The Effect of Attention on Body Size Adaptation and Body Dissatisfaction

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Abstract

The direction of attention towards people of a low fat body mass is associated with the tendency to perceive low fat bodies as “normal” sized (Stephen, Sturman, et al., 2018) and higher rates of body dissatisfaction (Moussally et al., 2016). Attentional bias towards low fat bodies may therefore contribute to the pathological levels of body size misperception and body dissatisfaction that are diagnostic symptoms of eating disorders (American Psychiatric Association, 2013; Cash & Deagle, 1997). This research investigated whether two attentional bias modification tasks influence body size perception and body dissatisfaction in a sample of 430 Caucasian women aged 18-35. Participants were trained to attend towards either high or low fat body stimuli using a Dot Probe task (Experiment 1) and a Visual Search task (Experiment 2). Pre- and post-training measures were used to determine the effect of the attention training on 1) attention to high vs low fat body stimuli, 2) the body size perceived as “normal”, and 3) body dissatisfaction. Bootstrapped one sample t-tests showed that participants who were trained to attend towards high fat body stimuli using the Dot Probe task significantly increased their attention towards high fat body stimuli ($p = .001$); however, their perceptions of a “normal” body size and their body dissatisfaction did not change significantly as a result of the attention training. Participants trained to attend towards low fat bodies using the Dot Probe task did not demonstrate a significant change in their attention, perceptions of a “normal” body size, or body dissatisfaction. Participants who were trained using the Visual Search task did not demonstrate a significant change in their attention, perception of a “normal” body size, or body dissatisfaction. The results indicate that the attentional bias modification tasks used in this experiment may be insufficient in the treatment of body image disturbances.

Statement of Originality

This work has not previously been submitted for a degree or diploma in any university. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made in the thesis itself.

(Signed)_______________________________ Date: 16/05/2020

Thea House

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The Effect of Attention on Body Size Adaptation and Body Dissatisfaction

Body Size and Shape Misperception

Humans do not always have an accurate perception of their body. In the US, 27.5% of women and 29.8% of men over- or under-estimate their body weight (Chang & Christakis, 2003), and this number rises to 40.7% when considering adolescents (Jiang et al., 2014). Similar results are found in adolescent samples from China (Yan et al., 2018) and South Korea (Lim & Wang, 2013), indicating that the phenomenon occurs across multiple cultures. This body distortion is referred to as body size and shape misperception (Challinor et al., 2017) and is thought to represent the perceptual component of body image disturbance (Cash & Deagle, 1997).

Body size and shape misperception is associated with multiple psychopathologies and negative health consequences. For example, overestimating one's body size, a distortion more pronounced in women (Chang & Christakis, 2003), is a core feature and diagnostic symptom of eating disorders such as *anorexia nervosa* and *bulimia nervosa* (American Psychiatric Association, 2013; Caspi et al., 2017; Mölbert et al., 2017). Both *anorexia nervosa* and *bulimia nervosa* are characterised by patients placing extreme emphasis on their weight and body shape, with patients often undertaking excessive exercise and food restriction to prevent weight gain (American Psychiatric Association, 2013; National Eating Disorders Collaboration, 2017).

Conversely, the underestimation of body size plays an important role in *muscle dysmorphia* which is when a person, typically male, underestimates their muscle size and is pathologically preoccupied with increasing muscle mass (Maida & Armstrong, 2005). The underestimation of body size also has negative health consequences for people who are classified as obese or overweight (World Health Organization, 2000), because failing to recognise the need for weight loss can act as a barrier to treatment (Powell et al., 2010). The study of body size and shape misperception is therefore vital to improving our understanding of these serious health conditions.

Body Size Adaptation

An area of research into body size and shape misperception that has gained momentum in the last decade is the study of body size adaptation (Brooks, Mond, et al., 2019; Challinor et al., 2017). Body size adaptation refers to the inaccurate body size perception experienced by a person after they are exposed to people of extreme body sizes. More specifically, exposure to low fat body stimuli causes people to perceive subsequently presented body stimuli as higher in body fat than reality, thus overestimating their body size. In contrast, exposure to high fat body stimuli causes people to perceive subsequently presented body stimuli as lower in body fat than reality, thus underestimating their body size. These perceptual shifts are called body size aftereffects and have been repeatedly demonstrated in experiments measuring the change in participants' perceptions of a "normal" body size (Brooks et al., 2016; Glauert et al., 2009; Winkler & Rhodes, 2005).

Although research on body size adaptation is a relatively recent emerging field of research, the perceptual phenomenon of adaption has been a topic of scientific discussion for over a century (Verstraten, 1996). Perceptual aftereffects have been demonstrated with simple stimuli including motion, colour, and orientation, as well as more complex stimuli such as faces (Thompson & Burr, 2009). For example, adaptation to feminine faces causes subsequently presented androgynous faces to be perceived as more masculine (Webster et al., 2004). Like body size aftereffects, these perceptual biases are thought to be caused by the imbalance in neuronal activity that results from the temporarily reduced response in neurons responding to adaptation stimuli (Barlow & Hill, 1963; Thompson & Burr, 2009). Early researchers argued aftereffects were visual malfunctions caused by neural fatigue and restricted to laboratory experiments (Gibson, 1986); however, more recently researchers have suggested adaptation may naturally function in everyday life to recalibrate perceptual norms (Rhodes et al., 2013; Webster, 2015; Webster & MacLeod, 2011). Therefore, adaptation to low (high) fat bodies causes subsequently viewed low (high) fat bodies to be perceived as more “normal”, whilst high (low) fat bodies are perceived as atypical.

Rather than being dismissed as a perceptual oddity, body size adaptation has been proposed as a potential mechanism involved in pathological body size and shape misperception (Brooks, Mond, et al., 2019; Challinor et al., 2017). Adaptation is suggested to cause people who are overexposed to low fat bodies—through the media or face-to-face interaction—to overestimate their own body size. This overestimation combined with a perceived pressure to be thin (Stice, 2002) may contribute to other body image disturbances such as body dissatisfaction, which is defined as the negative subjective evaluation of one’s body (Stice & Shaw, 2002). Body dissatisfaction is often considered the attitudinal component of body image disturbance and is a diagnostic symptom of eating disorders (American Psychiatric Association, 2013; Cash & Deagle, 1997). Women have been shown to report greater body dissatisfaction following exposure to low fat body stimuli (Groesz et al., 2002; Moreno-Domínguez et al., 2019; Tiggemann & McGill, 2004) and a potential explanation for this finding might be an adaptation induced overestimation of own body size.

Body size adaptation has also been proposed as a possible mechanism in the muscle related body image disturbances characteristic of *muscle dysmorphia*. Sturman et al. (2017) presented participants with body stimuli that were manipulated to appear either high or low in either body fat or muscle mass. Before and after the stimuli presentation, participants manipulated the body fat and muscle mass of body stimuli to make them look “normal”-sized. The researchers found separate aftereffects for body fat and muscle mass in the predicted directions. Participants exposed to stimuli high (low) in muscle mass proceeded to underestimate (overestimate) muscle mass in subsequently-presented body stimuli, whilst their perceptions of fat mass remained constant. Contrastingly, participants exposed to stimuli high (low) in body fat proceeded to underestimate (overestimate) body fat in subsequently-presented body stimuli, whilst their perceptions of muscle mass remained constant. These results support the concept of a multidimensional body space (Rhodes et al., 2013), indicating adaptation influences perceptual norms independently for body fat and muscle mass. These findings have important clinical implications, as the researchers suggested people regularly exposed to muscular body types might underestimate their own muscle mass, resulting in body dissatisfaction. Therefore, adaptation may provide a unified mechanism for explaining pathological misperceptions of both body fat and muscle mass.

Body size adaptation makes an appropriate mechanism to study in relation to body image disturbances for a number of reasons. For example, body size adaptation is a robust phenomenon that persists even when tested using different forms of body stimuli. Studies have shown body size aftereffects using computer generated synthetic bodies (Glauert et al., 2009), photographs of people that omitted the head, feet, and forearms (Hummel et al., 2012), photographs of people that did not omit any body parts (Brooks et al., 2016), and photographs of models taken from advertisement (Hummel et al., 2012). Body size aftereffects can also be induced using different techniques of body size manipulation. Studies have shown body size aftereffects using simple width adjustments on the horizontal axis (Winkler & Rhodes, 2005), increases in surface area (Hummel et al., 2013), spherize transforms (Brooks et al., 2016), as well as fat and muscle transformations (Sturman et al., 2017). Body size aftereffects have also been found in studies that, instead of using image distortion techniques, used standardised photographs of people separated into different weight categories (Oldham & Robinson, 2016; Robinson & Kirkham, 2014). Body size adaptation can therefore persist against variations in stimuli and size manipulations, indicating that body size adaptation may generalise beyond the laboratory and persist against the everyday variations in real world body stimuli.

Body size adaptation has also been shown to transfer from unfamiliar bodies to the self. In a cross adaptation experiment, participants adapted to photographs of themselves or unfamiliar people that had been expanded or contracted to imitate changes in body fat (Brooks et al., 2016). Participants' perceptions of a "normal"-sized body were assessed using both photographs of the participant as well as unfamiliar people. The results showed body size aftereffects were larger when test identities matched the adaptation identities; however, participants still presented body size aftereffects when test identities differed from the adaptation identities. Therefore, participants exposed to contracted (expanded) unfamiliar bodies proceeded to overestimate (underestimate) the size of their own body. By transferring across identities, body size adaptation can feasibly explain how overexposure to smaller body sizes in the media and real world can lead a person to overestimate their own body size.

Further support for the transfer of adaptation across identities comes from a study by Salvato et al. (2019) who found that adaptation to unfamiliar bodies also influenced participants' implicit perceptions of their own body size. Participants were exposed to unfamiliar body stimuli that were either high or low in fat mass. Before and after the body stimuli presentation, participants completed an Implicit Association Test (IAT) for "thin" versus "fat" words and "self" versus "other" words. The results showed that participants exposed towards high fat bodies proceeded to strongly associate "thin" and "self" concepts on the IAT, unlike participants exposed towards low fat bodies who demonstrated a significantly weaker association between "thin" and self" concepts. These changes in implicit associations are consistent with typical body size aftereffects and support the suggestion that exposure to people of extreme body sizes can influence the way we perceive our own body.

Furthermore, a study by Bould et al. (2018) found adaptation to unfamiliar bodies may also contribute to changes in body dissatisfaction. Participants were presented with high and low fat body stimuli of unfamiliar people and then asked to look at their own body in a mirror. The researchers found participants exposed to unfamiliar high fat bodies decreased their size estimations for their own body and reported reduced body dissatisfaction. Therefore, exposure to certain body sizes in everyday life is likely to affect our self-perceptions of body size, which may subsequently influence our body dissatisfaction.

Finally, research on people with eating disorders supports the suggestion that body size adaptation may play a role in body image disturbance. Mohr et al. (2016) found that people with *anorexia nervosa* and *bulimia nervosa* differed from healthy control participants by only showing body size aftereffects when exposed to high fat body stimuli. They did not overestimate body size when exposed to low fat body stimuli. Mohr et al. (2016) suggested that people with eating disorders are preadapted to low fat bodies and therefore the low fat body stimuli used in the experiment were not extreme enough to elicit body size aftereffects.

Mohr et al. (2016) suggested an explanation for this preadaptation was that people with eating disorders possess an attentional bias towards low fat bodies. Therefore, although they may be exposed to people of varying body sizes, their attention is predominantly directed towards low fat bodies. Eye-tracking studies demonstrate that people with *anorexia nervosa* and *bulimia nervosa* direct more attention towards low fat body stimuli than other body sizes (Blechert et al., 2009; Pinhas et al., 2014). Furthermore, increased attention has been shown to increase the magnitude of both low-level and high-level aftereffects, including orientation (Spivey & Spirn, 2000), motion (Rezec et al., 2004), and facial distortion (Rhodes et al., 2011). Therefore, people with eating disorders may adapt to low fat bodies in everyday life more than healthy people, meaning this enhanced adaptation cannot be additionally increased in the laboratory. This finding supports the study of body size adaptation as a mechanism in pathological body size and shape misperception, and suggests that an attentional bias may also contribute to the process.

Attentional Bias, Body Dissatisfaction, and Body Size Adaptation

People with eating disorders demonstrate multiple different attentional biases when presented with disorder relevant stimuli (Ralph-Nearman et al., 2019). For example, eye-tracking studies show that patients with *anorexia nervosa* direct more fixations to wider and bonier areas of the body, including the hip and collar bones, which were thought to be areas indicative of body fat levels (George et al., 2011). Attentional biases in eating disorders are often explained in terms of cognitive schemas. People with eating disorders preferentially attend to schema-related stimuli, i.e., stimuli relating to food, weight, and body shape, and these attentional biases are thought to contribute to the development and maintenance of eating disorder symptoms (Smith et al., 2018; Williamson et al., 2004). Although an attentional bias to low fat bodies is present in people with eating disorders (Blechert et al., 2009; Pinhas et al., 2014), the attentional bias is also present in non-clinical populations who report high levels of body dissatisfaction (Rodgers & DuBois, 2016). Therefore, an attentional bias towards low fat bodies might contribute to the development and maintenance of body image disturbances in healthy populations as well as clinical populations.

The association between body dissatisfaction and an attentional bias towards low fat bodies has been demonstrated using a variety of different methods (Rodgers & DuBois, 2016). One of the most commonly used methods is the Dot Probe task. This task involves the brief and simultaneous presentation of two body stimuli that differ in size. Following the body stimuli presentation, a probe appears in the location previously occupied by one of the body stimuli. Participants are required to respond to the probe as quickly as possible. Multiple studies show that participants high in body dissatisfaction are faster at responding to probes replacing low fat bodies, compared with other body sizes or non-body stimuli, demonstrating an attentional bias for low fat bodies (Dondzilo et al., 2017; Joseph et al., 2016; Moussally et al., 2016).

Opposing results were shown in one Dot Probe study by Glauert et al. (2010) who found body dissatisfaction negatively correlated with attentional bias towards low fat bodies. However, these results are likely to have been caused by the low ecological validity of the stimuli which involved emaciated and unclothed bodies (Rodgers & DuBois, 2016). The findings by Glauert et al. (2010) appear to be an exception when compared not just to other Dot Probe experiments, but also to eye tracking studies that confirm a positive relationship between body dissatisfaction and eye movements towards low fat bodies (Blechert et al., 2009; Cho & Lee, 2013; Gao et al., 2014; Stephen, Sturman, et al., 2018; Tobin et al., 2019).

Although the majority of Dot Probe and eye tracking studies indicate a positive relationship between body dissatisfaction and attentional bias towards low fat bodies, a recently developed compound Visual Search task did not find evidence for this relationship (Cass et al., 2020). Participants searched for a horizontal or vertical target bar amongst multiple distractor bars varying in orientation. Each bar was paired with a body stimulus that varied in body fat. The results showed that participants were faster at searching for the target bar when it was paired with low fat body stimuli, as opposed to average sized body stimuli, indicating an attentional bias towards low fat bodies. Importantly, this attentional bias towards low fat body stimuli did not correlate with body dissatisfaction. The researchers suggested the conflicting results may be due to task differences causing participants to employ different attentional strategies. For example, the Visual Search task involved longer reaction times and exposure to body stimuli than the previously mentioned Dot Probe tasks, and therefore participants may have been able to employ more volitional control when searching for the target bar. Interestingly, the facilitative search effect of the low fat body stimuli was greater for participants reporting high levels of eating restraint—a behavioural component of body image disturbance (Penelo et al., 2013)—meaning attentional bias towards low fat bodies was still related to a manifestation of body image disturbance. More research is required using alternative measures of attentional bias, such as the Visual Search task, in order to explain these conflicting findings and further our understanding of the relationship between attentional bias to low fat bodies and body dissatisfaction.

Many of the previously mentioned studies also solely focussed on attentional biases in women, by recruiting female participants and using female body stimuli. However, body ideals in Western society are dependent on gender, with drive for thinness being more commonly associated with women and drive for muscularity being more commonly associated with men (McCreary & Sasse, 2000; Murray et al., 2017). Reflecting this difference, the previously described Visual Search task was conducted on male participants using male body stimuli and found that men were faster at detecting the target bar when it was paired with muscular body stimuli as opposed to average sized body stimuli (Talbot et al., 2019). This attentional bias for muscular bodies was positively correlated with muscle dissatisfaction, indicating that body composition, and not just size, is involved in the relationship between attention and body image disturbance. Supporting these findings, an eye-tracking experiment showed that men with high body dissatisfaction directed more eye movements towards muscular male bodies, whereas women with high body dissatisfaction directed more eye movements to low fat female bodies (Cho & Lee, 2013). Therefore, although there are conflicting findings, these various measures of attentional bias generally support the conclusion that body size attentional biases depend on gender differences in idealised body shapes and sizes, and that these attentional biases positively relate to body and muscle dissatisfaction.

When discussing the relationship between body dissatisfaction and gendered differences in attentional biases, researchers often focus on social comparison theory. People with high body dissatisfaction are suggested to make upwards social comparisons by directing their attention towards people who have their ideal body size and shape, resulting in negative self-evaluations and further body dissatisfaction (Blechert et al., 2009; Festinger, 1954; Myers & Crowther, 2009). The perceptual mechanisms of this process are often overlooked; however, research on gender differences in body size adaptation provide a potential explanation for the negative effects of attending to idealised bodies. Brooks, Keen, et al. (2019) found that body size aftereffects for fat and muscle were larger when participants adapted to and judged bodies that matched their own gender. Eye-tracking experiments show that participants direct more attention to bodies that matched their own gender (Cho & Lee, 2013), and similar results have been found using a Dot Probe experiment (Joseph et al., 2016). As discussed previously, attention can increase the magnitude of low and high level aftereffects (Rezec et al., 2004; Rhodes et al., 2011; Spivey & Spirn, 2000); therefore, participants in Brooks, Keen, et al. (2019) may have been directing more attention to bodies that matched their own gender and consequently the magnitude of own-gender aftereffects increased. Given the tendency for the media to portray female bodies as thin and male bodies as muscular (Spitzer et al., 1999), attentional biases towards people of one’s own gender group may exacerbate adaptation induced body size and shape misperception.

Contrary to their predictions, Brooks, Keen, et al. (2019) also found that the separate aftereffect magnitudes for fat and muscle were uninfluenced by the gender of the participant or body stimuli. Aftereffects for body fat were not larger for female participants or conditions using female body stimuli, and aftereffects for muscle mass were not larger for male participants or conditions using male body stimuli. However, body dissatisfaction data were not collected on this sample, and therefore it is unknown whether we would expect to find a gendered effect of attention to idealised bodies. In a sample of people reporting high body dissatisfaction, we might expect women to direct more attention to bodies low in body fat and, as a result, present larger body fat aftereffects, especially when tested using female body stimuli. Similarly, we might expect men high in body dissatisfaction to direct more attention to bodies high in muscle mass and, and as a result, present larger muscle aftereffects, especially when tested using male body stimuli. Attentional bias may therefore play a crucial role in adaptation induced body size and shape misperceptions for men and women experiencing high body dissatisfaction.

The first study to investigate the relationship between attention, body dissatisfaction, and body size aftereffects was conducted by Stephen, Sturman, et al. (2018). Participants had their eye movements tracked whilst being exposed to pairs of unfamiliar body stimuli involving one high fat body and one low fat body. Body pairs were congruent with the participant's gender. To measure body size aftereffects, participants were assessed for their perceptions of a "normal"-sized body before and after the stimuli presentation. The results showed that participants' body dissatisfaction was indirectly related to their susceptibility to the body size aftereffect and that this relationship was mediated by the participants' attentional bias to low fat bodies. Namely, participants who experienced greater body dissatisfaction directed more attention to low fat bodies and displayed a greater decrease in their perception of a normal body size, indicating that they overestimated the size of the test stimuli to a greater extent. This relationship did not differ depending on the participants' gender, although female participants did direct more attention to low fat bodies than male participants, in line with thinness being more highly valued in women than men (Murray et al., 2017).

The results found by Stephen, Sturman, et al. (2018) have important implications for our understanding of body image disturbance. Firstly, as suggested by Stephen, Sturman, et al. (2018), the relationship between body dissatisfaction, attention, and body size adaptation may explain why some people are more likely to report body size and shape misperception than others, despite similar exposure to different body sizes via the media and social networks. Individual differences in body dissatisfaction are likely to affect levels of attention directed to different body sizes and, as a result of adaptation, influence how people perceive their own body. Secondly, the results support the suggestion by Mohr et al. (2016) that an attentional bias to low fat bodies could be causing people with eating disorders to develop a pre-existing adaptation to low fat bodies. Given the previously discussed findings on muscle aftereffects, it also seems plausible that an attentional bias towards muscular bodies may lead people with *muscle dysmorphia* to become preadapted to muscular bodies. Finally, it seems reasonable to infer that interventions aimed at modifying attention could be useful in the treatment of body image disturbances. Redirecting people's attention away from idealised body sizes may reduce their body size aftereffects for their own body, leading to less body size and shape misperception.

Attentional Bias Modification

The experimental manipulation of attention was shown to affect body size and shape misperception in an adaptation experiment conducted by Stephen, Hunter, et al. (2018). Participants were presented with pairs of unfamiliar body stimuli involving one high fat body and one low fat body. Importantly, participants in the high fat condition were instructed to attend to the high fat body stimulus whilst participants in the low fat condition were instructed to attend to the low fat body stimulus. Eye-tracking data showed the experiment instructions were effective at manipulating attention, because participants looked more frequently and for longer at the body size they were instructed to attend towards. Moreover, the direction of participants' body size aftereffects was dependent on their attention condition, indicating that despite being exposed to stimuli of both body sizes, the participants adapted to the body size they were instructed to attend towards. The participants' body dissatisfaction was measured before and after exposure to the body stimuli; however, body dissatisfaction scores did not change during the experiment and were not influenced by the participants' attention condition. These results suggest that the modification of attention can have a causal effect on body size adaptation but might not affect body dissatisfaction.

When speculating about the lack of change in body dissatisfaction, Stephen, Hunter, et al. (2018) suggested one possible explanation was that changes in body size perception do not translate into changes in body dissatisfaction. However, a number of studies demonstrate changes in body dissatisfaction co-occurring with changes in body size perception. For example, Preston and Ehrsson (2014) used full body illusions in virtual reality to simulate the experience for participants of owning a larger or smaller body. The results showed illusory ownership of a smaller body caused participants to report their actual body size being smaller, as well as report reduced body dissatisfaction. Preston and Ehrsson (2014) concluded that body size and shape misperception can have a causal influence on body dissatisfaction, and therefore it might also be possible for changes in body size adaptation to alter body dissatisfaction. Furthermore, in the study conducted by Bould et al. (2018), participants exposed to unfamiliar high fat body stimuli reported reduced size estimations for their own body, as well as reduced body dissatisfaction. These results support the suggestion that reducing a person's size estimation for their own body via body size adaptation can reduce their body dissatisfaction.

To manipulate attention, Stephen, Hunter, et al. (2018) asked participants to attend towards the body size of their condition, and eye-tracking data suggested that participants were fixating more on their designated body size. However, eye-tracking is a measure of overt attention processes and therefore participants may have been fixating on their designated body size whilst simultaneously covertly attending to the contrasting body size in their peripheral vision (Kulke et al., 2016). The experiment instructions may have modified attention enough to elicit body size aftereffects; however, these body size aftereffects may not have been large enough to influence body dissatisfaction. Alternative methods of attention manipulation may be more effective at increasing attention towards high and low fat body stimuli, and therefore could elicit larger body size aftereffects which may be more likely to influence body dissatisfaction.

An alternative method of attention manipulation was used by Dondzilo et al. (2018), who trained participants to attend towards or to avoid low fat bodies using an attentional bias modification version of the Dot Probe task. For participants trained to attend towards low fat bodies, the probe replaced a low fat body stimulus on 100% of the attention training trials. For participants trained to avoid low fat bodies, the probe replaced a neutral abstract art image on 100% of the attention training trials. To assess the effects of the attention training on attentional bias, participants completed the traditional version of the Dot Probe task before and after the attention training in which the location of the probe was randomised so as to measure, rather than train, attentional bias. The results showed that participants trained to attend towards low fat bodies significantly increased their attentional bias towards low fat bodies as a result of the attention training, demonstrated by faster reaction times when the probe replaced the low fat body. The faster reaction times may be more representative of a change in attention, when compared to the eye tracking measures used by Stephen, Hunter, et al. (2018), because we would not expect participants to respond faster to probes replacing low fat bodies if they had been simultaneously covertly attending away from the low fat body.

After participants completed the Dot Probe task, Dondzilo et al. (2018) exposed participants to a body image-related stressor and then measured the participants' negative affect which, like body dissatisfaction, is a risk factor of eating disorders (Stice et al., 2017). The results showed that participants trained to attend towards low fat bodies increased their negative affect following the body image-related stressor more than participants trained to avoid low fat bodies. Therefore, although Dondzilo et al., (2018) did not measure body dissatisfaction, their results show that increasing attention towards low fat bodies using a Dot Probe task can have an effect on risk factors of eating disorders. Attentional bias modification tasks, like the Dot Probe task, may therefore be an effective method of attention manipulation and thus could be used to induce body size aftereffects that may also influence body dissatisfaction.

The Present Study

The present study investigates whether two attentional bias modification tasks—the Dot Probe task and Visual Search task—affect body size adaptation and body dissatisfaction in a female non-clinical population. Both the Dot Probe task and the Visual Search task are established attentional bias modification techniques that have been used in the treatment of various psychological conditions. For example, both techniques have been used effectively in reducing symptoms of anxiety and depression and in acting as a buffer to stress vulnerability (Jones & Sharpe, 2017). The techniques also offer potential therapeutic benefits that cannot be offered by traditional talking therapies such as Cognitive Behavioural Therapy. For example, the techniques are low in cost and intensity and can potentially be administered online via a computer or smart phone without a therapist present (Kuckertz & Amir, 2017). The Dot Probe task is a more common method of attentional training; however, both tasks have rarely been applied to the treatment of body image disturbances. Therefore, this research aims to train participants' attention on both a Dot Probe task and a Visual Search task, using the same body stimuli, to further our understanding of both techniques.

