THE EFFECT OF EXPOSURE TO SOCIAL MEDIA IMAGES OF FOOD ON EATING BEHAVIOUR INTENTIONS AND MOTIVATIONS

CLAIRE E. MINISTER

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GRADUATE PROGRAM IN PSYCHOLOGY,

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Abstract

Objective: The current study examined the effects of exposure to social media food images on young women's intentions and motivations to eat healthily and intentions to engage in dieting behaviours. Method: Female undergraduate students ($N = 221$) were randomly assigned to view one of three sets of Instagram images: 1) 'healthy' snacks and meals, 2) 'unhealthy' snacks and meals, and 3) photos without food or people. All participants completed trait measures of orthorexia nervosa (ON) and dietary restraint, along with pre-post measures of intention and motivation to eat healthily, intention to diet, and post-exposure measures of inspiration and state eating comparison. Results: There was no difference between conditions on intention to eat healthily, motivation to eat healthily or intention to diet, overall. However, women with more symptoms of ON (versus fewer symptoms of ON) reported greater state eating comparison tendencies following exposure to unhealthy food images. Furthermore, restrained eaters (but not unrestrained eaters) showed greater intent to diet on some measures following exposure to healthy food images. Clinical implications are discussed.

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Introduction

Social media use is prevalent in our society, with 63% of American adults using Instagram daily (Perrin & Anderson, 2019). The sharing of food images on social media is particularly prolific and pictures of food are one of the six most popular content categories on Instagram (Hu et al., 2014). Taking photos of food and sharing them on social media has now become a general consumer trend, with a current search of the hashtag #food returning 446 million posts on Instagram. Furthermore, social media have been shown to change the way individuals interact with and make choices about what foods to eat, and this has sparked interest in research on how to use social media for the promotion of pro-health behaviours (e.g., McGloin & Eslami, 2015; The Hartman Group, 2012). However, while social media provide a possible avenue for implementing population based pro-health interventions, the prevalence of food images on social media and the influence of this content on dietary behaviours may also have significant negative consequences that cannot be overlooked.

Social media are generally a highly visual type of media that promote cultural ideals and can lead to unfavourable self-evaluations. Recent research has shown that use of social media can lead to decreased self-esteem, increased body dissatisfaction and negative mood, particularly among young women (Brown & Tiggemann, 2016; Hogue & Mills, 2019; Rodgers et al., 2015; Sidani et al., 2016; Vogel et al., 2014). This has important societal health implications as body dissatisfaction is shown to correlate with unhealthy weight control behaviours (e.g., chronic or severe dieting) and eating disordered symptomatology (e.g., excessive exercise, purging), both of which are associated with increased risk of negative physical health outcomes (Allen et al., 2015; Bouzas et al., 2019; McCuen-Wurst et al., 2018). Furthermore, several studies have shown that social media use is directly associated with problematic and disordered eating behaviours

(Fardouly et al., 2017; Hummel & Smith, 2015; Rounsefell et al., 2020; Sidani et al., 2016; Smith et al., 2013). Young women, who are the most frequent users of social media, are also thought to be the most vulnerable to these effects (Luo et al., 2020). Though there has been a significant interest in research examining the psychological effects of social media use on body image and attitudes about food, most studies have focused on visual cues related to thin and attractive models and peers, and no known research to this date has examined the direct influence of exposure to social media-based food images on eating intentions or behaviours, indicating a critical gap in the research which this study can begin to address.

Social Influence and Eating

Food and eating are inextricably linked with our social lives, with food functioning not just as a form of sustenance but also, as Rozin (2005, p. S108) describes it, "a social vehicle" that serves as a way to establish social connections and make social distinctions. Given this, it may come as no surprise that our food choices and eating behaviours are profoundly influenced by social factors. Research has shown that we evaluate our own eating behaviours by comparing ourselves to the eating behaviours of others and use this to draw conclusions as to what we should eat, how much we should eat, and even how we should feel about what we have eaten (Polivy, 2017).

Festinger's (1954) social comparison theory, which is a grounding theory for much of the work related to social media and disordered eating in the published literature (e.g., Fardouly et al., 2017; Hummel & Smith, 2015; Smith et al., 2013), posits that individuals evaluate themselves based on comparison with others who share similar attributes. Upward social comparisons occur when comparing oneself to a superior other on a relevant comparison criterion, while downward comparisons are elicited by an inferior other. Social comparison can

occur both on type and amount of food eaten, as well as on dimensions related to food and eating behaviours such as body weight and shape. While social media research has primarily examined the effect of appearance-related comparisons on eating behaviours, numerous in-person studies have shown that eating-related comparison in terms of the quantity or hedonic value of the food another person gets also affects eating behaviour (Higgs & Thomas, 2016; Polivy, 2017). For example, a meta-data analysis of 38 studies examining the modelling of food intake found a large effect, such that individuals consistently increase or decrease the amount of food they eat to match that of an eating companion (Vartanian et al., 2015). In addition to influencing the *amount* of food we consume, social comparison can impact the perceived palatability of food. In a recent study by Mills et al. (2020), students who were told that another student had gotten a better meal than they did liked their meal less and ate less of it. Similarly, a student who was told that another student had gotten a worse meal than they did liked their meal more and ate more of it.

Social comparison can shift people's behaviour because it alters perceived social norms or perceptions of rules or standards for how to act. These norms may be *injunctive,* referring to the perceived attitudes or approval of others, or *descriptive,* referring to perceptions of others' engagement in behaviours (Cialdini et al., 1991). Interest in the relationship between social norms and ingestive behaviours has predominantly focused on how these norms influence drinking and drug use in young adults; there is a substantial body of evidence indicating that young adults tend to overestimate peers' alcohol consumption and use of illicit drugs, and that this overestimation is associated with increased alcohol and drug use (Dempsey et al., 2018).

A related body of research suggests that perceived social norms, and in particular, descriptive norms, may also have an important influence on dietary choices. A meta-analysis and systematic review conducted in 2014 identified six high-quality studies that examined the

influence of exposure to diet choice norm information on subsequent consumption of healthy and/or "unhealthy" foods (Robinson, Thomas, et al., 2014). In these studies, norms were communicated either through exposure to explicit written information regarding a referent social groups' eating choices, such as a poster containing a written message that fellow students ate over three servings of vegetables per day (Robinson, Fleming, et al., 2014), or visual cues indicating the popularity of a given food choice, such as empty wrappers suggesting that prior participants' had selected a "healthy" energy bar or candy bar (Burger et al., 2010). Meta-analysis results indicated that informational food choice norms had a consistent effect on food choice, such that individuals who were exposed to healthy food-choice norms were significantly more likely to select healthy foods. Only one study directly examined whether exposure to an unhealthy food norm increased unhealthy consumption; no significant effect was found.

The findings that social norms influence dietary choices have since been replicated by additional studies conducted after publication of the review (Higgs et al., 2019; Thomas et al., 2017). In line with social comparison theory, these findings suggest that individuals who are exposed to normative information about others' dietary choices are driven to shift their behaviour so as to match what they perceive to be the social norm. If an individual is led to believe that others are making healthy dietary choices, they are more likely to make a healthy dietary choice themselves.

In sum, there is a robust literature showing that people pay attention to what other people are eating and that it influences their own eating behaviour. Based on the existing literature, social comparison and perceived social norms may act as driving processes for these effects, such that individuals are driven to make dietary choices that match what they perceive to be the social norm.

Social Media and Eating

The significant role of social influence (i.e., social comparison, social norms) in determining our eating choices and behaviours has cultivated interest in how such influence may be utilized in population-level nutrition interventions (Hawkins et al., 2020; Petit et al., 2016). Diet quality is an important modifiable risk factor for obesity and major chronic diseases, yet, despite significant national and international intervention efforts aimed at improving dietary choices, public adherence to national nutritional guidelines remains at suboptimal levels (Zhu et al., 2021). Nationally representative surveys indicate that fruit and vegetable consumption is on the decline in Canada, with Canadians eating 4.6 servings of fruits and vegetables per day in 2015 compared to 5.2 servings in 2004, despite the most recent Canadian Food Guide recommending that Canadians comprise half of their daily diet with fruits and vegetables (Health Canada, 2021; Tugault-Lafleur & Black, 2019). Furthermore, as of 2015, 49% of total daily caloric intake from Canadians aged 19-30 years is from ultra-processed foods (e.g. fast food, snacks, chips, candies, cookies, sweetened cereals, sauces and dressings), despite evidence indicating that regular consumption of highly processed foods is linked to increased risk of chronic disease (Health Canada, 2019; Moubarac, 2017).

The exponential rise of social media over the past decade, along with the limited success of traditional interventions aimed at healthy eating, has led to a spike in public-health driven interventions aimed at leveraging social media in attempt to promote healthy eating (Capurro et al., 2014; Kite et al., 2016; Klassen et al., 2018). However, research has shown that these campaigns suffer from poor engagement, high attrition rates, and limited success in changing behaviour (Maher et al., 2014; Williams et al., 2014). Furthermore, because social media are poorly regulated, the content created by health professional and governments must compete with

that of corporate food and wellness industries which spend fortunes on sophisticated social marketing campaigns. These companies use image-based marketing strategies to exploit young adults' social vulnerabilities, often via peer and celebrity endorsements devised to sell the fantasy of health, beauty and success from the products being promoted (Freeman et al., 2016; Kent et al., 2019).

Social media provide abundant opportunity for social comparison, and studies have shown that the desire to engage in social comparison is a motivating factor for use of these platforms, particularly among women (Haferkamp et al., 2012). The negative effects of exposure to image-related social media content on young women are well documented (Brown & Tiggemann, 2016; Hogue & Mills, 2019; Holland & Tiggemann, 2016), and studies show that such exposure can indirectly lead to disordered eating through the process of upward social appearance-related comparisons and increased body dissatisfaction (Fardouly et al., 2017; Hummel & Smith, 2015; Rounsefell et al., 2020; Smith et al., 2013). Furthermore, as young adults increasingly turn to social media to access and share wellness information (Raggatt et al., 2018), a concerning number of pro-eating disorder trends masked as "healthy living" content have emerged that may be using social media to normalize and promote disordered eating and exercise attitudes and behaviours (Pila et al., 2017). As there is also evidence that social media shifts social norms towards extreme levels (Bigley & Leonhardt, 2018), a notable concern is that the prolific sharing of harmful diet-related content on these platforms may lead to an overestimation of peers' engagement in pro-eating disorder behaviours due to a misperception of social dietary norms.

Overall, though social media may provide a unique avenue for delivery of nutrition-related public health interventions, engagement with these platforms may also have negative

effects. In addition to their role in perpetuating unrealistic and dangerous beauty ideals that may indirectly cause unhealthy eating behaviours, social media are also implicated in pervasive dissemination of harmful dietary advice under the guise of "healthful eating" that may act to shift perceived social norms towards extreme, and potentially unhealthy, levels (Bigley & Leonhardt, 2018; Boepple & Thompson, 2014, 2016). Given that young adults, and particularly young women, have been shown to change their behaviour in relation to peers or role models on social media, it is important to understand the effects of exposure to social-media based food images on this population, especially given the popularity of sharing food-related content on social media platforms.

Orthorexia Nervosa

Researchers and clinicians have recently identified a dangerous condition thought to be propagated by social media, known as "orthorexia nervosa" (ON), which is characterized by a pathological obsession with foods associated with "clean" and "healthy" eating, rigid avoidance of foods perceived as unhealthy, and very strict dietary rules with violations causing significant emotional distress (Brytek-Matera et al., 2020; Fixsen et al., 2020; Koven & Abry, 2015; Valente, Cesuroglu, et al., 2021). Over the past two decades ON has garnered increased focus and scientific debate over its validity and clinical utility (see Strahler & Stark, 2020 for a recent review), with some researchers positing that it is simply the medicalization of a new lifestyle phenomenon (He et al., 2021), and others arguing that it is not a stand-alone disorder but instead a form of a clinically recognized eating disorder or obsessive-compulsive disorder (e.g., Altman & Shankman, 2009; Meule & Voderholzer, 2021). However, a recent review by Strahler and colleagues (2018) supported the epidemiological relevance of ON and there is a growing body of evidence to suggest that this extreme style of eating and thinking can cause physical and

psychosocial impairments in various areas of life (e.g., Brytek-Matera et al., 2016; Nevin & Vartanian, 2017; Park et al., 2011; Strahler et al., 2018; Valente et al., 2020), leading to a push among clinicians to have ON recognized as a distinct clinically recognized eating disorder (e.g., Reynolds & McMahon, 2020; Ryman et al., 2019).

Despite a growing interest in ON among clinicians and researchers, the condition is yet to be recognized as a disorder in either the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) or the International Classification of Diseases 11th revision (ICD-11) (American Psychiatric Association, 2013; World Health Organization, 2019), likely due to the lack of agreement over how ON should be defined and diagnosed (Cena et al., 2019). However, a recent literature review by Cena and colleagues (2019) that examined proposed definitions and classification criteria for ON found that the condition is most frequently defined by persistent obsession or fixation on healthy nutrition and diet that leads to an overly selective and/or restrictive diet, pronounced distress when self-imposed nutrition standards are not adhered to, and impairment in one or both of the following: physical health due to nutritional imbalance, and/or psychosocial functioning due to pathological thoughts and behaviours related to "healthy" eating.

