonstrated success in retraining BAS and BIS reactions towards foods. The instructions are easy to follow, which may allow for better dissemination of the program, particularly for future younger participants. Specifically, an active training component encouraging BAS reactions (e.g., approaches towards healthy foods) was shown to decrease reaction times to foods, above and beyond changes due to habituation in a sham training group. This study therefore found that, even among women at high risk for disordered eating habits, an approach/avoidance training program may significantly change how individuals react to foods.

This study also provided initial evidence that a training program that takes place in participants' own environments, not a controlled laboratory setting, can lead to noticeable changes in women's approach strategies towards foods, particularly if multiple training sessions are completed. Given that eating does not occur in highly controlled environments, the effectiveness of the training, despite occurring on different devices, in different environments, with different distractors, is highly encouraging. Specifically, approach/avoidance retraining using the dot-probe may not only lead participants to implicitly use healthier approaches, but to actively choose healthier foods. Based on these findings, there is tentative evidence that maladaptive behaviors can be reversed, which may assist women in leading healthier, happier lives.

THE IMPACT OF THE PARENT-DAUGHTER RELATIONSHIP ON COLLEGE WOMEN'S THIN IDEAL INTERNALIZATION AND APPROACH/AVOIDANCE OF FOODS

Abstract

Despite evidence suggesting the importance of parent-child relationships on women's health in general, such relationships are understudied in the context of women's drive for thinness and restrained eating. This is concerning, as thin ideal internalization begins in girls as young as four, when parents are the most influential source of socialization in girls' lives, and continues to escalate into emerging adulthood. As a result, emerging adult women, particularly those in college, have high rates of maladaptive eating. Thus, this study sought to examine whether past and current parent-daughter relationships significantly altered the relationship between measures of women's thin ideal internalization and their reaction times to healthy foods in a dot-probe task. Participants (n = 35) completed measures of drive for thinness (DFT), restrained eating, past and current maternal and paternal relationships, as well as an implicit measure of their reactions to healthy versus unhealthy foods via an online dot-probe task. Interestingly, when women had low levels of DFT, they reacted to healthy foods at approximately the same rate, regardless of past paternal control. However, when their DFT was high, past paternal control moderated the relationship such that those whose fathers were more controlling had faster reaction times to healthy foods, compared to those with low levels of paternal control. In addition, when women had low levels of restrained eating, their reaction times to foods were essentially the same, regardless of the current mother-daughter relationship. However, when restrained eating levels were high, those with warm and responsive current relationships with their mothers had faster reaction times to foods, compared to those with poorer

mother-daughter relationships. These findings suggest that certain aspects of the parent-daughter relationship may provide a barrier against unhealthy eating habits, even when women are experiencing high levels of thin ideal internalization. Therefore, encouraging early, healthy parent-child relationships may prevent the development of disordered eating habits, and intervening in the family system in adulthood may lead to positive changes.

Introduction

Thin ideal internalization, or the belief that the smaller the body is, the better it is, escalates throughout girls' lives, with almost ¾ of women disliking their own bodies by the time they turn 18 (Schneider et al., 2013). Such thin ideal internalization is often measured by examining women's beliefs surrounding thinness, or their drive for thinness (DFT), and their actions to be thin, or restrained eating habits. Unfortunately, the development of such beliefs and habits have been associated with women's adverse health. For instance, Anorexia Nervosa, which is characterized by both severe DFT and restriction, is associated with the highest rates of death for any mental illness (Fichter & Quadflieg, 2016). These deaths are due not only to the physical effects of malnutrition, such as kidney and heart malfunctions, but the psychosocial effects of disordered eating, such as isolation and negative affect (American Psychiatric Association, 2013). Given the widespread impact of thin ideal internalization on individuals' well-being, it is imperative to understand what factors may best be intervened upon.

Unfortunately, eating disorder development begins far earlier than the lay public is typically aware of. For instance, one study found that not only did 35% of 9- and 10-year-old girls want to be thinner, but 7 to 11% of those girls already met the criteria for Anorexia Nervosa (Deleel et al., 2009). Furthermore, another 17% of similarly aged girls may suffer from subclinical levels of eating disorders, meaning that they still experience detrimental habits such

as restriction, just at a lesser frequency (Erickson & Gerstle, 2007). This is problematic, as the earlier subclinical behaviors are experienced, the more likely women may be to develop more severe symptomology and health impairments in adulthood.

Disturbingly, thin ideal internalization develops even earlier in childhood. For example, girls as young as 4 to 6 already indicate wanting to have smaller bodies, feel that being fat would be unacceptable, and associate being fat with negative traits such as being mean (Borbeck & Drummond, 2006; Musher-Eizenman, Holub, Edwards-Leeper, Persson, & Goldstein, 2003). Such thin ideal internalization escalates as girls age; by the end of adolescence, over 70% of young women indicate a desire to be thinner (Schneider et al., 2013). High DFT leaves women increasingly vulnerable to the development of potentially deadly eating habits. Indeed, almost 50% of college women have been found to exhibit subclinical levels of eating disorders, while 13.5% had a diagnosable disorder (Berg, Frazier, & Sherr, 2009; Eisenberg, Nicklett, Roeder, & Kirz, 2011).

Given the escalation of thin ideal internalization and eating disorders as girls age, it is imperative to understand what childhood factors may be related to decreases in young adult risk factors. In particular, parents have been shown to be the most influential source of socialization for young girls (Furman & Buhrmester, 1992). Thus, while this study will inspect the habits of college women, who are particularly at risk for thin ideal internalization (e.g., Berg et al., 2009; Eisenberg et al., 2011), it will examine both current and past parent-daughter relationships. Examining both current and past relationships may allow for a better understanding of what familial patterns not only provide barriers against disordered beliefs and habits, but what components might actively promote health.

The parent-child relationship. Family Systems Theory suggests that dyads within families (e.g., mother and daughter, father and daughter, mother and father) interact to affect the family, or system, as a whole; individual units are not separate actors, but interrelated (Whitchurch & Constantine, 2004). In the context of preventing the escalation of thin ideal internalization, it is therefore necessary to examine how parent-daughter relationships might encourage women's healthy habits. In addition, while it would be ideal to include all family members, it is also true that certain dyads within each system may be more strongly linked (Cox & Paley, 2003). Specifically, current research suggests that, while siblings do have some effect on one another's eating habits, the mother-daughter and father-daughter dyads most strongly influence women's thin ideal internalization (Rodgers & Chabrol, 2009).