In the present study, participants will have their attention trained towards either high or low fat body stimuli using a Dot Probe task (Experiment 1) or a Visual Search task (Experiment 2). To assess the effects of attentional bias modification, participants will have their attentional bias, body size adaptation, and body dissatisfaction measured before and after the attention training. Given the previously discussed gender differences in attentional bias and body size ideals (Cho & Lee, 2013; Murray et al., 2017), this study will only recruit female participants and use female body stimuli. A commonly discussed advantage of attentional bias modification tasks is the potential for them to be completed by patients online in a home setting (Kuckertz & Amir, 2017); therefore, participants in the present study will complete the experiment online using the Gorilla Experiment Builder, which has been shown to be an effective program for running reaction time sensitive experiments (www.gorilla.sc; Anwyl-Irvine et al., 2019). However, research tends to show that attentional bias modification techniques produce larger effects when conducted in a laboratory or clinical setting, as opposed to online in a home setting (Cristea et al., 2015; Linetzky et al., 2015; MacLeod & Clarke, 2015); therefore, the experiment will additionally be completed in a laboratory setting to test whether experiment setting influences the experiment results.

This research will therefore extend the findings of Stephen, Hunter, et al. (2018) by using alternative methods of attention manipulation that are established in the treatment of various psychological conditions (Beard, 2011). This will further our understanding of the relationship between attention, body size adaptation, and body dissatisfaction. It will also inform the use of interventions that implement attentional bias modification tasks in the treatment of body-image disturbances such as body size and shape misperception and body dissatisfaction.

Hypotheses

Hypothesis 1: Participants trained to attend to low (high) fat body stimuli will exhibit a greater attentional bias to low (high) fat body stimuli after the training than before.

Hypothesis 2: Participants trained to attend to low (high) fat body stimuli will perceive lower (higher) fat body stimuli as "normal" after the training than before.

Hypothesis 3: Participants trained to attend to low (high) fat body stimuli will exhibit higher (lower) body dissatisfaction after the training than before.

Experiment 1: Dot Probe Task

Experiment 1 employed the most commonly used attentional bias modification task—the Dot Probe task—to train participants attention towards high versus low fat bodies and assessed whether attentional bias modification resulted in changes to participants' body size misperception and body dissatisfaction.

Methods.

Design.

This experiment used a between-participants experimental design with the independent variable being the body size of the stimuli that participants were trained to attend toward (high fat versus low fat). All participants completed an attention training version of the Dot Probe task. Half of participants were trained to attend toward high fat body stimuli, using the training Dot Probe trials in which the probe replaced the high fat body stimuli on 100% of the training trials. The other half of participants were trained to attend toward low fat body stimuli, using the training Dot Probe trials in which the probe replaced the low fat body stimuli on 100% of the training trials. Before and after completing the training Dot Probe trials, participants were measured for their attentional bias, body size adaptation, and body dissatisfaction. The three dependent variables were as follows:

1. Change in attentional bias (ΔAB)

   All participants completed a pre- and post-training assessment version of the Dot Probe task, during which the location of the probe was randomised so that the probe had an equal probability of replacing either the high or low fat body stimulus. Therefore, the pre- and post-training Dot Probe trials measured, rather than trained, participants' attentional bias. ΔAB was calculated by subtracting participant's pre-training attentional bias score from their post-training attentional bias score.

2. Change in point of subjective normality (ΔPSN)

   To measure body size adaptation, all participants completed a pre- and post-training method of adjustment task to indicate the body size that they perceived as most "normal"—the point of subjective normality (PSN). ΔPSN was calculated by subtracting participant's pre-training PSN score from their post-training PSN score.

3. Change in body dissatisfaction (ΔBD)

   All participants completed a pre- and post-training body dissatisfaction questionnaire based on the body shape satisfaction scale designed by Pingitore et al. (1997). ΔBD was calculated by subtracting participant's pre-training body dissatisfaction score from their post-training body dissatisfaction score.

Participants.

A power analysis was conducted using G*Power v3.1.9.2 to determine the required sample size to detect an effect for the primary outcome (ΔAB). This experiment is based on the Dot Probe task designed by Dondzilo et al. (2018) who found a medium effect size (d = 0.49) for ΔAB when participants were trained to attend toward low fat bodies. Initially reported effect sizes tend to be larger than population effect sizes due to regression towards the mean and the tendency of journals to favour the publication of significant effects (Lakens, 2013). To account for this potential overestimation, the power analysis for the present experiment used the effect size found by Dondzilo et al. (2018) and reduced it by a third (to d = 0.33). The power analysis showed that 75 participants were required per condition to provide the main analyses (one sample t-tests) with 80% power to detect an effect at an alpha level of 5%. Therefore, 150 participants were recruited to complete the experiment in the online setting. The average age and BMI of the participants were 23.95 years (*SD* = 5.22) and 25.71 units (*SD* = 9.62).

To ensure that data collected in the online setting were comparable to data collected in a laboratory setting, an additional 70 participants (35 per condition) were recruited to complete the experiment in a laboratory setting (mean age = 21.10 years, *SD* = 3.48; mean BMI = 23.70, *SD* = 5.14). When conducting the main analyses (one sample t-tests) on this sample, the analyses had 80% power to detect a medium effect size at an alpha level of 5% (*d* = 0.49).

The sample was restricted to Caucasian women aged 18-35 years to target a population where eating disorders are particularly prevalent (Hay et al., 2015). The sample excluded other ethnicities and genders to minimise effects caused by participants processing bodies of a gender or ethnicity that was different to their own. Data from 23 participants (15 online; 8 laboratory) were excluded from the final sample size and data analysis because the participants confirmed that they did not meet the inclusion criteria. When participants were excluded, replacement participants were recruited to meet the target sample size.

Data collection took place between November 2019 and March 2020. For the online experiment setting, self-selection sampling was used to recruit participants who responded to advertisements on Macquarie University's SONA study signup system (*N* = 84). These participants were reimbursed with one hour of course credit. Self-selection sampling was also used to recruit participants who responded to advertisements on Prolific (www.prolific.co; *N* = 66). These participants were reimbursed with £7.50 (GBP) by Prolific. No geographical restrictions were implemented when recruiting via Prolific (see Appendix A for geographical breakdown).

For the laboratory experiment setting, self-selection sampling was used to recruit participants who responded to advertisements on Macquarie University's SONA study signup system as well as flyers posted around the local area and social media posts to psychology groups. Opportunity and snowball sampling were also used to recruit friends of the researcher. Participants who signed up for the laboratory experiment could choose to be reimbursed with either one hour of course credit or $20 (AUD).

To ensure that different participants were recruited for the laboratory experiment setting and the online experiment setting, participants were informed that they should not participate in the experiment if they had previously completed the experiment via an alternate platform. In all experiment settings, participants completed a questionnaire that asked if they had previously completed the experiment in the alternate settings. No participant reported that they had previously completed the experiment in an alternate setting; therefore, it is assumed that different participants were recruited for each experimental setting.

To ensure that data analysis was only conducted on participants who sufficiently followed the experiment instructions, participants were required to respond accurately on over 60% of both the pre- and post-training Dot Probe trials to be included in the final sample and data analysis. Data from seven participants who completed the experiment in the online setting were excluded from the final sample size and data analysis for not meeting this requirement. Additional participants were recruited to replace these excluded participants.

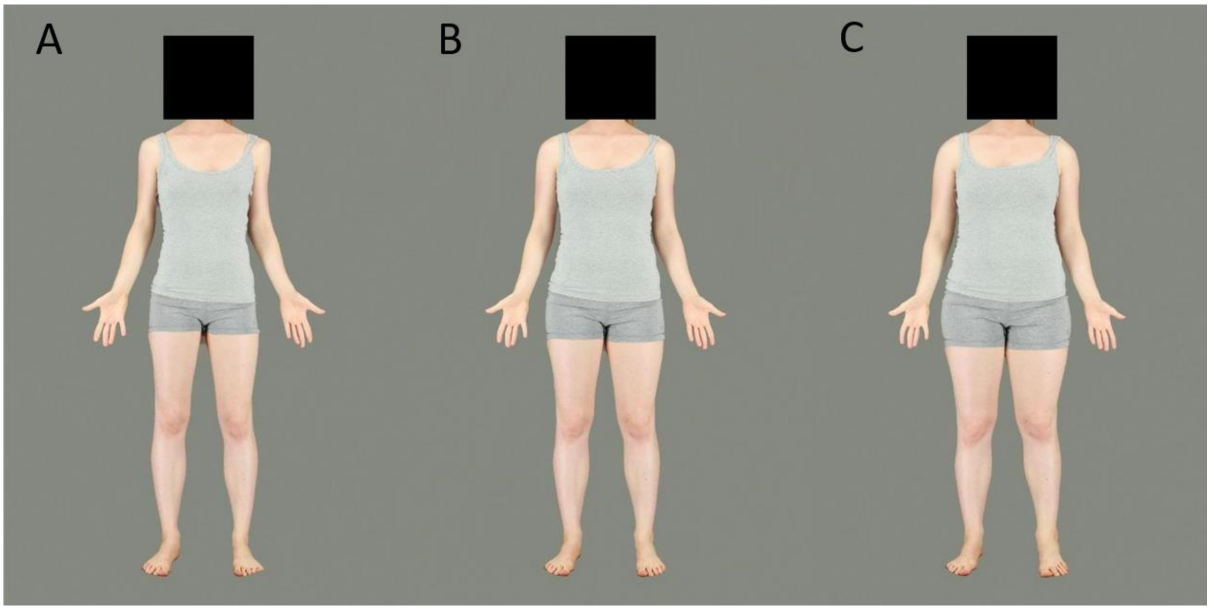
Stimuli.

Photographs were obtained from previous studies on 128 Caucasian women aged 18-30 (hereafter referred to as models) who provided written consent for their photographs to be used in future research (Stephen et al., 2016). Each photograph involved the model posing alone in a standard anatomical position. To ensure that their body size was clearly visible, models removed jewellery, tied back long hair, and wore tight-fitting grey singlets and shorts. The researchers standardised the photographs by rendering the backgrounds grey and aligning each model's body to the centre of the image. Whilst controlling for height and muscle mass, photographs of the 10 models with the highest fat mass and the 10 models with the lowest fat mass were selected to create high and low fat body templates. The 10 high fat and 10 low fat models had a mean difference in fat mass of 12kg. For the 10 high fat photographs, a high fat body template was created in Psychomorph (Tiddeman et al., 2001) by finding the average coordinates for 130 landmark points delineated on each body. The same process was used to create a low fat body template from the 10 low fat photographs. For each of the 130 landmark points, the difference between the high fat averaged coordinates and the low fat averaged coordinates was calculated to form a vector. These vectors were then used to simulate changes in fat mass in the photographs of the remaining models.

Fifty of the remaining models had their photographs transformed using Psychomorph by moving each landmark point along its corresponding vector. For each model's photograph, 13 frames were created that gradually increased in equidistant increments of apparent body fat. The difference between each frame represented a change of 2kg of fat mass. Frame 0 displayed a body reduced by 12kg of fat mass from the model's real body. Frame 12 displayed a body increased by 12kg of fat mass from the model's real body. Frame 6 displayed the model's real body and therefore did not include a fat transformation. Fat transforms of 20 models were selected as body stimuli for the present study (mean age = 21.15, *SD* = 3.60; mean BMI = 20.15, *SD* = 1.23). All body stimuli had their face covered with a black square to prevent adaptation to facial rather than body size (Figure 1).

Figure 1

Example Body Stimuli.



Note. This figure displays 3 of the 13 frames for a single model. Image A shows the version of the model with lowest fat mass (Frame 0). Image B shows the unmanipulated version of the model (Frame 6). Image C shows the version of the model with the highest fat mass (Frame 12).

To maintain consistency for participants completing the experiment online versus in the laboratory setting, the experiment was always presented in a display with a 4:3 aspect ratio, regardless of the participant's computer screen size. In the laboratory setting, the experiment was presented on a 35.3 x 26.5cm display with a resolution of 1292 x 969 pixels. The experiment was viewed by participants at an approximate distance of 60cm. For all Dot Probe tasks, body stimuli were presented at a size of 387 x 581 pixels (10.08 x 15.09° degrees of visual angle). For the method of adjustment tasks used to measure participants' PSNs, body stimuli were presented at a size of 451 x 677 pixels (11.73 x 17.54°). When the experiment was completed by participants online, stimuli size was dependent on the screen size of the device used by the participant; however, the aspect ratio of the stimuli remained the same.

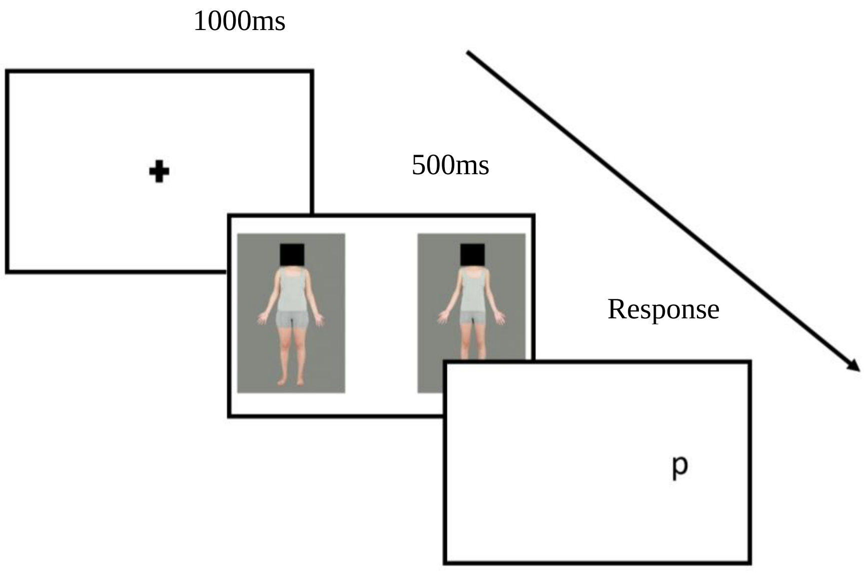
Measures.

Dot Probe task.

The Dot Probe task was based on the version used by Dondzilo et al. (2018). Each trial started with a fixation cross presented in the centre of the computer screen for 1000ms. The fixation cross then disappeared, and two body stimuli were presented simultaneously for 500ms. Body stimuli pairs consisted of the highest body fat frame (Frame 12) and the lowest body fat frame (Frame 0) of the same model. Each body stimulus was presented at random on either the left or right side of the fixation cross location. The centre of each body stimulus was located on the midpoint of the display’s y-axis and 25% of the display’s width away from the midpoint on the x-axis. In the laboratory setting display, the centre of each body stimulus was distanced away from the x-axis midpoint by 323 pixels (8.42°) along the x-axis. Immediately after the body stimuli presentation, a probe was generated at random (either the letter “p” or “q”). The probe appeared in the position previously occupied by one of the body stimuli. Participants were instructed to identify the letter as quickly and accurately as possible, by pressing the appropriate keys (“p” or “q”) on the keyboard (Figure 2).

Figure 2

Example Dot Probe Trial.



Note. At the start of each Dot Probe trial, a fixation cross was presented to participants for 1000ms. Then one high and one low fat body stimulus were presented for 500ms, located at random on either the left or right side of the screen. Immediately after the body stimuli disappeared, a probe appeared (the letter “p” or “q”) on either the left or right side of the screen. Participants had to identify the letter as quickly and accurately as possible. In this example trial, the probe (“p”) appeared in the same location as the low fat body stimulus.

For training Dot Probe trials, the location of the probe was dependent on the experimental condition. For trials training participants to attend to high fat body stimuli, the probe replaced the high fat body stimulus on 100% of the trials. For trials training participants to attend to low fat body stimuli, the probe replaced the low fat body stimulus on 100% of the trials. Participants completed 360 training Dot Probe trials, presented in 6 blocks of 60 trials with a 15 second break between each block. The body stimuli for the training Dot

Probe task always involved the same ten models; however, body stimulus pairs were presented in a randomised order for each participant.

For pre- and post-training Dot Probe trials, the location of the probe was randomised so that the probe had an equal probability of replacing each body stimulus. Participants completed 80 trials. The body stimuli involved a different set of ten models to the training Dot Probe trials. To calculate the pre- and post-training attentional bias scores, mean response times were collected for pre- and post-training Dot Probe trials where participants responded correctly. Trials were excluded from the calculation if the participant's reaction time was less than 200ms or more than 2.5 standard deviations above the participant's mean reaction time on the pre- and post-training Dot Probe trials. The mean response times of the included trials were substituted into the following formula using low fat body stimuli as the target (MacLeod & Mathews, 1988):

[(left probe/right target – left probe/left target) + (right probe/left target – right probe/right target)]/2

The 'left probe/right target' refers to the mean response time when the probe was located in the left area but the low fat body stimulus was located in the right area, and so on. A positive attentional bias score represents an attentional bias to low fat body stimuli and a negative attentional bias score represents an attentional bias to high fat body stimuli. ΔAB was calculated by subtracting the pre-training Dot Probe attentional bias score from the post-training Dot Probe attentional bias score; therefore, a positive (negative) ΔAB meant that participants directed more attention toward low (high) fat body stimuli after the training than before.

Point of subjective normality (PSN).

To measure body size adaptation, participants completed a modified version of the method of adjustment task used by Stephen et al. (2016). During the task, participants were presented with one of the 13 frames, selected at random, for a single model. Each frame was positioned so that the centre of the body stimulus was on the centre of the display. Participants could cycle through the 13 frames for the model by pressing ‘p’ on the computer keyboard to move to the next highest body fat frame and pressing ‘q’ on the keyboard to move to the next lowest body fat frame. The sequence was looped so participants were able to manipulate the model’s body size by continually cycling through the 13 frames.

Written instructions on the computer screen asked participants to manipulate the body until it looked “normal-sized”. Once the participants had made the body appear “normal-sized”, they used the computer mouse to press a “Select” button on the computer screen, allowing them to proceed to the next model. The mean fat mass chosen as “normal-sized” for 10 different models was used to calculate each participant’s PSN score. The body stimuli involved the same 10 models as the 10 models used in the pre- and post-training Dot Probe trials, and therefore were a different set of models to the training Dot Probe trials. The presentation order of the 10 models was randomised for each participant’s pre- and post-training PSN tasks. ΔPSN was calculated by subtracting the pre-training PSN score from the post-training PSN score. A positive (negative) ΔPSN meant that the body size participants perceived to be “normal” was higher (lower) after the training than before.

Body dissatisfaction.

Body dissatisfaction was measured using a modified version of the body shape satisfaction scale originally designed by Pingitore et al. (1997). The scale required participants to rate their satisfaction with 18 parts or features of their body, including their waist, stomach, and thighs. Participants were asked to respond based on their feelings “at this moment" to specifically measure state, rather than trait, body dissatisfaction (Thompson, 2004). Responses were measured using a slider scale rather than a Likert scale to minimise the likelihood that participants remembered and reproduced their pre-training responses when completing the post-training scale. Response options for each of the 18 items ranged from 0-100 (100 as "Very dissatisfied" and 0 as "Very satisfied"). A body dissatisfaction score was calculated by summating the responses for all 18 items; therefore, possible body dissatisfaction scores ranged between 0 and 1800 with a higher score indicating greater body dissatisfaction. All participants completed the body shape satisfaction scale pre- and post-training. Cronbach alpha values for Experiment 1 were 0.94 (online) and 0.95 (laboratory) for pre-training and 0.96 (online) and 0.96 (laboratory) for post-training, indicating excellent internal consistency for the scale. ΔBD was calculated by subtracting the pre-training body dissatisfaction score from the post-training body dissatisfaction score. A positive (negative) ΔBD meant that participants' body dissatisfaction had increased (decreased) after training.

Procedure.

Participants in the laboratory setting began the experiment by having their height and weight measured by the experimenter with a tape measure and a Tanita SC-330 body composition analyser. Height and weight data were collected from participants so that each participant's BMI (kg/m^2) could be calculated. The remainder of the experiment was completed by participants on a computer using the Gorilla Experiment Builder (www.gorilla.sc; Anwyl-Irvine et al., 2019). All experiment instructions were presented on the computer screen for the participant to read. In the online setting, participants were given a hyperlink to access the experiment in a setting of their choosing. Access to the online experiment expired after 90 minutes to minimise the likelihood of participants taking breaks during the experiment. Participants could only access the online experiment if they were using a laptop or desktop computer, and not a smartphone or tablet, to ensure that participants were able to make keyboard responses. In the laboratory setting, participants completed the experiment on a desktop computer in the presence of an experimenter in the Department of Psychology, Macquarie University. The entire experiment took each participant approximately 45 minutes to complete.

The first task presented to participants by the Gorilla Experiment Builder was a questionnaire asking the participant whether they had already completed the experiment in the alternate settings (in the laboratory setting or online via SONA or Prolific) and to provide demographic information (age, gender, and ethnicity). Participants completing the experiment in the online setting were also asked to self-report their height and weight, using either metric or imperial measures depending on their preference.

Participants then completed their pre-training measures. First, they completed the pre-training body dissatisfaction questionnaire. Next, participants completed three practice PSN trials followed by the ten pre-training PSN trials. For the body stimuli in the practice PSN trials, three models were selected at random for each participant from the pool of ten models used in the pre- and post-training PSN trials. After the pre-training PSN trials, participants completed ten practice Dot Probe trials followed by 80 pre-training Dot Probe trials. The body stimuli in the practice Dot Probe trials used the same ten models as the pre- and post-training Dot Probe trials. Like the pre- and post-training Dot Probe trials, the practice Dot Probe trials randomised the probe location so that it had an equal probability of replacing each body stimulus. After the pre-training Dot Probe trials, participants completed the 360 training Dot Probe trials.

Following the training Dot Probe trials, participants completed the post-training measures. First, they completed the post-training body dissatisfaction questionnaire. Then they completed 80 post-training Dot Probe trials and ten post-training PSN trials that were interwoven in the same block i.e. one PSN trial, then eight Dot Probe trials, then one PSN trial, and so on. The interwoven order of the post-training PSN and Dot Probe trials was counterbalanced so that half of participants started with one PSN trial (followed by eight Dot Probe trials, and so on) and half of participants started with eight Dot Probe trials (followed by one PSN trial, and so on). The post-training measures used this order because the post-training Dot Probe trials directed participants' attention towards both high and low fat body stimuli which could reduce potential body size adaptation induced by the training Dot Probe trials. An interwoven order should minimise order effects and increase the likelihood of detecting an effect for body size adaptation.

Results.

Preregistered analyses.

The following analyses were conducted on R version 3.6.3 (R Core Team, 2020) and preregistered in November 2019 with the Open Science Framework (www.osf.io; see Appendix B). Descriptive statistics for participants' age, BMI, and pre-training scores are presented in Appendix C.

Hypothesis 1: Participants trained to attend to low (high) fat body stimuli will exhibit a greater attentional bias to low (high) fat body stimuli after the training than before.

To test Hypothesis 1, one sample t-tests were conducted to compare participants' ΔAB data against a value of 0 separately for each condition (high fat and low fat) and each experiment setting (online and laboratory). A significantly positive (negative) ΔAB would indicate that participants directed more attention toward low (high) fat body stimuli after the training than before. A Shapiro-Wilk test indicated the data for the high fat condition in the online setting were not normally distributed, $W(75) = 0.96$, $p = .031$ (see Appendix D for histograms and normal Q-Q plots); therefore, the one sample t-tests were bootstrapped (2000 iterations, bias-corrected accelerated) using the R package wBoot (Weiss, 2016). After correcting for multiple comparisons using the Holm–Bonferroni method (Holm, 1979), the results of the four bootstrapped one sample t-tests demonstrated that ΔAB only differed significantly from 0 for the high fat condition conducted in the laboratory experiment. In support of Hypothesis 1, these participants demonstrated a significantly negative ΔAB, indicating that they directed more attention to high fat body stimuli after the training than before. The remaining conditions were not statistically significant and therefore do not support Hypothesis 1 (Table 1).

Hypothesis 2: Participants trained to attend to low (high) fat body stimuli will perceive lower (higher) fat body stimuli as "normal" after the training than before.

To test Hypothesis 2, one sample t-tests were conducted to compare participants' ΔPSN data against a value of 0 separately for each condition (high fat and low fat) and each experiment setting (online and laboratory). A significantly positive (negative) ΔPSN would indicate that the body size participants perceived to be "normal" was higher (lower) after the training than before. A Shapiro-Wilk test indicated the data for the low fat condition in the laboratory setting were not normally distributed, $W(35) = 0.89$, $p = .002$ (see Appendix D for histograms and normal Q-Q plots); therefore, the one sample t-tests were bootstrapped (2000 iterations, bias-corrected accelerated) using the R package wBoot (Weiss, 2016). After correcting for multiple comparisons using the Holm–Bonferroni method (Holm, 1979), the results of the four bootstrapped one sample t-tests demonstrated that ΔPSN did not differ significantly from 0 in either condition for either experiment setting (Table 1). These results do not support Hypothesis 2.

Hypothesis 3: Participants trained to attend to low (high) fat body stimuli will exhibit higher (lower) body dissatisfaction after the training than before.