Notwithstanding the ongoing discussion about its definition and diagnostic criteria, ON has gained such clinical recognition that even the American-based National Eating Disorders Association (NEDA) has an entire section devoted to the condition. According to the site, individuals with ON become fixated on "healthy eating" and engage in behaviours such as compulsively checking nutrition labels and ingredient lists, eliminating an increasing number of food groups, experiencing significant distress when "safe" or "healthy" foods are not available, taking an unusual interest in how healthy the diets of others are, and obsessively following

healthy lifestyle and food accounts on Instagram and Twitter (National Eating Disorders Association, 2017). Likewise, the Canadian-based National Eating Disorder Information Centre (NEDIC) also features ON on their website and acknowledges that although the diagnostic category is informally used, ON "represents real distress" related to problematic eating behaviours that can significantly negatively impact on one's life (National Eating Disorder Information Centre, 2021).

While social media use is commonly implicated as a risk factor and developmental pathway for ON, there is a dearth of scholarly literature examining this relationship. Of the studies available, one surveyed social media users ($N = 680$) to examine the link between social media and ON symptoms, and found that Instagram use was associated with an increased tendency towards ON (Turner & Lefevre, 2017). Another study interviewed women with (self-reported) ON ($N = 9$) and found that the majority deemed Instagram use as contributing to the development of their symptomology (Valente, Renckens, et al., 2021). Diet-related food images, especially those depicting "clean eating" diets, were considered to be the most harmful by interviewees, with some reporting that this content was particularly triggering. However, the study did not elaborate on the specific types of negative effects that Instagram content may have on individuals with ON.

Finally, a qualitative study by Greville-Harris and colleagues (2020) that examined the content of online blogs written by individuals with self-reported ON found that social media was a key focus of discussion across blogs. Specifically, many bloggers reported that social media, and in particular, Instagram, fuelled their disordered eating by normalizing problematic health claims regarding restricting, detoxing, and eliminating food groups. Furthermore, bloggers reported frequently comparing their diets to those of others on social media and felt that these

comparisons exacerbated and maintained their symptoms. Engaging in upward comparisons with others online who were perceived as following a "healthier lifestyle" were particularly problematic, leading the bloggers to instigate stricter dietary rules, while engaging in downward diet and health-related comparisons online with those who had seemingly less healthy diets caused the bloggers to feel superior in their eating habits, which acted to positively reinforce their disordered eating cognitions and behaviours.

Altogether, the findings from studies examining ON and social media suggest that individuals with ON engage in problematic "health" content online, that content such as healthy food images may be particularly triggering, and that social media promotes ON-related cognitions and behaviours in part through social comparison with others' diets online. However, to date not one study has tested the effect of social media on individuals with ON in an experimental setting.

Dietary Restraint

Restrained eating is another form of disordered eating shown to be associated with social media engagement (Rounsefell et al., 2020). The construct of dietary restraint, which was first introduced by Herman and Mack in 1975, refers to the attempt to control one's weight by restricting food intake. Chronic restrained eaters are typically unsuccessful in maintaining their diet and instead fluctuate between periods of restriction and overeating, a pattern of restraint best identified by the Revised Restraint Scale (RRS) (Heatherton et al., 1988). As a result of the extensive literature on RRS-identified restrained eaters, a characteristic profile of this population has emerged, with research indicating that RRS restrained eaters are predominantly female, usually have significantly lower body satisfaction and self-esteem, and are more likely to be

depressed, anxious, and overweight or obese (Adams et al., 2019; Eldredge et al., 1990; Jones & Crowther, 2013; Klem et al., 1990; Nederkoorn et al., 2004; Polivy et al., 1994).

Several studies have indicated that exposure to food cues differentially impacts restrained eaters. For example, Buckland and colleagues (2013) exposed currently restrained eaters and unrestrained eaters as identified by the Dutch Eating Behaviour Questionnaire (DEBQ; van Strien et al., 1986), to either an image of a diet-friendly food (an orange) or a tempting food cue (chocolate), and then measured subsequent intake of palatable snack food. They found that restrained eaters consumed less after exposure to the diet-friendly food than the tempting food, while unrestrained eaters' intake was unaffected by exposure conditions. In a follow-up study that measured the impact of diet-food images compared to control images, the authors found that exposure to diet-food images compared to non-food images also reduced intake in restrained, but not unrestrained, eaters (Buckland et al., 2014). It is important to note that because these studies used the DEBQ to identify restrained eaters, the results may not generalize to RRS-identified restrained eaters, who are considered to represent a different population of dieters. Specifically, it is thought that the DEBQ identifies individuals who are "successful" in limiting food intake and/or losing weight, typically by employing a flexible dieting approach, while the RRS identifies individuals who expend a great deal of effort towards dieting but are not consistently successful in maintaining their diet (see Mills et al., 2018 for a summary). However, a recent study by Kemps and colleagues (2016) found that RRS-identified restrained eaters also consumed less when exposed to a diet-food cue versus a tempting-food cue, suggesting that RRS-identified restrained eaters are similarly impacted by exposure to diet-related food cues, compared to restrained eaters who are currently or successfully eating less to lose weight.

As restrained eaters are more responsive to food- and diet-related stimuli than unrestrained eaters, this population may be particularly sensitive to social media images associated with diet. Indeed, there is evidence that RRS-identified restrained eaters who are exposed to tempting-food related media content increase their post-exposure intake, while unrestrained eaters are unaffected (Shimizu & Wansink, 2011). Research has also shown that exposure to social media images of thin, ideal bodies typically results in increased food intake in restrained versus unrestrained eaters identified by the RRS (Boyce & Kuijer, 2014; Mills et al., 2002; Seddon & Berry, 1996; Strauss et al., 1994; Warren et al., 2005). Given that restrained eaters generally have a higher body mass index, the finding that they eat more after viewing very thin models may be due to a negative contrast effect, whereby such exposure triggers restrained eaters to engage in upward comparison and perceive the social media models as being dissimilar to themselves, resulting in negative self-evaluation (Trottier et al., 2007) and overeating (Boyce & Kuijer, 2014). Other researchers propose that the effect is due to self-enhancement, whereby restrained eaters who are exposed to thin ideals are more likely to feel inspired by the models, resulting in a temporary fantasy of being thin and feeling of thinness that leads them to relax their attempts to suppress eating (Mills et al., 2002). Though the mechanisms that lead restrained eaters to overeat after exposure to thin-ideals are still unclear, studies have frequently found that unlike restrained eaters, the intake of unrestrained eaters is unaffected after such exposure (Buckland et al., 2018), indicating that restrained eaters are more vulnerable to the effects of exposure to certain social media cues.

Taken together, the literature suggests that restrained eaters moderate their intake based on whether they are exposed to diet-related or tempting food cues. Though social media-related research on this population has primarily focused on the effects of exposure to body-related

content, with the general finding that viewing thin models typically causes overeating in restrained eaters, food cue studies suggest that viewing diet-related food images posted on platforms like Instagram may trigger restrained eaters to restrict their intake, while exposure to tempting food images may induce them to abandon their dietary attempts. It is important to understand the effects that food images have on restrained eaters as exposure to seemingly healthy images in individuals at risk of disordered eating may inadvertently lead to harmful behaviour, such as strengthening the intent to engage in restrictive behaviours. This can be a considered a negative outcome as dietary restraint increases risk of obesity and of developing a clinical eating disorder (Delinsky & Wilson, 2008; Jacobi et al., 2004; Mann et al., 2007). For example, in a study examining the negative consequences of dieting that tracked weight gain, dietary restraint, and eating disorder pathology in a group of 336 female participants during their first year of college, it was found that disordered eating was predicted, prospectively, by dietary restraint (Delinsky & Wilson, 2008).

Current Study and Hypotheses

The primary aim of the current study was to examine the effects of exposure to social media food images on young women's intentions and motivations to eat healthfully and intentions to engage in dieting behaviours. As social media use is most prevalent among young adults, and as women are significantly more likely than men to have their food choice behaviours influenced by healthy food choices and are particularly vulnerable to pathological eating attitudes and behaviours, the study was limited to young adult women (Nelson & Fleming, 2019; Strahler, 2019). An experimental design was used in an attempt to isolate the causal effects of social media exposure on the outcome variables of interest. Healthy eating intention and motivation, intention to diet, and state eating comparison were assessed following forced

exposure to one of three types of social media content posted by a fictitious Instagram user: images of 'healthy' snacks and meals, images of 'unhealthy' snacks and meals, and images of landscapes and buildings (hereafter called 'nature images') that did not contain food or people. Consistent with past literature, nature images were chosen as the control as they are also a common form of content on Instagram (Brown & Tiggemann, 2016; Prichard et al., 2020).

Social comparison theory and social norm theory predict that an individual who is exposed to photos of food posted by a similar other person will make inferences about the dietary habits of the other person, reflect on how healthy their own diet is in comparison, and, if the comparison is upward in direction, align their eating intentions and behaviours in a way that is congruent with the superior target. In the current study, the primary hypotheses were that among young women: (H1) exposure to food images on social media (healthy or unhealthy) would lead to increased eating comparisons with the fictitious Instagram account owner; (H2) the healthy food images condition would trigger more upward comparisons relative to the unhealthy food images condition; and (H3) the healthy food and nature images would inspire individuals to eat more healthfully and spend more time in nature, respectfully, and (H4) the healthy food images condition would lead to increased intention and motivation to engage in healthy eating behaviours, both over time and in relation to the unhealthy food and nature image conditions.

Additionally, two moderators were selected to take into account individual differences in disordered eating behaviours, as previous research reviewed above suggests that these individual difference variables may make certain women more sensitive to the effects of exposure to healthy versus unhealthy food images on social media.

First, we examined the moderating effects of ON and hypothesized that (H5) increased levels of ON would lead to a greater degree of eating comparison in the food image conditions

(healthy and unhealthy) compared to the control, as well as a greater increase in healthy eating motivations and intentions in the healthy food image condition relative to the nature image condition. These predictions were based on prior research suggesting that individuals with ON engage in frequent online diet-related comparisons (Greville-Harris et al., 2020) and feel "triggered" by exposure to healthy food images on social media (Valente, Renckens, et al., 2021).

Next, we examined the moderating effect of dietary restraint (H6) and hypothesized that exposure to the food image conditions versus the nature image condition would lead to increased eating comparison in restrained eaters compared to unrestrained eaters. Furthermore, we predicted that restrained versus unrestrained eaters would show greater intent to diet after exposure to healthy food images, and decreased intent to diet following exposure to unhealthy food images, compared to exposure to nature images. These predictions are in line with prior research indicating that weight-related dimensions of comparison are more relevant to restrained eaters (see Polivy & Pliner, 2015 for review) and that food cue type moderates post-exposure food intake of restrained eaters in relation to unrestrained eaters (Buckland et al., 2014; Kemps et al., 2016; Shimizu & Wansink, 2011).

Methods

Participants

268 female York University undergraduate students aged 18-25 years were recruited using York University's Undergraduate Research Participant Pool (URPP) for a study entitled "Instagram and Personality Traits" that was advertised as exploring how different personality types react to certain social media content. This age bracket was chosen because young adults are the highest users of social media (Pew Research Center, 2021). Individuals with current eating disorders

were excluded for ethical reasons, and in order to obtain a representative sample of normal eaters. Students were granted 1.5 research participation credits for their participation in both portions of the 2-part study (1 credit for part 1 and .5 credits for part 2, respectively), to go towards their York University Introductory Psychology research requirement. The recruitment and all portions of the experiment were conducted online using Qualtrics software. Of the 268 participants who completed part 1 of the study, 225 went on to complete part 2 and were included in the final data set. Of the 225 participants who completed both parts of the study, four participants were flagged as not meeting eligibility criteria; one participant identified as male, and three participants indicated that they previously had or might currently have an eating disorder. These participants were all excluded from analysis, leaving a total of 221 participants.

Demographics

The participants ranged in age from 18 to 25 years (M = 19.55, SD =1.78). The self-reported ethnicity of the sample was: 24.4% Caucasian/European; 24.4% South Asian; 14.9% Latin, Central, and South American; 12.7% African; 12.7% Middle Eastern; 9.0% East Asian; 7.2% South East Asian; .4% First Nations/Indigenous; and 1.8% other. Only .01% of the sample did not report their ethnicity.

Sample Size Estimation

G*Power 3.1 was used to calculate sample size a-priori. 40 participants per condition (N = 120) would provide sufficient power (0.8) to detect a moderate effect size (.25) using a conventional Type I error rate (0.05) in a mixed ANOVA. The sample size was met. Additional participants were recruited to ensure sufficient power for tests of moderation effects, which are generally lower in power than other effects (Shieh, 2009), and to allow for attrition.

Measures

Baseline Measures

Demographics. Age and ethnicity were collected in order to provide descriptive statistics on the sample.