Generally, children with parents who are affectionate and responsive to children's emotions, as well as who set realistic boundaries and rules, have better mental health (Baumrind, Larzelere, & Owens, 2010). While the majority of research on the parent-daughter relationship has focused more on direct effects of parents on girls' eating habits, such as pressure to be thin, a handful of studies have confirmed the importance of high quality parent-daughter relationships on thin ideal internalization. Specifically, while lack of parental warmth and both high and low control were associated with adolescents' disordered eating habits, high levels of DFT in particular were associated with nonoptimal parenting habits (Haycraft & Blisset, 2010). Conversely, girls who had warm and responsive parents did not appear to have any thin ideal internalization (Haycraft & Blisset, 2010). These patterns continue into adulthood, with high levels of both past and current parental control, as well as low warmth, being associated with both thin ideal internalization and clinically diagnosable eating disorders (Jauregui Lobera, Bolanos Rios, & Garrido Casals, 2011; Sira & White, 2010). Interestingly, Jauregui and

colleagues (2011) found that adults who reported their parents as being low in warmth and high in control during childhood and early adolescence had higher disordered eating symptoms, while the current mother-child relationship, not the paternal relationship, affected existing symptomology.

Evidence also suggests that parent-daughter relationships may continue to affect women across generations, and even when direct influences are considered. For instance, Jones, Blodgett Salafia, and Hill (2019) found that the combined effect of maternal and paternal warmth acted as a protective factor against adolescent girls' DFT, even when parents pressured daughters to lose weight. In addition, Canetti and colleagues (2008) found that not only was low parental warmth associated with the severity of women's restrictive behaviors, there was also a generational pattern of low warmth and disordered eating; even when the uncaring relationship was between women's parents and their own mothers (i.e., grandmothers), women's anorexic symptoms increased. These findings emphasize the importance of understanding how the family environment affects women's eating habits, as failure to study such relationships may ignore a viable and effective means of prevention and intervention. In addition, by studying these patterns in emerging adult women, the effects of both current and past family relationships on eating habits may be better illuminated.

Approach and avoidance of foods. While past studies have found associations between parent-daughter relationships and self-reported measures of DFT and clinically diagnosed eating disorders (e.g., Blisset & Haycraft, 2010; Jones et al., 2019), no known studies have examined how relationships affect women's implicit reactions to foods. Thus, there is a gap in knowledge regarding how beliefs lead to actual disordered eating habits. Specifically, while there are studies on the development of DFT, and studies on restrained eating, there is no known research on how

the parent-daughter relationship affects the transition from DFT to active restriction. Therefore, this study proposed to examine how the parent-daughter relationship might affect thin ideal internalization, as measured by DFT and self-reported restrained eating, and an implicit measure of women's unconscious reactions to foods.

One increasingly studied paradigm used to measure implicit reactions is the Approach/Avoidance paradigm. Those who use approach strategies tend to respond to pleasurable stimuli and rewards; such strategies are hypothesized to be based in the Behavioral Activation System in the brain (Gray & McNaughton, 2000). Conversely, those who use avoidance strategies tend to direct their attention away from negative stimuli, punishment and nonreward; such behaviors are entrenched via the Behavioral Inhibition System (Gray & McNaughton, 2000).

It is possible for individuals to overly approach or avoid stimuli, such that their habits become maladaptive. Indeed, such patterns have been confirmed in the field of eating disorder research. For instance, those with Binge Eating Disorder, characterized by a compulsion to overeat, tend to overly approach foods, particularly those that are high in calories (Deluchi, Costa, Friedman, Goncalves, & Bizarro, 2017; Leehr et al., 2016). Conversely, those with Anorexia Nervosa, who have a strong aversion to eating, have been found to either avoid all foods, or approach low calorie foods (Neimeijer, de Jong, & Roefs, 2015; Paslakis et al., 2016; Veenstra & de Jong, 2011). These studies confirm that dysfunctional approach/avoidance strategies may play a significant role in the development and continuation of poor eating habits. Indeed, there is limited evidence that retraining approach/avoidance habits may lead to reductions in eating disorder symptomology (e.g., Boutelle, Monreal, Strong, & Amir, 2016; Brockmeyer, Hahn, Reetz, Schmidt, & Friederich, 2015).

These findings emphasize the importance of investigating implicit reactions to foods. Thus, this study will include a measure of approach/avoidance reactions to healthy and unhealthy foods. Specifically, a dot-probe program will be utilized to examine women's BAS/BIS usage towards foods. Such programs feature images that appear two at a time, side by side. When the images disappear, a stimulus, such as a "+", appears to the left or right of the screen, corresponding with the location of one of the previously shown images. The length of time that it takes for participants to react to one image over the other can indicate their approach or avoidance biases. For instance, if healthy versus unhealthy pictures appear, and participants react more rapidly to the "+" when they are located under healthy pictures, this may indicate that they have approach strategies towards such foods.

Present study. Given the strong link between the development of DFT and disordered eating as women age, it is imperative to understand what lifelong factors might prevent or lessen thin ideal internalization. Therefore, while the majority of studies have focused on direct parental impacts on girls' body image and eating habits such as parental pressure to be thin (Rodgers & Chabrol, 2009), this study will examine the quality of both past and current mother-daughter and father-daughter relationships (e.g., warmth, control, and overall positive relationship quality). In addition, this study will include an implicit measure of eating habits, as well as self-reported DFT and restrained eating, in order to examine how healthy parent-daughter relationships may discourage negative beliefs from becoming entrenched, maladaptive behaviors. This will also allow the researcher to best determine if parent-daughter relationships may have not only an impact on women's feelings about themselves, but also on their everyday eating habits.

Method

The current study utilized a subset of data from a larger project. Specifically, while the overall experiment included an initial survey, five online training sessions, and a final survey, this study will only examine survey data and the initial online session. The study was approved by the university's institutional review board.

Participants. Of the 40 participants recruited, 35 completed at least one initial training session, which will be used as a measure of their baseline approach towards healthy foods. Participants were 21.17 years of age on average (range = 19- 25; *SD* = 1.72), a majority White (*n* = 31; 88.6%), mostly heterosexual (*n* = 33; 94.3%), single (*n* = 23; 65.7%), and of average weight according to Body Mass Index (BMI) (*M* = 23.03; *SD* = 3.39). To calculate BMI, participants' self-reported weight and height were inputted into the following formula: BMI = [Weight in pounds/(height in inches)^2] * 703 (Center for Disease Control). Only two participants (5.7%) indicated that they currently or in the past suffered from an eating disorder; participants self-identified as having either Anorexia Nervosa or Binge Eating Disorder.