To test Hypothesis 3, one sample t-tests were conducted to compare participants' ΔBD data against a value of 0 separately for each condition (high fat and low fat) and each experiment setting (online and laboratory). A significantly positive (negative) ΔBD would indicate that participants' body dissatisfaction had increased (decreased) after training. Shapiro-Wilk tests indicated that many of the conditions were not normally distributed (High Fat/Online: $W(75) = 0.46$, $p < .001$; Low Fat/Online: $W(75) = 0.83$, $p < .001$; High Fat/Laboratory: $W(35) = 0.93$, $p = .034$; see Appendix D for histograms and normal Q-Q plots); therefore, the one sample t-tests were bootstrapped (2000 iterations, bias-corrected accelerated) using the R package wBoot (Weiss, 2016). After correcting for multiple comparisons using the Holm–Bonferroni method (Holm, 1979), the results of the four bootstrapped one sample t-tests demonstrated that ΔBD did not differ significantly from 0 in either condition for either experiment setting (Table 1). These results do not support Hypothesis 3.

Online versus Laboratory Comparison

To determine whether the experiment setting impacted on the effects of the training Dot Probe task, bootstrap resampling was conducted using the R package bootES (Kirby & Gerlanc, 2013) with 2000 samples to estimate 95% confidence intervals for the effect sizes (Cohen's *d*) of each condition and experiment setting. The effect sizes and estimated 95% confidence intervals are reported in Figure 3. For each condition, the online and laboratory 95% confidence intervals overlap, demonstrating that it is unlikely experiment setting influenced the size of the effects of the training Dot Probe task on ΔAB, ΔPSN, or ΔBD.

Table 1

Results of the Bootstrapped One Sample T-tests Comparing ΔAB, ΔPSN, and ΔBD Against a Value of 0 for Each Condition and Experiment Setting.

				ΔAB				ΔPSN				ΔBD			
Experiment	Condition	*N*	df	*M* [95% CI]	*SD*	*t*	*p*	*M* [95% CI]	*SD*	*t*	*p*	*M* [95% CI]	*SD*	*t*	*p*
Online	High Fat	75	74	1.47 [-11.53, 14.99]	58.35	0.22	.816	-0.20 [-0.77, 0.41]	2.54	-0.68	.501	-35.84 [-122.20, 3.36]	247.14	-1.26	.078
	Low Fat	75	74	8.29 [-4.59, 20.89]	58.00	1.24	.213	-0.41 [-0.92, 0.11]	2.37	-1.50	.135	-9.85 [-38.45, 10.84]	103.49	-0.83	.379
Laboratory	High Fat	35	34	-22.77 [-39.55, -8.13]	47.71	-2.82	.001*	-0.51 [-1.34, 0.26]	2.49	-1.22	.188	0.54 [-19.9, 25.50]	69.06	0.05	.942
	Low Fat	35	34	6.73 [-6.09, 20.40]	40.81	0.98	.306	-0.83 [-1.88, -0.11]	2.72	-1.80	.027	6.09 [-15.25, 28.00]	67.40	0.53	.591

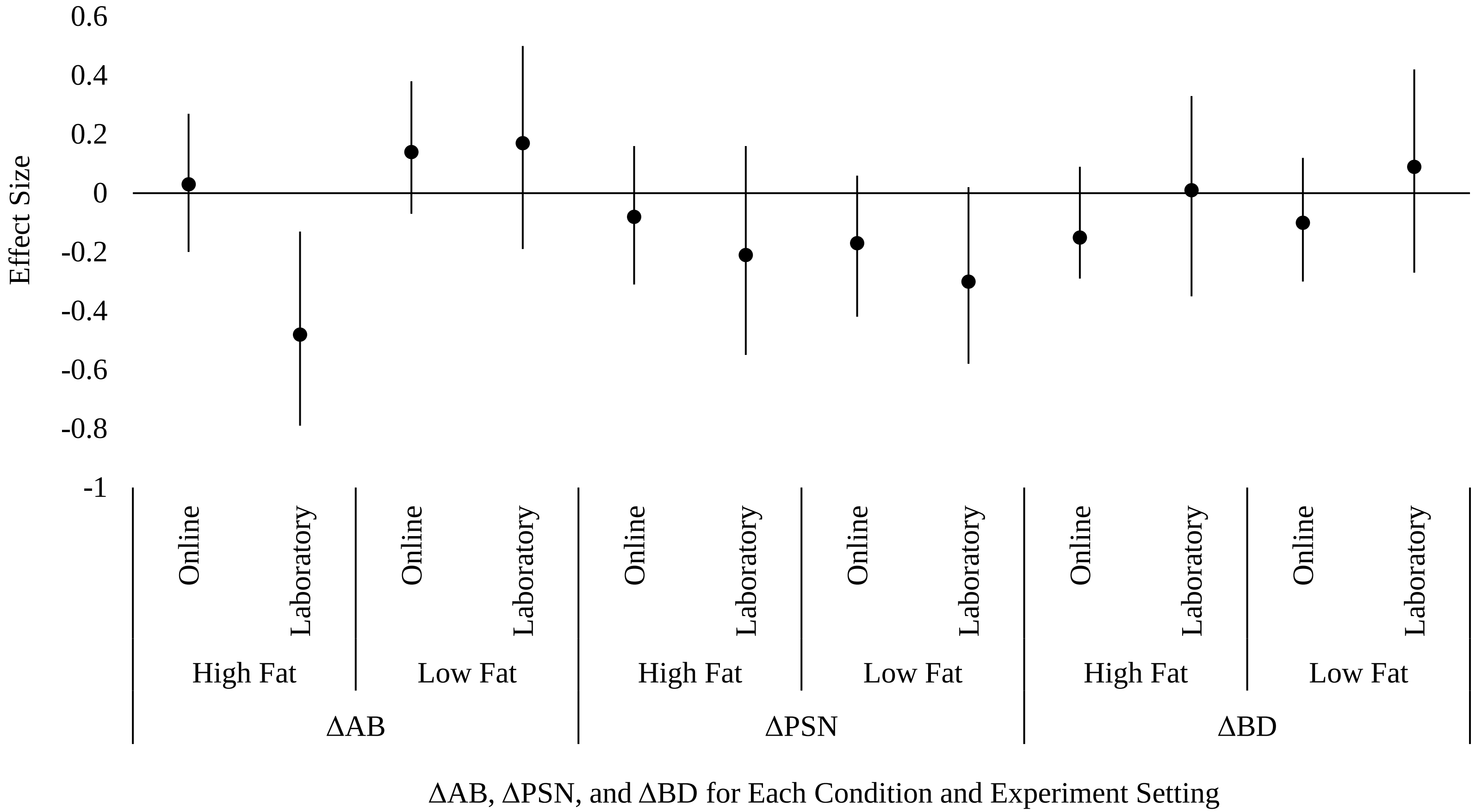
Note 1. To correct for multiple comparisons, a Holm–Bonferroni criterion was applied, requiring the smallest *p*-value be less than .004 to be statistically significant (Holm, 1979). The smallest reported *p*-value (laboratory high fat ΔAB) was less than .004; therefore, participants in this condition directed significantly more attention to high fat body stimuli after the training than before. The remaining *p*-values were larger than their Holm-Bonferroni criterion and therefore did not withstand the correction for multiple comparisons. These results were therefore not statistically significant.

Note 2. CI refers to confidence intervals.

* $p < .004$

Figure 3

Effect Sizes with their 95% Confidence Intervals for ΔAB, ΔPSN, and ΔBD for Each Condition and Experiment Setting.



Note. Effect sizes are reported as Cohen's *d* and 95% confidence intervals were estimated using the R package bootES and bootstrap resampling with 2000 samples (Kirby & Gerlanc, 2013).

Additional analyses.

To compliment the preregistered analyses, a number of additional analyses were conducted. Firstly, 12 Bayesian one sample t-tests were conducted comparing ΔAB, ΔPSN, and ΔBD against a value of 0 for each condition and experiment setting, using JASP version 0.11.1.0 and the JASP default prior (Cauchy prior, r=0.707; JASP Team, 2020). Bayes factors were calculated to determine the likelihood of each alternative hypothesis in relation to its corresponding null hypothesis (Table 2). For each test, the alternative hypothesis assumed that the true mean of the sample was not equal 0, whilst the null hypothesis assumed that the true mean of the sample was equal to 0. A Bayes factor between 3 and 10 was interpreted as moderate evidence for the alternative hypothesis, a Bayes factor between 1 and 3 was interpreted as anecdotal evidence for the alternative hypothesis, a Bayes factor between 1/3 and 1 was interpreted as anecdotal evidence for the null hypothesis, and a Bayes factor between 1/3 and 1/10 was interpreted as moderate evidence for the null hypothesis (Jeffreys, 1961; Lee & Wagenmakers, 2014).

All Bayes factors for the experiment conducted in the online setting demonstrated moderate evidence for the null hypothesis, except for ΔPSN in the low fat condition which only provided anecdotal evidence for the null hypothesis. In agreement with the results of the preregistered one sample t-tests, the Bayes factor for ΔAB for the high fat condition in the laboratory setting demonstrated moderate evidence for the alternative hypothesis, indicating that these participants directed more attention to high fat body stimuli after the training than before. The remaining Bayes factors for the laboratory setting all demonstrated evidence for the null hypothesis. Evidence was moderate with ΔAB for the low fat condition and ΔBD for both conditions; however, evidence was only anecdotal for ΔPSN in both conditions.

Table 2

Bayes Factors for the 12 One Sample T-tests Comparing ΔAB, ΔPSN, and ΔBD Against a Value of 0 for Each Condition and Experiment Setting.

Experiment	Condition	ΔAB	ΔPSN	ΔBD
Online	High Fat	0.13	0.16	0.27
	Low Fat	0.26	0.37	0.18
Laboratory	High Fat	5.23	0.36	0.18
	Low Fat	0.28	0.77	0.21

Note. Bayes factors were calculated using JASP version 0.11.1.0 and the JASP default prior (Cauchy prior, r=0.707; JASP Team, 2020).

The final stage of additional data analysis involved combining the online and laboratory data into one data set (N = 220) to increase the sample size and thus statistical power of the data analysis. It was considered appropriate to combine the data sets because, as reported previously, the bootstrapped 95% confidence intervals for the online and laboratory effect sizes overlapped (Figure 3), meaning it is unlikely that experiment setting influenced the effect sizes of each experiment's results. The preregistered and Bayesian analyses were rerun on the combined data set (see Appendix E), but the overall pattern of results did not change from the original preregistered analyses; the only exception being that ΔAB in the high fat condition no longer significantly differed from 0 (p =.240) with its Bayes factor demonstrating moderate evidence for the null hypothesis (BF = 0.21).

Discussion.

The results of the experiment conducted in the online setting showed that participants trained to attend towards low (high) fat body stimuli did not exhibit a greater attentional bias to low (high) fat body stimuli, perceive lower (higher) fat body stimuli as “normal”, or exhibit higher (lower) body dissatisfaction as a result of the attention training. These results do not support any of the experiment hypotheses, and indicate that the training Dot Probe task conducted in the online setting did not effectively modify participants’ attention towards high or low fat body stimuli for either condition. Given the training Dot Probe task failed to modify participants’ attention, the absence of change for participants’ perceptions of a “normal” body size and body dissatisfaction is in line with expectations, because perceptions of a “normal” body size and body dissatisfaction were only hypothesised to change as a result of a change in attention towards high and low fat body stimuli. Therefore, we would not expect participants to change their perceptions of a “normal” body size or their body dissatisfaction without also presenting a change in attention towards high or low fat body stimuli.

The results of the experiment conducted in the laboratory setting demonstrated similar results for participants in the low fat condition. These participants did not demonstrate greater attentional bias to low fat body stimuli, perceive lower fat body stimuli as “normal”, or exhibit higher body dissatisfaction as a result of the attention training. Like the experiment conducted online, it appears the training Dot Probe task in the laboratory setting did not increase participants’ attention towards low fat body stimuli and, consequently, participants did not change their perceptions of a “normal” body size or their body dissatisfaction.

The results of the experiment conducted in the laboratory setting are less clear for participants trained to attend towards high fat body stimuli. As a result of the attention training, these participants demonstrated an increase in attention towards high fat body stimuli; however, they did not perceive higher fat body stimuli as “normal” or exhibit lower body dissatisfaction. Therefore, the training Dot Probe task appeared to increase participants’ attention towards high fat body stimuli without influencing their perceptions of a “normal” body size or body dissatisfaction.

When considering the relationship between attention and perceptions of a “normal” body size, the results for the high fat condition in the laboratory setting can be interpreted in a number of ways. One interpretation is that there is not a strong causal relationship between attention towards high fat bodies and perceptions of a “normal” body size; therefore, the reported increase in attention towards high fat bodies did not cause a change in perceptions of a “normal” body size. However, this interpretation seems unlikely, given research by Stephen, Hunter, et al. (2018) showing that participants’ perceptions of a “normal” body size depended on the body size they were instructed to attend towards. Furthermore, a substantial body of evidence suggests that attention increases the magnitude of aftereffects, including orientation (Spivey & Spirn, 2000), motion (Rezec et al., 2004), and facial distortion (Rhodes et al., 2011); therefore, it seems reasonable to infer that attention, when successfully modified, also increases the magnitude of body size aftereffects.

An alternative explanation for the lack of body size aftereffects, is that although participants significantly increased their attention towards high fat bodies as a result of the attention training, the effect size for this increase in attention was medium (d = -0.48) and may have been too small to induce the hypothesised body size aftereffects. This experiment was more cognitively demanding for participants when compared to the experiment conducted by Stephen, Hunter, et al. (2018) which simply instructed participants to attend to one body over another. Therefore, the training Dot Probe task may not have increased attention towards high fat bodies enough to change participants’ perceptions of a “normal” body size. Increasing the number of training Dot Probe trials could increase the magnitude of the change in attentional bias and therefore potentially also the likelihood of participants displaying body size aftereffects; however, this could be difficult to test in an experimental setting as more trials may come at the expense of participant motivation, due to the repetitive nature of the training Dot Probe task.

Another potential explanation for the results, is that although participants' reaction times demonstrated an increase in attention towards high fat bodies, participants may have specifically needed to increase their fixations towards high fat bodies to present body size aftereffects. In the experiment conducted by Stephen, Hunter, et al. (2018), participants were explicitly instructed to attend towards one body size over another, and eye-tracking data showed that participants increased their fixations towards the body size they were instructed to attend towards. However, in the present experiment, participants were not explicitly instructed to look or direct attention towards the body stimuli. Based on previous similar Dot Probe studies, the stimulus-onset asynchrony of the body stimuli in this task was 500ms (Dondzilo et al., 2017, 2018; Joseph et al., 2016). This is technically enough time for participants to make at least one eye movement towards the body stimuli (Carpenter, 1988); however, without eye-tracking measures, it is unknown whether or where participants made eye movements during the task. If participants did not fixate more towards the body size they were being trained to attend towards, then the faster reaction times to probes replacing high fat body stimuli may have been solely caused by participants covertly attending towards the high fat bodies. It is therefore possible that body size adaptation is influenced more by changes in overt attention, rather than covert attention, and increased fixations towards specific body sizes are required for participants to present body size aftereffects.

Although this explanation may account for the contrasting results between the present experiment and the experiment conducted by Stephen, Hunter, et al. (2018), the explanation is challenged by previous eye-tracking research on the tilt aftereffect. Spivey and Spirn (2000) showed that when participants fixated on a fixation cross, but covertly attended to gratings of various orientations, they subsequently displayed tilt aftereffects in the predicted directions. These findings indicate that tilt aftereffects do not rely on increased fixations and can also be induced by increased covert attention; therefore, it seems reasonable to predict the same is true for body size aftereffects. Future research using a shorter stimulus-onset asynchrony to minimise eye-movements will be required to determine whether covert attention is sufficient to induce body size aftereffects, or whether body size adaptation depends on increased fixations.

The stimulus-onset asynchrony of 500ms used in the present experiment was chosen based on previous research that successfully increased participants attention towards low fat bodies (Dondzilo et al., 2018). However, 500ms is relatively long and, as a result, the conclusions that can be drawn from the experiment results are limited. As mentioned previously, 500ms is enough time for participants to make at least one eye movement (Carpenter, 1988), as well as multiple shifts in covert attention (Carlson et al., 2006). Therefore, by the time participants were presented with the probe they may have already redirected their attention multiple times, causing variations in their reaction times when responding to the probe. Research shows that the Dot Probe task is most reliable when using a much shorter stimulus-onset asynchrony of 100ms, presumably because participants are limited in the number of overt and covert attentional shifts they can make during the stimuli presentation (Chapman et al., 2019). It is therefore possible that the significant increase in attention towards high fat bodies was actually a Type 1 error caused by random noise in the data, due to participants making multiple attentional shifts during the body stimuli presentation. If the change in attention was a Type 1 error, then participants would not have actually increased their attention towards high fat bodies, which would explain why participants did not additionally present body size aftereffects.

Support for this suggestion comes from the results of the experiment conducted online, which showed that participants trained to attend towards high fat bodies did not significantly increase their attention towards high fat bodies. The effect sizes for the data collected online had overlapping confidence intervals with the effect sizes for the data collected in the laboratory, meaning it is unlikely the training Dot Probe task was more effective when conducted in the laboratory setting as opposed to online. Furthermore, when the online and laboratory data were combined to form one larger data set, participants trained to attend towards high fat bodies did not significantly increase their attention towards high fat bodies.

Although a Type 1 error is plausible, the effect size for the high fat condition in the laboratory setting was the only effect size with confidence intervals that did not overlap with 0, supporting the suggestion that participants did increase attention towards high fat bodies. The Bayesian analyses also indicated moderate support for this hypothesis (BF = 5.23), reducing the likelihood of the result being a Type 1 error. Furthermore, research shows that long stimulus-onset asynchronies (greater than 400ms) are actually more likely to produce Type 2 errors than Type 1 errors on the Dot Probe task, because on a portion of trials participants fixate away from the target stimulus which increases participants' reaction times when responding to probes replacing target stimuli (Petrova et al., 2013). Therefore, it seems likely that participants did increase their attention towards high fat bodies; however, the present experiment will need to be repeated to determine the replicability of these results, and conducted with shorter stimulus-onset asynchronies to reduce attentional shifts and improve reliability.

A potentially more likely interpretation for the lack of body size aftereffects, is that participants trained to attend towards high fat bodies in the laboratory setting may have had an attentional bias towards low fat bodies before beginning the training Dot Probe task. Participants in this condition had a positive mean pre-training attentional bias score of 12.21 with 95% confidence intervals that had just a small overlap with 0 (see Appendix C), indicating a possible pre-existing attentional bias towards low fat bodies. In contrast, participants in the remaining conditions had mean pre-training attentional bias scores that were very close to 0 (High Fat/Online: -0.08; Low Fat/Online: -0.64; Low Fat/Laboratory: -2.66; see Appendix C), indicating a minimal pre-existing bias for either body size. For participants with a pre-existing attentional bias towards low fat bodies, the effects of the attention training towards high fat bodies may mainly reflect a reduction in participants' attentional bias towards low fat bodies rather than a new attentional bias towards high fat bodies. Therefore, the attention training may have been less effective at producing body size aftereffects, because participants did not direct a sufficient amount of attention towards high fat bodies relative to low fat bodies.

The participants trained to attend towards high fat bodies in the laboratory setting did not only demonstrate a lack of change for perceptions of a "normal" body size, because they also demonstrated a lack of change for body dissatisfaction. This lack of change for body dissatisfaction is a less surprising finding for a number of reasons. Firstly, changes in body dissatisfaction might be contingent on participants changing their perceptions of a "normal" body size. Therefore, we might not expect to see a change in body dissatisfaction without also seeing a change in participants' perceptions of a "normal" body size. Secondly, even if participants did adapt to the high fat body stimuli, we might not expect this change in perception to influence body dissatisfaction. Whilst exposure to unaccompanied high fat bodies has been shown to decrease body dissatisfaction (Bould et al., 2018; Moreno-Domínguez et al., 2019), there is less evidence that directing attention towards high fat bodies, in the presence of low fat bodies, causes the same reduction in body dissatisfaction. Stephen, Hunter, et al. (2018) exposed participants to both a high fat and a low fat body stimulus, but instructed participants to direct their attention towards the high fat body stimulus. Participants adapted to the high fat body stimulus; however, their body dissatisfaction remained constant. Therefore, it is possible that a change in body dissatisfaction in the present experiment was unlikely to occur, given the presence of the opposing body stimulus in the training Dot Probe task.

The present experiment accounted for potential confounds that may have contributed to the non-significant body dissatisfaction results reported by Stephen, Hunter, et al. (2018), by modifying the measure of body dissatisfaction. Participants were asked to respond “at this moment”, thus increasing the likelihood of measuring state rather than trait body dissatisfaction. Responses were also measured on a slider scale, rather than a Likert scale, to reduce the likelihood of participants remembering and reproducing their pre-training responses when responding on the post-training scale. Therefore, this experiment should have been unaffected by the methodological limitations that Stephen, Hunter, et al. (2018) speculated may have contributed to their lack of change in body dissatisfaction.

There are multiple interpretations for the lack of change for body size perception and body dissatisfaction for participants trained to attend towards high fat bodies in the laboratory setting experiment; however, for all other conditions and experiment settings the attention training did not influence participants’ attention towards high and low fat bodies. These findings appear to contrast with the results of the Dot Probe task conducted by Dondzilo et al. (2018). In their study, Dondzilo et al. (2018) conducted an attention training version of the Dot Probe task which significantly increased participants’ attention towards low fat bodies. However, Dondzilo et al. (2018) presented participants with the low fat body stimulus alongside an abstract art image, as opposed to a high fat body stimulus like the present experiment. Therefore, the high and low fat body stimuli used in the present experiment may have been too visually alike to cause an increase in attention towards one body size over another. The high and low fat body stimuli used in the present experiment differed in apparent fat mass by 24kg; therefore, future research could investigate whether more extreme body stimuli that differ by a greater amount of apparent fat mass are visually contrasting enough to induce an attention training effect.

Interestingly, Dondzilo et al. (2020) conducted the same training Dot Probe task as Dondzilo et al. (2018) using a touch screen computer, requiring participants to locate the probe rather than identify it, and found participants did not significantly increase their attention towards low fat bodies. Although this experiment required participants to make slightly different responses than the experiment conducted by Dondzilo et al. (2018), this discrepancy does support criticisms of the Dot Probe task relating to its poor reliability (Chapman et al., 2019; Price et al., 2015; Schmukle, 2005). Dondzilo et al. (2020) did not find a significant effect when participants were trained to attend towards low fat bodies; however, participants trained to avoid low fat bodies did significantly decrease their attention towards low fat bodies and, subsequently, significantly reduced their state depressive rumination—a thought process associated with eating-related symptoms in eating disorders (Naumann et al., 2015). Dondzilo et al. (2020) suggested that these results supported the development of Dot Probe-based interventions using touch screen and smart phone technology in the treatment of body image disturbance. However, the results of the present experiment suggest that any Dot Probe-based intervention should be developed with caution.

It is possible that the decrease in attention towards low fat bodies, as reported by Dondzilo et al. (2020), may actually reflect a decrease in attention towards bodies generally, rather than specifically to low fat bodies. Therefore, if the effects of the training Dot Probe generalise beyond the laboratory to everyday life, participants may direct less attention to bodies they see in the media or in public spaces; however, they may still display an attentional bias towards smaller body sizes, which could reduce their perceptions of a "normal" body size and potentially interfere with any reduction in state depressive rumination. The results of the present experiment suggest it may be challenging to train participants to direct attention towards people of specific body sizes using a Dot Probe task; however, future research could investigate whether modifications to the task can improve the effectiveness of the attention training, for example, by extending the number of training trials, shortening the stimulus-onset asynchrony, and using more extreme body sizes. Although, in light of the present experiment results, the inconsistent results demonstrated by Dondzilo et al. (2018) and Dondzilo et al. (2020), and criticisms of the Dot Probe task relating to poor reliability (Chapman et al., 2019; Price et al., 2015; Schmukle, 2005), any training Dot Probe task will be required to demonstrate high reliability and replicability before development as an intervention in the treatment of body image disturbance.

Experiment 2: Visual Search Task

Experiment 2 employed a less commonly used attentional bias modification task—the Visual Search task—to train participants attention towards high versus low fat bodies and assessed whether attentional bias modification resulted in changes to participants' body size misperception and body dissatisfaction.

Methods.

Design.

This experiment is identical to Experiment 1; however, all participants completed a Visual Search task instead of a Dot Probe task for the attentional training and the pre- and post-training measures of attentional bias. The between-participants variable was the body size targeted in attention training (high fat versus low fat) and the dependent variables were change in attentional bias (ΔAB), change in point of subjective normality (ΔPSN), and change in body dissatisfaction (ΔBD).

Participants.

The recruitment protocol and target sample size used for Experiment 2 were identical to Experiment 1 to maintain consistency between the two experiments. One hundred and fifty participants were recruited for the experiment conducted online (75 per condition). The average age and BMI of the participants were 23.74 years (*SD* = 4.76) and 25.04 units (*SD* = 9.12). Seventy of these 150 participants were recruited via Macquarie University's SONA study signup system and 80 were recruited via Prolific (see Appendix F for geographical breakdown of participants recruited via Prolific). Like Experiment 1, the target sample size for the experiment conducted in the laboratory setting was 70 participants (35 per condition). Fourteen participants (11 online; 3 laboratory) were excluded for confirming they did not meet the demographic inclusion criteria (Caucasian, female, and aged 18-35). Seventy-eight participants were excluded for failing to accurately respond on over 60% of both the pre-and post-training Visual Search trials (60 online; 18 laboratory). When participants were excluded, replacement participants were recruited to meet the target sample size. No participants had to be excluded for confirming they had previously completed the experiment in an alternate setting. Unfortunately, all face to face data collection was terminated at Macquarie University in March 2020 due to the coronavirus outbreak, and therefore the final sample size for the laboratory experiment was restricted to 60 participants (30 per condition). The average age and BMI of the participants were 21.05 years (*SD* = 3.62) and 23.55 units (*SD* = 5.97).

Stimuli.

The body stimuli used in Experiment 2 were identical to the stimuli used in Experiment 1. In the laboratory setting, all Visual Search task body stimuli were presented at a size of 129 x 194 pixels (3.37 x 5.07°). Like Experiment 1, PSN stimuli were presented at a size of 451 x 677 pixels (11.73 x 17.54°). In the online setting, stimuli size was dependent on the participant's screen size; however, the aspect ratio remained the same.