ON. The Eating Habits Questionnaire (EHQ) (Gleaves et al., 2013) is a 21-item measure that assesses the feelings, cognitions and behaviours regarding an excessive focus on healthy eating, called ON (see Appendix A). The measure consists of three subscales: healthy eating behaviors (e.g., "I prepare food in the most healthful way"), problems associated with healthy eating (e.g., "My healthy eating is a significant source of stress in my relationships"), and feeling positively about healthy eating (e.g., "I feel in control when I eat healthily") (Gleaves et al., 2013; Oberle et al., 2017). Participants are asked to score items on a 4-point Likert scale with anchors ranging from "*False, not at all true*" to "*Very true*". Gleaves et al. (2013) showed the test to have excellent reliability with a Cronbach's alpha of .90 and test-retest coefficient of 0.78, as well as demonstrated validity. Scores are summed for a total score which ranges from 0 to 63, with higher scores reflecting more symptoms of ON.

The use of the EHQ represents a departure from much of the research conducted on ON to date. However, the most widely used measure of ON symptomology, the ORTO-15, was recently criticized for confounding normal healthy versus pathological eating behaviours, leading to an over-detection of pathology in a non-disordered population (Dunn & Bratman, 2016; McComb & Mills, 2019; Missbach et al., 2017; Valente et al., 2019). The Eating Habits Questionnaire (EHQ) was developed to address some of the issues of the ORTO-15 and a recent largescale study assessing psychometric properties of four ON measurement tools endorsed the use of the EHQ over the ORTO-15 (Meule et al., 2020). In the current study, this measure was

administered prior to the experiment and used to assess the potential moderating effect of ON symptoms on the image exposure condition. Cronbach's α for this study's sample was .91.

Dietary Restraint. The 10-item Revised Restraint Scale (RRS) (Herman et al., 1978) was used to assess restrained eating behaviours and attitudes (see Appendix B). The scale consists of two subscales, with four items measuring weight fluctuations (e.g., "what is your maximum weight gain within a week?"), and six items measuring concern for dieting (e.g., "how often are you dieting?") (Herman & Polivy, 1980; Polivy et al., 1988). Items are scored on a 4- or 5-point Likert scale (0 to 3 or 0 to 4) depending on the item, and the total RRS scores range from 0 to 35, with higher scores indicating chronic dieting, typically in the absence of sustained weight loss (Polivy, 1996).

The RRS has established validity and has been shown to have high test-retest reliability and internal consistency (Allison et al., 1992; Klem et al., 1990; Polivy et al., 1988). In the current study, this RRS was administered prior to the experiment and used to assess the potential moderating effect of restrained eating status (restrained eater; unrestrained eater) on the image exposure condition, with a conventional cut-off score of 15 or higher used to identify restrained eaters (Herman & Polivy, 1980). Cronbach's α for this study's sample was .76.

Pre/Post- Exposure Outcome Measures

Healthy Eating Intentions and Motivation. Intention and motivation to engage in healthy eating were measured by a series of visual analogue scale (VAS) items that were either created for this study or adapted from items used in previous behaviour change research examining healthy eating (Povey et al., 2000; Rhodes et al., 2006) (see Appendix C). VAS are commonly used to assess behaviour change constructs and were chosen for these measures so as to increase the likelihood of detecting incremental changes and to reduce the risk of recall bias

(Bertholet et al., 2012; Tiggemann & McGill, 2004). For each item, participants were instructed to indicate their current feelings by moving a slider to indicate a point on a 10 cm horizontal line extending between two polar anchors (e.g., *not at all* and *very much*). Responses were scored to the nearest millimeter so that each item was out of 100.

Intention to engage in healthy eating was assessed by asking participants to rate their desire (want) and intention to eat a healthy diet over the coming days (from *not at all* to *very much*). The measures that assessed motivation to eat healthily used items consistent with those used in other studies focused on assessing health behaviour change (Bassett-Gunter et al., 2013; Bertholet et al., 2012). Specifically, participants were asked to rate their motivation to eat a healthy diet and their confidence in their ability to eat a healthy diet (from *not at all* to *very much*), as well as their perceived importance of eating a healthy diet and willingness to put in effort to eat a healthy diet (from *not at all* to *extremely*). The latter three items measure unique dimensions of motivation (confidence, importance, readiness) that are commonly assessed in motivational intervention paradigms, and which are thought to represent intermediate steps towards behaviour change (Bertholet et al., 2012). All VAS items were examined individually.

Intention to Diet. Intention to engage in dieting behaviours was assessed at baseline and post-manipulation using three VAS measures, with items adapted from the modified version of the 10-item Dutch Eating Behaviour Questionnaire-Restraint Scale (van Strien et al., 1986) as used by Ata and colleagues (2013) (see Appendix D). Participants were asked to indicate how likely they would be to engage in the following in the coming weeks: eating less at mealtimes than usual, watching their diet to avoid weight gain, and restricting calories to lose weight. Items were rated from *not at all* to *extremely*, and each item was examined individually.

Post-Exposure Outcome Measures

Social Media Questionnaire. A questionnaire was created for this study to examine participants' social media use (see Appendix E). Participants were asked to indicate the social media platforms they use (if any) and estimate the amount of time spent on each platform (i.e., "How often do you use the platform: *daily, weekly, monthly, less than once a month*?"; "How many hours per day do you spend on the platform: *<1, 1-2, 2-3, 3-4, ≥ 4*?"). Additionally, the questionnaire asked participants if they frequently saw food or nature content on the specific platforms they engaged with. The purpose of the questionnaire was to provide descriptive statistics on participants' type of social media exposure and level of use, as is typical with research on social media effects. The questionnaire was administered at the end of the study to avoid priming participants to reflect on how often they observe food and nature content.

State Eating Comparison. This scale was developed for the current study based on a measure created by Tiggemann and Zaccardo (2015) to examine state appearance comparison after exposure to Instagram images of cultural ideals of beauty and thinness or a control group of nature images. In the current scale, items were adapted to pertain to eating habits (see Appendix F). Participants were asked to use two 7-point Likert scales to rate the extent to which they thought about their eating habits when viewing the Instagram images (1 = *no thought about eating habits*, 7 = *a lot of thought about eating habits*), and the extent to which they compared their eating habits to the (fictional) person who posted the images (1 = *no comparison,* 7 = *a lot of comparison*). The mean score of the two items were averaged to create a final score. Higher scores indicated that the participant engaged in more comparison between their own eating habits and those of the fictitious Instagram account owner. This measure was used as an outcome

measure of interest, as well as a manipulation check to ensure that the items were perceived as intended. The Cronbach's α for the eating subscale in this study's sample was .90.

Eating Habits Direction-of-Comparison. A single item measure asked participants to rate how healthy they thought their eating habits were in comparison to the person who posted the Instagram images (see Appendix F). Responses were indicated on a 5-point Likert scale (*much less healthy, less healthy, the same, healthier, much healthier*). Responses of *less healthy* and *much less healthy* were coded as upward comparisons, responses of *the same* were coded as lateral comparisons, and responses of better and much better were coded as downward comparisons (Fardouly et al., 2017). Responses were only considered valid for those participants who had indicated some level of eating comparison in the state comparison measure (i.e., a score of >1). The purpose of this measure was to confirm the direction of eating comparison.

State Inspiration. We adapted a scale from Tiggemann and Zaccardo (2015) who used a similar measure to assess appearance and travel inspiration after viewing Instagram images. This scale was used to assess the perceived motivating effects of the images (see Appendix G). Using two 7- point semantic differential items, participants were asked to rate how inspired they felt to eat healthily and spend more time in nature when viewing the Instagram images, from *not at all inspired* to *very inspired*.

Materials

Experimental Instagram Task Images

Three sets of stimulus materials were created for the study: 20 healthy food images, 20 unhealthy food images, and 22 nature images. Two nature images were also included in each of the unhealthy and healthy food image sets, in an attempt to reduce demand characteristics around the purpose of the study and to allow for nature-related items on the questionnaire to appear

plausible. Images were identified on Instagram using relevant hashtags for healthy foods (e.g., #cleaneating, #healthydiet), unhealthy foods (e.g., #dessert, #cheatmeal), and photos of landscapes and buildings (e.g., #travelontario, #exploreCanada, and #disoverON). The final images were selected from a larger pool of 450 images (150 per condition) that were pre-tested by five independent female raters from the target age group on visual appeal and inspirational quality, as well as for the food images, palatability and perceived healthiness/unhealthiness.

To maintain ecological validity, additional piloting was conducted for the food image sets (experimental conditions) to ensure that the images were perceived as intended by participants and were balanced for appeal. Eighty of the highest ranked images from the pre-test (40 healthy, 40 unhealthy) were piloted with a sample of 25 female undergraduate students (M_{age} = 23.29, *SD* = 4.70). Each image was rated on healthiness ("This is healthy") and palatability ("I would like to eat this") using a 5-point Likert scale (1 = *strongly disagree,* 5 = *strongly agree*), with rating scales similar to those used in prior studies (Motoki et al., 2018). The healthiness scores were reverse coded for images intended to represent 'unhealthy' meals and snacks. To be considered for inclusion in the final stimulus sets, images had to receive a score of > 4 on the healthy/unhealthy measure to ensure that the selected images were strongly representative of healthy and unhealthy foods. Additionally, given that palatability has been shown to influence attention to visual food cues, appetitive motivation, and eating behaviour (Samson & Buijzen, 2020; Stubbs & Whybrow, 2004), only images that received a positive rating on palatability (>3) were included.

Using the above criteria, 20 images were selected for each of the two food conditions based on pilot results. Each set was comprised of a 50-50 split of savoury and sweet food images and captured a wide variety of food groups and types. Two paired t-tests were conducted to

confirm equivalence of the image sets on perceived healthy/unhealthiness and appeal. There was no significant difference between the healthiness ratings for the healthy (M = 4.65, SD = .37) versus unhealthy (M = 4.57, SD = .36) food image conditions when unhealthy images were reverse coded, $t(24) = .95$, $p = .35$, $d = .42$. The healthy images were marginally more palatable than the unhealthy images (healthy: M = 4.05, SD = 0.70; unhealthy: M = 3.79, SD = .71) but the difference was not significant, $t(24) = 1.82$, $p = .08$, $d = .70$.

To increase perceived similarity to the sample (i.e., young women aged 18-25) and, therefore, likelihood of social comparison, the images were set up on a fake Instagram account that included a biography of the account-owner, stating that they were a young woman named Anna who was a university student living in Toronto and who enjoyed taking pictures and sharing her day-to-day life and interests online. Participants were asked for their feedback on her photos. The introductory description along with sample images for each of the three conditions can be seen in Appendix H.

Procedure

Study Design

The study was conducted in two parts one week apart to reduce demand characteristics by ensuring that trait and baseline measures did not prime participants for the experimental task in a way that would influence their responses to outcome measures. Ethics approval was granted by the York University Human Participants Review Committee prior to study launch. Eligible participants could see and sign up for the study through York University's online experiment management system. Both parts of the study were conducted using Qualtrics, an online survey platform. See Table 1 for a description of the measures administered at each time point.

As the study was conducted remotely, participants were able to complete both parts of the study using a device of their choice, and the survey was optimized for use on both computer and mobile devices. However, a set of instructions was provided at the start of each part of the study that asked participants to complete the study on a desktop or laptop computer and refrain from using a mobile device or tablet during the duration of the study.

Table 1.

Measures Administered at Each Time Point

Part 1	Part 2
Demographics	VAS Healthy Eating Intentions & Motivations
VAS Healthy Eating Intentions & Motivations	VAS Intent to Diet Items
VAS Intent to Diet Items	State Eating Comparison Measure
Revised Restraint Scale (RRS)	Eating Habits Direction-of-Comparison Measure
Eating Habits Questionnaire (EHQ)	State Inspiration Measure
	Social Media Questionnaire

Note. Measures appear in their order of presentation at each time point.

Part 1: Baseline Measures

Part 1 of the study consisted of a series of questionnaires and measures. After accessing the online survey via a custom URL, participants confirmed their eligibility, provided informed consent to participate, and completed a brief demographics questionnaire. Then, participants were asked to complete baseline ratings on the VAS measures of healthy eating intention and

motivation constructs as follows: *desire; intention; motivation; confidence; perceived importance;* and *willingness to put in effort.* After this, they completed baseline ratings on the three VAS measures of intent to diet: *eat less at mealtimes than usual; watch diet to avoid weight gain;* and *restrict calories to lose weight*. Filler scales were included to reduce demand characteristics around the purpose of the study. Finally, participants completed the RRS and the EHQ to measure typical eating behaviours with regards to dieting and symptoms of disordered eating prior to the manipulation, along with several filler questionnaires so as to reduce demand characteristics.

After completing Part 1 of study, participants were given 6 to 10 days to participate in Part 2 of the study.