Procedure. University student listervs were used to recruit potential participants. In order to be eligible, participants had to be female, between the ages of 18 and 25, speak fluent English, and have access to a computer or tablet. The first 40 qualified participants to contact the researcher were recruited; only 35 completed at least one training session and were therefore included in the present study. Participants indicated their consent for the study twice; the initial page for both surveys was the informed consent document, and participants had to confirm that they had read and understood the information before they could continue.

Participants were entered into a drawing in order to compensate them for their time. For every component of the study that participants completed, participants received an additional

entry. Therefore, if they completed both surveys and all five training sessions, they were awarded a total of seven entries. Those who completed all seven were eligible to win a $100 giftcard to Amazon, and all participants were eligible to win two $50 or two $25 giftcards.

Measures. ***Approach/avoidance dot-probe task*****.** While the overall study looked at a series of dot-probe trainings to alter how participants approached foods, the present study will only examine their initial session as a baseline measure of approach/avoidance tendencies.

In the dot-probe program, participants were presented with two photos, side-by-side. While there were 42 pairs of photos total (14 healthy-unhealthy, 14 healthy-neutral, and 14 unhealthy-neutral), the photo pairs of interest in this study were those times in which a healthy food appeared next to an unhealthy food. Photo sets were repeated twice, for a total of 28 healthy-unhealthy pairs. After the pictures appeared for 1,000 milliseconds, a "+" would appear where one of the photos was previously located; participants had an additional 1,000 milliseconds to respond, before the next pictures were automatically displayed. Participants were asked to indicate if the "+" appeared on the left (e.g., E) or right of the screen (e.g., I). Participants completed this study on their own devices, in their own chosen environment. Inquisit software by Millisecond allowed for online data collection and storage, and the app itself, Inquisit 5 Player, controlled for variables such as internet speed and screen size.

Reaction times. In order to measure women's approach/avoidance of healthy and unhealthy foods, a reaction time variable was created. Specifically, the average time it took participants to react to a "+" placed under a healthy food, when that healthy food was pictured versus an unhealthy food, was examined. This means that the faster a participant's reaction time was, the faster they reacted to healthy foods in general.

DFT. The 7-item Drive for Thinness Subscale from the Eating Disorder Inventory (Garner, Olmstead, & Polivy, 1983) was used to measure women's DFT. A sample item from the scale is, "If I gain a pound, I worry that I will keep gaining." Responses are on a scale ranging from 0 (*Never*) to 5 (*Always*), such that higher scores indicate higher levels of DFT. In this study, the scale had a reliability of $\alpha = .91$.

Restrained eating. In order to measure dietary restraint, the 10-item Restraint subscale of the Dutch Eating Behavior Questionnaire (DEBQ) was utilized (Van Strien, Frijters, Bergers, & Defares, 1986). An example item is, "Do you deliberately eat foods that are slimming?" Responses ranged from 1 (*never*) to 5 (*very often*), with higher scores indicating higher restrained eating. This subscale had a Cronbach's Alpha of .93 in this study.

Past parent-daughter relationship. The Sibling Inventory of Differential Experiences – Revised (SIDE-R; Barret-Singer & Weinstein, 2000) was utilized to examine the quality of past relationships among daughters and their mothers and fathers. Specifically, the maternal and paternal warmth and control subscales were examined for each parent. There were 18 items total (9 per parent; 5 warmth and 4 control items). Item response options ranged from 0 (*almost never*) to 3 (*almost always*), with higher scores indicating higher levels of warmth or control. Example items include, "My mother/guardian has tended to favor me " and "My father/guardian has been strict with me." These represent warmth and control, respectively. The maternal warmth subscale had an alpha of .57, and the maternal control subscale had an alpha of .73. The paternal warmth subscale had an alpha of .76, and the paternal control subscale had an alpha of .82. Given the low reliability of the maternal warmth scale, it was not utilized in the analyses (Nunnally, 1978).

Current parent-daughter relationship. The maternal and paternal subscales of the Parent-Adolescent Relationship Quality Scale (Moller & Stattin, 2001) were used to examine the

overall quality of the current mother-daughter and father-daughter relationships. There were 12 items total; 6 per parent. Example items are, "How much does your *mother/guardian* mean to you?" and "If you need advice on important questions, how often do you turn to your *father/guardian*?" with responses ranging from 1 (*nothing at all*) to 5 (*very much*). Higher scores indicated higher quality relationships (e.g., warm, responsive). In this study, the maternal scale had a Cronbach's Alpha of .86, and the paternal scale had a reliability of $\alpha = .87$.

Analysis. In order to determine if maternal/paternal relationship quality variables indirectly impacted the relationship between women's thin ideal internalization and their approach/avoidance habits with foods, several moderation analyses were conducted. The following independent variables were examined: DFT and Restrained Eating. The dependent variable examined was participants' initial reaction times to healthy versus unhealthy foods. Moderating variables examined were: paternal past affection (maternal excluded), maternal/paternal past control, and the current mother-daughter and father-daughter positive relationship quality. The independent variables, moderating variables, and the interaction terms were centered around zero before analyses were completed.

SPSS 25.0 was utilized for these analyses. Specifically, hierarchical regressions were employed to examine potential moderations. In Step 1, the centered independent variables were entered. In Step 2, the interaction term was entered.

Results

When DFT was the independent variable, only past paternal control trended towards significantly moderating the relationship between DFT and reaction times to healthy foods, Step 2: $\Delta R^2 = .11$, $\Delta F(1, 31) = 3.89$, $p = .057$. Step 1 was not significant. Specifically, when women had low levels of DFT, their reaction times to healthy foods were essentially the same, regardless

of past paternal control. When women had high levels of DFT, however, the relationship was moderated such that low levels of paternal control were associated with slower reaction times, while higher levels of paternal control were associated with faster reaction times.

Table 2
Summary of Hierarchical Regression Moderation Analysis for DFT and Reaction Times to Healthy Foods

	Model 1			Model 2		
Variable	*B*	*SE B*	*β*	*B*	*SE B*	*B*
DFTCent	-2.02	1.68	-.21	-0.61	1.76	-.06
PastDadContCent	-2.79	5.16	-.09	-4.94	5.06	-.17
PastDadContCent x DFTCent				-1.36	0.69	-.36
R^2		.07			.14	
F for change in R^2		1.17			2.43	

*$p < .05$.