Measures.

Visual Search task.

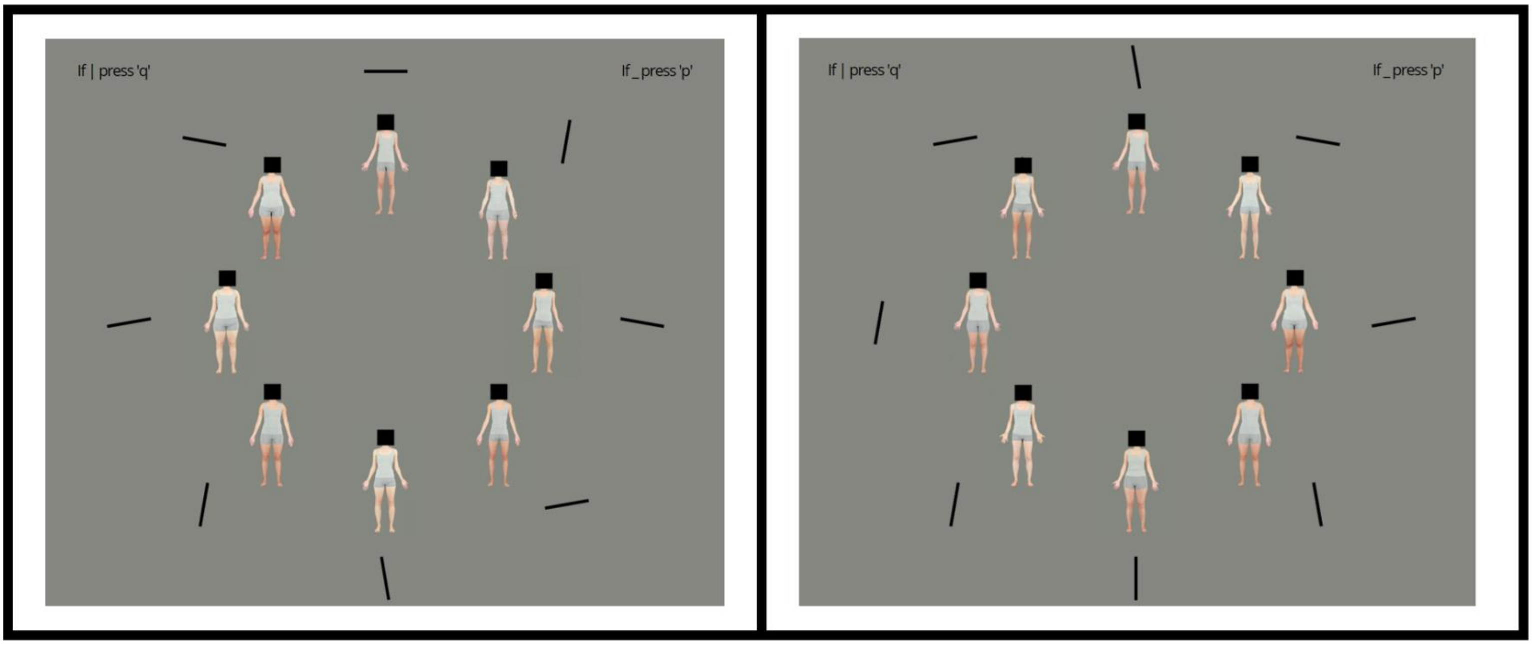
The Visual Search task was a modified version of the task designed by Talbot et al. (2019). Each trial started with a fixation cross presented for 1000ms in the centre of the computer screen. The fixation cross then disappeared and four high fat and four low fat body stimuli appeared on the screen. The centres of the eight body stimuli were located equidistant from each other in a circular array with a radius that was 21% of the display's width. In the laboratory setting, the radius was 271 pixels (7.08°).

For each training Visual Search trial, the four high fat and four low fat body stimuli were selected at random from the same body stimuli used in the training Dot Probe trials. For each pre- and post-training Visual Search trial, the four high fat and four low fat body stimuli were selected at random from the same body stimuli used in the pre- and post-training Dot Probe trials. For both the training and the pre- and post-training Visual Search trials, the eight selected body stimuli were positioned on the circle in a random order.

Each body stimulus was paired with a short oblique black bar (1 x 16 pixels; 0.03 x 0.42°) that was located immediately adjacent to the body stimulus. The centres of the eight bars were located equidistant from each other in a circular array with a radius that was 34% of the display's width. In the laboratory setting, the radius was 439 pixels (11.43°). For each trial, one "target" bar was randomly orientated at either a horizontal or vertical angle. The remaining seven "distractor" bars were randomly oriented at either 80°, 100°, 170°, or 190°. For each trial, participants were required to detect whether there was a horizontal or vertical bar present. Participants were instructed before the task to respond as quickly and as accurately as possible by pressing the appropriate keys (“q” for vertical or “p” for horizontal) on the computer keyboard. During the task, reminder instructions were displayed at the top of the screen in case participants forgot which letter to press (Figure 4).

Figure 4

Example of Two Different Visual Search Trials.



Note. In the left display, the target bar is horizontal and paired a low fat body stimulus (at the top of the circle). In the right display, the target bar is vertical and paired with a high fat body stimulus (at the bottom of the circle). Reminder instructions were displayed at the top of the screen, informing participants that they should press “q” if a vertical bar was present and “p” if a horizontal bar was present.

For the training Visual Search trials in which participants were trained to attend to high fat body stimuli, the target bar was paired with a high fat body stimulus at random on 100% of the trials. For training Visual Search trials in which participants were trained to attend to low fat body stimuli, the target bar was paired with a low fat body stimulus at random on 100% of the trials. For the pre- and post-training Visual Search trials, the target and distractor bars were paired randomly with each body stimulus, meaning that the target bar had an equal probability of being paired with each body stimulus.

To calculate the pre-and post-training attentional bias scores, mean response times were measured on trials where participants responded correctly. The mean response time when the target bar was paired with a low fat body stimulus was subtracted from the mean response time when the target bar was paired with a high fat body stimulus. Therefore, a positive attentional bias score represented an attentional bias to low fat body stimuli and a negative attentional bias score represented an attentional bias to high fat body stimuli. ΔAB was calculated by subtracting the pre-training attentional bias score from the post-training attentional bias score; therefore, a positive (negative) ΔAB meant that the participant directed more attention toward low (high) fat body stimuli after the training than before.

Point of subjective normality (PSN).

The measurement and calculation for ΔPSN was identical to Experiment 1.

Body dissatisfaction.

The measurement and calculation for ΔBD was identical to Experiment 1. Cronbach alpha values in Experiment 2 were 0.93 (online) and 0.95 (laboratory) for pre-training and 0.95 (online) and 0.96 (laboratory) for post-training, indicating excellent internal consistency for the scale.

Procedure.

Experiment components were presented in the same order and involved the same number of trials as Experiment 1. Before completing the 80 pre-training Visual Search trials, participants completed ten practice Visual Search trials that used the same format and body stimuli models as the pre-training Visual Search trials. For the training Visual Search task, participants completed 360 trials presented in six blocks of 60 trials with a 15 second break between each block. The 80 post-training Visual Search trials and ten post-training PSN trials were completed in one block using the same counterbalanced interwoven order as Experiment 1.

Results.

Preregistered analyses.

The following analyses were conducted on R version 3.6.3 (R Core Team, 2020) and preregistered in November 2019 with the Open Science Framework (www.osf.io; see Appendix G). Descriptive statistics for participants' age, BMI, and pre-training scores are presented in Appendix H.

Hypothesis 1: Participants trained to attend to low (high) fat body stimuli will exhibit a greater attentional bias to low (high) fat body stimuli after the training than before.

To test Hypothesis 1, one sample t-tests were conducted to compare participants' ΔAB data against a value of 0 separately for each condition (high fat and low fat) and each experiment setting (online and laboratory). A significantly positive (negative) ΔAB would indicate that participants directed more attention toward low (high) fat body stimuli after the training than before. A Shapiro-Wilk test indicated the data for the low fat condition in the online setting were not normally distributed, $W(75) = 0.94$, $p = .001$ (see Appendix I for histograms and normal Q-Q plots); therefore, the one sample t-tests were bootstrapped (2000 iterations, bias-corrected accelerated) using the package wBoot (Weiss, 2016). After correcting for multiple comparisons using the Holm–Bonferroni method (Holm, 1979), the results of the four bootstrapped one sample t-tests demonstrated that ΔAB did not differ significantly from 0 in either condition for either experiment setting (Table 3). These results do not support Hypothesis 1.

Hypothesis 2: Participants trained to attend to low (high) fat body stimuli will perceive lower (higher) fat body stimuli as "normal" after the training than before.

To test Hypothesis 2, one sample t-tests were conducted to compare participants' ΔPSN data against a value of 0 separately for each condition (high fat and low fat) and each experiment setting (online and laboratory). A significantly positive (negative) ΔPSN would indicate that the body size participants perceived to be "normal" was higher (lower) after the training than before. A Shapiro-Wilk test indicated the data for the low fat condition in the laboratory setting were not normally distributed, $W(30) = 0.92$, $p = .022$ (see Appendix I for histograms and normal Q-Q plots); therefore, the one sample t-tests were bootstrapped (2000 iterations, bias-corrected accelerated) using the package wBoot (Weiss, 2016). After correcting for multiple comparisons using the Holm–Bonferroni method (Holm, 1979), the results of the four bootstrapped one sample t-tests demonstrated that ΔPSN did not differ significantly from 0 in either condition for either experiment setting (Table 3). These results do not support Hypothesis 2.

Hypothesis 3: Participants trained to attend to low (high) fat body stimuli will exhibit higher (lower) body dissatisfaction after the training than before.

To test Hypothesis 3, one sample t-tests were conducted to compare participants' ΔBD data against a value of 0 separately for each condition (high fat and low fat) and each experiment setting (online and laboratory). A significantly positive (negative) ΔBD would indicate that participants' body dissatisfaction had increased (decreased) after training. Shapiro-Wilk tests indicated that the ΔBD data were not normally distributed for either condition in either experiment setting (High Fat/Online: $W(75) = 0.49$, $p < .001$; Low Fat/Online: $W(75) = 0.82$, $p < .001$; High Fat/Laboratory: $W(30) = 0.90$, $p = .010$; Low Fat/Laboratory: $W(30) = 0.35$, $p < .001$; see Appendix I for histograms and normal Q-Q plots); therefore, the one sample t-tests were bootstrapped (2000 iterations, bias-corrected accelerated) using the package wBoot (Weiss, 2016). After correcting for multiple comparisons using the Holm–Bonferroni method (Holm, 1979), the results of the four bootstrapped one sample t-tests demonstrated that ΔBD did not differ significantly from 0 in either condition for either experiment setting (Table 3). These results do not support Hypothesis 3.

Online versus Laboratory Comparison

To determine whether the experiment setting impacted on the effects of the training Visual Search task, bootstrap resampling was used with 2000 samples to estimate 95% confidence intervals for the effect sizes of each condition and experiment setting (Kirby & Gerlanc, 2013). The effect sizes and estimated 95% confidence intervals are reported in Figure 5. For each condition, the online and laboratory 95% confidence intervals overlap, demonstrating that it is unlikely experiment setting influenced the size of the effects of the training Visual Search task on ΔAB, ΔPSN, or ΔBD.

Table 3

Results of the Bootstrapped One Sample T-tests Comparing ΔAB, ΔPSN, and ΔBD Against a Value of 0 for Each Condition and Experiment Setting.

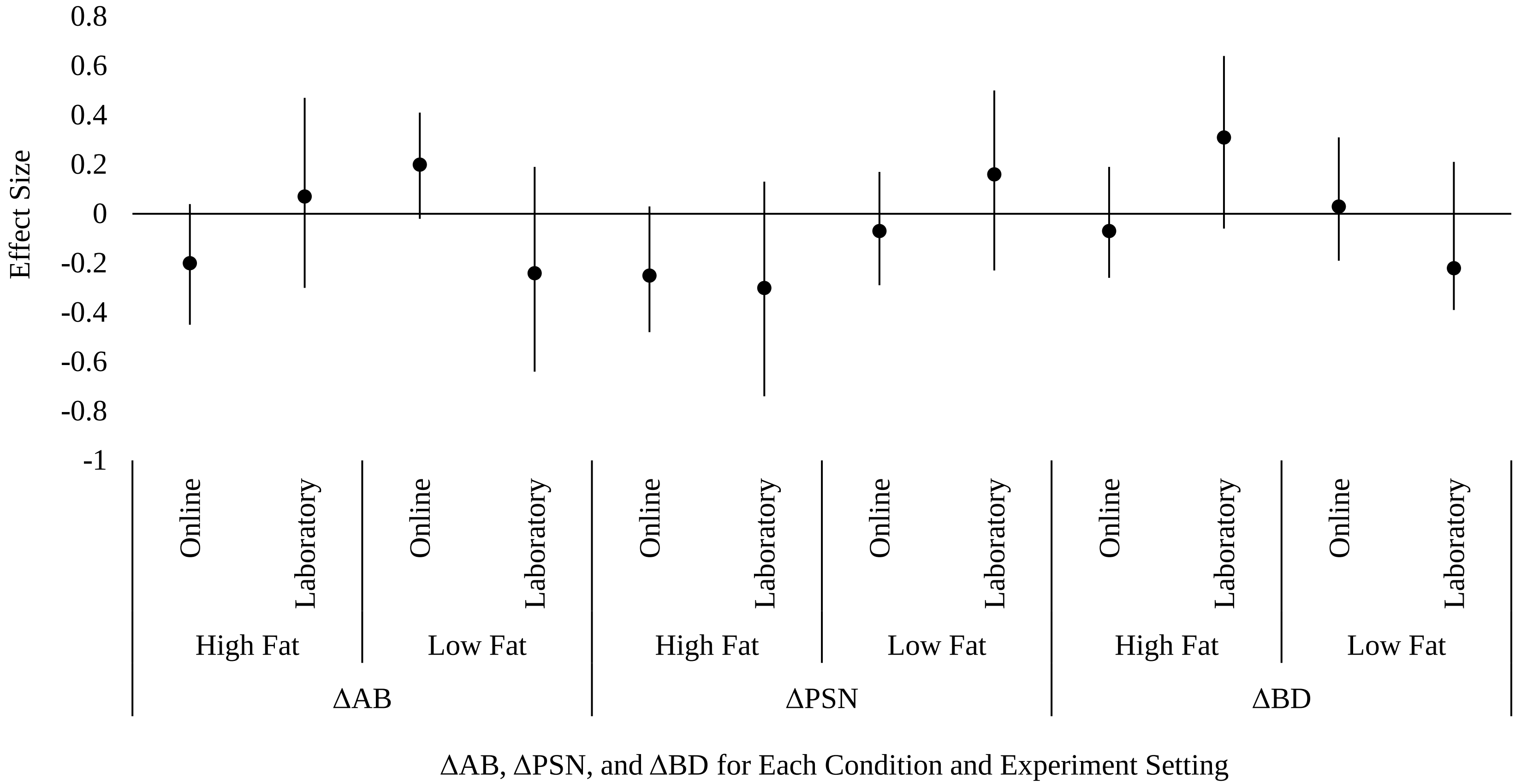
				ΔAB				ΔPSN				ΔBD			
Experiment	Condition	*N*	df	*M* [95% CI]	*SD*	*t*	*p*	*M* [95% CI]	*SD*	*t*	*p*	*M* [95% CI]	*SD*	*t*	*p*
Online	High Fat	75	74	-48.97 [-98.89, 7.38]	242.54	-1.75	.089	-0.49 [-0.95, -0.07]	1.96	-2.16	.022	-11.01 [-77.18, 11.60]	162.54	-0.59	.414
	Low Fat	75	74	77.18 [-2.57, 170.60]	385.44	1.73	.059	-0.15 [-0.66, 0.36]	2.28	-0.57	.582	2.51 [-18.75, 17.41]	79.50	0.27	.742
Laboratory	High Fat	30	29	17.18 [-63.65, 102.30]	230.86	0.41	.665	-0.64 [-1.37, 0.13]	2.17	-1.62	.096	22.20 [-0.71, 50.89]	72.43	1.68	.063
	Low Fat	30	29	-58.35 [-136.10, 30.88]	245.61	-1.30	.206	0.36 [-0.39, 1.23]	2.30	0.86	.352	-57.77 [-254.50, -4.10]	268.97	-1.18	.012

Note 1. To correct for multiple comparisons, a Holm–Bonferroni criterion was applied, requiring the smallest *p*-value to be less than .004 to be statistically significant (Holm, 1979). No *p*-values were smaller than their Holm Bonferroni criterion and therefore all results were not statistically significant.

Note 2. CI refers to confidence intervals.

Figure 5

Effect Sizes with their 95% Confidence Intervals for ΔAB, ΔPSN, and ΔBD for Each Condition and Experiment Setting.



Note. Effect sizes are reported as Cohen's *d* and 95% confidence intervals were estimated using the R package bootES and bootstrap resampling with 2000 samples (Kirby & Gerlanc, 2013).

Additional analyses.

To compliment the preregistered analyses, a number of additional analyses were conducted. Firstly, 12 Bayesian one sample t-tests were conducted comparing ∆AB, ∆PSN, and ∆BD against a value of 0 for each condition and experiment setting, using JASP version 0.11.1.0 and the JASP default prior (Cauchy prior, r=0.707; JASP Team, 2020). Bayes factors were calculated to determine the likelihood of each alternative hypothesis in relation to its corresponding null hypothesis (Table 4). For each test, the alternative hypothesis assumed that the true mean of the sample was not equal 0, whilst the null hypothesis assumed that the true mean of the sample was equal to 0. A Bayes factor between 3 and 10 was interpreted as moderate evidence for the alternative hypothesis, a Bayes factor between 1 and 3 was interpreted as anecdotal evidence for the alternative hypothesis, a Bayes factor between 1/3 and 1 was interpreted as anecdotal evidence for the null hypothesis, and a Bayes factor between 1/3 and 1/10 was interpreted as moderate evidence for the null hypothesis (Jeffreys, 1961; Lee & Wagenmakers, 2014).

Bayes Factors for the experiment conducted in the online setting all demonstrated evidence for the null hypothesis, except for ∆PSN in the high fat condition which provided anecdotal evidence for the alternative hypothesis. Evidence for the null hypothesis was anecdotal for ∆AB in both conditions and moderate for ∆PSN for the low fat condition and ∆BD for both conditions. Bayes factors for the experiment conducted in the laboratory setting all demonstrated evidence for the null hypothesis. Evidence was moderate with ∆AB for the high fat condition and ∆PSN for the low fat condition; however, evidence was anecdotal for the remaining conditions.

Table 4

Bayes Factors for the 12 One Sample T-tests Comparing ΔAB, ΔPSN, and ΔBD Against a Value of 0 for Each Condition and Experiment Setting.

Experiment	Condition	ΔAB	ΔPSN	ΔBD
Online	High Fat	0.54	1.12	0.15
	Low Fat	0.53	0.15	0.13
Laboratory	High Fat	0.21	0.62	0.68
	Low Fat	0.42	0.27	0.36

Note. Bayes factors were calculated using JASP version 0.11.1.0 and the JASP default prior (Cauchy prior, r=0.707; JASP Team, 2020).

The final stage of additional data analysis involved combining the online and laboratory data into one data set (N = 210) to increase the sample size and thus statistical power of the data analysis. It was considered appropriate to combine the data sets because, as reported previously, the bootstrapped 95% confidence intervals for the online and laboratory effect sizes overlapped (Figure 5), meaning it is unlikely that experiment setting influenced the effect sizes of each experiment's results. The preregistered and Bayesian analyses were rerun on the combined data set (see Appendix J), but the overall pattern of results did not change from the original preregistered analyses.

Discussion.

The results of the experiments conducted in both the online and laboratory settings showed that participants trained to attend towards low (high) fat body stimuli did not exhibit a greater attentional bias to low (high) fat body stimuli, perceive lower (higher) fat body stimuli as "normal", or exhibit higher (lower) body dissatisfaction as a result of the attention training. These results do not support any of the experiment's hypotheses and indicate that the training Visual Search task did not effectively modify participants' attention towards high or low fat body stimuli for either condition. Given the training Visual Search task failed to modify participants' attention, the absence of change for participants' perceptions of a "normal" body size and body dissatisfaction is in line with expectations, because perceptions of a "normal" body size and body dissatisfaction were only hypothesised to change as a result of a change in attention towards high and low fat body stimuli. Therefore, we would not expect participants to change their perceptions of a "normal" body size or their body dissatisfaction without also presenting a change in attention towards high or low fat body stimuli.

The results of this experiment demonstrate that the training Visual Search task was ineffective at modifying attention towards high vs low fat bodies. However, as the first attempt to use a Visual Search task to modify attentional biases towards high and low fat bodies, this research can be used as the first step in the development of an effective Visual Search attention training task. One likely reason for the ineffectiveness of the training Visual Search task, is that each training Visual Search trial presented participants with four high fat bodies and four low fat bodies. Therefore, the seven distractor body stimuli, paired with the seven distractor bars, were not uniformly one body size. For example, when participants were trained to attend towards low (high) fat bodies, the target bar was paired adjacent to a low (high) fat body and the seven distractor bodies included three low (high) fat bodies and four high (low) fat bodies. Equal numbers of high and low fat bodies were used in the present experiment to ensure that participants did not adapt to the more numerous body size, rather than the body targeted in the attention training. However, the body stimulus paired adjacent to the target bar may not have effectively captured the participant's attention towards bodies of that particular size, because it was not the only body of that size and thus did not "pop-out". If the target body failed to effectively capture participants' attention then we would not expect the training Visual Search task to effectively train participants to attend towards one body size over another.

Contrastingly, in the Visual Search task developed by Talbot et al. (2019), each Visual Search trial presented participants with seven average sized bodies, each paired with a distractor bar, and one muscular body that was paired with the target bar. By ensuring the seven distractor bodies were all average sized, the muscular body may have been more likely to capture participants' attention, and thus the experiment was able to measure the participants' attentional bias towards muscular bodies. Future research should test the effectiveness of a training Visual Search task in which participants trained towards low (high) fat bodies are presented with an array of seven average sized bodies, each paired with a distractor bar, and one low (high) fat body paired with a target bar. This design of a Visual Search task may be more effective in training participants' attention towards high and low fat body stimuli.

Another important consideration for future research, is that many participants performed poorly at the pre- and post-training Visual Search trials and therefore may have misunderstood the task instructions or lacked motivation to follow them. As previously mentioned, 78 participants (60 online; 18 laboratory), out of the 452 participants who completed the experiment (371 online; 81 laboratory), were excluded from the data analyses for failing to accurately respond on over 60% of both the pre- and post-training Visual Search trials. Seventy-eight is a concerningly high number and far greater than the number of participants who had to be excluded from Experiment 1 for failing to respond accurately on over 60% of both the pre- and post-training Dot Probe trials (7 online; 0 laboratory). Considering both Experiment 1 and Experiment 2 were similar in terms of experiment length and task repetitiveness, but differed in terms of difficulty, it seems likely that excluded participants in Experiment 2 misunderstood the task instructions rather than lacked motivation to follow them.

In the Visual Search experiments conducted by Talbot et al. (2019) and Cass et al. (2020), participants were given verbal instructions and the opportunity to ask questions to clarify misunderstandings. However, given some participants completed the present experiment in an online setting, these participants were required to read the instructions from the computer screen and were unable to ask for clarifications. To maintain consistency between the online and laboratory settings, the instructions were presented in the same format and under the same conditions for participants completing the present experiment in the laboratory setting. For both experiment settings, participants read the experiment instructions in their own time and pressed a button when they were ready to begin the practice Visual Search trials. Participants then completed ten practice Visual Search trials, after which the written instructions were repeated for participants to read in their own time before pressing a button to move onto the pre-training Visual Search trials. For each Visual Search trial, reminder instructions were also displayed at the top of the screen, informing participants that they should press “q” if a vertical bar was present and “p” if a horizontal bar was present. Given the number of excluded participants, these instructions and practice trials were clearly insufficient for ensuring a high level of task comprehension.

Given the high number of participants who were excluded for low accuracy, it is possible that a number of the participants included in the experiment responded accurately on over 60% of the trials simply by chance and without fully understanding the experiment instructions. Data from these participants may have contributed to the lack of significant results, because these participants would be less likely to be influenced by the training Visual Search task and any training effects would be less likely to be detected by the pre- and post-training Visual Search trials. For future research conducting similar Visual Search tasks in an online setting, it may be useful to add diagrams and visual aids to the written instructions to improve participant understanding. More practice trials could be included with feedback given to inform participants of the accuracy of their responses. If more detailed instructions and feedback are included, then it may also be useful to raise the minimum required percentage of correct responses to over 60% to increase the likelihood of participants included in the data analysis having a full comprehension of the task.

An additional approach could be to develop an “odd-one-out” style training Visual Search task like those developed in the treatment of anxiety, depression, and substance abuse (Mogoaşe et al., 2014). For example, Dandeneau and Baldwin (2004) developed an attention training Visual Search task for helping people with low self-esteem deal with negative social information. Each training Visual Search trial involved a 4x4 matrix with 15 photographs of a person frowning and one photograph of a person smiling. Participants were required to locate and tap the smiling photograph as quickly as possible. The study found participants with low self-esteem who were trained to attend towards smiling faces decreased their attentional bias towards rejection words, as shown on a subsequent Stroop task. The researchers suggested the training Visual Search task could therefore be used as a potential intervention to reduce attentional bias for rejection in people with low self-esteem. Future body image research should investigate whether a similar “odd-one-out” training Visual Search task can be adapted to train participants to attend towards high or low fat body stimuli. The task could be completed by participants using smart phones or other touch screen devices and may be simpler for participants than the Visual Search task used in the present experiment. If the task effectively modifies attentional bias then we may find it also influences participants’ perceptions of a “normal” body size and body dissatisfaction.