Part 2: Experimental Manipulation and Post-Exposure Measures

For Part 2 of the study, participants were automatically randomly assigned, using the Qualtrics Randomizer feature, to one of three conditions: (1) exposure to healthy food images (n = 74), (2) exposure to unhealthy food images (n = 76), and (3) exposure to nature images (control group; n = 71). During the Instagram image viewing task, individuals in all three conditions were exposed to 22 sequential pre-selected social media images: the control (nature images) condition viewed images of landscapes and street scenes (no food or people), the healthy food images group viewed images that primarily consisted of healthy meals and snacks (20 healthy food images, two nature images), and the unhealthy food images group viewed images that consisted primarily of unhealthy meals and snacks (20 unhealthy food images, two nature images). Each image was shown on its own page and was paired with a single question about the image which asked participants to rate their agreement with a statement such as "this photo is visually appealing" or "I like the colors in this photo". The purpose of these questions was to

provide a credible rationale for the study and to focus participants' attention on the images. Each page was timed so that participants could not proceed before a full eight seconds had passed; participants could spend up to 180 seconds on the page before they were automatically advanced to the next page.

Immediately after the Instagram image viewing task, participants provided post-exposure ratings on the six healthy eating measures (intentions, motivation), as well as post-exposure ratings on the three measures of intent to diet. Finally, participants completed the post-exposure state eating comparison measure, direction-of-comparison item, inspiration measure, and social media questionnaire.

Data Analysis

All statistical analyses were conducted using SPSS version 27. An alpha of .05 was used for significance testing.

To examine the effects of the experimental manipulation, a one-way between-groups analysis of variance (ANOVA) was conducted to explore the effect of image type on post-exposure state eating comparison for the different conditions (healthy food images, unhealthy food images, control) (H1), along with a multinomial logistic regression test to determine direction-of-comparison (upward, lateral, downward) for those individuals who scored >1 on the state social comparison measure in the healthy and unhealthy food groups only (H2). A one-way ANOVA was also conducted to explore the effects of the images on inspiration to eat healthily (H3), and a series of mixed ANOVAs were conducted to determine whether differences between Part 1 and Part 2 in participants' healthy eating intentions and motivations were dependent upon experimental condition (H4). Time (baseline, post-exposure) was the within-subjects factor, and experimental condition (three levels: healthy food images; unhealthy food images; nature

images) was the between-subjects factor. The dependent variables were the six VAS healthy eating measures of *desire, intent, motivation, confidence, perceived importance,* and *willingness to put in effort.* Any statistically significant interactions between time and condition were followed up with Bonferroni corrected pairwise comparisons to probe significant findings.

To test the secondary hypotheses, a series of moderation analyses were conducted using the PROCESS SPSS macro version 3.5 (Hayes, 2017). We tested model 1, which includes one outcome variable, one predictor, one moderator, and room for covariates. The predictor variable for all analyses was experimental condition.

To explore the possible moderating effect of ON (H5), the EHQ was set as a continuous moderator variable and six analyses were conducted on each of the following outcome variables: *desire to eat healthily; intent to eat healthily; motivation to eat healthily; confidence in ability to eat healthily; perceived importance of healthy eating*; *willingness to put in effort to eat a healthy diet*; and post-exposure state eating comparison. For each of the healthy eating intention and motivation analyses, the relevant baseline VAS score was included as a covariate to control for the baseline score.

To examine the possible moderating effect of dietary restraint (H6), the RRS scale was set as a categorial moderator variable (two levels: unrestrained eater; restrained eater) and four analyses were conducted with each of the following the outcome variables: *intend to eat less at mealtimes*, *intend to restrict calories to lose weight*, *intend to watch diet to avoid weight gain*, and post-exposure state eating comparison. For each of the intent to diet analyses, the relevant pre-exposure score was included as a covariate to control for baseline score.

Results

Univariate inspection of histograms, skewness, and kurtosis indicated that most measures were non-normally distributed. Transformations were attempted but did not normalize the distributions. Moreover, responses were skewed in ways that were theoretically meaningful (i.e., most people have a desire to eat healthily and see eating healthily as important). Therefore, we retained the non-transformed scores. Additionally, inspection of the standard scores for each variable (across groups for baseline data and within each group for outcome variables) indicated a single univariate outlier within each of the state eating comparison and ON variables (as indicated by a z-score of ± 3.29 SDs, Tabachnick & Fidell, 2013). Close inspection of the data revealed that the state eating comparison outlier was very likely the result of respondent-related error. The error could not be corrected and so we opted to report on the analysis with this data point removed so as to avoid fundamental misrepresentation of the results (Leys et al., 2019). There was no indication that the ON outlier was the result of a measurement or participant error and therefore this data point was retained at this stage of the data analysis.

Additionally, assumptions were checked for each of the fitted models. Normality was confirmed through visualization of normal Q-Q plots and histograms of the residuals. Fitted data was examined for outliers (i.e., residuals greater than ± 3.29 SDs), influential observations (using Cook's distance threshold) and high-leverage points. Homogeneity of variance was confirmed for all ANOVA models using Levene's test for equality of variances. Mixed ANOVA models were additionally assessed for homogeneity of covariances using Box's test of equality of covariance matrices. For the moderation and multinomial logistic regression analyses, the assumptions of linearity and homoscedasticity of residuals were confirmed through visualization of scatterplots and residuals plots. Multicollinearity was assessed using thorough examination of

correlation tables and Tolerance level. Results of model assumption testing are described in each section below.

Baseline Between-Group Differences: A series of one-way between-groups ANOVAs were conducted to examine whether participants in all three conditions were equivalent on baseline measures at the start of the study. Assumptions were met for all ANOVAs. The findings from these analyses are reported in Table 2. The only statistically significant difference between conditions was for the baseline measure *intend to watch diet to avoid weight gain*, $F(2, 193) = 3.45$, $p = .03$, with those in the nature images condition reporting marginally lower intent to watch diet to avoid weight gain at baseline than those in the unhealthy food images condition ($M_{diff} = -14.29$, 95% CI [-28.08, -.50]), $p = 0.04$. As this measure was used in moderation analyses which control for baseline scores by including them as covariates, no adjustment to the planned statistical analysis was necessary.

There were no statistically significant differences between the conditions on any other baseline measure, suggesting that overall, randomization to group was reasonably successful.

Table 2.

Baseline Differences on Measures in the Full Sample and Separated by Condition

Measures	Full Sample	Healthy Food Images	Unhealthy Food Images	Nature Images	Overall		
	M (SD)	*M (SD)*	*M (SD)*	*M (SD)*	*F*	*DF*	*P*
Healthy Eating Intentions							
Desire to eat healthily	69.51 (23.76)	71.07 (21.39)	69.74 (23.80)	67.61 (26.34)	.38	218	.68
Intent to eat healthily	58.16 (24.93)	58.45 (24.35)	56.96 (25.71)	59.16 (24.98)	.15	217	.86
Healthy Eating Motivations							
Motivated	54.93 (28.60)	56.07 (27.74)	52.37 (29.74)	56.51 (28.44)	.47	217	.63
Confident in ability	57.69 (26.03)	59.96 (26.56)	54.86 (26.79)	58.29 (24.68)	.73	214	.48
Perceived Importance	69.40 (26.53)	66.97 (25.89)	70.83 (28.75)	70.41 (24.86)	.47	218	.63
Willingness to put in effort	59.15 (26.06)	57.86 (25.72)	58.07 (27.77)	61.69 (24.65)	.49	217	.62
Intention to Diet							
Eat less at mealtimes	36.08 (29.97)	38.57 (29.69)	36.69 (30.30)	32.88 (30.09)	.62	201	.54
Restrict calories to lose wt	28.86 (28.80)	29.59 (27.29)	31.44 (29.86)	25.47 (29.29)	.73	191	.49
Watch diet to avoid wt gain	38.90 (33.56)	36.56 (31.83)	47.42 (34.10)	32.58 (33.42)	3.5	190	.03
EHQ	15.50 (9.02)	16.28 (9.02)	15.51 (9.34)	14.62 (8.67)	.61	218	.55
RRS	11.11 (5.75)	11.70 (5.62)	11.88 (5.52)	11.72 (6.12)	1.03	218	.36

Note. EHQ = Eating Habits Questionnaire; RRS = Revised Restraint Scale; wt = weight. Range of possible scores for each construct are as follows: Desire to eat healthily: 0-100; Intent to eat healthily: 0-100; Motivated: 0-100; Confident: 0-100; Perceived importance: 0-100; Willingness to put in effort: 0-100; Intent to eat less at mealtimes: 0-100; Intent to restrict calories to lose weight: 0-100; Intent to watch diet to avoid weight gain: 0-100; EHQ = 0-63; RRS = 0-35.

Descriptive Analysis of Typical Social Media Use

Despite not specifically recruiting participants who used social media, all participants who responded to the social media questionnaire ($N = 220$) reported using at least one type of social media platform. A total of 95.9% of participants ($n = 211$) reported using Instagram, making this the most popular social media platform among this sample. It was also the most frequently used platform, with 89% of Instagram-users reporting daily use of one to two hours per day. Additionally, food content was commonly seen on Instagram; 67% of frequent (i.e., accessing at least once a week) Instagram users indicated that they often saw food-related content on the platform (reported percentage is a sum of "*Agree*" and "*Strongly Agree*" score responses for the item "On Instagram, I often see the following content: food"). Although this study was specific to Instagram, it seems that across most social media platforms, viewing food content was very common, with the majority of regular users of TikTok (79.8%), Pinterest (61.9%), and Facebook (54.2%) indicating that they were frequently exposed to food content on these platforms.

Primary Hypotheses

Hypothesis 1: Effect of Condition on State Eating Comparison

This hypothesis was tested using a one-way ANOVA to explore the effect of condition on post-exposure state eating comparison. The assumption of homogeneity of variances was violated ($p < .001$). To account for this, a one-way Welsh ANOVA was conducted and Games-Howell post-hoc tests were used for pairwise comparisons. All other model assumptions were met. Results showed a significant difference in state eating comparison between conditions, Welch's $F(2, 133.72) = 49.57$, $p < .001$. State eating comparison scores were examined between the nature image condition ($M = 1.54$, $SD = 1.02$), the unhealthy food images condition ($M =$

3.32, *SD* = 1.95), and the healthy food images condition (*M* = 3.66, *SD* = 1.84). Post hoc analysis revealed that state eating comparison score was lower in the nature condition than in the unhealthy food images condition (M_{diff} = 1.78, 95% CI [1.18, 2.39]) and that this was statistically significant, $p < .001$. The difference between the unhealthy food images condition and the healthy food images (M_{diff} = 0.34, 95% CI [- .40, 1.07], $p = .53$) was not significant. The results confirm the hypothesis that both food image conditions induced a significantly greater degree of eating comparison relative to the control.

See Table 3 for the means and standard deviations for all non-categorical outcome measures (i.e., excluding the direction of comparison measure) at baseline and post-exposure, separated by experimental condition.

Table 3.

Means and Standard Deviations for Outcome Measures Separated by Condition

	Healthy Food Images *M (SD)*	Unhealthy Food Images *M (SD)*	Nature Images *M (SD)*
Healthy Eating Intentions			
Desire to Eat Healthily			
Baseline	71.07 (21.39)	69.44 (23.82)	67.61 (26.35)
Post-Exposure	63.05 (28.02)	67.64 (28.24)	59.46 (30.39)
Intent to Eat Healthily			
Baseline	58.45 (24.35)	57.12 (25.71)	59.56 (24.94)
Post-Exposure	52.86 (26.31)	50.56 (27.31)	48.70 (27.22)
Healthy Eating Motivations			
Motivated			
Baseline	56.07 (27.74)	51.80 (29.52)	56.32 (28.61)
Post-Exposure	47.88 (26.82)	50.92 (30.02)	46.06 (29.40)
Confident in Ability			
Baseline	60.08 (26.92)	55.05 (26.92)	57.64 (24.61)
Post-Exposure	55.68 (26.05)	54.79 (26.85)	53.05 (27.76)

Perceived Importance			
Baseline	67.44 (25.76)	70.44 (28.74)	70.36 (25.03)
Post-Exposure	64.27 (25.71)	66.57 (29.48)	65.77 (29.07)
Willingness to put in Effort			
Baseline	57.86 (25.72)	57.51 (27.53)	61.71 (24.83)
Post-Exposure	54.15 (26.01)	54.57 (26.86)	53.91 (25.42)
Intention to Diet			
Eat Less at Mealtimes			
Baseline	37.70 (29.59)	37.18 (29.59)	32.88 (30.09)
Post-Exposure	33.70 (28.46)	33.06 (28.94)	33.70 (28.46)
Restrict Calories to Lose Weight			
Baseline	29.59 (27.29)	32.97 (30.31)	25.28 (29.37)
Post-Exposure	31.52 (29.85)	31.08 (30.16)	21.02 (26.68)
Watch Diet to Avoid Weight Gain			
Baseline	37.29 (32.00)	47.81 (34.22)	32.56 (33.66)
Post-Exposure	36.08 (33.93)	42.80 (32.81)	29.31 (31.13)
State Eating Comparison			
Post-Exposure	3.66 (1.84)	3.32 (1.95)	1.54 (1.02)
Inspiration: Eat Healthily			
Post-Exposure	4.49 (1.80)	3.40 (1.95)	2.31 (1.57)
Inspiration: Spend Time in Nature			
Post-Exposure	4.36 (1.95)	4.17 (1.94)	5.61 (1.72)

Note. Range of possible scores for each construct are as follows: Desire to eat healthily: 0-100; Intent to eat healthily: 0-100; Motivated to eat healthily: 0-100; Confident in ability to eat healthily: 0-100; Perceived importance: 0-100; Willingness to put in effort: 0-100; Eat less at mealtimes: 0-100; Restrict calories to lose weight: 0-100; Watch diet to avoid weight gain: 0-100; State eating comparison: 1-7; Inspiration: to eat healthily: 1-7; Inspiration: to spend time in nature: 1-7.