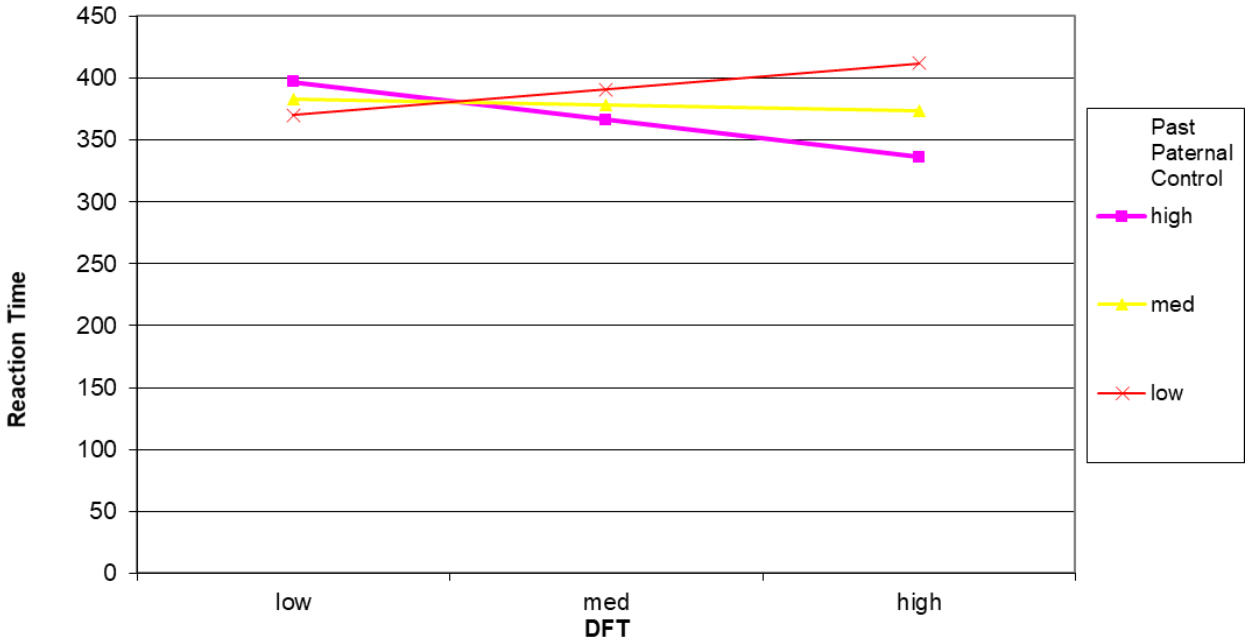

Figure 1. The relationship between women's DFT and reaction times to healthy foods, as moderated by past paternal control. Low and high groups created by examining one standard deviation above and below the mean.

When restrained eating was examined, only the current mother relationship moderated the relationship between restraint and reaction times. Step 1 was not significant. Step 2 indicated an interaction effect, $\Delta R^2 = .17$, $\Delta F(1, 30) = 6.68$, $p = .02$. When women had low levels of restraint, their reaction times to healthy foods were essentially the same, regardless of the current mother-daughter relationship. However, when their restraint was high, those with high levels (e.g., good mother-daughter relationships), had significantly faster reaction times to healthy foods than those with poorer mother-daughter relationships.

Table 3

Summary of Hierarchical Regression Moderation Analysis for Restrained Eating and Reaction Times to Healthy Foods

	Model 1			Model 2		
Variable	*B*	*SE B*	*β*	*B*	*SE B*	*β*
ResCent	-2.69	1.63	-.28	-1.03	1.63	-.11
CurMotherRelCent	-1.97	3.91	-.09	-16.25	6.59	-.71*
ResCent x CurMotherRelCent				-2.22	0.86	-.76*
R^2		.09			.26	
F for change in R^2		1.56			6.68*	

*$p < .05$.

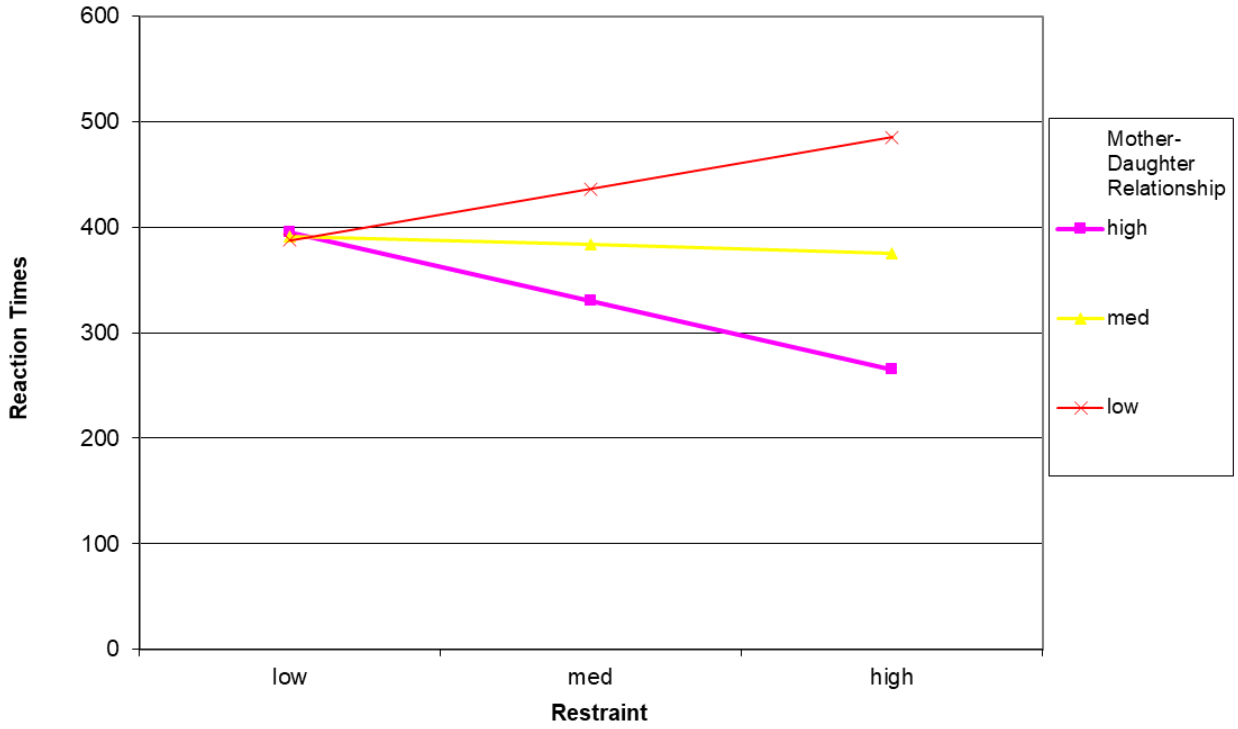

Figure 2. The relationship between women's restrained eating and their reaction times to healthy foods, as moderated by the current mother-daughter relationship. Low and high groups created by examining one standard deviation above and below the mean.