Although the results of this experiment demonstrated that the training Visual Search task was ineffective at modifying attention towards high and low fat bodies, the experiment can be used to guide future research aiming to modify body size attentional biases. When compared to the Dot Probe task, the Visual Search task has been rarely used to study attentional biases in body image research (Cass et al., 2020; Jiang & Vartanian, 2018; Rodgers & DuBois, 2016; Talbot et al., 2019) and is less frequently used in attentional bias modification research and treatment (Kuckertz & Amir, 2015). Body image research could therefore benefit from developing the Visual Search task for attentional bias modification towards high and low fat bodies. Therefore, whilst this experiment was unsuccessful, it marks a valuable first step for research using the Visual Search task to direct people's attention towards bodies of different sizes.

General Discussion

This research investigated whether two attentional bias modification tasks—the Dot Probe task and the Visual Search task—affect attention towards high and low fat bodies, body size adaptation, and body dissatisfaction in a female non-clinical population. Participants had their attention trained towards either high or low fat bodies using a Dot Probe task (Experiment 1) or Visual Search task (Experiment 2). Both experiments were completed by participants online or in a laboratory setting.

The majority of the results for both experiments showed that participants trained to attend to low (high) fat body stimuli did not exhibit a greater attentional bias to low (high) fat body stimuli, perceive lower (higher) fat body stimuli as "normal", or exhibit higher (lower) body dissatisfaction as a result of the attention training. These results do not support any of the research hypotheses and instead indicate that neither the Dot Probe task or Visual Search task increased participants' attention towards high and low fat body stimuli and, consequently, participants did not change their perceptions of a "normal" body size or body dissatisfaction. These results unfortunately tell us very little new information about the predicted relationship between attention, body size adaptation, and body dissatisfaction.

Although, changes in perceptions of a “normal” body size and body dissatisfaction were predicted to be contingent on changes in attentional bias; therefore, the null results for these findings were in line with expectations given the lack of change in attentional bias.

The only exception to these results, was that participants trained to attend towards high fat bodies using the Dot Probe task in the laboratory setting demonstrated an increase in attention towards high fat bodies without changing their perceptions of a “normal” body size or body dissatisfaction. As previously discussed, there are a number of possible explanations for the results of this condition. Firstly, there may not be a strong causal relationship between attention and perceptions of a “normal” body size and body dissatisfaction. Secondly, attention towards high fat bodies may not have been increased by a sufficient magnitude to induce changes in perceptions of a “normal” body size or body dissatisfaction. Thirdly, increased covert attention may be insufficient to change perceptions of a “normal” body size and body dissatisfaction without an additional increase in fixations. Fourthly, the significant increase in attention may simply be a Type 1 error caused by random noise in the data. Finally, and potentially most plausibly, participants in this condition may have had a pre-existing attentional bias towards low fat bodies, and therefore the attention training did not facilitate a sufficient increase in attention towards high fat bodies. Regardless of which explanation is most likely, the results of this experiment showed that the increase in attention towards high fat bodies did not translate into changes in perceptions of a “normal” body size or body dissatisfaction. It is therefore inadvisable that the tasks are used in this present form for future research into the treatment of body image disturbance.

The results of Experiment 1 are at odds with a large body of research using the Dot Probe task as an effective method of attentional bias modification in reducing symptoms of anxiety and depression and acting as a buffer to stress vulnerability (Jones & Sharpe, 2017; Kuckertz & Amir, 2015; MacLeod & Clarke, 2015). The results of Experiment 1 also challenge recent research using the Dot Probe task to train participants to attend towards or avoid low fat bodies (Dondzilo et al., 2018; Dondzilo et al., 2020). Despite their popularity, attentional bias modification tasks like the Dot Probe task have received criticism from researchers who point to the small effect sizes, low-quality trials, and possible publication bias in the literature (Cristea et al., 2015). The Dot Probe task has also been criticised for being an unreliable measure of attentional bias (Chapman et al., 2019; Price et al., 2015; Schmukle, 2005). Therefore, the results of Experiment 1 support criticisms of the Dot Probe task for failing to effectively modify attentional bias.

As previously discussed, there are a number of possible modifications to the present Dot Probe task that may improve its effectiveness, such as extending the number of training trials, shortening the stimulus-onset asynchrony of the body stimuli, and using more extreme body sizes. However, given the critiques of the Dot Probe task and the lack of research using the Visual Search task to modify body size attentional biases, it may be more fruitful for research to study whether a Visual Search task can be used to modify participants' attention towards different body sizes. Possible variations to the Visual Search task used in Experiment 2 include making the distractor bodies one uniform size so that the body size paired with the target bar is more likely to "pop-out" and capture the participants' attention. Researchers could also develop an "odd-one-out" style training Visual Search task in which participants are explicitly asked to search for the high or low fat body size on each trial.

If an attention training version of the Visual Search task, or an alternative attentional bias modification task, can reliably influence body size attentional bias, body size adaptation, and body dissatisfaction, then the task could play a role in the treatment of body image disturbance—a diagnostic symptom of eating disorders (American Psychiatric Association, 2013). Increasing a person's attention towards larger body sizes could reduce the person's size perception of their own body, via body size adaptation, and also potentially reduce their body dissatisfaction (Brooks, Mond, et al., 2019; Stephen, Hunter, et al., 2018).

To test the clinical meaningfulness of such effects, further research would need to test the cross-task transfer effect of the attention training task (MacLeod et al., 2009). For example, if an attention training Visual Search task can effectively modify attentional bias as measured on multiple different measures of attentional bias, such as eye-tracking measures or the Posner Curing task (Posner, 1980), then we can be confident that the attention training has produced a more generalised change in attentional bias that is not restricted to specific elements of the attention training task. A generalised change in attentional bias would be more likely to extend beyond the specific attention training task to more naturalistic situations, and therefore may influence body size perception and body dissatisfaction in everyday life.

To further assess the clinical meaningfulness of such an attention training task, longitudinal studies would be needed to assess the time course of attention training effects (MacLeod et al., 2009). Longitudinal studies would help to determine whether training participants' attention can induce a lasting change in cognition that endures after treatment. For example, Browning et al. (2012) trained patients in remission from depression to attend towards positive faces. Four weeks after the attention training regime, participants still demonstrated effects from the attention training regime, including increased attention towards positive faces and reduced symptoms of depression. A similar sustained change in attentional bias towards larger bodies could contribute to long-term reductions in body size and shape misperception and body dissatisfaction.

Finally, although this research tested female participants using female body stimuli, it is important to note that the marginalisation of men in eating disorder research has led to a poor understanding of eating disorders and body image disturbances affecting men (Murray et al., 2017). Although women are more commonly diagnosed with eating disorders, evidence shows that men report similar body image disturbances and may be more likely to suffer from muscle-related dissatisfaction (Mitchison & Mond, 2015). Therefore, attentional bias modification research should also be conducted on male participants using male body stimuli, to investigate whether training men to attend away from idealised bodies and towards more "normal"-sized bodies can influence body size and shape misperception and body dissatisfaction.

In conclusion, the Dot Probe and Visual Search tasks used in this research failed to sufficiently modify attention towards high and low fat bodies and neither attention training task influenced body size adaptation or body dissatisfaction. These results provide support for arguments against attentional bias modification tasks that point to their poor replicability and reliability (Chapman et al., 2019; Cristea et al., 2015; Price et al., 2015; Schmukle, 2005) and therefore the tasks will need to be developed to a high standard of replicability and reliability before use in the treatment of body image disturbance. Given critiques of attentional bias modification tasks are largely directed at the Dot Probe task, it is an arguably worthwhile pursuit for research to investigate whether an effective version of the Visual Search task, or an alternative attentional bias modification task, can be developed to train attention towards different body sizes. Although evidence for attentional bias modification tasks is mixed, the tasks are low in cost and can be administered online via a computer or smart phone without a therapist present (Kuckertz & Amir, 2017) and therefore their development is worth pursuing.

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Appendix A
Experiment 1 (Dot Probe Task): Participants Recruited via Prolific

Table A1

The Current Country of Residence of the Participants Recruited via Prolific (N = 66).

Current Country of Residence	Number of Participants
Australia	13
Canada	1
Czech Republic	1
Finland	1
Greece	1
Ireland	1
Italy	3
Mexico	1
Netherlands	1
New Zealand	1
Poland	4
Portugal	4
Spain	1
United Kingdom	13
United States	19
No response	1

Note. Data obtained from participants' responses on their Prolific screener questionnaire.

Appendix B
Experiment 1 (Dot Probe Task): Preregistration Form Submitted to the Open Science Framework

Title

The Effect of the Dot Probe task on Attentional Bias, Body Size Adaptation, and Body Dissatisfaction.

Authors

MISS Thea House, Ian Stephen, Ian Penton-Voak, and Kevin R. Brooks

Description

The direction of attention toward people of a smaller body size is associated with higher rates of body dissatisfaction (Moussally, Brosch, & Van der Linden, 2016) and the tendency to perceive smaller bodies as “normal” sized (Stephen, Sturman, Stevenson, Mond, & Brooks, 2018). This research tests whether an attentional bias modification task—the Dot Probe—can be used to alter 1) attention to high vs low fat body stimuli, 2) the body size perceived as “normal”, and 3) body dissatisfaction. The experiment will be conducted in a laboratory setting and an online non-laboratory setting to test whether experimental environment influences attentional bias modification. This research will further our understanding of the relationship between attention, body perception, and body dissatisfaction, and will inform the use of attentional bias modification tasks as potential interventions for body image disturbances.

Hypotheses

Hypothesis 1 (directional): Participants trained to attend to low (high) fat body stimuli will exhibit a greater attentional bias to low (high) fat body stimuli after the training than before.

Hypothesis 2 (directional): Participants trained to attend to low (high) fat body stimuli will perceive lower (higher) fat body stimuli as “normal” after the training than before.

Hypothesis 3 (directional): Participants trained to attend to low (high) fat body stimuli will exhibit higher (lower) body dissatisfaction after the training than before.

Hypothesis 4 (directional): Participants trained in a laboratory setting will show greater changes in attentional bias, body adaptation, and body dissatisfaction than participants trained in a non-laboratory setting.

Design Plan

Study type

Experiment - A researcher randomly assigns treatments to study subjects, this includes field or lab experiments. This is also known as an intervention experiment and includes randomized controlled trials.

Blinding

For studies that involve human subjects, they will not know the treatment group to which they have been assigned.

Is there any additional blinding in this study?

No

Study design

All participants will have their attention modified using a training version of the Dot Probe. To assess the effect of the training Dot Probe, participants will have their attentional bias, body size adaptation, and body dissatisfaction measured before and after completing the training Dot Probe. The between-participants independent variable is the body size of the stimuli that the participants are trained to attend toward. Half of the participants will be trained to attend toward high fat body stimuli using Dot Probe training trials in which the probe replaces the high fat body stimuli on 100% of the trials. The other half of the participants will be trained to attend toward low fat body stimuli using Dot Probe trials in which the probe replaces the low fat body stimuli on 100% of the training trials. The three dependent variables are as follows:

Primary Outcome: Change in attentional bias (ΔAB)

To measure attentional bias, all participants will complete a pre- and post-training assessment version of the Dot Probe. During the pre- and post-training Dot Probe trials, the location of the probe will be randomised so that the probe has an equal probability of replacing each body stimulus. Therefore, the pre- and post-training Dot Probe trials are used to measure, rather than train, participants' attentional bias. Participant response times will be used to calculate a pre- and post-training attentional bias score. ΔAB will be calculated by subtracting the pre-training attentional bias score from the post-training attentional bias score.

Secondary Outcome 1: Change in point of subjective normality (ΔPSN)

To measure body size adaptation, all participants will use a method of adjustment task to indicate the body size that they perceive as most "normal"—the point of subjective normality (PSN). This task will be completed pre- and post-training. ΔPSN will be calculated by subtracting the pre-training PSN score from the post-training PSN score.

Secondary Outcome 2: Change in body dissatisfaction (ΔBD)

All participants will complete a body shape satisfaction scale pre- and post-training. ΔBD will be calculated by subtracting the pre-training body dissatisfaction score from the post-training body dissatisfaction score.

The pre-training measures will be completed in the following order by all participants: body shape satisfaction scale; PSNs; assessment Dot Probe. After completing the pre-training measures, participants will complete the training Dot Probe. Following the training Dot Probe, all participants will complete the post-training body shape satisfaction scale. Then they will simultaneously complete the post-training Dot Probe trials and post-training PSN trials in an interwoven order i.e. 1 PSN trial, then 8 Dot Probe trials, then 1 PSN trial, then 8 Dot Probe trials, and so on. The interwoven order of the post-training PSN and Dot Probe trials will be counterbalanced so that half of participants start with 1 PSN trial (followed by 8 Dot Probe trials, and so on) and half of participants start with 8 Dot Probe trials (followed by 1 PSN trial, and so on). The post-training measures use this order because the post-training Dot Probe will direct participants’ attention towards both high and low fat body stimuli which could reduce potential body size adaptation induced by the training Dot Probe. An interwoven order should minimise order effects and increase the likelihood of detecting an effect for body size adaptation. This research also tests whether the results can be replicated outside of a laboratory setting. Therefore, the entire experiment will be conducted using the software Gorilla (https://gorilla.sc/) once in a laboratory setting and once in an online non-laboratory setting. For the laboratory setting, participants will complete the experiment in the Department of Psychology, 4 First Walk (4FW), Macquarie University. For the online non-laboratory setting, participants will be able to access the experiment via an online link and can complete the experiment in a location of their choosing. Different participants will be recruited for each experimental setting.

No files selected

Randomization

For each experiment, the body size that participants are trained to attend toward (high versus low fat) will be block randomised using Gorilla's randomisation node with a balanced 5:5 ratio.

Sampling Plan

Existing Data

Registration prior to creation of data

Explanation of existing data

N/A

Data collection procedures

We aim for recruitment and data collection to take place between November 2019 and April 2020. If data collection is slower than anticipated, then data collection will be extended until October 2020. For the laboratory experiment, self-selection sampling will be used to recruit participants who respond to advertisements on Macquarie University's SONA study signup system as well as flyers posted around the local area and social media posts to psychology groups. Opportunity and snowball sampling will be used to recruit friends of the researcher. For this experiment, participants can choose to be reimbursed with either one hour of course credit or $20 (AUD) for participation. For the online non-laboratory experiment, self-selection sampling will be used to recruit participants who respond to advertisements on Macquarie University's SONA study signup system. These participants will be reimbursed with one hour of course credit for participation. Self-selection sampling will also be used to recruit participants who respond to advertisements on Prolific (https://www.prolific.co/). These participants will be reimbursed with the recommended hourly rate offered by Prolific.

The sample will be restricted to Caucasian women aged 18-35 years. This restriction will be outlined in the experiment advertisements and will be communicated to respondents who express an interest in participating. Only participants who confirm that they meet this criteria will be able to sign up to the experiment on SONA and Prolific. At the start of each experiment, participants will be also be asked to provide their age, gender, and ethnicity, and any participants who do not identify as Caucasian women aged 18-35 years will have their data excluded from analysis.

To ensure that different participants are recruited for the experiment conducted in the laboratory setting and the experiment conducted online in a non-laboratory setting, participants recruited through the SONA study signup system will only be able to sign up to one of the experiments. Participants who respond to advertisements and express an interest in either experiment will be informed that they cannot participate in the experiment if they have previously completed the experiment in the alternate settings (laboratory; online via SONA; online via Prolific). In addition, at the start of each experiment, participants will be asked whether they have previously completed the experiment in the alternate setting. If participants confirm that they have completed the experiment previously in an alternate setting, then their data will be excluded from analysis.

No files selected

Sample size

We aim to recruit 70 participants for the experiment conducted in the laboratory setting (35 participants per condition) and 150 participants for the experiment conducted online in the non-laboratory setting (75 participants per condition). If participants are excluded from analysis, then additional participants will be recruited to meet the target sample size.

Sample size rationale

A power analysis was conducted using G*Power v3.1.9.2 to determine the required sample size for the laboratory experiment to find an effect for the primary outcome (ΔAB). This experiment is based on the Dot Probe task designed by Dondzilo, Rieger, Palermo, and Bell (2018) who found a medium effect size (d = 0.49) for ΔAB with the participants trained to attend toward thin bodies. Using this effect size, the power analysis showed that 35 participants would be required per condition to provide one sample t-tests with 80% power to detect an effect at an alpha level of 5%. Therefore, 70 participants will be recruited for the laboratory experiment (35 per condition).

This power analysis was repeated for the online experiment conducted in a non-laboratory setting. The effect size found by Dondzilo et al. (2018) was reduced by a third (d = 0.33) to accommodate for the additional variation that is expected to be present in the results for the online non-laboratory experiment. This power analysis showed that 75 participants would be required per condition to provide one sample t-tests with 80% power to detect an effect at an alpha level of 5%. Therefore, 150 participants will be recruited for the online non-laboratory experiment (75 per condition).

Stopping rule

Data collection will be terminated once the target sample size has been recruited or on September 30th 2020.

Variables

Manipulated variables

The manipulated variable is the size of the body stimuli that participants are trained to attend toward (high versus low fat). To create the high and low fat body stimuli, ten photographs have been obtained from previous research on female Caucasian participants who provided written consent for their photographs to be used in future research. For each identity, Psychomorph was used to create a high and low fat version based on prototypes that differed in body fat mass by 12kg (Sturman, Stephen, Mond, Stevenson, & Brooks, 2017). All body stimuli used in the current experiment will have their face covered with a black square to prevent adaptation to facial rather than body size.

Participants will have their attention trained using a training Dot Probe task that is based on the version used by Dondzilo et al. (2018). The task consists of 360 trials and is completed on a computer. Each trial starts with a fixation cross presented in the centre of the computer screen for 1000ms. The fixation cross then disappears, and two body stimuli (one high fat and one low fat version of the same identity) are presented simultaneously for 500ms. Each body stimulus is presented at random either on the left or right of the fixation cross. The body stimuli then disappear and a probe is presented (either the letter "p" or "q"). For participants trained to attend to high (low) fat body stimuli, the probe will be located in the position previously occupied by the high (low) fat body stimulus on all 360 trials. Participants are instructed to identify the letter as quickly and accurately as possible, by pressing the appropriate keys ("p" or "q") on the keyboard. The 360 training trials will be presented in 6 blocks of 60 trials. The 60 trials per block involve the 10 body stimulus pairs each presented 3 times with the 'p' probe and 3 times with the 'q' probe. For each block, the order of these 60 trials will be randomised. Between each block, participants will be given a fifteen second break.

No files selected

Measured variables

Change in attentional bias (ΔAB):

To measure attentional bias, all participants will complete a pre- and post-training assessment version of the Dot Probe. The pre- and post-training Dot Probe trials are identical to the training Dot Probe; however, the location of the probe (left vs right) will be randomised separately to the body stimuli. Therefore, for each trial the probe has an equal probability of appearing in the location previously occupied by each body stimulus. The body stimuli for the pre- and post-training Dot Probe trials will be a different set of ten identities to those used for the training Dot Probe; however, the stimuli have been obtained using the same approach. For the pre-training Dot Probe trials, participants will complete 80 trials presented one after another in a random order. The 80 trials include 10 body stimulus pairs each being presented 4 times with the ‘p’ probe and 4 times with the ‘q’ probe. The post-training Dot Probe trials will also consist of 80 trials; however, the trials will be presented in 10 blocks of 8 trials (see section titled 'Study design'). The 8 trials for each block will be selected from the 80 pre-training trials at random. Participant response times will be used to calculate a pre- and post-training Dot Probe attentional bias score (see section titled 'Indices'). ΔAB will be calculated by subtracting the pre-training Dot Probe attentional bias score from the post-training Dot Probe attentional bias score; therefore, a positive (negative) ΔAB means that participants directed more attention toward low (high) fat body stimuli after the training than before.

Change in point of subjective normality (ΔPSN):

To measure body size adaptation, participants’ PSNs will be obtained with a version of the method of adjustment used by Stephen, Bickersteth, Mond, Stevenson, and Brooks (2016). During the task, participants will be presented with ten body stimuli one at a time in a random order. The ten body stimuli be the same identities as those used for the pre- and post-training Dot Probe trials and therefore will be different identities to those used for the training Dot Probe. From each identity’s original photograph, a further 12 images have been made using Psychomorph to vary the body fat mass ±6 equidistant increments from the original photograph up to and including the high and low fat versions used for the pre- and post-training Dot Probe (Sturman, Stephen, Mond, Stevenson, & Brooks, 2017). These thirteen versions of each identity will be used to measure participants' PSN scores. Participants will initially be presented at random with one of the thirteen versions of a single identity. Participants will then be able to cycle through the 13 versions of the identity by pressing 'p' on the keyboard to move to the next largest version of the body and pressing 'q' on the keyboard to move to the next smallest version of the body. Once participants reach the largest body size, pressing 'p' will move them to the smallest version of the body. Likewise, once participants reach the smallest body size, pressing 'q' will move them to the largest version of the body. Therefore, participants will be able to manipulate the person's body size by continually cycling through the thirteen versions of the identity. Participants will be instructed to click the mouse to select the version of the body that they think looks the most "normal". Clicking the mouse will move the participant onto the next identity, and the participant will be able to repeat the process until they have selected a "normal" body size for each of the 10 identities. The mean fat mass chosen as "normal" for the 10 identities will be calculated to produce each participant's PSN score. This task will be completed pre- and post-training. ΔPSN will be calculated by subtracting the pre-training PSN score from the post-training PSN score. A positive (negative) ΔPSN means that the body size participants perceived to be "normal" was higher (lower) after the training than before.

Change in body dissatisfaction (ΔBD):

Body dissatisfaction will be measured using a modified version of the body shape satisfaction scale originally designed by Pingitore, Spring, and Garfieldt (1997). The scale requires participants to rate their satisfaction with eighteen parts or features of their body. Participants are asked to respond based on their feelings "at this moment" to increase the likelihood of detecting changes in state body dissatisfaction caused by the Dot Probe (Thompson, 2004).

Participants' responses will be measured using a slider scale rather than a Likert scale to minimise the likelihood that participants will remember and reproduce their pre-training responses when completing the post-training scale. Response options for each of the eighteen items will range from 0-100 (100 as "Very dissatisfied" and 0 as "Very satisfied"). A body dissatisfaction score will be calculated by summating the responses for all eighteen items; therefore, a higher score will indicate greater body dissatisfaction. All participants will complete the body shape satisfaction scale pre- and post-training. ΔBD will be calculated by subtracting the pre-training body dissatisfaction score from the post-training body dissatisfaction score. A positive (negative) ΔBD means that participants' body dissatisfaction has increased (decreased).

Additional measures:

At the start of the experiment, participants will provide their age and have their BMI (kg/m^2) calculated. Participants completing the experiment in the laboratory setting will have their BMI measured using a Tanita SC-330 body composition analyser. Participants completing the experiment in a non-laboratory setting will be asked to self-report their height and weight for their BMI to be calculated. Any analysis conducted with these data will be exploratory rather than confirmatory.

No files selected

Indices

Change in attentional bias (ΔAB):

To calculate the pre- and post-training Dot Probe attentional bias scores, mean response times will be calculated for pre- and post-training trials where participants responded correctly. The mean response times will be substituted into the following formula using low fat body stimuli as the target (MacLeod & Mathews, 1988):

[(left probe/right target – left probe/left target) + (right probe/left target – right probe/right target)]/2

The ‘left probe/right target’ refers to the mean response time when the probe is located in the left area but the low fat body stimuli is located in the right area, and so on. A positive attentional bias score represents an attentional bias to low fat body stimuli and a negative attentional bias score represents an attentional bias to high fat body stimuli. ΔAB will be calculated by subtracting the pre-training Dot Probe attentional bias score from the post-training Dot Probe attentional bias score.

Change in point of subjective normality (ΔPSN):

The pre- and post-training PSN scores will be calculated by averaging the fat mass chosen as “normal” for the 10 identities. ΔPSN will be calculated by subtracting the pre-training PSN score from the post-training PSN score.

Change in body dissatisfaction (ΔBD):

To calculate a body dissatisfaction score, participant responses for all eighteen items on the body shape satisfaction scale will be summated; therefore, a higher score will indicate greater body dissatisfaction. ΔBD will be calculated by subtracting the pre-training body dissatisfaction score from the post-training body dissatisfaction score.

No files selected

Analysis Plan

Statistical models

Data collected from the laboratory and online non-laboratory experiment will be analysed separately using the following data analysis plan.

To test Hypotheses 1-3, one-sample t-tests for each condition (high fat and low fat conditions) and for each DV (ΔAB, ΔPSN, and ΔBD) will be conducted against a value of zero to analyse the effect of the training Dot Probe on ΔAB, ΔPSN, and ΔBD. Hypothesis 1 will be supported if participants trained to attend to low (high) fat body stimuli demonstrate a significantly positive (negative) ΔAB. Hypothesis 2 will be supported if participants trained to attend to low (high) fat body stimuli demonstrate a significantly negative (positive) ΔPSN. Hypothesis 3 will be supported if participants trained to attend to low (high) fat body stimuli demonstrate a significantly positive (negative) ΔBD.

To compare the results for the data collected in the laboratory and online non-laboratory setting, bootstrap resampling will be used with 2000 samples to compute 95% confidence intervals for each effect size. Hypothesis 4 will be supported if participants trained in a laboratory setting demonstrate greater effect sizes for ΔAB, ΔPSN, ΔBD with non-overlapping confidence intervals when compared to participants trained in a non-laboratory setting.

No files selected

Transformations

N/A

Inference criteria

A standard $p<.05$ criterion will be used to interpret the results of the one sample t-tests and the Holm-Bonferroni method will be used to adjust for multiple comparisons (Holm, 1979).