Hypothesis 2: Effect of Condition on Direction-of-Comparison

A multinomial logistic regression was used to determine how different food images (healthy, unhealthy) affected direction of eating comparison (downward, lateral, upward). All model assumptions were met. As seen in Table 4, examination of direction-of-comparison results indicated significant relative differences in the frequency of making upward comparisons, lateral comparisons, or downward comparisons between the healthy and unhealthy food image conditions, χ^2 (4) = 49.91, $p < .001$. Specifically, individuals in the healthy food images condition made significantly more upward than lateral comparisons, and significantly more upward than downward comparisons, when compared to the unhealthy food images condition.

Table 4.

Frequency of Upward Comparisons in Healthy Food Images Group Compared to Unhealthy Food Images Group

Condition	Comparison	*B*	*SE*	*W*	*p*
HFI[a]	Upward vs Lateral	2.29	.46	24.91	<.001
	Upward vs Downward	2.81	.51	30.31	<.001

Note. [a]The reference condition category is unhealthy food images. HFI = Healthy food images condition; *B* = Unstandardized regression coefficient; *W* = Wald test.

Hypothesis 3: Effect of Image Type on Inspiration

Two one-way between groups ANOVAs were conducted to explore the effect of image type on mean post-exposure inspiration to eat healthily and, as a control, on inspiration to spend time in nature for the different conditions. All model assumptions were met.

There was a significant difference between conditions for both inspiration to eat healthily, $F(2, 217) = 27.01$, $p < .001$, partial $\eta^2 = .20$, and inspiration to spend time in nature, $F(2, 217) = 12.42$, $p < .001$, partial $\eta^2 = .10$. Inspiration to *eat healthily* was examined across the nature image condition ($M = 2.31$, $SD = 1.57$), the unhealthy food images condition ($M = 3.40$, $SD = 1.95$), and the healthy images condition ($M = 4.49$, $SD = 1.80$). Bonferroni post hoc analysis revealed that the difference between the nature images condition and the unhealthy food images condition was statistically significant ($M_{diff} = 1.09$, 95% CI [.38, 1.80], $p < .001$), as was the difference between the unhealthy food images condition and the healthy food images ($M_{diff} = 1.09$, 95% CI [.38, 1.79], $p < .001$).

Inspiration to *spend time in nature* was examined across the unhealthy food images condition ($M = 4.17$, $SD = 1.94$), the healthy food images condition ($M = 4.36$, $SD = 1.94$), and the nature images condition ($M = 5.61$, $SD = 1.72$). Bonferroni post hoc analysis revealed that the difference between the healthy food and nature images conditions was statistically significant ($M_{diff} = 1.24$, 95% CI [.49, 1.99]) $p < .001$), but the difference between the unhealthy and healthy food images conditions ($M_{diff} = 0.19$, 95% CI [-.93, .55], $p = 1.00$) was not.

Hypothesis 4: Effect of Condition on Intentions and Motivations to Eat Healthily

A series of mixed-ANOVAs were conducted to examine the effect of condition on intentions and motivations to eat a healthy diet. Assumptions were met for all models. Table 3 above provides the baseline and post-exposure means and standard deviations for each of the healthy eating intention and motivation measures.

Healthy Eating Intentions.

Desire to Eat Healthily. The interaction between condition and time on participants' desire to eat a healthy diet was not statistically significant, $F(2, 216) = 1.27$, $p = .28$,

partial η^2 = .01. There was a significant main effect of time, $F(1, 216) = 10.23$, $p = 0.002$, partial η^2 = 0.05. Bonferroni post-hoc analysis revealed that on average, participants rated their desire to eat healthily significantly higher at baseline (M = 69.37, SE = 1.62) compared to post-exposure (M = 63.47, SE = 1.95), M_{diff} = 5.99, 95% CI [2.30, 9.68], p = .002. The main effect of condition was not significant, $F(2, 216) = 9.31$, p = .40, partial η^2 = .01.

Intent to Eat Healthily. The interaction between condition and time on participants' intention to eat a healthy diet was not significant, $F(2, 213) = 1.15$, p = .32, partial η^2 = .01. A main effect of time showed a statistically significant difference in intention to eat healthily between baseline and post-exposure, $F(1,213) = 21.72$, $p < .001$, partial η^2 = .09. Bonferroni post-hoc analysis revealed that participants rated their intention to eat a healthy diet significantly higher at baseline (M = 58.38, SE = 1.70) compared to post-exposure (M = 50.54, SE = 1.86), M_{diff} = 7.83, 95% CI [4.52, 11.15], $p < .001$. There was no main effect of condition, $F(2, 216) = .08$ p = .92, partial η^2 = .00.

Healthy Eating Motivations.

Motivated. The interaction between condition and time on participants' motivation to eat a healthy diet was not significant, $F(2, 215) = 2.91$, p = .057, partial η^2 = .03. A main effect of time showed a statistically significant difference on motivation between baseline and post-exposure across all conditions, $F(1, 215) = 14.81$, $p < .001$, partial η^2 = .06. Bonferroni post-hoc analysis revealed that on average, participants were significantly more motivated to eat healthily at baseline (M = 54.73, SE = 1.941) compared to post-exposure (M = 48.29, SE = 1.95), M_{diff} = 6.44, 95% CI [3.14, 9.74], $p < .001$. The main effect of condition was not significant, $F(2, 215) = .02$, p = .98, partial η^2 = .00.

Confident in Ability. The interaction between condition and time on participants' confidence in their ability to eat a healthy diet was not statistically significant, $F(2, 208) = .76$, $p = .47$, partial $\eta^2 = .01$, nor were there main effects of time $F(1, 208) = 3.54$, $p = .06$, $\eta^2 = .02$, or condition, $F(1, 208) = .33$, $p = .72$, $\eta^2 = .00$.

Perceived Importance. The interaction between condition and time on participants' perceived importance in eating a healthy diet was not statistically significant, $F(1, 215) = .06$, $p = .94$, partial $\eta^2 = .00$. There was a statistically significant difference on perceived importance from baseline and post-exposure, $F(2, 215) = 5.80$, $p = .017$, partial $\eta^2 = .03$. Bonferroni post-hoc analysis revealed that on average, participants perceived eating a healthy diet to be significantly more important at baseline ($M = 69.41$, $SE = 1.80$) compared to post-exposure ($M = 65.54$, $SE = 1.91$), $M_{diff} = 3.88$, 95% CI [.70, 7.05], $p = .017$. The main effect of condition was not significant, $F(2, 215) = .24$, $p = .79$, partial $\eta^2 = .00$.

Willingness to Put in Effort. The interaction between condition and time on participants' willingness to put in effort to eat a healthy diet was not significant, $F(2, 215) = .34$, $p = .34$, partial $\eta^2 = .01$. A main effect of time showed a statistically significant difference on willingness to put in effort between baseline and post-exposure, $F(1, 215) = 11.21$, $p < .001$, partial $\eta^2 = .05$. Bonferroni post-hoc analysis revealed that on average, participants were significantly more willing to put in effort to eat healthfully at baseline ($M = 59.03$, $SE = 1.77$) compared to post-exposure ($M = 54.21$, $SE = 1.78$), $M_{diff} = 4.82$, 95% CI [1.98, 7.65], $p < .001$. There was no main effect of condition, $F(2, 215) = .13$ $p = .88$, partial $\eta^2 = .00$.

Hypothesis 5. Moderating Effect of ON

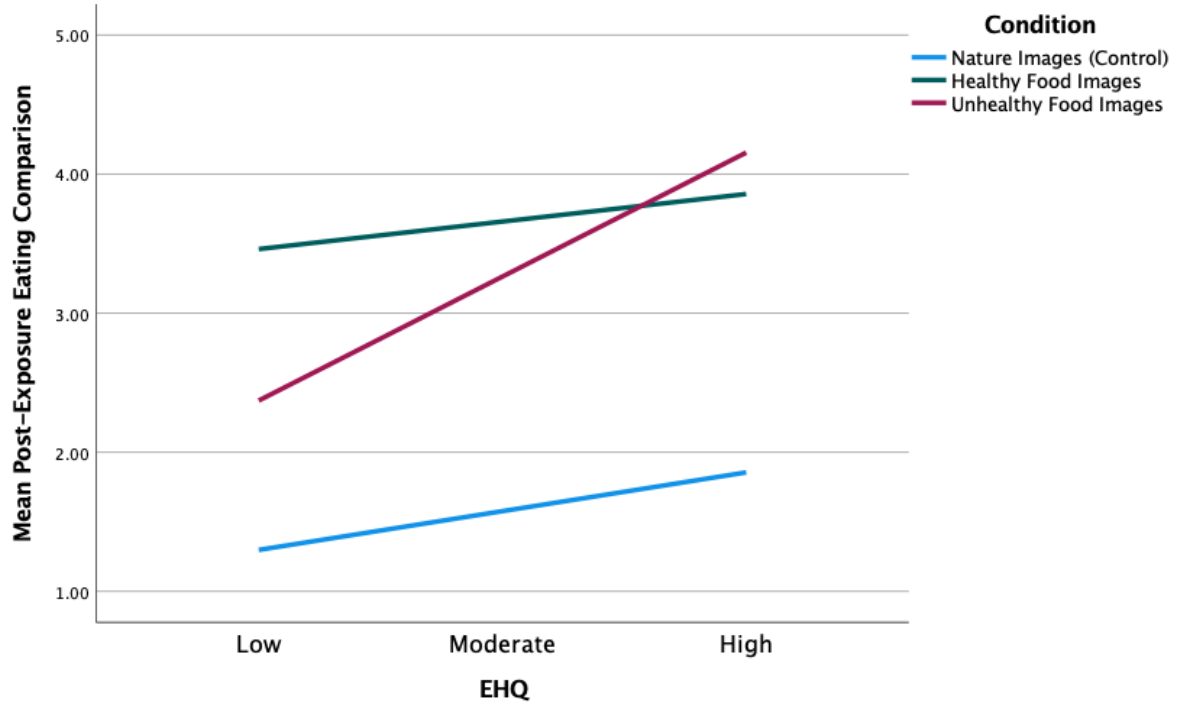
A series of moderation analyses were conducted to determine potential moderating effects of ON on condition for measures of intention and motivation to eat healthily and for state

eating comparison. Regression diagnostics revealed unusual data points in each of the ON moderation models tested. Residual outliers and/or influential points were identified in the following models: *desire to eat a healthy diet* (*n* = 1)*, intent to eat a healthy diet* (*n* = 1), *motivation to eat a healthy diet* (*n* = 1), *confidence in ability to eat a healthy diet* (*n* = 1), *perceived importance of eating healthy* (*n* = 2), *willingness to put in effort to eat healthy (n* = 1)*,* and *state eating comparison* (*n* = 1). Sequential removal of these data points did not influence the significance of the results; therefore, the original distribution was used so as to maintain interpretability of the results. All other model assumptions were met.

Results of the moderation analyses indicated no significant moderating effect of ON on condition for any of the measures of intention or motivation to eat healthily (i.e., *desire; intent; motivation; confidence; perceived importance; willingness to put in effort*). However, the effect of exposure to unhealthy food images versus nature images on mean post-exposure eating comparison scores was significantly moderated by ON for all levels of the moderator. Specifically, from low to moderate to high levels of ON, level of post-exposure eating comparison was significantly different in the unhealthy food images condition compared to nature (control) images. This result is depicted in Figure 1. However, eating comparison did not vary as a function of ON symptoms in the healthy food images condition, relative to the nature image condition. Results are summarized in Table 5.

Figure 1.

Simple Slopes of the Regression of State Eating Comparison on Condition for Different Levels of EHQ



Note. EHQ = Eating Habits Questionnaire; "Moderate" EHQ scores represent the sample mean, "Low" scores represent one standard deviation below the mean, and "High" scores represent one standard deviation above the mean.

Table 5.