Discussion

Summary and interpretation of findings. The purpose of this study was to determine if the parent-child relationship significantly altered the associations between both women's DFT and self-reported restrained eating and an implicit measure of their approaches to foods. Despite evidence for the importance of the quality of parent-child relationships, such relationships continue to be understudied. In addition, those studies that have examined the parent-daughter relationship have focused on either women's beliefs about being thin, or their entrenched, maladaptive eating (e.g., Haycraft & Blisset, 2010); the transformation between belief and action, i.e. the development of implicit behaviors, has not been examined. In order to address these gaps, this study sought to determine whether past parental control and warmth, or the current parent-daughter relationship, could change how women's DFT and restrained eating affected their implicit reaction times to healthy versus unhealthy foods. Two relationships were indeed relevant: past paternal control altered the relationship between women's DFT and reaction times, and the current mother-daughter relationship affected the association between women's restrained eating and reaction times.

DFT. DFT was examined as it not only begins to develop at very young ages (e.g., Borbeck & Drummon, 2006; Musher-Eizenman et al., 2003), but increases until almost 3/4 of young women want to be thinner (Schneider et al., 2013). While past paternal and maternal control and warmth, as well as the current parent-daughter relationship were examined as moderators, only one relationship meaningfully altered the association between women's DFT and reaction times to healthy foods. Specifically, when women had low levels of DFT, their reaction times to healthy foods were essentially the same. However, when they had high levels of

DFT, higher levels of past paternal control were associated with faster reaction times to healthy foods. Conversely, low levels of paternal control were related to the slowest reaction times.

While on the surface this might appear to indicate that higher paternal control is a protective factor, even when girls have significantly internalized the thin ideal, it is possible that this is not the case. In fact, this would go against past parenting research, which suggests that moderate levels of control lead to the healthiest outcomes for children (e.g., Baumrind et al., 2010). Therefore, it does not theoretically make sense that high parental control would be associated with healthier implicit habits.

It is possible that this relationship is not catching positive approaches towards healthy foods, but rather participants' avoidance of unhealthy foods. The BIS and avoidance strategies in general pull individuals' attention away from stimuli that they feel are scary or punishing (Gray & McNaughton, 2000). Indeed, children who grow up with highly controlling parents do not learn how to set reasonable boundaries themselves, but rather learn to fear negative outcomes. This could mean that the presence of a highly controlling father exacerbated already high levels of thin ideal internalization, such that women began to overly utilize their BIS and avoid foods they deemed "scary." There is in fact evidence that those who are highly fearful of gaining weight, such as those with severely restrictive eating behaviors, may overly value healthy foods (Neimeijer et al., 2015). Therefore, it may be that past paternal control intensifies women's fear of being fat, such that they are overly reactive to unhealthy foods, giving the appearance of approaching healthy foods.

Conversely, it may be that this sample's "high" control is not truly reflective of overly controlling parenting. Meaning, in this sample, the range of responses may not have captured the extreme ends of control. Indeed, while the possible range of scores was from 4 to 16, the highest

score was 14, and 88.6% of responses were 12 or lower. As such, these findings might more accurately reflect the literature, such that moderate levels of control were associated with healthier approaches to foods, even when women's DFT was high.

It was somewhat surprising that only one parent-daughter relationship variable altered how women's DFT affected reaction times. It is possible that, while parental warmth has been found to play a significant role in the general development of women's DFT (e.g., Jones et al., 2019), control, not warmth, most strongly alters how DFT affects actual eating behaviors. While warmth may encourage women to feel more content with themselves, it may be that high levels of parental control translate to women's control of their own eating habits. It is also plausible that the current parent-daughter relationship did not significantly impact the relationship between DFT and reaction times to foods because DFT begins developing in early childhood (e.g., Borbeck & Drummon, 2006; Musher-Eizenman et al., 2003); it may be early parent-daughter relationship factors that continue to most strongly affect DFT. However, other studies have found associations between warm, early parent-child relationships and fewer restrictive behaviors in adulthood (e.g., Jauregui et al., 2011). Future studies should seek to determine if early, warm parent-daughter relationships truly do not affect approach/avoidance strategies, or if the low power of this study prevented the illumination of this relationship.

Restrained eating. Unlike DFT, only women's current mother-daughter relationship meaningfully altered the association between women's self-reported restrained eating and their reaction times to foods. Specifically, when women had low levels of restrained eating, their reaction times to foods were virtually the same. However, when they experienced high levels of restraint, the association was altered, such that high quality relationships with mothers appeared

to encourage faster reaction times to healthy foods, whereas poorer relationships were associated with slower reactions to foods.

Unlike high levels of control, high levels of warmth have been associated with healthier outcomes in disordered eating studies (e.g., Haycraft & Blisset). Furthermore, Jones and colleagues (2019) found that parental warmth in particular seemed to provide a barrier against negative feelings about women's bodies. Therefore, it is possible that, despite women's self-reported desire to restrict and actively limit food intake, they may still have internalized healthy foods as "good;" their positive relationships with their mothers may have encouraged them to use BAS approach strategies towards healthy goals (Gray & McNaughton, 2000).

It may be that past parent-daughter relationship factors did not change the relationship between women's self-reported restrained eating and implicit approaches, because restrictive behaviors escalate in emerging adulthood (e.g., Berg et al., 2009). Hence, the current relationship may most strongly affect behaviors that have only recently developed or escalated. These findings are in line with Jauregui and colleagues (2011), who found that only the current maternal-daughter, not father-daughter, relationship affected eating habits. It may be that mother-daughter relationships remain most significant as women age.

Synthesis. While these are preliminary findings and interpretations should be taken with caution, these results provide evidence for the importance of including the parent-daughter relationship in thin ideal internalization research. Indeed, both a past paternal factor, control, and the current quality of the mother-daughter relationship meaningfully impacted the connections between women's DFT and restrained eating, and their approach/avoidance habits. Because parents are the most influential source of socialization in childhood when DFT begins to develop (e.g., Musher-Eizenman et al., 2003), it may be that that early relationships continue to most

strongly affect women's DFT in adulthood. In addition, though it was surprising that only a paternal factor affected women's development, the measure of past maternal warmth was unable to be utilized due to low reliability. Furthermore, past research has suggested that paternal control, not maternal control, appears to distinctly affect adolescents with eating disorders when compared to those without; as such, it may be that earlier levels (i.e., before adulthood) of paternal control may play a particular role in affecting girls' eating habits (Soenens et al., 2008).