Data exclusion

Participants will be excluded from the analysis if they terminate the experiment before completion, take longer than 90 minutes to complete the experiment, or if their response accuracy is less than 60% on the pre-and post-training Dot Probe trials. At the start of each experiment, participants will be asked whether they have previously completed the experiment in the alternate setting (laboratory; online via SONA; online via Prolific). If participants confirm that they have completed the experiment previously in an alternate setting, then their data will be excluded from analysis. Individual pre- and post-training Dot Probe trials in which the participant responded incorrectly will be excluded from analysis. Individual pre- and post-training Dot Probe trials will also be excluded from analysis if the participant's reaction time is less than 200ms or more than 2.5 standard deviations above the participant's mean reaction time.

Missing data

Casewise deletion will be used to handle missing data.

Exploratory analysis

N/A

Other

References

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Appendix C
Experiment 1 (Dot Probe Task): Pre-training Descriptive Statistics

Table C

Descriptive Statistics for Age, BMI, Pre-training Attentional Bias Score, Pre-training PSN score, and Pre-training Body Dissatisfaction Score for Each Condition and Experiment Setting.

			Age (years)			BMI (kg/m²)			Pre-training Attentional Bias Score			Pre-training PSN score			Pre-training Body Dissatisfaction Score		
Experiment	Condition	*N*	*M*	*SD*	95% CI	*M*	*SD*	95% CI	*M*	*SD*	95% CI	*M*	*SD*	95% CI	*M*	*SD*	95% CI
Online	High Fat	75	23.71	5.17	[22.52, 24.90]	25.86	11.76	[23.16, 28.57]	-0.08	42.45	[-9.85, 9.68]	11.82	3.56	[11.00, 12.64]	878.07	347.61	[798.09, 958.05]
	Low Fat	75	24.20	5.29	[22.98, 25.42]	25.57	6.94	[23.97, 27.16]	-0.64	34.27	[-8.52, 7.25]	11.56	4.04	[10.63, 12.49]	896.56	284.31	[831.15, 961.97]
Laboratory	High Fat	35	21.49	4.16	[20.06, 22.92]	24.49	5.42	[22.63, 26.36]	12.21	39.05	[-1.20, 25.62]	10.43	3.32	[9.29, 11.58]	770.66	282.28	[673.69, 867.62]
	Low Fat	35	20.71	2.64	[19.81, 21.62]	22.90	4.79	[21.25, 24.54]	-2.66	28.55	[-12.47, 7.15]	10.67	4.02	[9.29, 12.05]	758.46	318.27	[649.13, 867.79]

Note. CI refers to confidence intervals.

Appendix D

Experiment 1 (Dot Probe Task): Histograms and Normal Q-Q Plots for Each Condition and Experiment Setting