Moderating Effects of ON

	B	*SE*	*t*	*p*
Health Eating Intentions				
Desire to Eat Healthily				
Condition (Image type)				
Healthy Food	3.67	8.06	.46	.64
Unhealthy Food	6.34	8.30	.76	.45
EHQ	.39	.31	1.24	.22
Condition x EHQ				
Healthy Food x EHQ	-.13	.44	-.29	.77
Unhealthy Food x EHQ	-.03	.45	-.07	.95
Baseline HE Want	.52	.08	6.84	.00
Intent to Eat Healthily				
Condition (Image type)				
Healthy Food	1.65	7.07	.23	.82
Unhealthy Food	5.98	7.38	.81	.42
EHQ	.74	.28	2.66	.01
Condition x EHQ				
Healthy Food x EHQ	-.16	.39	.42	.68
Unhealthy Food x EHQ	-.16	.40	-.41	.68
Baseline HE Intention	.51	.07	7.46	.00
Healthy Eating Motivations				
Motivated				
Condition (Image type)				
Healthy Food	2.59	6.97	.37	.27
Unhealthy Food	5.28	7.15	.73	.71
EHQ	.54	.27	1.98	.46
Condition x EHQ				
Healthy Food x EHQ	-.05	.38	-.12	.91
Unhealthy Food x EHQ	-.10	.39	-.27	.79
Baseline HE Motivation	.56	.06	10.03	.00
Confident in Ability				
Condition (Image type)				
Healthy Food	1.19	7.02	2.74	.87
Unhealthy Food	2.68	7.24	.17	.71

EHQ	.28	.28	.98	.33
Condition x EHQ				
Healthy Food x EHQ	-.01	.39	-.03	.98
Unhealthy Food x EHQ	.01	.40	-.03	.98
Baseline HE Confidence	.59	.06	9.81	.00
Perceived Importance				
Condition (Image type)				
Healthy Food	-.32	6.93	-.05	.96
Unhealthy Food	-2.02	7.05	-.29	.78
EHQ	.36	.27	1.34	.18
Condition x EHQ				
Healthy Food x EHQ	.03	.38	.07	.94
Unhealthy Food x EHQ	.15	.38	.39	.70
Baseline HE Importance	.60	.06	9.79	< .001
Willingness to Put in Effort				
Condition (Image type)				
Healthy Food	-.37	5.99	-.06	.06
Unhealthy Food	7.04	6.15	1.15	.95
EHQ	.51	.24	2.15	.25
Condition x EHQ				
Healthy Food x EHQ	.18	.33	.54	.59
Unhealthy Food x EHQ	-.27	.33	-.81	.42
Baseline HE Effort	.60	.05	11.01	.00
Post-Exposure Eating Comparison				
Condition (Image type)				
Healthy Food	2.22	.50	4.44	< .001
Unhealthy Food	.67	.51	1.31	.19
EHQ	.03	.02	1.56	.12
Condition x EHQ				
Healthy Food x EHQ	-.009	.03	-.31	.76
Unhealthy Food x EHQ	.06	.03	2.33	.02
Low EHQ	1.07	.38	2.85	.005
Moderate EHQ	1.69	.27	6.37	< .001
High EHQ	2.30	.37	6.19	<. 001

Note. B = Unstandardized regression coefficient; EHQ = Eating Habits Questionnaire;

HE = Healthy eating.

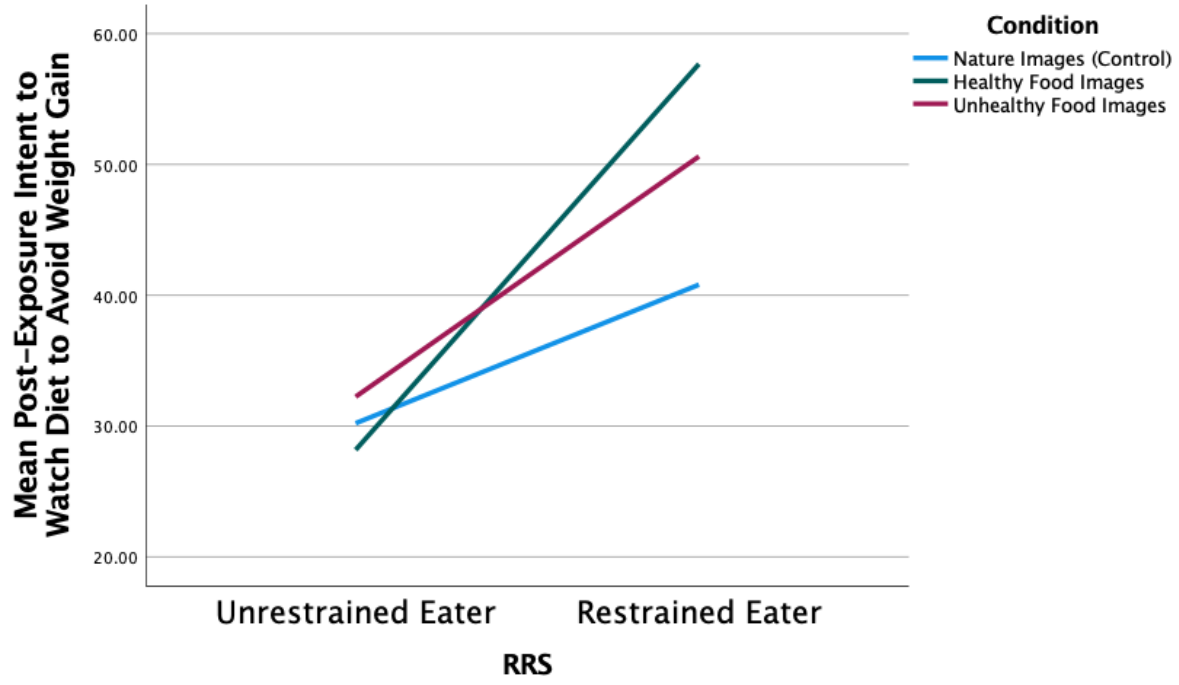
Hypothesis 6: Moderating Effects of Dietary Restraint

A series of moderation analyses were conducted to determine potential moderating effects of dietary restraint on condition for measures of intention to diet and state eating comparison. An assessment of the Normal Q-Q plots for the dietary restraint moderation models indicated a mild deviation from normality for the model that included *intend to restrict calories to lose weight* as the outcome measure. A transformation of the raw data for this outcome variable failed to correct normality when the model was re-tested. As regression is relatively robust to deviations from normality, particularly given a large enough sample size (Knief & Forstmeier, 2020), we proceeded with planned analysis of the non-transformed data. All other assumptions were met. Table 3 above provides the baseline and post-exposure means and standard deviations for each of the intent to diet outcome measures and the post-exposure comparison measure.

As shown in Figure 2, results of the moderation analysis indicated that dietary restraint significantly moderated the effect of exposure to healthy food images compared to nature (control) images for the outcome variable *intend to watch diet to avoid weight gain.* Specifically, there was a significant effect of restraint status on intent to watch diet to avoid weight gain in the healthy food images condition. There was no significant effect of restraint status in the control and unhealthy conditions. There was no significant interaction between dietary restraint and either the *intend to watch diet to avoid weight gain* or *intend to restrict calories to lose weight* variables. There was no significant interaction between dietary restraint and post-exposure eating comparison. See Table 6 for a summary of results.

Figure 2

Intent to Watch Diet to Avoid Weight Gain as a Function of Condition and Dietary Restraint Status



Note. RRS = Revised Restraint Scale; Restrained Eater = RRS ≥ 15; Unrestrained Eater = RRS < 15.

Table 6.

Moderating Effects of Dietary Restraint

	B	*SE*	*t*	*p*
Intent to Diet				
DI_1: Eat less at mealtimes				
Condition (Image type)				
Healthy Food	3.19	4.94	.65	.52
Unhealthy Food	3.01	4.90	.62	.54
RRS	11.45	6.99	1.64	.10
Condition × RRS				
Healthy Food × RRS	1.92	9.46	.20	.84
Unhealthy Food × RRS	2.34	9.60	.24	.81
Baseline DI_1	.42	.06	6.76	.00
DI_2: Restrict calories to lose weight				
Condition (Image type)				
Healthy Food	3.88	4.34	.89	.37
Unhealthy Food	1.32	4.40	.30	.77
RRS	6.21	6.22	1.00	.32
Condition × RRS				
Healthy Food × RRS	13.48	8.11	1.66	.10
Unhealthy Food × RRS	15.39	8.29	1.86	.07
Baseline DI_2	.58	.06	1.06	.00
DI_3: Watch diet to avoid weight gain				
Condition (Image type)				
Healthy Food	-2.03	4.70	-.43	.67
Unhealthy Food	2.03	4.78	.42	.67
RRS	10.59	6.65	1.59	.11
Condition x RRS				
Healthy Food × RRS	18.90	8.73	2.17	.03
Unrestrained Eater	-2.03	4.70	.42	.67
Restrained Eater	16.86	7.34	2.30	.02
Unhealthy Food × RRS	7.77	8.68	.90	.37
Baseline DI_3	.57	.05	10.43	.00
Post-Exposure State Eating Comparison				
Condition (Image Type)				

Healthy Food	1.57	1.19	1.32	.19
Unhealthy Food	-1.17	1.19	-.98	.33
RRS				
Condition x RRS				
Healthy food × RRS	.02	.33	.51	.61
Unhealthy food × RRS	.08	.03	2.45	.02

Note. B = Unstandardized regression coefficient; DI = Intent to diet; RRS = Revised Restraint Scale; Restrained Eater = RRS ≥ 15; Unrestrained Eater = RRS < 15.

Discussion

The present study aimed to determine the experimental effects of exposure to Instagram images of unhealthy and healthy food images on young women's intentions and motivations to eat healthily. Drawing from Festinger's social comparison theory (Festinger, 1954), we looked to extend the current research on the effects of social media, which until now has predominantly examined the effect of body-focused content on appearance comparisons, so as to understand the effects of social media food-focused content on eating comparisons. It was hypothesized that exposure to the food images would induce young women to compare their diet to the fictitious account owner who had posted the photos (H1). Consistent with Festinger's theory, we predicted that exposure to "idealized" healthy food images would lead participants to engage in upward comparisons (H2).

We also predicted that the images would have motivating effects on participants, presumably through processes of social comparison and perceived social norms. First, we hypothesized that participants would perceive to be inspired by the healthy food images to eat healthily (H3). Furthermore, we predicted that individuals in the healthy food images condition

would experience an increase in healthy eating intentions and motivations compared to the control and unhealthy conditions (H4).

Additionally, we were interested in investigating whether pre-existing individual differences in the extent to which women are focused on dieting or healthy eating would moderate the effects of condition on various outcome variables of interest. First, we examined possible moderation effects of ON (H5) and predicted that increased levels of ON would increase intention and motivation to eat healthily scores in the healthy food image condition, relative to the control condition. We also hypothesized that increased levels of ON would lead to increased levels of state eating comparison in the healthy and unhealthy food images conditions, relative to control. Next, we examined possible moderating effects of dietary restraint (H6), hypothesizing that restrained eaters (versus unrestrained eaters) would have higher intent to diet scores after exposure to the healthy food images condition, and lower intent to diet scores after exposure to the unhealthy food images condition. We also predicted that restrained eaters would engage in higher levels of eating comparison after exposure to both food image conditions, relative to the control.

Discussion of Primary Hypotheses

Our primary hypotheses were partially supported. As predicted, young women who were exposed to images of a fictitious similar other's dietary choices on social media engaged in eating comparison, and for the healthy food images group, this comparison tended to be upward in direction. This is in line with prior research which shows that women frequently engage in eating comparisons and that one of the most common forms of upward comparison (in addition to quantity) is a comparison about how much "healthier" a superior target's diet is to one's own (Fitzsimmons-Craft, 2017).

Social comparison and social norms theory suggest that an upward comparison to a superior peer, in this case, the fictious healthy food Instagram account owner, typically leads to a desire to reduce the perceived discrepancy between oneself and the superior target on the comparator of interest (Festinger, 1954), so as to match the social norm. In this case, we predicted that individuals in the healthy food images group would aim to reduce this discrepancy by increasing their motivation and intention to eat healthy. Instead, the results showed that all participants, regardless of whether they viewed images of healthy food, unhealthy food, or nature, rated themselves as higher on motivation and intention to eat healthily at baseline than at post-exposure.

These results suggest that young women may be prone to comparing their diet to that of a peer when they are presented with information on social media about the peer's dietary choices, however, this does not result in any measurable influence on their intention or motivation to eat a healthy diet, regardless of whether the comparator's diet is perceived as being more or less healthy than their own. There is a significant body of evidence to suggest that social comparison and social norms can influence eating behaviour. However, most studies examining the influence of social comparison and social norms on eating have targeted a particular type of food choice (e.g. fruits and vegetables; a specific type of snack bar) as opposed to general intentions to "eat healthily", and have measured actual eating behaviour (Burger et al., 2010; Robinson, Fleming, et al., 2014; Thomas et al., 2017).

It may be that participants in the healthy food images condition did not view the Instagram user's diet as matching their own definition of healthy. However, pilot testing revealed strong agreement on the perceived healthiness of the food images. Some participants might have interpreted healthy eating not to be specific to nutrition, but more generally as a way of being

that makes them feel good. Given this, it is possible that social comparison motivates behaviours only when the criterion is relatively specific and linked to a clear behavioural target (e.g., believing that peers consume a certain number of units of alcohol or eat a certain number of servings of vegetables and adjusting one's alcohol or vegetable intake accordingly).