Conversely, only the current relationship with mothers affected women's actual, self-reported current restrained eating. When emerging adult women establish their own place of residence away from parents, they may be more readily able to engage in actual disordered eating habits; indeed, almost 50% of college age women indicate that they do at least once a week (Berg et al., 2009). Therefore, current relationships may more strongly affect emerging adult women's developing dieting beliefs and desires than past relationships. Although the current father-daughter relationship may not have had an effect in this study due to low power, research does support the idea that the mother-daughter relationship remains stronger in emerging adulthood than the father-daughter relationship, both generally and in terms of eating influences (e.g., Canetti, Kanyas, Lerer, Latzer, & Bachar, 2008; Furman & Buhrmester, 1992).

Limitations and future directions. Future studies should seek to include larger, more diverse samples. Though the existence of two significant or moderately significant results in such a small sample size was encouraging, there was low power to find further effects. While sample demographics were consistent with the local population, participants were overwhelmingly white; research indicates that other ethnicities are equally as likely to suffer from disordered eating habits, if not more so (Goeree, Ham, & Iorio, 2011). Future research should include a

more ethnically diverse sample, in order to determine if the current relationships remain the same.

In addition, though all participants indicated having mothers and fathers, research on other family types, such as same-sex and single parent families, is needed. For instance, more than ¼ of households with children are not run by married couples (Krueger, Jutte, Franzini, Elo, & Hayward, 2015). Future studies should examine how alternative family systems may alter how parents affect the relationship between thin ideal internalization and implicit eating.

Furthermore, because the sample size was small, each parent was examined separately, despite the fact that families work as a system, and the mother-father dyad would interact to affect daughters (Whitchurch & Constantine, 2004). Indeed, past research has indicated that the combined effect of parents' warmth significantly prevents the development of girls' DFT (Jones et al., 2019). Future research should seek to better incorporate the ways in which all family members affect one another, not examine them as separate entities.

Finally, while it was encouraging that parent-daughter relationships might affect women's implicit reactions to foods, the researchers were unable to confirm if faster reaction times were a result of approaches to healthy foods, or avoidance of unhealthy foods. While the literature provides a rationale for the directionality of these findings, future studies should attempt to untangle directionality via the inclusion of repeated dot-probe sessions.

Strengths and contributions. One of the biggest strengths of this study was the inclusion of an implicit measure of participants' reactions to foods. While past research has focused on how the parent-child relationship affects women's self-reported thin ideal internalization or presence of entrenched disordered eating habits such as severe restriction, no known studies have examined how beliefs transform into disordered eating habits. Thus, there

has been a lack of knowledge regarding how thin ideal internalization transforms into disordered eating, and how high quality parent-daughter relationships might provide a barrier against such developments. This study addresses that gap, finding that healthy parent-daughter relationships may prevent the transformation of thin ideal internalization to actual negative behaviors, by encouraging healthy approaches to foods.

In addition, despite the recognized benefits of warm and reasonable parenting on children and adults' well-being (e.g., Baumrind et al., 2010), the majority of studies continue to focus on direct parenting influences on eating, such as bulimic modeling and parental pressure to be thin (Rodgers & Chabrol, 2009). The present study provided evidence for the potential effectiveness of parenting interventions to assist in the prevention of women's maladaptive eating habits. Past research has suggested that parental warmth provides a barrier against DFT (Jones et al., 2019); the current findings extend that idea to indicate that a high quality parent-child relationship can not only prevent thin ideal internalization, but in turn protect women who still develop DFT from developing actual poor eating habits. A warm, responsive parent-child relationship therefore assists in preventing the problem not only from starting, but also negates the harmful effects of those maladaptive beliefs that do develop. As such, these findings suggest that early parenting interventions may provide long-lasting benefits for women, such that high quality relationships may encourage implicit, healthy reactions to foods, despite women's thin ideal internalization.

Conclusion

These findings confirm the importance of including parent-daughter relationship quality in research on body image and eating. It is possible that high quality relationships may encourage healthy approach strategies towards foods, even in the presence of women's thin ideal internalization. Specifically, early, positive father-child relationships may provide girls with

long-lasting barriers against poor eating habits, while having a current high quality relationship with one's mother may lead women to approach their dieting desires using healthier methods. Given the high rates of death associated with maladaptive eating strategies (e.g., Fitcher & Quadflieg, 2016), it is imperative to address all aspects of women's environments, particularly the parent-daughter relationship, that may assist them in living healthily. Furthermore, because this study used an implicit measure of women's approaches to eating foods, these findings provide evidence for the potential impact of such interventions on actual eating habits, such that higher-quality family systems may encourage healthier eating.

DISCUSSION

The goal of the research completed in this dissertation was to determine if an online training program could alter how women approached healthy foods, and to examine what parental factors might impact women's overall approach/avoidance strategies with food. A dot-probe program was created in order to inspect and potentially alter approach strategies, and maternal and paternal measures of direct (e.g., parental pressure to be thin, parental bulimic modeling) and indirect (e.g., parental warmth, parental control) influences were examined. Two unique studies were created to accomplish these goals: the first focused on the effectiveness of the training program, and the second examined how parent-daughter relationships affected the relationship between women's thin ideal internalization and their approach and avoidance habits. While the literature review suggested that several other variables might affect approach/avoidance behavior, such as parental bulimic modeling or teasing, when tested in this sample these variables were not significant; therefore, they were not included moving forward.

Study 1

In the first study, an online, dot-probe, repeated sessions training program was tested in both an experimental and sham training group. The Behavioral Activation System (BAS) and Behavioral Inhibition System (BIS) theories suggested that implicit training towards healthy goals may lead to better activation and usage of the BAS, and therefore approach strategy usage in general (Gray, 1970; Gray & McNaughton, 2000). It was expected that those in the experimental group, who were led to approach healthy foods a majority of the time, would have faster reaction times to healthy foods at their final training session, compared to those in the sham training group, who equally approached and avoided foods. Only participants who

completed three or more training sessions (e.g., a majority of the five training sessions) were included in the final analyses.

Those who were trained to approach healthy foods did in fact have faster reaction times to healthy foods, meaning that they reacted more rapidly to healthy versus unhealthy foods by their final training session when compared to the sham training group. This indicates that it is possible to alter ingrained approach and avoidance habits (e.g., Deluchi et al., 2017). While both the experimental and sham training groups separately had decreased reaction times by the end of the training period, those in the experimental group showed even greater improvement, despite the fact that those in the experimental group actually completed a slightly lower average number of training sessions. These findings indicate the importance of repeated training sessions when attempting to alter approach and avoidance strategies with foods, as well as the inclusion of a sham comparison group. The majority of past research has included only single training sessions, with no control group (see Jones et al., 2017); the present study suggests that, in order to see meaningful change, multiple sessions are required.