Figure D1

Histogram for ΔAB for the High Fat Condition in the Online Setting

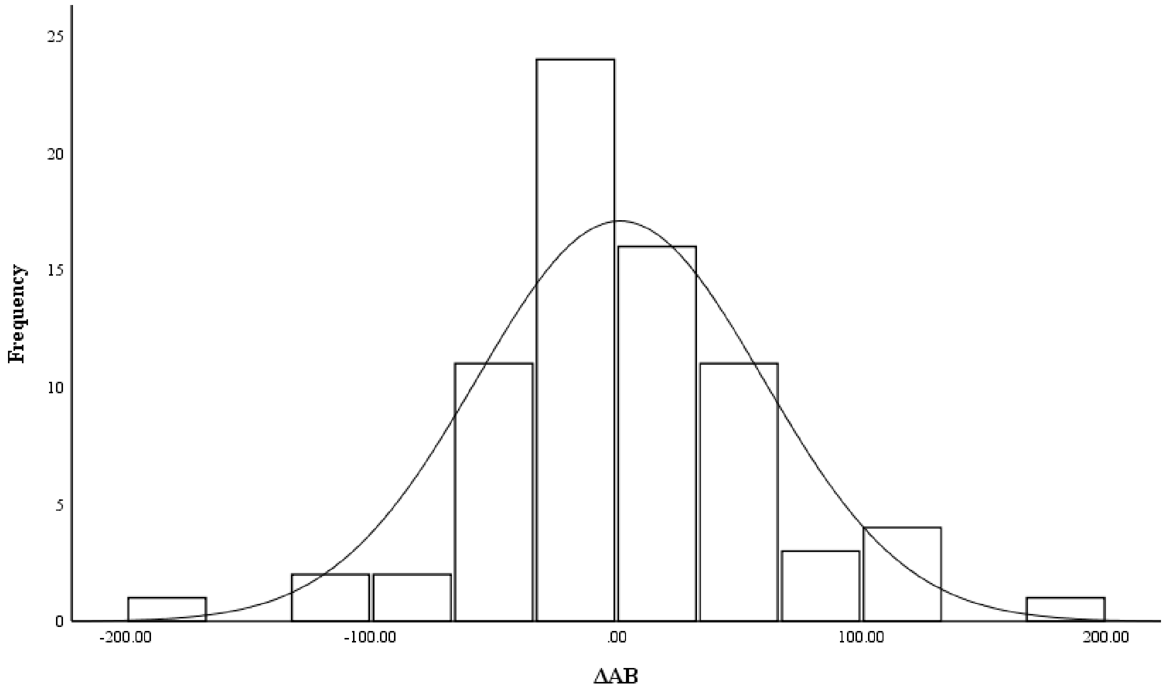


Figure D2

Normal Q-Q Plot for ΔAB for the High Fat Condition in the Online Setting

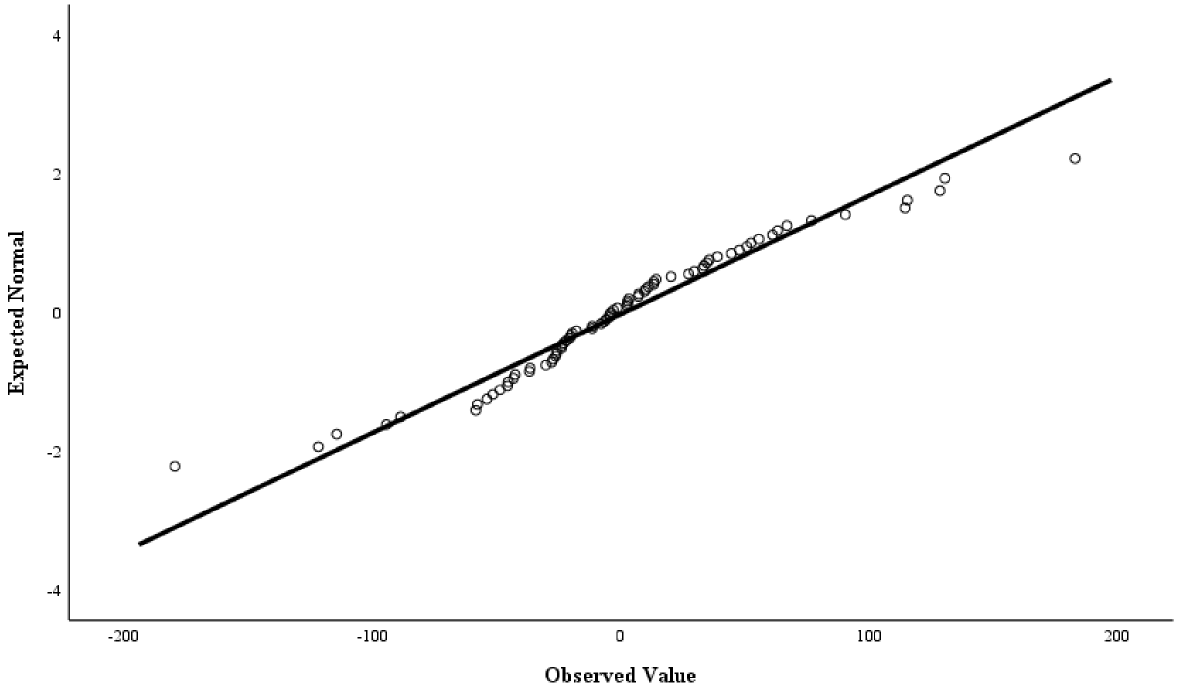


Figure D3

Histogram for ΔAB for the Low Fat Condition in the Online Setting

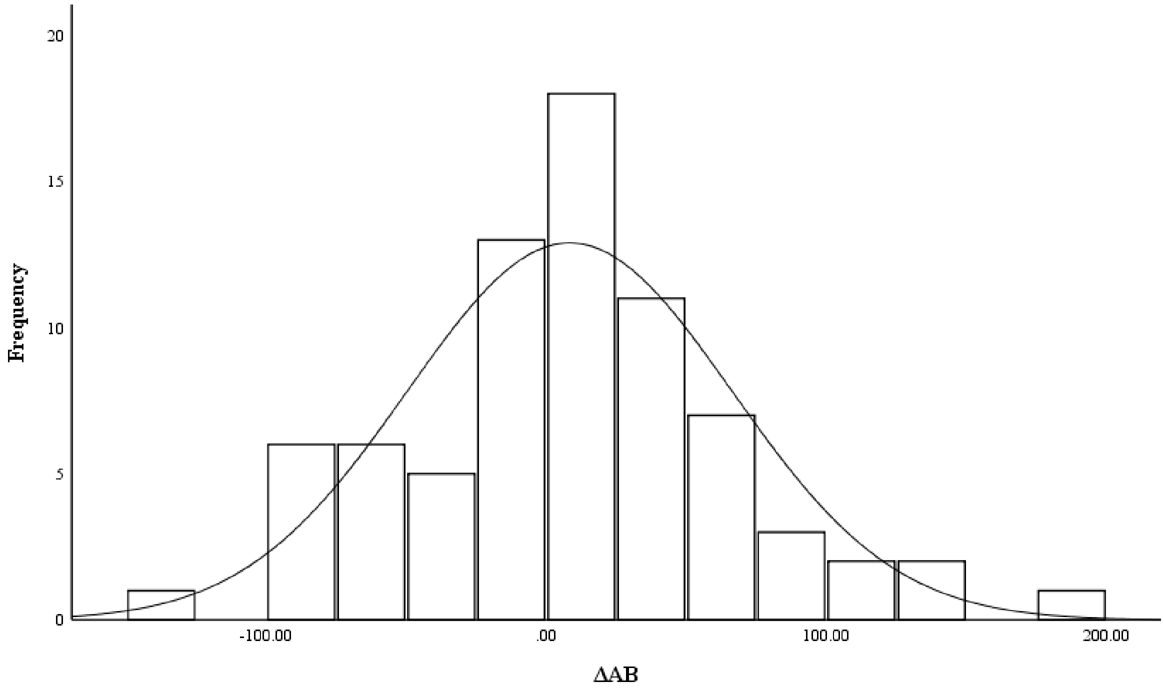


Figure D4

Normal Q-Q Plot for ΔAB for the Low Fat Condition in the Online Setting

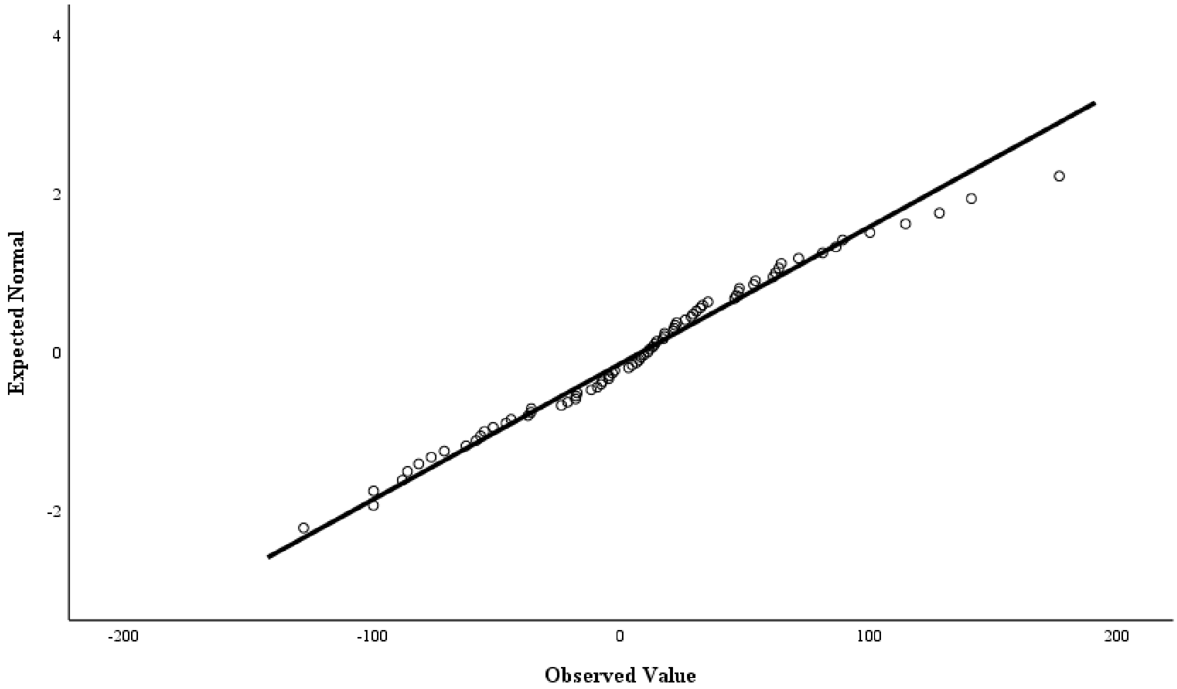


Figure D5

Histogram for ΔAB for the High Fat Condition in the Laboratory Setting

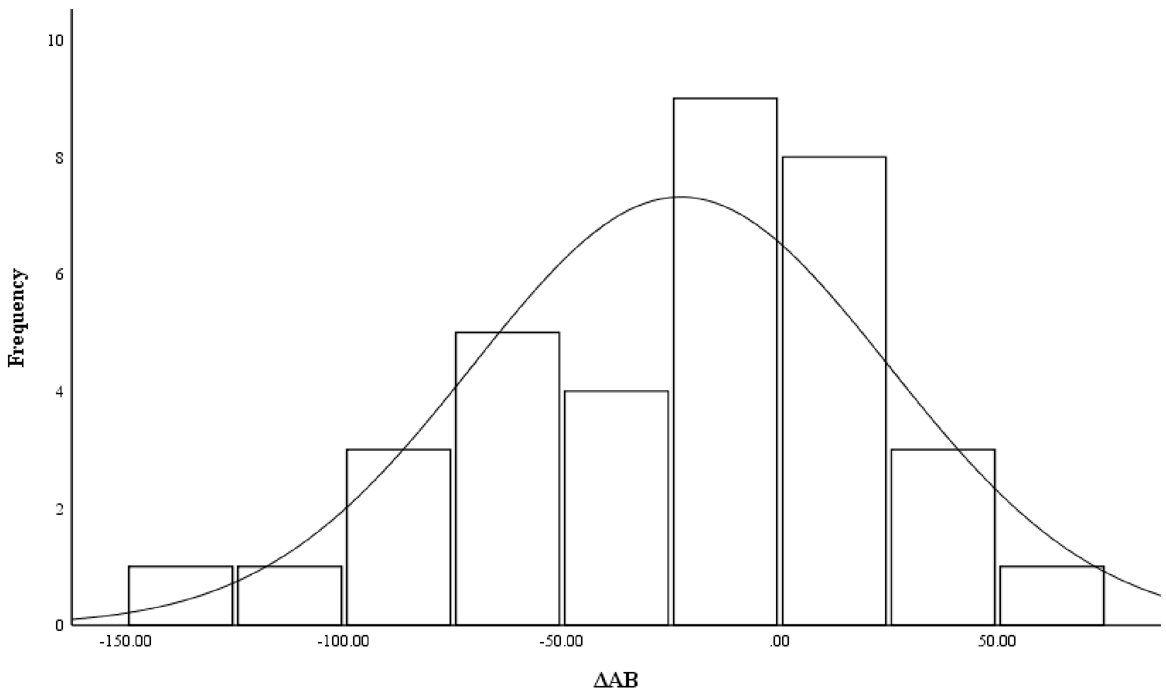


Figure D6

Normal Q-Q Plot for ΔAB for the High Fat Condition in the Laboratory Setting

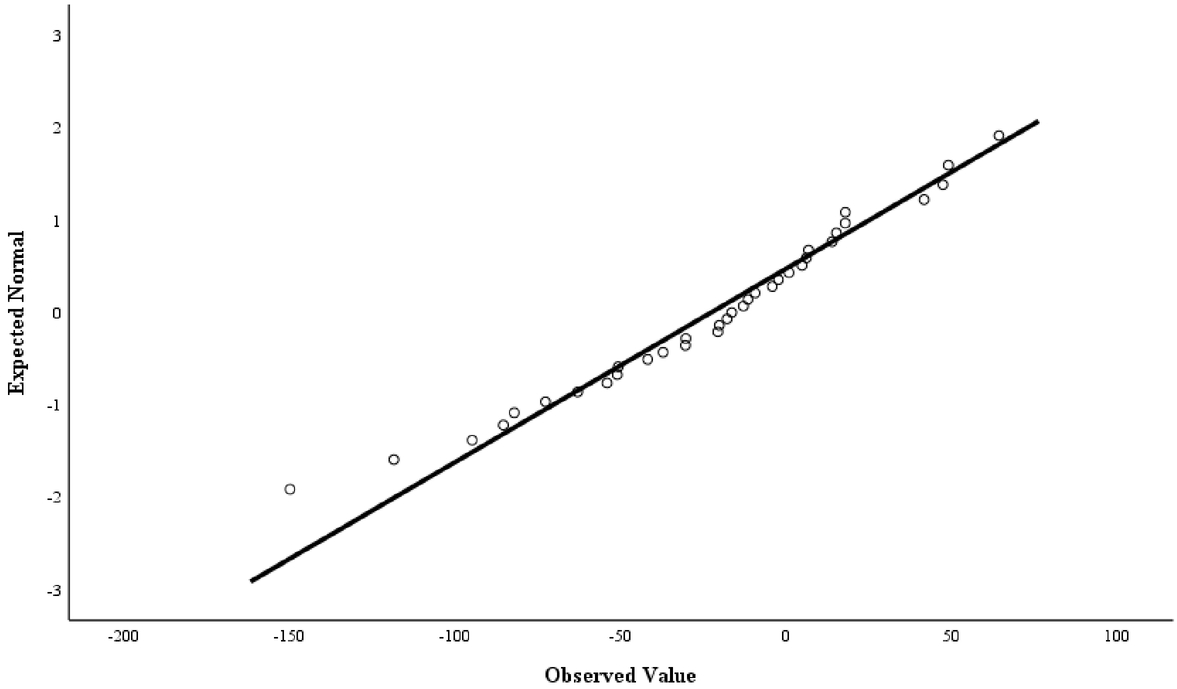


Figure D7

Histogram for ΔAB for the Low Fat Condition in the Laboratory Setting

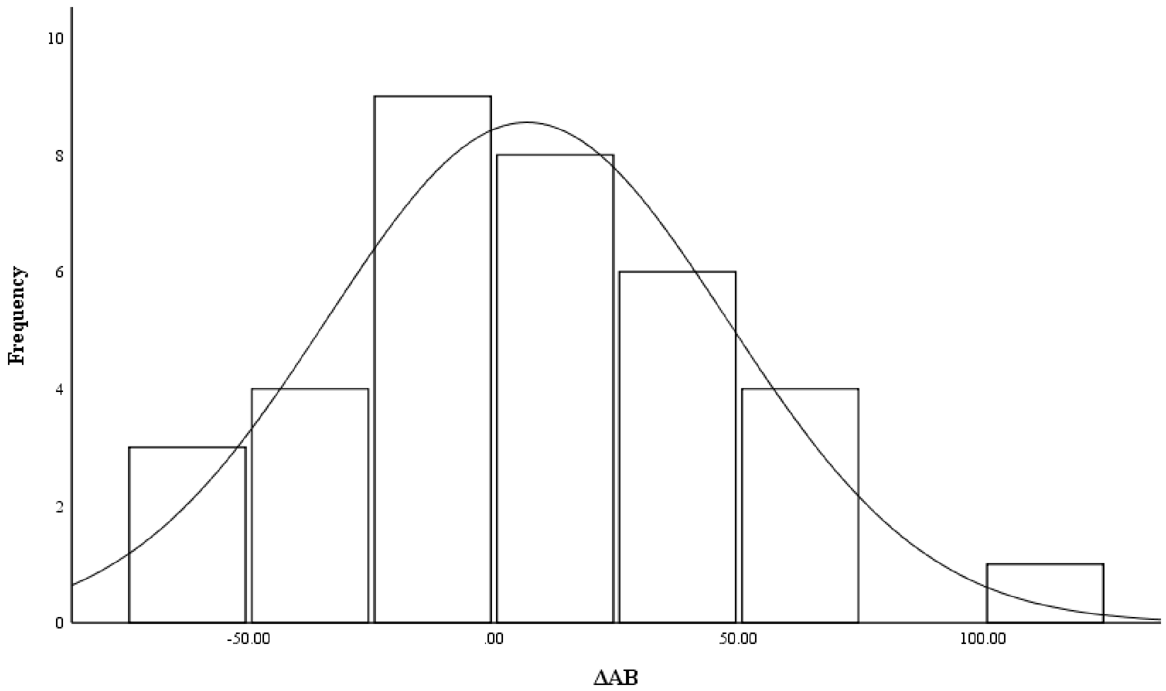


Figure D8

Normal Q-Q Plot for ΔAB for the Low Fat Condition in the Laboratory Setting

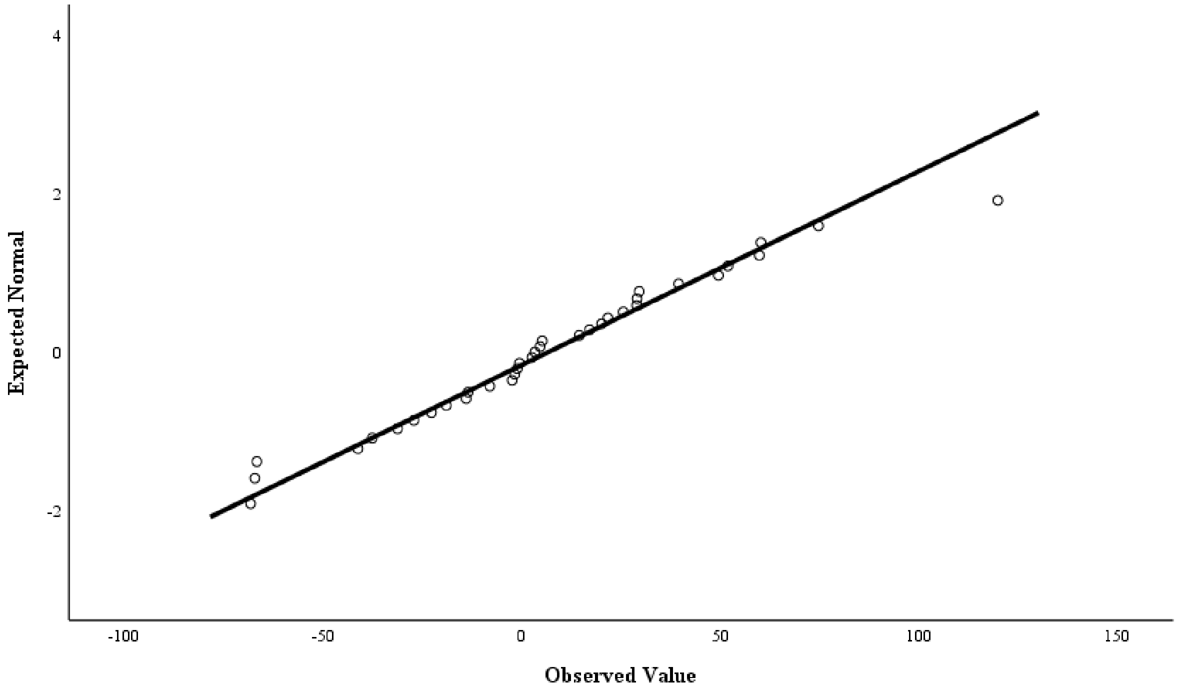


Figure D9

Histogram for ΔPSN for the High Fat Condition in the Online Setting

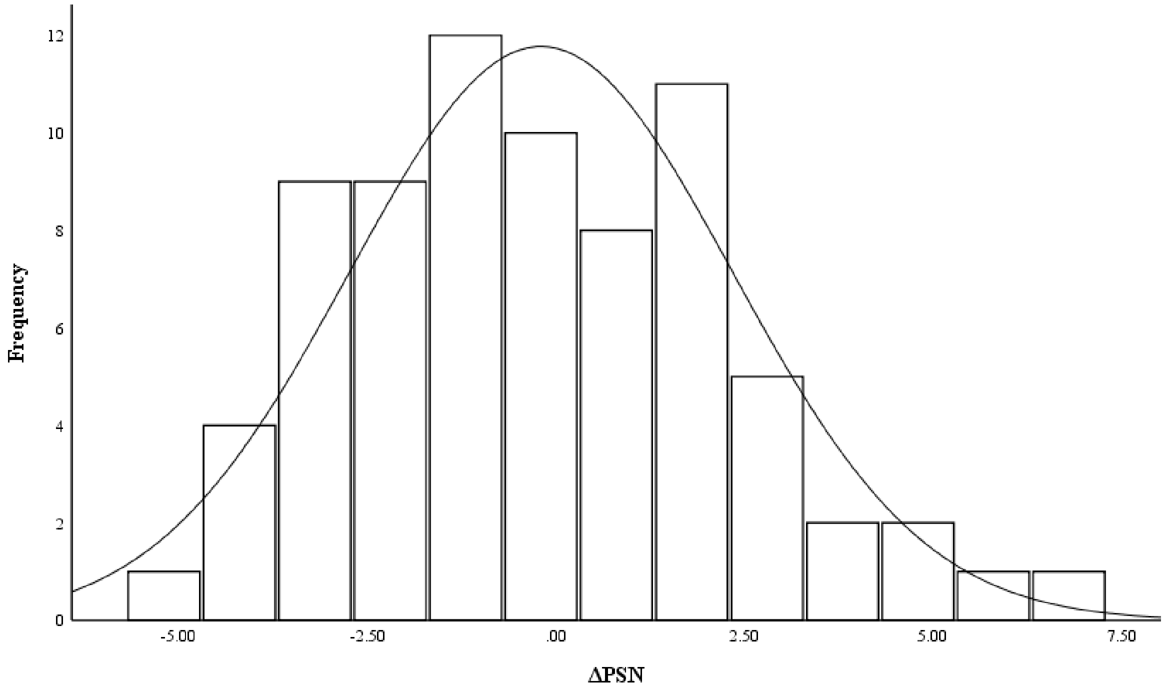


Figure D10

Normal Q-Q Plot for ΔPSN for the High Fat Condition in the Online Setting

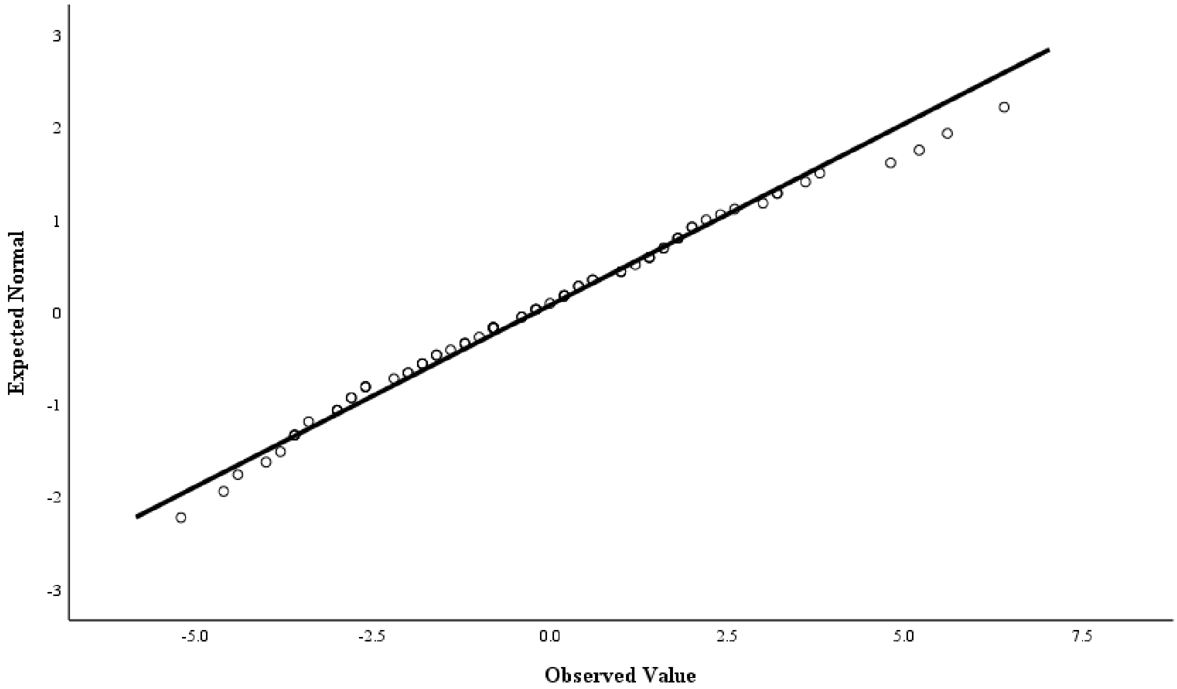


Figure D11

Histogram for ΔPSN for the Low Fat Condition in the Online Setting

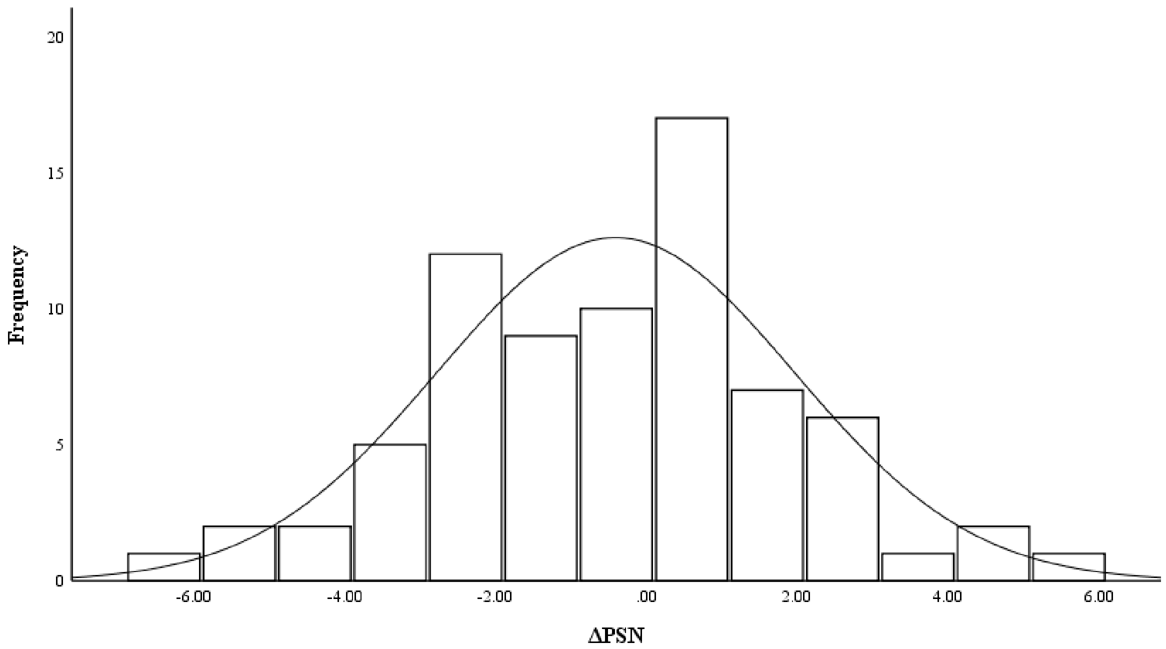


Figure D12

Normal Q-Q Plot for ΔPSN for the Low Fat Condition in the Online Setting

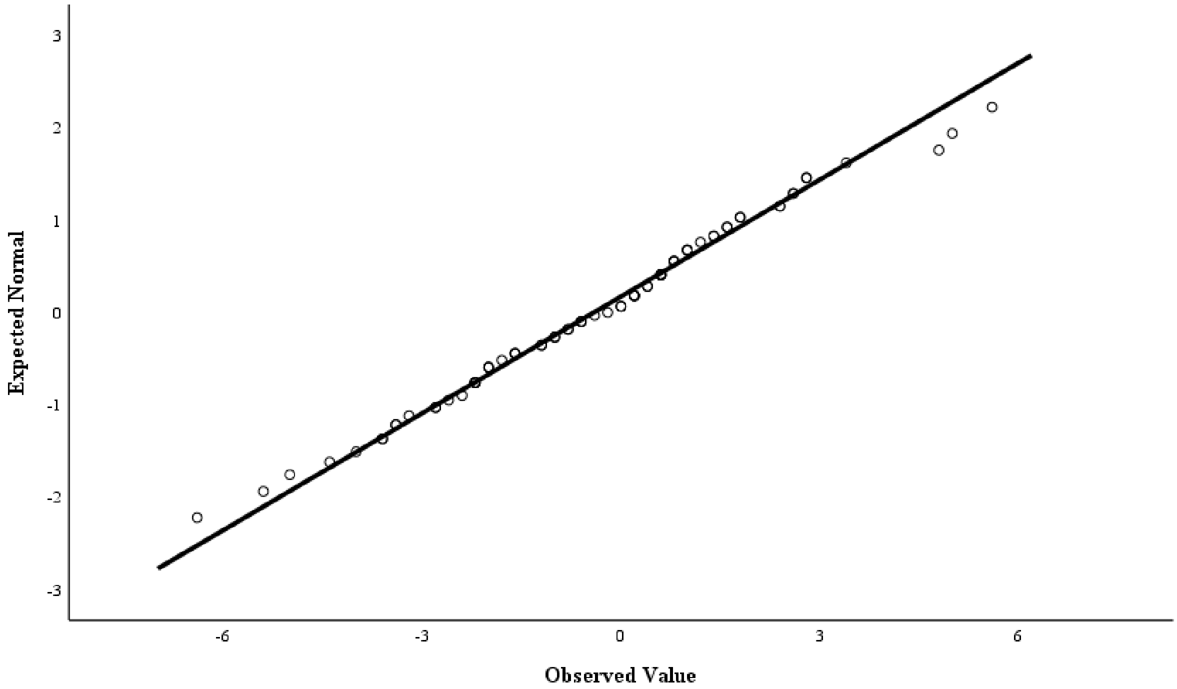


Figure D13

Histogram for ΔPSN for the High Fat Condition in the Laboratory Setting

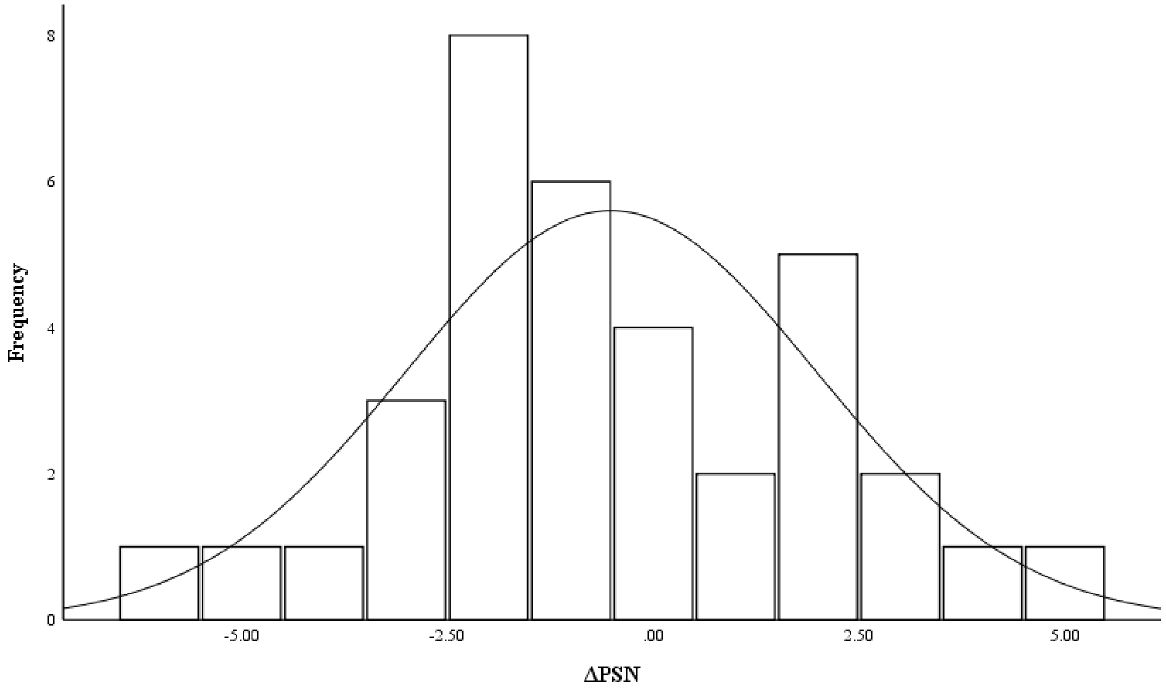


Figure D14

Normal Q-Q Plot for ΔPSN for the High Fat Condition in the Laboratory Setting

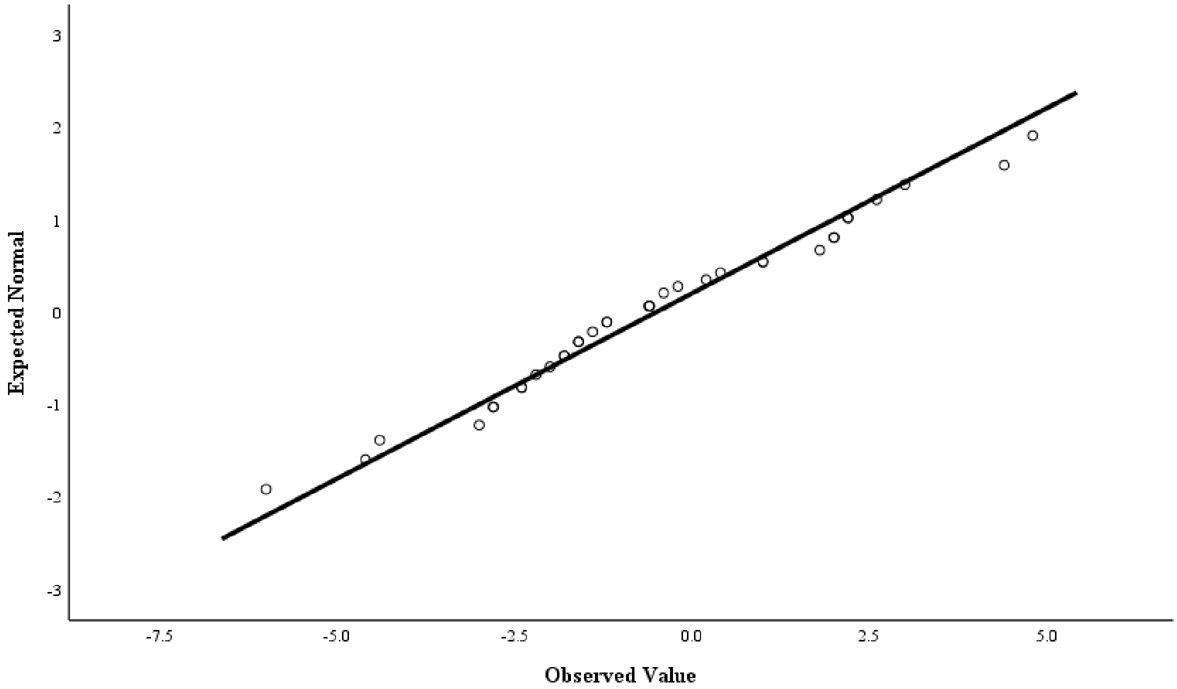


Figure D15

Histogram for ΔPSN for the Low Fat Condition in the Laboratory Setting

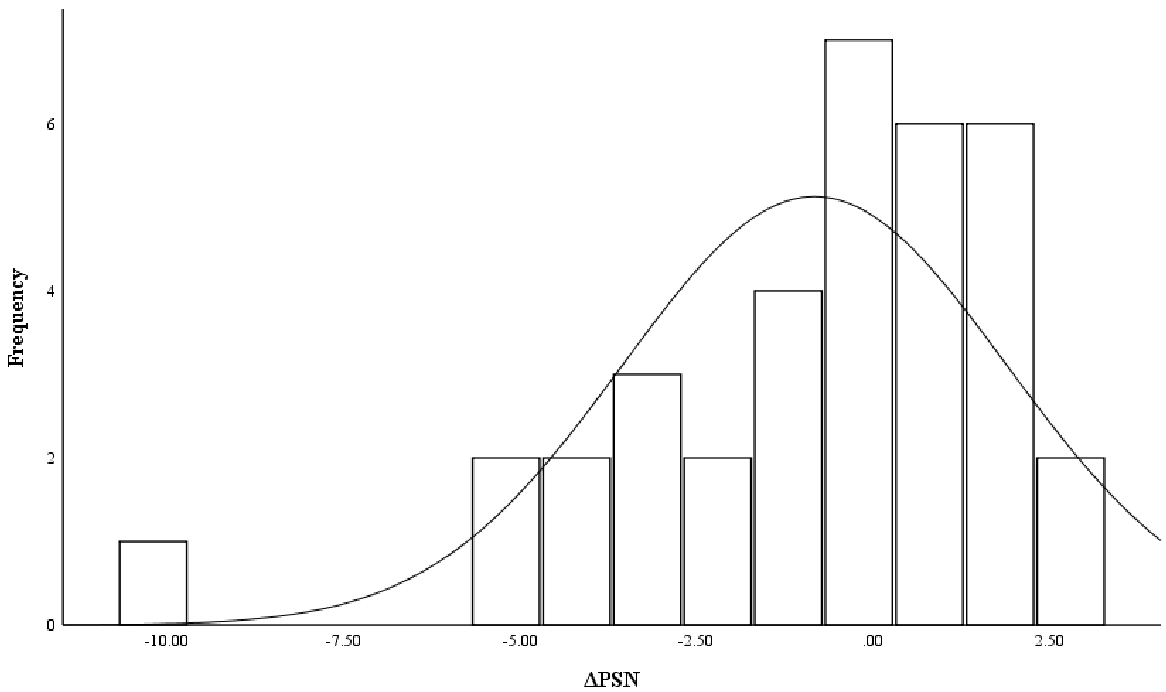


Figure D16

Normal Q-Q Plot for ΔPSN for the Low Fat Condition in the Laboratory Setting

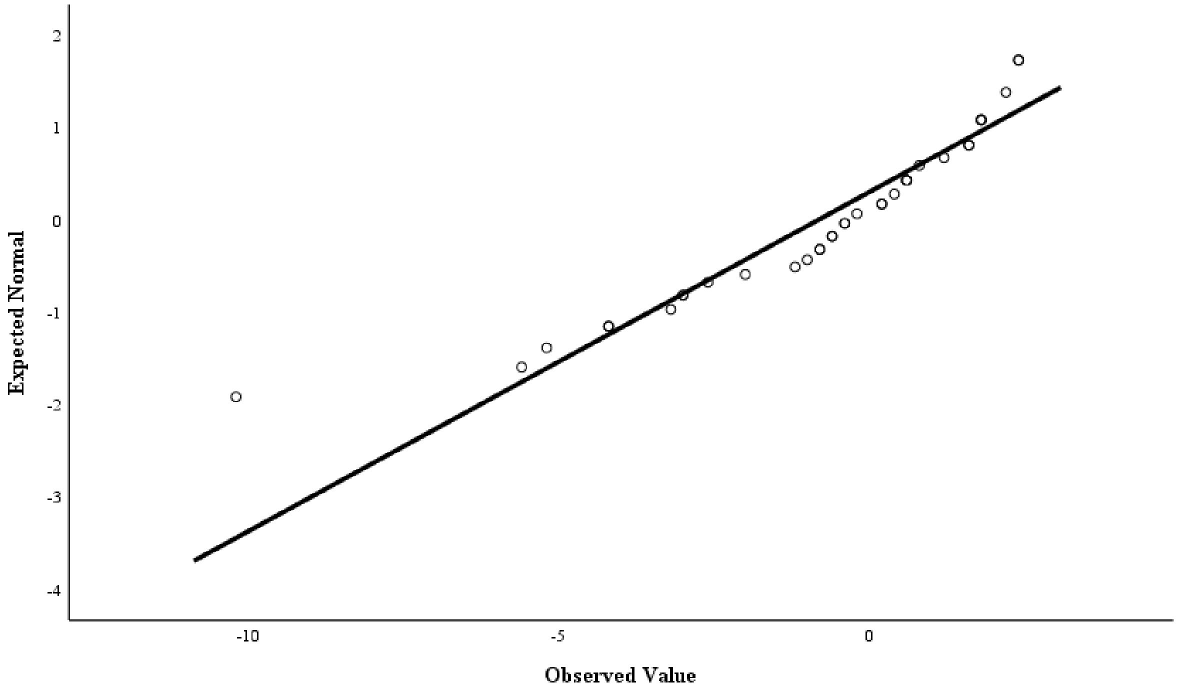


Figure D17

Histogram for ΔBD for the High Fat Condition in the Online Setting

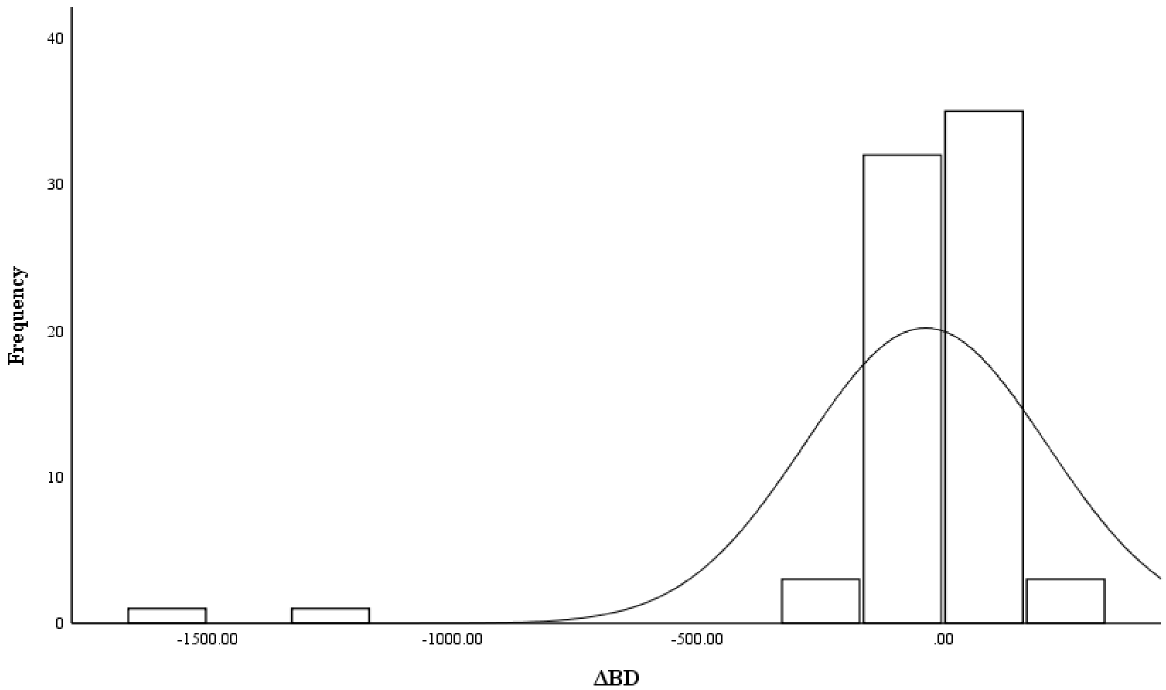


Figure D18

Normal Q-Q Plot for ΔBD for the High Fat Condition in the Online Setting

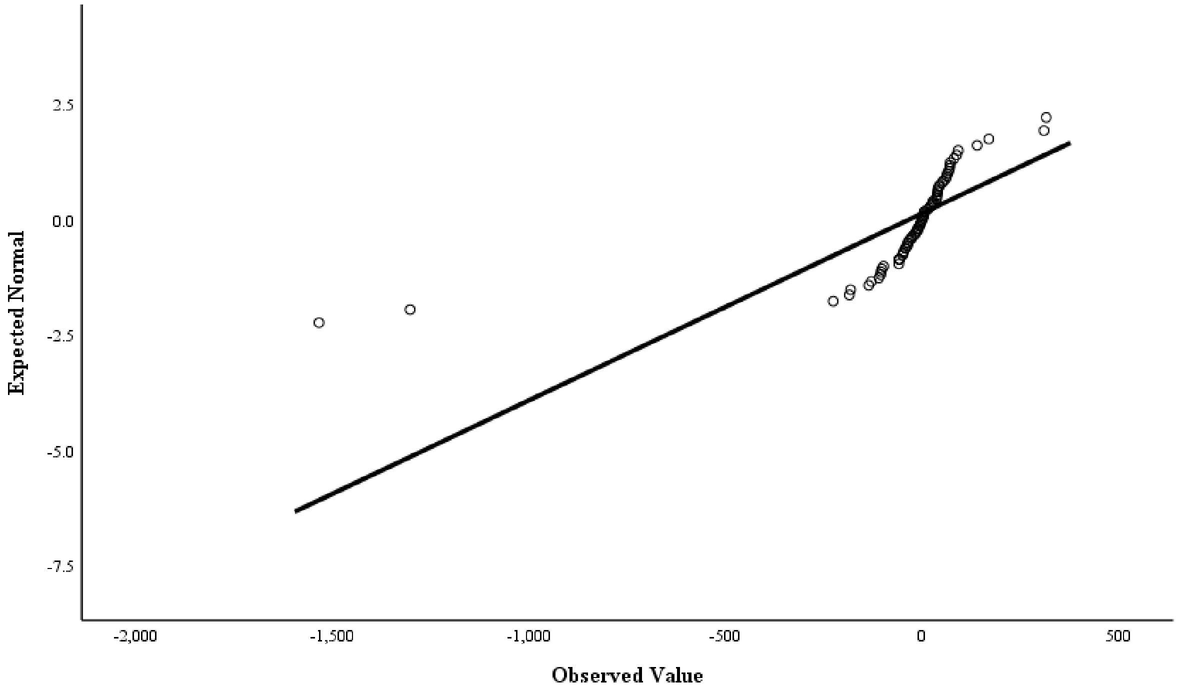


Figure D19

Histogram for ΔBD for the Low Fat Condition in the Online Setting

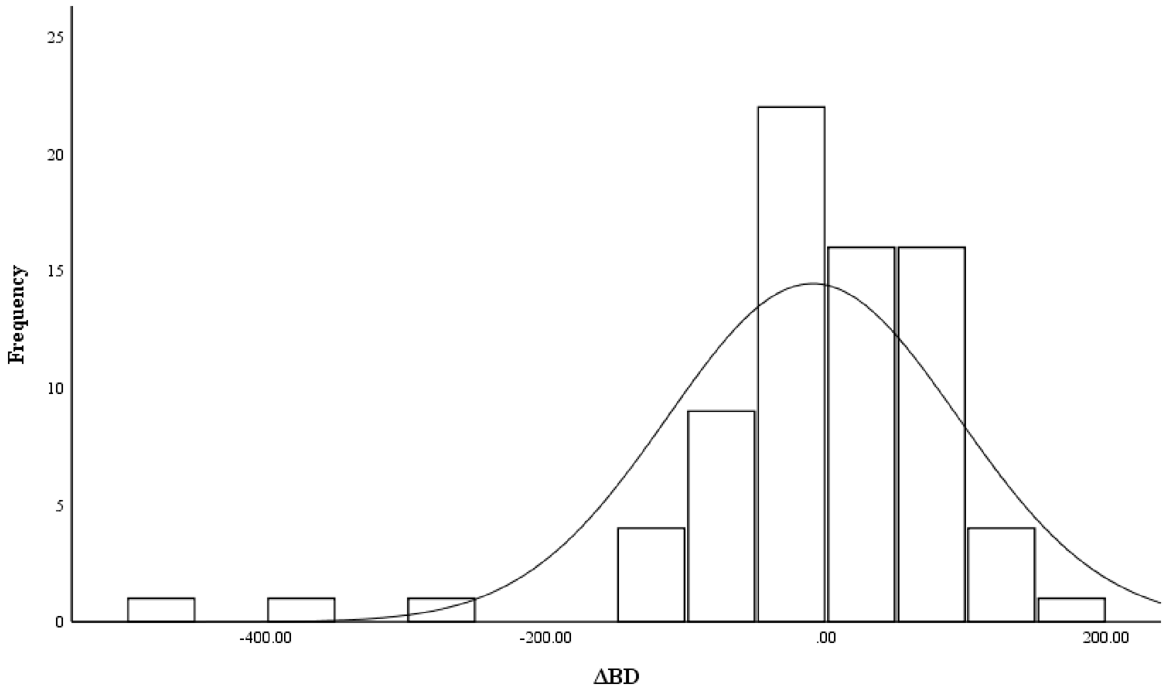


Figure D20

Normal Q-Q Plot for ΔBD for the Low Fat Condition in the Online Setting

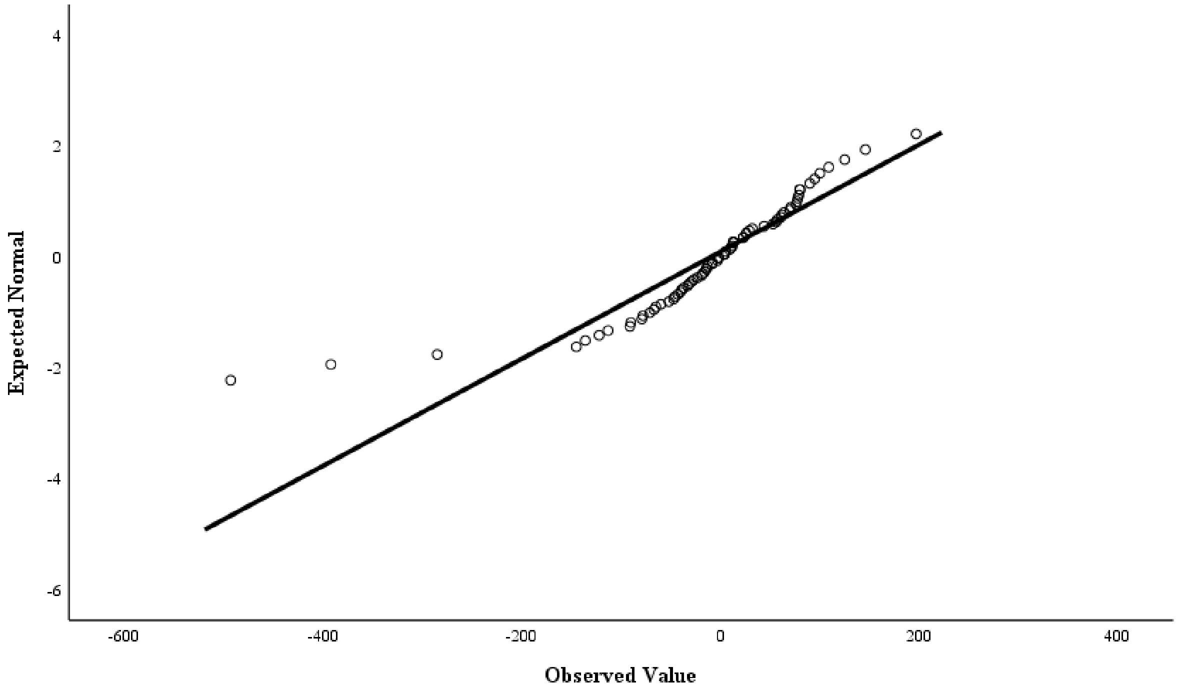


Figure D21

Histogram for ΔBD for the High Fat Condition in the Laboratory Setting

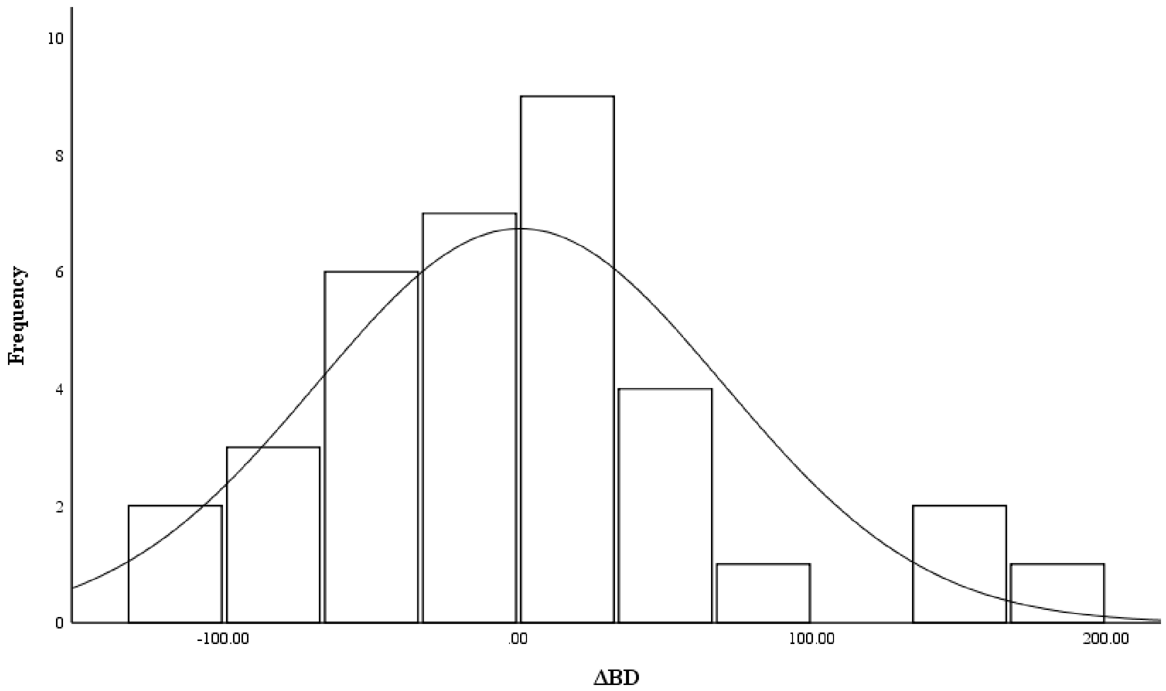


Figure D22

Normal Q-Q Plot for ΔBD for the High Fat Condition in the Laboratory Setting

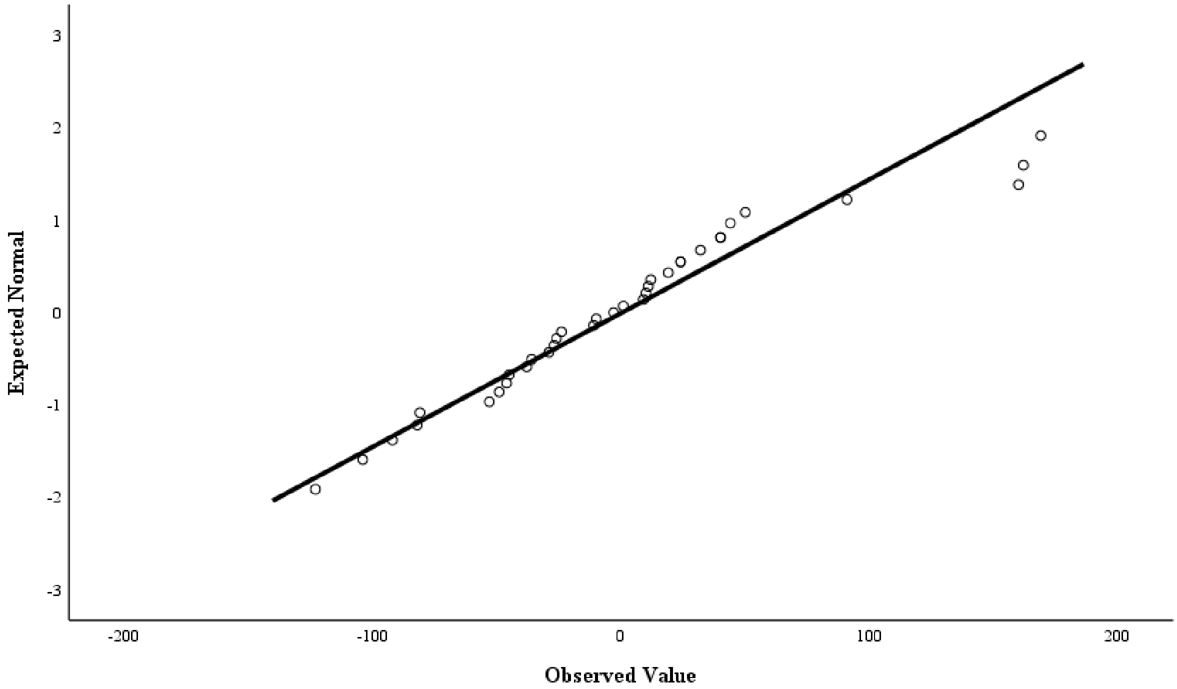


Figure D23

Histogram for ΔBD for the Low Fat Condition in the Laboratory Setting

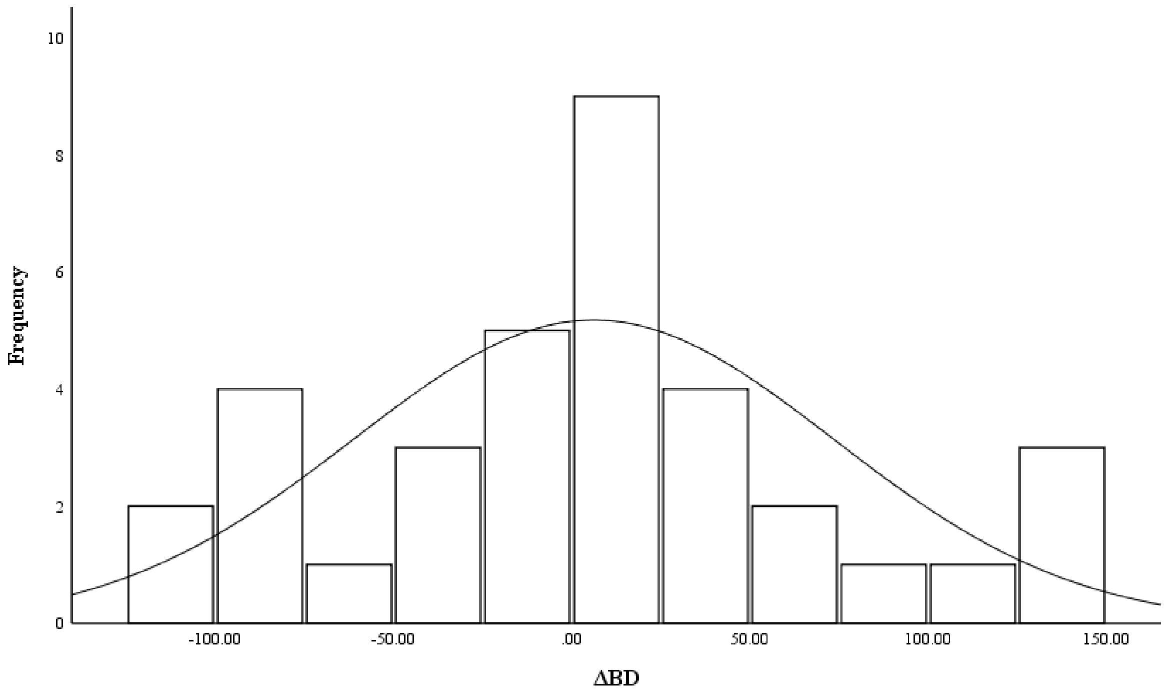
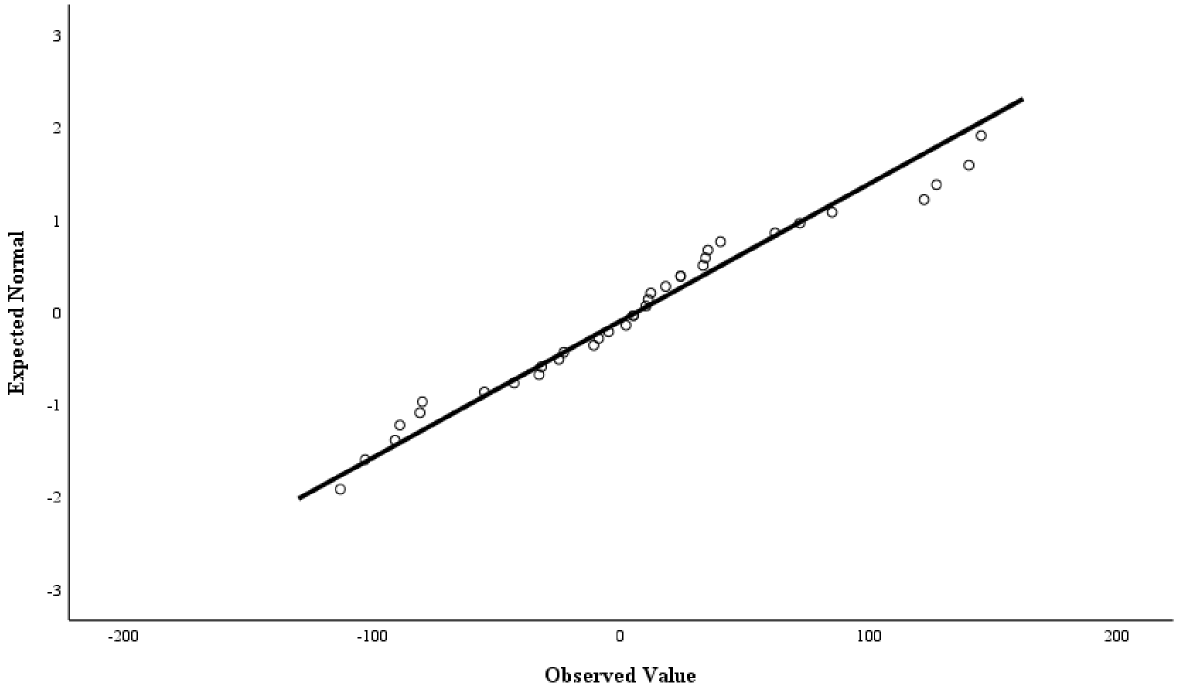


Figure D24

Normal Q-Q Plot for ΔBD for the Low Fat Condition in the Laboratory Setting



Appendix E

Experiment 1 (Dot Probe Task): Results of the Preregistered Analyses Rerun with the Online and Laboratory Data Combined.

Table E1

Results of the Bootstrapped One Sample T-tests Comparing ΔAB, ΔPSN, and ΔBD Against a Value of 0 for Each Condition.

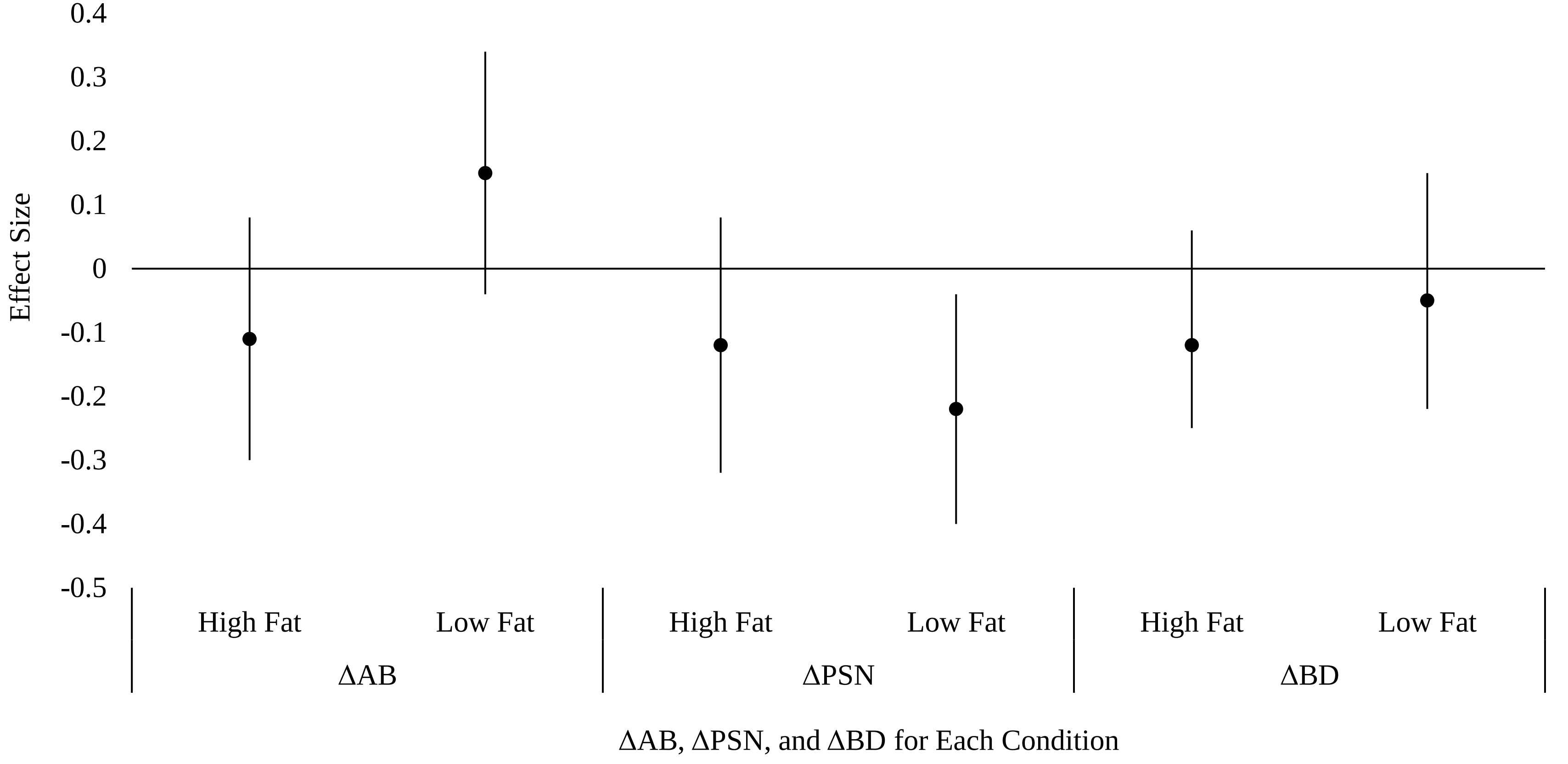
			ΔAB				ΔPSN				ΔBD			
Condition	*N*	df	*M* [95% CI]	*SD*	*t*	*p*	*M* [95% CI]	*SD*	*t*	*p*	*M* [95% CI]	*SD*	*t*	*p*
High Fat	110	109	-6.25 [-16.50, 4.09]	56.13	-1.77	.240	-0.30 [-0.76, 0.16]	2.52	-1.25	.199	-24.26 [-84.36, 2.64]	207.95	-1.22	.088
Low Fat	110	109	7.79 [-1.45, 18.21]	52.95	1.54	.104	-0.54 [-1.03, 0.36]	2.49	-2.30	.017	-4.78 [-24.54, 10.59]	93.51	-0.54	.553

Note 1. To correct for multiple comparisons, a Holm–Bonferroni criterion was applied, requiring the smallest *p*-value to be less than .008 to be statistically significant (Holm, 1979). No *p*-values were smaller than their Holm Bonferroni criterion and therefore all results were not statistically significant.

Note 2. CI refers to confidence intervals.

Figure E1

Effect Sizes with their 95% Confidence Intervals for ΔAB, ΔPSN, and ΔBD for Each Condition.



Note. Effect sizes are reported as Cohen's *d* and 95% confidence intervals were estimated using the R package bootES and bootstrap resampling with 2000 samples (Kirby & Gerlanc, 2013).

Table E2

Bayes Factors for the 6 One Sample T-tests Comparing ΔAB, ΔPSN, and ΔBD Against a Value of 0 for Each Condition.

Condition	ΔAB	ΔPSN	ΔBD
High Fat	0.21	0.23	0.22
Low Fat	0.33	1.30	0.12

Note. Bayes factors were calculated using JASP version 0.11.1.0 and the JASP default prior (Cauchy prior, r=0.707; JASP Team, 2020).

Appendix F
Experiment 2 (Visual Search Task): Participants Recruited via Prolific

Table F1

The Current Country of Residence of the Participants Recruited via Prolific (N = 80).

Current Country of Residence	Number of Participants
Australia	3
Canada	1
Estonia	2
Finland	1
Germany	2
Greece	4
Hungary	1
Italy	2
Poland	7
Portugal	7
Slovenia	1
Spain	2
United Kingdom	21
United States	25
No response	1

Note. Data obtained from participants' responses on their Prolific screener questionnaire.

Appendix G
Experiment 2 (Visual Search Task): Preregistration Form Submitted to the Open Science Framework

Title

The Effect of the Visual Search task on Attentional Bias, Body Size Adaptation, and Body Dissatisfaction.

Authors