Furthermore, several studies have shown that food cues may impact our food choices even if we were not aware of the cues or their effect on us (Hagmann et al., 2018; Stämpfli et al., 2017). It may be that participants' intended eating behaviours were impacted in ways that they were unable to report on and that could only be measured by observing eating behaviour. Because this study was conducted online and during the COVID-19 pandemic, measuring in vivo food intake in the lab was not possible.

The online setting may have also decreased the likelihood that participants would be influenced by social eating norms. As suggested by Robinson (2015) in his review of eating norms and behaviour, the relatively novel and sometimes mildly intimidating experience of participating in an in-person laboratory study may induce an elevated sense of uncertainty among participants that acts to bolster their adherence to social eating norms. This effect may have been diminished with the remote administration of the current study, which required no interaction with a study investigator and could be completed in private at a time and place of the participant's choosing, thus reducing the unfamiliarity and social ambiguity of the situation.

Additionally, social norms are shown to have a greater impact on health-decisions if the referent group is perceived to be similar (Dempsey et al., 2018). Although the study induced a social comparison effect with a fellow young woman who was also a university student living in Toronto, without additional information to go on, perhaps the participants did not identify with this individual as a referent group. As food is strongly tied to culture (Rozin, 2005), it is

plausible that individuals were unintentionally induced to make judgements about the social group of the fictitious account owner based on the food images she was posting. This judgement may have led some participants to perceive the fictitious other as being less similar to them than if she had posted foods that linked her culturally to themselves.

Interestingly, despite reportedly feeling *less motivated* to eat a healthy diet after exposure to the healthy food images, participants also reported feeling significantly *more inspired* to eat healthy as a result of viewing the healthy food images. Thrash and colleagues (Thrash et al., 2014) conceptualize inspiration as a multi-faceted motivational state that consists of two distinct processes: one may be inspired *by,* such that an evocative object leads one to gain awareness of new or better possibilities, and one may be inspired *to,* referring to the motivation to actualize the inspirational qualities embodied in the evocative object. In the current study, it may be that the healthy food images evoke participants to feel inspired *by* the images, but not inspired *to* act. The distinction between inspiration and motivation in this context may be important to consider in future studies, as findings from a qualitative study currently underway in our lab suggest that "healthy lifestyle" related social media content that is interpreted as inspirational by participants may, in some cases, be masking less salient negative effects. Specifically, the feeling of inspiration may conceal underlying anxieties about ones' own inability to live up to the "healthy" ideal, with these negative feelings and cognitions only recognized after deeper processing of the images' effects.

Finally, it is possible that the nature images that were intended to be a control group also impacted motivation to eat healthily because they elicited thoughts of a healthy lifestyle.

Discussion of Secondary Hypotheses

In addition to our main analyses examining young women's reactions to food images on social media in general, we also aimed to explore potential moderating effects of dietary restraint and preoccupation with healthy eating on various outcome measures.

Moderating Effect of ON

There was no significant moderating effect of ON on healthy eating intentions and motivations in the healthy food images group, contrary to our hypothesis that increased levels of ON would lead to increased scores in this condition. In other words, we did not find that a preoccupation with healthy eating increased one's determination to eat healthily upon viewing healthy food images. Although past qualitative studies have suggested that content such as healthy food cues on social media can promote ON symptoms and "trigger" individuals with ON, it was not clear as to what those specific triggers may be and how they may impact individuals with ON (Greville-Harris et al., 2020; Valente, Renckens, et al., 2021).

The healthy food images included in the current study were chosen based on what a pilot sample of 'typical' young women found healthy. This resulted in photos of meals and snacks that contained a variety of food groups that had been prepared in various ways. For example, some foods were grilled or baked while others were raw, and some images contained fish, chicken, dairy, whole grains, fruits, and/or foods with naturally higher fats like nut butters and avocado. A key feature of ON is rigidity around the types of foods being consumed and the way in which food is prepared. Such rigid dietary rules are self-imposed and therefore vary on an individual level in terms of the types of foods that are deemed "healthy", however, it is common for individuals with ON to eliminate multiple entire food groups, whether this be carbohydrates, trans fats, animal products, dyes or sugars (von Ranson et al., 2013), and specialized diets such

as vegetarianism and veganism appear to increase the risk of developing ON (Brytek-Matera et al., 2019). Given this, and in consideration of the food images used in this study, it is plausible that the healthy food images were overly inclusive and balanced, and therefore not particularly triggering *or* motivating to individuals with ON.

Though ON did not moderate healthy intention and motivation scores, it *was* found to significantly moderate post-exposure eating comparison scores. Eating comparison scores were generally low in the control group and equivalent across levels of ON symptoms. Similarly, eating comparison scores were generally high in the healthy food images group and equivalent across levels of ON symptoms. However, ON symptom level made a difference in how much participants compared themselves to the target when unhealthy food images were seen. Women low on ON tended to engage in less eating-related social comparison when exposed to unhealthy versus healthy food images, while women high on ON tended to engage in the same level of comparison regardless of whether the target comparator's diet was perceived as healthy or unhealthy. This finding was surprising, as it was predicted that healthy foods would be more relevant comparison criteria for individuals scoring high on ON and therefore lead to greater levels of comparison, when in fact, the opposite was found to be true and unhealthy food images elicited different responses across the spectrum of ON symptoms.

The results suggest that young women with increased ON symptomology tend to engage in a greater degree of eating comparison overall compared to those who have less symptoms, as they compare their diet not only to their peers' healthy food choices, but to their peers' *unhealthy* food choices as well. These results are supported by qualitative findings which indicate that individuals with ON frequently engage in downward comparison with others on social media whose diets are perceived to be inferior to their own, and that this results in feelings of

superiority and motivation to adhere to problematic dietary patterns (Greville-Harris et al., 2020).

The findings are clinically relevant as an ecological momentary assessment study conducted by Fitzsimmons-Craft (2017) that tracked 232 young women over a two-week period showed that both upward and downward state-based eating comparisons predicted urges to engage in disordered or problematic eating. Though the study did not examine ON symptoms specifically, the results may be relevant to young women with ON given that the condition is recognized as a form of disordered eating with a specific focus on "healthy" foods. In particular, it is possible that the tendency to socially compare ones' diet to that of others may be exacerbating eating disorder symptoms in young women with ON.

Moderating Effect of Restrained Eating

We also predicted that dietary restraint would have a moderating effect on intent to diet measures such that exposure to healthy food images compared to unhealthy or nature images would lead to a greater increase in post-exposure intention to diet scores for restrained eaters compared to unrestrained eaters. The hypothesis was partially supported. Unsurprisingly, intent to diet scores were generally higher for restrained versus unrestrained eaters. Specifically, it was found that restrained eaters (versus unrestrained eaters) reported being significantly more likely to watch their diet to avoid weight gain after exposure to healthy food images compared to after they had viewed the nature images. The two other diet-related questions, *intent to restrict calories to lose weight*, and *intent to eat less at mealtimes*, were not influenced by condition. It is important to note that the distribution of the measure *intent to restrict calories to lose weight* had a mild deviation from normality, which may have increased Type II error. Nevertheless, there was no effect of exposure to unhealthy food images on intent to diet.

Given that only one of the three dietary intent measures was significantly impacted by dietary restraint after exposure to healthy food images, the conclusions that can be drawn from this finding are tentative. However, the results indicate that there is at least some impact of exposure to healthy food images on social media on intent to diet in restrained eaters. In their goal conflict model of eating, Strobe and colleagues (2008) propose that goals regulate behavior by enhancing the processing of goal-relevant information so as to increase the probability of engaging in goal-directed action, and by controlling attention to increase the probability that the goal will be kept in mind. In the current experiment, the exposure to healthy food images may have activated restrained eaters' pre-existing intentions and goals to engage in dietary behaviours that were congruent with the images they were exposed to.

Although past studies have found that unhealthy foods trigger increased eating consumption in restrained eaters, these results did not translate over to decreased intentions to diet in the current study. In line with goal conflict theory, it may be that by asking restrained eaters to state their intentions to diet, we effectively reminded them of their dietary goals, the latter of which is an environmental intervention recommended by Stroebe and colleagues (2008) to counteract the drive to consume tempting foods. Furthermore, goal-conflict theory suggests that eating enjoyment is signalled by palatable food, which then leads to dysregulation when tempting foods are made available. Though our study exposed participants to images of palatable food, we did not measure actual behaviour. It is possible that restrained eaters *were* dysregulated after viewing these images, and that this effect was simply not captured given the use of proxy measures for behaviour.

There was also no evidence that restrained eaters are more likely to engage in eating comparisons after exposure to food cues of a fictional peer, compared to unrestrained eaters. It

may be that the primary comparison processes driving increased sensitivity to diet-related cues in restrained eaters are appearance-related as opposed to food-related, as seen in other studies examining the social comparison effect of exposure to thin-ideals on restrained eaters (Polivy, 2017). However, it is important not to generalize these findings to all restrained eaters as defined by the academic literature, as a recent review by Mills and colleagues (2018) found that the term 'restrained eater' represents a heterogeneous group of dieters, depending on how they are defined and assessed. In the current study, dietary restraint was measured by the RRS, which is thought to detect individuals who typically "fail" at dieting and often go through cyclical periods of restricting and overeating (Mills et al., 2018). Therefore, the findings of the current study may be specific to this particular type of restrained eaters, and it may be that restrained eaters identified by alternative questionnaires are more prone to engaging in eating comparisons when exposed to the dietary choices of others.

Limitations

There are several important limitations to consider when interpreting the results of the study. The first pertains to the VAS items used to measure the effects of the manipulation. As this was a novel study, a number of measures had to be adapted or created for the purposes of this study. VAS measures are commonly used in behavior change research, and VAS measures of healthy eating motivation have shown good re-test reliability and validity in their prediction of actual eating behaviors (Stubbs et al., 2000). However, these measures are more reliable when used in controlled (laboratory) conditions, and are best used in conjunction with other variables (e.g. food intake) rather than as proxies for them (Heller et al., 2016; Stubbs et al., 2000). Given that the study was conducted remotely during the COVID-19 pandemic, it was not possible to measure immediate post-exposure eating behaviours in a laboratory setting.

Furthermore, VAS measures are known to produce skewed data along with ceiling and floor effects (Heller et al., 2016). Most of the outcomes measures in the study were non-normally distributed, as noted in the Results section. On the one hand, statistical assumptions were mostly met and responses are more interpretable by retaining original scores. This experiment achieved a large sample size to protect against issues of nonnormality. On the other hand, the data from some of the healthy eating and diet intent measures indicated potential ceiling and floor effects, respectively, thus lowering the likelihood that any discernable effects near the top/bottom end of the scale could be detected. The outcome measures with the highest risk of ceiling and floor effects (whereby 15-20% of participants achieved the best or worst possible score; McHorney & Tarlov, 1995) included *desire to eat healthily* and *perceived importance of eating healthily* (risk of ceiling effects), and all three intent to diet measures (risk of floor effects). Unfortunately, increasing the sample size typically fails to mitigate error that comes with these effects (Garin, 2014). These extreme scores at baseline were also vulnerable to regression toward the mean (Barnett et al., 2005), which may explain the unexpected decrease in almost all eating intention and motivation scores across all conditions over time.

There are several possibilities as to why we observed extreme scores on these measures. High scores on the healthy eating intention/motivation VAS measures might be subject to social desirability bias. In contemporary North American society, a healthy diet is highly valued and arguably equated with virtuousness (Askegaard et al., 2014). Given the societal moral discourse on what we should be eating, it may be that participants were not honest in their responding, perhaps consciously or subconsciously portraying themselves to be stronger in their intentions and motivations to eat a healthy diet than they really were. As we were unable to examine post-

exposure eating behaviours, we were forced to assume that these proxies were accurate reflections of behavioural changes.

Similarly, intent to diet questions may also be influenced by current societal norms. Consumer research trends indicate a decline in the popularity of "dieting" and increased skepticism towards diet-specific products and programs (Mintel, 2015). However, anecdotal evidence suggests that despite a societal shift away from the use of terms such as "dieting" and "calorie restriction", behaviours that are traditionally classified as dieting (e.g. calorie restriction for weight loss purposes) have not necessarily declined, but have instead been reconceptualized as "healthy" eating behaviours that fit within a broader context of a "healthy lifestyle" (Chen, 2016). This lexical change is thought to be driven by the dieting industry, with large-scale dieting companies such as Noom and Weight Watchers branding (or rebranding) themselves as health and wellness organizations, despite continuing to provide programs that are framed around calorie restriction for weight loss purposes (Chen, 2016; Conason, 2020; Dennett et al., 2020; King, 2020).

Given that dieting has become less fashionable in North America, it may be that participants in the current study were less inclined to admit their intentions to diet in the current study due to social desirability bias, or alternatively, failed to identify intended restrictive eating behaviours as "dieting" or "calorie restriction", instead considering these behaviours to be part of a broader program of healthful living. This may also explain why only one of the three intent to diet measures was significantly impacted by exposure to healthy food images. It is possible that the currently available scales and measures for dietary restraint use outdated descriptors for dieting behaviour and that in the present study this resulted in a decreased ability to accurately detect intended dieting behaviours among young women. However, another possible explanation

is that there truly is a paradigm shift occurring such that young women from a non-disordered eating population are indeed less likely to engage in dieting behaviours, in which case, the skewed distribution may accurately represent the population.