Indeed, although not discussed in Paper 1, those that completed only two training sessions (n = 3) altered the findings of the study such that the effects of the training were no longer significant (p = .20). While such interpretations must be made with caution given the low number of participants, these findings provide preliminary evidence for the need for multiple (e.g., at least three or more) training sessions. Results also did not change when only those with four or five training sessions were included, indicating that three sessions may be a potential threshold for effectiveness. Overall, these findings highlight the ability of a program to healthily alter women's approaches to foods, even in a population known for its high levels of body dissatisfaction and disordered eating (see Berg et al., 2009). It was particularly exciting to note

that women had improvements in reactions to foods, even though the training took place on their own devices, in uncontrolled environments.

Study 2

In the second study, the effect of maternal and paternal relationship variables on women's initial approach and avoidance strategies, as measured by their average reaction times to healthy foods, and thin ideal internalization were examined. Family Systems Theory highlights the importance of examining the relationship between and among family dyads (Whitchurch & Constantine, 2004), as individual family members do not develop in a vacuum. Indeed, research indicates that parents in particular strongly affect women's eating habits (Rodgers & Chabrol, 2009).

In addition, Baumrind's parenting styles suggest that when parents are warm and responsive to children's needs, while also expressing moderate levels of control (e.g., setting realistic boundaries that are discussed and modified with children), children have healthier outcomes (Baumrind et al., 2010). Past research has provided limited support for the effect of positive parent-child relationships on eating habits (e.g., Haycraft & Blisset, 2010), such that healthy parent-child relationships, characterized by warmth and reasonable boundary settings, have been associated with healthier eating habits. Thus, this study proposed that healthy mother-daughter and father-daughter relationships would alter the effect of women's thin ideal internalization, specifically their DFT and restrained eating, on their approach and avoidance habits, such that positive relationships would buffer the effect of negative beliefs on implicit eating habits.

Interestingly, two significant findings emerged. The current mother-daughter relationship altered the connection between women's restraint and reaction times, such that when women had

high levels of restraint, higher quality mother-daughter relationships were associated with faster approaches to healthy foods (i.e., their reaction time to healthy foods at the final training session were faster than at the initial session). Similarly, when the relationship between daughters and fathers were high in past levels of control, women approached healthy foods when they also indicated higher levels of drive for thinness (DFT)

While these findings are seemingly contradictory, it is important to note that women's initial reactions to healthy and unhealthy foods were studied, meaning that their first, untrained reactions were examined. Therefore, faster reaction times may not necessarily indicate positive approaches to healthy foods, but could also indicate avoidance of unhealthy foods. Indeed, research has indicated that warm parent-child relationships are associated with healthier eating habits (e.g., Haycraft & Blisset, 2010; Jones et al., 2019), while controlling parenting is associated with disordered eating and poor body image (e.g., Jauregui et al., 2011; Sira & White, 2010). As such, it may be that a warm parent-daughter relationship leads to faster reaction times via positive approaches to healthy foods, while high parental control may lead to faster avoidance of unhealthy foods. Conversely, it may be that the sample in this study did not have parents who were unhealthily controlling, and "high" levels of control might actually reflect moderate, healthy monitoring behaviors. Overall, while preliminary in nature, these findings suggest that women's eating habits may benefit from both past and current healthy parent-child relationships.

While the original proposed plan was to also examine more direct parental variables, such as parental pressure to be thin and parental bulimic modeling, these relationships were excluded from the results presented in Paper 2, as they were not significant, despite past research indicating the importance of such factors (e.g., Abramovitz & Birch, 2000; Anschutz et al., 2010;

Damiano et al, 2016; Dixon et al., 2010). It is possible that, given the low power of this study, such relationships may still be important, but were unable to be detected at this time. It is worth noting that Jones and colleagues (2019) found that high parental warmth led to significantly lower levels of DFT, even when a direct measure, parental pressure, was accounted for. Therefore, the current findings also provide evidence for the idea that focusing on direct pressures from parents to lose weight may not lead to the most effective prevention and intervention strategies.

Furthermore, the study as proposed was going to include two self-reported food approach and avoidance scales as dependent variables, in addition to examining initial reaction times to healthy versus unhealthy foods. While several of these analyses were in fact significant, the researcher found that the scales did not appear to measure what they were intended to measure. For example, while the Approach subscale from the Planning and Eating Behaviors Scale is intended to examine how often individuals make healthy approaches towards food planning, instead it was highly, positively related to both aspects of women's thin ideal internalization. In essence, the researcher determined that, rather than capturing behaviors made due to positive health beliefs, the scale was instead assessing restrictive behaviors to avoid high calorie intake.

Integration and Implications

While the two studies focused on separate aspects of approach/avoidance behavior, they complement each other well; the first focused on the overall effectiveness of the dot-probe training program, while the second examined what parental factors might affect the effectiveness in the first place. Specifically, because women are influenced by the environment around them, it was imperative to understand what environmental factors might encourage the effectiveness of a training program. While there are many other possible influential factors, such as friends and

peers, the media, etc., parents are the strongest influence on girls' behaviors when thin ideal internalization begins in childhood (Musher-Eizenman et al., 2003).

When combined, these studies suggest that an effective prevention program should address the interactions among women's family contexts, their thin ideal internalization, and their unconscious food biases. Such an integrated approach may directly alter eating habits via changing implicit reactions to foods. Furthermore, it may encourage the retention of such healthy habits and feelings about the self by improving the parent-child relationship. While past research has focused separately on parent-child relationships or approach/avoidance behavior, this is the first known research to examine both simultaneously. Given that girls' unhealthy eating does not develop in isolation, but within the context of familial dyads (Whitchurch & Constantine, 2004), such a gap in the literature was imperative to address.

Specifically, because past, high paternal control may be associated with increased avoidance strategies in adulthood, or alternatively, moderate levels of control may be associated with increased approach strategies, this suggests that childhood family interventions may have important, long-lasting effects on women's health. In addition, although friends and significant others are often found to have strong influences on emerging adults, maternal influences remain strong (Furman & Buhrmester, 1992); indeed, a warm and affectionate mother-daughter relationship led to healthier approaches to foods. Therefore, a biologically-based program that includes a parent training component, to encourage warmth and reasonable levels of control, may provide the most effective and long-lasting outcomes. Such a combined strategy to prevent thin ideal internalization and negative, implicit biases may help reduce the early development of DFT and restraint, and in turn, the development of deadly eating disorders in adulthood.

In addition, the results from Study 1 and Study 2 highlight the need to include implicit, unconscious measures of eating behaviors. Given women's high levels of DFT and disordered eating (see Berg et al., 2009; Eisenberg et al., 2011), it is possible that their self-reported eating habits may be skewed, such that habits that they believe to be healthy may actually be unhealthy, or motivated by unhealthy beliefs. Therefore, in this study, the use of the dot-probe task, and the subsequent examination of unbiased reaction times, may have provided for a more accurate measure of women's actual eating habits. While future research is needed, such cognitive restructuring may also provide for a more universal approach to intervention and prevention; rather than refining programs to different genders, ethnicities, and age groups, this method might allow for cognitive rewiring regardless of identity.

Limitations

Perhaps the most significant limitation of this dissertation was the small sample size. Though many of the previous studies discussed have had small sample sizes as well (e.g., Boutelle et al., 2016: training $n = 9$; Veling et al., 2013: training $n = 22$, control $n = 22$), such small samples, and consequently low power, have been noted to be a significant limitation in the field of approach/avoidance food research (see Jones et al., 2017). Thus, while the chosen sample size was necessary given resource constraints, it may have prevented the discovery of aspects of the parent-daughter relationship that could alter women's thin ideal internalization and approaches to foods. Specifically, it was surprising that no direct parental influences on eating (e.g., bulimic modeling, parental pressure to be thin) significantly altered the relationship between women's thin ideal internalization and their reaction times, given the emphasis on such factors in previous research (e.g., Rodgers & Chabrol, 2009). Furthermore, despite the finding that those in the experimental training group approached healthy foods more than twice as fast

compared to those in the sham training group by the final session (experimental: $M = 84.03$; sham: $M = 41.14$), this finding was technically only trending in significance. Therefore, the small sample size may have obscured the ability to detect the true effectiveness of such a training program.

In addition, the chosen sample did not include a variety of gender identities or ages. While women were the focus of this study due to their particularly high rates of disordered eating when compared to men (e.g., Eisenberg et al., 2011), these results cannot be directly extended to men. Future studies should seek to incorporate men, particularly emerging adult men, who also suffer from clinically diagnosable eating disorders at a higher rate than the general male population (Eisenberg et al., 2011). Relatedly, though young girls suffer from thin ideal internalization at higher rates than boys (Tremblay et al., 2011), given the deadly health consequences faced by both male and female adults, it is necessary to examine the effectiveness of this training program in both male and female children.

The sample was also majority white. While that was consistent with the population in the area studied, it is also known that ethnicity is not a valid predictor of disordered eating development; maladaptive eating habits are present across ethnicities (e.g., Mitchinson & Hay, 2014). In fact, some studies suggest that people of color may be more likely than their Caucasian counterparts to suffer from some symptoms, such as bingeing and purging (Goeree, Ham, & Iorio, 2011). Thus, it is important to include non-white participants, in order to be able to concretely say that approach/avoidance retraining programs can successfully help all those suffering improve their implicit eating strategies.

In addition, only two participants in the present study self-identified as having an eating disorder (one in the experimental group, and one in the sham group). Given the small sample

size, the current study was unable to control for initial levels of disordered eating. Future studies may want to either pre-screen for clinically diagnosed eating disorders, or include a large enough sample size so that separate groups could be examined (e.g., no symptomology, subclinical, and clinical).

Finally, according to women's self-reports, all parents were heterosexual couples. Though it can be argued that the similarity of the sample is a strength, it is also true that the findings of this study may not be accurately extended to other family types. For instance, while recent data found that about 67% of households with children are run by married couples, 16% had a single mother-run household, and 2% had a single father-run household (Krueger, Jutte, Franzini, Elo, & Hayward, 2015). Given that Family Systems Theory emphasizes the importance of examining familial dyads and how those components interact as a whole (Whithcurh & Constantine, 2004), it is possible that different family structures may have differential effects on women's development. Consequently, future studies should seek to include not only more participants in general, but a wider range of participants and family types.

Strengths

While the majority of studies on approach/avoidance food training have included only one training session completed in a controlled environment (see Jones et al., 2017), the current study asked participants to complete multiple training sessions, on participants' own devices, in their location of choice. This is important, as research suggests that multiple training sessions, not single sessions, have long-lasting effects on women's approach habits (Kemps et al., 2015; Kemps et al., 2016). Previous research has suggested that successful retraining in the laboratory did not extend to in-home settings (e.g., Allom & Mullan, 2015; Jones et al., 2017). The success

of the present study despite the lack of a regulated environment indicates that retraining may be generalizable to women's actual eating habits and everyday lives.

In addition, the majority of past studies either examined only one training strategy (approach or avoidance) or compared an approach to an avoidance training group (see Jones et al., 2017). This is problematic, as participants may simply get better at reacting to the task in general due to habituation. Furthermore, training participants to avoid healthy foods is ethically questionable, as it may worsen women's already maladaptive reactions to foods. Therefore, the inclusion of a sham training group, in which participants equally approached and avoided healthy foods, allowed the researcher to determine if participants had truly altered their implicit approaches by the end of the study, without potentially detrimentally altering women's reactions.

Finally, no known approach/avoidance food studies have included parental measures. Given that thin ideal internalization and disordered eating begin early and escalate throughout adolescence and emerging adulthood (see Deleel et al., 2009), it is imperative to understand how parents may encourage girls to have healthy eating habits. Generally, not only are parents the most important source of socialization in childhood, but mother-daughter relationships in particular continue to strongly influence adult women (Furman & Buhrmester, 1992). Specifically, past research has supported the idea that the quality of the parent-child relationship both in childhood and in adulthood influences women's thin ideal internalization (e.g., Canetti et al., 2008; Jones et al., 2019). Consequently, this study included both past and current relationship measures. The present study has shown that, even in adulthood, a healthy parent-child relationship may continue to provide an effective barrier against maladaptive habits, and intervention within the family may assist in altering unhealthy eating.

Conclusion

The research completed in this dissertation highlights the importance of examining a range of methods to prevent and intervene in women's thin ideal internalization and disordered eating. Specifically, while BAS/BIS cognitive restructuring may assist women in making unconscious, healthy choices, this study also found that such a biologically-based method was enhanced by healthy parent-daughter relationships. Perhaps most importantly, this study has contributed to the literature by providing evidence for the success of retraining even in uncontrolled environments. Such findings provide hope for the viability of a widespread, easily distributed training program that could alter how individuals approach eating, thereby hopefully leading to a healthier population, both physically and mentally.

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