Another possible limitation of this study is that the selected food images may not have been culturally diverse enough for the current sample. Culture plays a profound role in taste and food preferences (Højlund, 2015), and although the items were piloted carefully in advance for preference and healthiness, no data on ethnic/cultural background was collected by the pilot participants and so there is no way to ensure that the pilot sample was representative of the study sample on these domains. Given that our study sample was quite diverse in ethnic and cultural background, it may be that the final food images selected, which depicted predominantly Western-style meals and snacks, were not motivating to all individuals due to differing culturally influenced taste preferences.

A related limitation is that the use of an experimental and forced exposure paradigm to evaluate the effects of social media makes it difficult to mimic the evolving and targeted social media environment that young adults are exposed to in real-world settings. Specifically, social media platforms such as Instagram use artificial intelligence algorithms that determine what content individual users will be exposed to based on their past online behaviour (Appel et al., 2020). In this way, the social media platform can curate tailored content that is designed to appeal specifically to a given user's preferences. Though rigorous selection and piloting of the test images with a demographic similar to the sample likely helped to offset some of these effects, it is conceivable that exposure to individually customized content may have a greater impact on one's cognitions and behaviours than can be detected with exposure to non-individualized content.

Finally, online administration meant that there was no way to ensure that participants were fully engaged in the study, and no attention checks were included in the design to screen for inattentive respondents. Studies show that the frequency of random responding (i.e., indiscriminate endorsement of items) in self-report data is approximately 5% in non-disordered populations (Clark et al., 2003; Pinsoneault, 2002), and that even at this rate, random responses can significantly affect results (Credé, 2010). Remote administration may increase the likelihood of random responses, as participants are shown to be more prone to distractibility when completing online experiments remotely (Clifford & Jerit, 2014). In the current study, the remote access meant that there was no way to minimize external distractions as would be feasible during a lab study. In attempts to reduce this risk, participants were instructed to not browse on other websites during the study, and to complete the study in one sitting without taking breaks. However, participants could not be actively monitored to ensure that they were following these instructions.

Strengths of the Current Study

Despite the aforementioned limitations, the study had a number of strengths. The pre-post randomized experimental design provides for greater control over random effect, and the experimental task was carefully designed and piloted. The measure on social eating comparison served as a manipulation check and indicated that the images were perceived as they were intended. All efforts were made to reduce study demand characteristics, including conducting the study over two time points and including filler questions unrelated to the study.

The use of the EHQ was also a strength of this study, as it has stronger psychometric properties than the traditionally used ORTO-15 for measurement of ON (Meule et al., 2020). And while several measures had to be created for this study, they were adapted from measures

previously used in the published literature. Furthermore, a large and ethnically diverse sample was collected, helping to protect against any deviations from normality and allowing the results to be generalized to a broader population. Finally, this study is the first of its kind to examine the impact of social media images on healthy eating intentions and motivation and provides a foundation for future research on this topic.

Future Directions

Food images are ubiquitous on social media, and the results of our study results suggest that young women who engage in social media online are regularly exposed to this content. Yet, the effect of food images on the dietary intentions and motivations of young women has never been researched before. Given the prevalence of this content online, more work is needed to understand exactly how exposure to these images impact young women's healthy eating intentions and behaviours. In the current study, we found that exposure to food images on social media did not impact healthy eating intentions and motivations in young women, regardless of whether the food being depicted was healthy or unhealthy. Future studies should examine whether these results translate to actual eating behaviours.

Furthermore, this study provides a foundation for future experimental research on ON. The current findings suggest that individuals scoring high on ON symptomology tend to engage in greater eating comparison overall. Though prior research suggests that social comparison may lead to increased eating disorder urges (e.g., Fitzsimmons-Craft, 2017), this has yet to be studied specifically within the ON population and additional research is needed to understand if there is a relationship between exposure to food images and eating disorder symptoms among young women with ON.

Finally, the current study showed that individuals who engage in dieting are possibly at risk to be triggered to diet after viewing healthy food images, which suggests that exposure to this content may be harmful to at-risk individuals such as those who engage in problematic or disordered eating. As the study was restricted to a non-eating disordered population, and as only one of three dietary intent measures showed significant results, more work is needed to understand how individuals with dietary restraint are triggered by food image content and to determine whether negative effects of exposure to such content extend more broadly to individuals with eating disorders.

Conclusions

This is the first study of its kind to examine the effects of food images on dietary intentions and motivations in young women and explore how these effects may differ depending on pre-existing eating behaviors and cognitions. The findings illustrate that exposure to food images on social media triggers social comparison, and that the direction of comparison depends on the type of food images being displayed. Additionally, this study showed that exposure to healthy food images does not lead to greater intention or motivation to eat healthily. From a public health perspective, these are important results as they suggest that social media food image content may have limited utility in public health interventions aimed at changing diets. Furthermore, as the findings indicate that at-risk populations may be more triggered to engage in social comparison and dieting intentions, it is possible that exposure to food content on social media may have negative effects in young women. Although more research is needed, this information is clinically and societally relevant and important to consider from a public health perspective, as it may be that the promotion of healthy eating through use of social media image-based content inadvertently perpetuates problematic or disordered food choices in young adults.

Overall, these findings add to our knowledge about the effect of different types of social media food images on eating comparison and dietary intentions and motivations of young women and provide novel information about how this content is impacting different types of viewers. Furthermore, the findings extend theories of social comparison and eating comparison and add to knowledge about possible risk factors for women at risk of or exhibiting symptoms of disordered eating. This research is important so as to better understand the effect of food images being shared online and help inform public health intervention planning to ensure that social media-based dietary interventions are not unintentionally causing harmful effects.

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Appendix A

Eating Habits Questionnaire (EHQ)

		False, not at all true	Slightly true	Mainly true	Very true
1.	I am more informed than others about healthy eating	1	2	3	4
2.	I turn down social offers that involve eating unhealthy food	1	2	3	4
3.	The way my food is prepared is important in my diet	1	2	3	4
4.	I follow a diet with many rules	1	2	3	4
5.	My eating habits are superior to others	1	2	3	4
6.	I am distracted by thoughts of eating healthily	1	2	3	4
7.	I only eat what my diet allows	1	2	3	4
8.	My healthy eating is a significant source of stress in my relationships	1	2	3	4
9.	I have made efforts to eat more healthily over time	1	2	3	4
10.	My diet affects the type of employment I would take	1	2	3	4
11.	My diet is better than other people's diets	1	2	3	4
12.	I feel in control when I eat healthily	1	2	3	4
13.	In the past year, friends or family members have told me that I'm overly concerned with eating healthily	1	2	3	4
14.	I have difficulty finding restaurants that serve the foods I eat	1	2	3	4
15.	Eating the way I do gives me a sense of satisfaction	1	2	3	4
16.	Few foods are healthy for me to eat	1	2	3	4
17.	I got out less since I began eating healthily	1	2	3	4

	False, not at all true	Slightly true	Mainly true	Very true
18. I spend more than 3 h a day thinking about healthy food	1	2	3	4
19. I feel great when I eat healthily	1	2	3	4
20. I follow a health-food diet rigidly	1	2	3	4
21. I prepare food in the most healthful way	1	2	3	4

Please answer the following questions by selecting the response that best fits your current eating habits.

Appendix B

Revised Restraint Scale (RRS)

1. How often are you dieting?

   Never Rarely Sometimes Often Always

2. What is the maximum amount of weight (in pounds) that you have ever lost within 1 month?

   0-4 5-9 10-14 15-19 20+

3. What is your maximum weight gain within a week?

   0-1 1.1-2 2.1-3 3.1-5 5.1 +

4. In a typical week, how much does your weight fluctuate?

   0-1 1.1-2 2.1-3 3.1-5 5.1 +

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

   Not at All Slightly Moderately Very Much

6. Do you eat sensibly in front of others and splurge alone?

   Never Rarely Often Always

7. Do you give too much time and thought to food?

   Never Rarely Often Always

8. Do you have feelings of guilt after overeating?

   Never Rarely Often Always

9. How conscious are you of what you're eating?

   Not at All Slightly Moderately Very Much

10. How many pounds over your desired weight were you at your maximum weight?

    0-1 1-5 6-10 11-20 21+

Appendix C

Healthy Eating Intention and Motivation Measures

Healthy Eating Intentions

Please rate your CURRENT feelings on the following items by sliding the bar to the point on the line that best describes how you are feeling RIGHT NOW:

	Not at all	Very Much
In the coming days, to what extent do you want to eat a healthy diet?	|---|	
In the coming days, to what extent do you intend to eat a healthy diet?	|---|	

Healthy Eating Motivation

Please rate your CURRENT feelings on the following items by sliding the bar to the point on the line that best describes how you are feeling RIGHT NOW:

	Not at all	Very Much
How motivated are you to eat a healthy diet?	|---|	
How confident are you in your ability to eat a healthy diet?	|---|	
How important is it for you to eat healthy?	|---|	
How much effort are you willing to put in to eat a healthy diet ?	|---|	

Appendix D

Intention to Diet Measures

Please rate your CURRENT feelings on the following items by sliding the bar to the point on the line that best describes how you are feeling RIGHT NOW:

	Not at all	Very Much
In the coming weeks how likely are you to eat less at meal times than you usually do?	|----------|	
In the coming weeks how likely are you to restrict your calorie intake so that you lose weight?	|----------|	
In the coming weeks how likely are you to watch your diet so that you don't gain weight?	|----------|	

Appendix E

Social Media Questionnaire

1) Which social media sites do you use? (check all that apply)
   - ☐ Facebook
   - ☐ Instagram
   - ☐ Twitter
   - ☐ Pinterest
   - ☐ Snapchat
   - ☐ Tumblr
   - ☐ Tiktok
   - ☐ None of the above

2) How often do you use these sites?
   [response options populated based on responses to item #1]

	Daily	Weekly	Monthly	Less than once a month
Facebook	☐	☐	☐	☐
Instagram	☐	☐	☐	☐
Twitter	☐	☐	☐	☐
Pinterest	☐	☐	☐	☐
Snapchat	☐	☐	☐	☐
Tumblr	☐	☐	☐	☐
Tiktok	☐	☐	☐	☐
Facebook	☐	☐	☐	☐

3) On average, how many **hours per day** do you spend on each of the following social media sites:
[response options populated based on "daily" responses for item 2]

	Less than 1 hour	1-2 hours	2-3 hours	3-4 hours	More than 4 hours
Facebook	☐	☐	☐	☐	☐
Instagram	☐	☐	☐	☐	☐
Twitter	☐	☐	☐	☐	☐
Pinterest	☐	☐	☐	☐	☐
Snapchat	☐	☐	☐	☐	☐
Tumblr	☐	☐	☐	☐	☐
Tiktok	☐	☐	☐	☐	☐

4) I often see the following content on [social media site]:
[response options populated based on "daily" or "weekly" responses for item 2]

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Facebook					
Food	☐	☐	☐	☐	☐
Nature	☐	☐	☐	☐	☐
Instagram					
Food	☐	☐	☐	☐	☐
Nature	☐	☐	☐	☐	☐
Twitter					
Food	☐	☐	☐	☐	☐
Nature	☐	☐	☐	☐	☐
Pinterest					

Food	☐	☐	☐	☐	☐
Nature	☐	☐	☐	☐	☐
Snapchat					
Food	☐	☐	☐	☐	☐
Nature	☐	☐	☐	☐	☐
Tumblr					
Food	☐	☐	☐	☐	☐
Nature	☐	☐	☐	☐	☐
Tiktok					
Food	☐	☐	☐	☐	☐
Nature	☐	☐	☐	☐	☐

Appendix F

State Eating Comparison Measures

Eating Comparison

1) To what extent did you think about your eating habits when viewing these Instagram images?

No thought about dietary habits						A lot of thought about dietary habits
1	2	3	4	5	6	7

2) To what extent did you compare your eating habits to the person who posted these Instagram images?

No comparison						A lot of comparison
1	2	3	4	5	6	7

Eating Habits Direction-of-Comparison

3) How healthy do you think your eating habits are compared to person who posted these Instagram images?

Much less healthy	Less healthy	The same	Healthier	Much Healthier
1	2	3	4	5

Appendix G

State Inspiration Measure

When viewing the images, how inspired were you to…

	Not at all Inspired (1)						Very Inspired (2)
Eat healthily	1	2	3	4	5	6	7
Spend more time in nature	1	2	3	4	5	6	7

Appendix H

Instagram Task

Introductory Paragraph. The following photos were posted on Instagram by a young woman named Anna. Anna is a university student living in Toronto who enjoys taking pictures and sharing her day-to-day life and interests online. We are interested in your feedback on her photos. For each photo, please indicate how much you agree or disagree with the accompanying statement. Each photo will be displayed **for at least 8 seconds** before you can move to the next page. The photos are large and you may have to scroll to see the entire photo.

Healthy Image Condition Sample Images

Unhealthy Image Condition Sample Images

Nature Image Condition Sample Images