MISS Thea House, Ian Stephen, Ian Penton-Voak, and Kevin R. Brooks

Description

The direction of attention toward people of a smaller body size is associated with higher rates of body dissatisfaction (Moussally, Brosch, & Van der Linden, 2016) and the tendency to perceive smaller bodies as “normal” sized (Stephen, Sturman, Stevenson, Mond, & Brooks, 2018). This research tests whether an attentional bias modification task—the Visual Search—can be used to alter 1) attention to high vs low fat body stimuli, 2) the body size perceived as “normal”, and 3) body dissatisfaction. The experiment will be conducted in a laboratory setting and an online non-laboratory setting to test whether experimental environment influences attentional bias modification. This research will further our understanding of the relationship between attention, body perception, and body dissatisfaction, and will inform the use of attentional bias modification tasks as potential interventions for body image disturbances.

Hypotheses

Hypothesis 1 (directional): Participants trained to attend to low (high) fat body stimuli will exhibit a greater attentional bias to low (high) fat body stimuli after the training than before.

Hypothesis 2 (directional): Participants trained to attend to low (high) fat body stimuli will perceive lower (higher) fat body stimuli as "normal" after the training than before.

Hypothesis 3 (directional): Participants trained to attend to low (high) fat body stimuli will exhibit higher (lower) body dissatisfaction after the training than before.

Hypothesis 4 (directional): Participants trained in a laboratory setting will show greater changes in attentional bias, body adaptation, and body dissatisfaction than participants trained in a non-laboratory setting.

Design Plan

Study type

Experiment - A researcher randomly assigns treatments to study subjects, this includes field or lab experiments. This is also known as an intervention experiment and includes randomized controlled trials.

Blinding

For studies that involve human subjects, they will not know the treatment group to which they have been assigned.

Is there any additional blinding in this study?

No

Study design

All participants will have their attention modified using a training version of the Visual Search. During the training Visual Search, participants will be required to search for a target stimulus amongst an array of distractor stimuli. The target stimulus and each distractor stimulus will be paired with an image of a body that is either high or low body fat. The between-participants independent variable is the body size of the stimuli that the participants are trained to attend toward. Half of the participants will be trained to attend toward high fat body stimuli using Visual Search training trials in which the target stimulus is paired with a high fat body stimulus on 100% of the trials. The other half of the participants will be trained to attend toward low fat body stimuli using Visual Search trials in which the target stimulus is paired with a low fat body stimulus on 100% of the trials. To assess the effect of the training Visual Search, participants will have their attentional bias, body size adaptation, and body dissatisfaction measured before and after completing the training Visual Search. The three dependent variables are as follows:

Primary Outcome: Change in attentional bias (ΔAB)

To measure attentional bias, all participants will complete a pre- and post-training assessment version of the Visual Search. During the pre- and post-training Visual Search trials, the target stimulus will be paired at random with both high and low fat body stimuli. Therefore, the pre- and post-training Visual Search trials are used to measure, rather than train, participants' attentional bias. Participant response times will be used to calculate a pre- and post-training attentional bias score. ΔAB will be calculated by subtracting the pre-training attentional bias score from the post-training attentional bias score.

Secondary Outcome 1. Change in point of subjective normality (ΔPSN)

To measure body size adaptation, all participants will use a method of adjustment task to indicate the body size that they perceive as most "normal"—the point of subjective normality (PSN). This task will be completed pre- and post-training. ΔPSN will be calculated by subtracting the pre-training PSN score from the post-training PSN score.

Secondary Outcome 2. Change in body dissatisfaction (ΔBD)

All participants will complete a body shape satisfaction scale pre- and post-training. ΔBD will be calculated by subtracting the pre-training body dissatisfaction score from the post-training body dissatisfaction score.

The pre-training measures will be completed in the following order by all participants: body shape satisfaction scale; PSNs; assessment Visual Search. After completing the pre-training measures, participants will complete the training Visual Search. Following the training Visual Search, all participants will complete the post-training body shape satisfaction scale. Then they will simultaneously complete the post-training Visual Search trials and post-training PSN trials in an interwoven order i.e. 1 PSN trial, then 8 Visual Search trials, then 1 PSN trial, then 8 Visual Search trials, and so on. The interwoven order of the post-training PSN and Visual Search trials will be counterbalanced so that half of participants start with 1 PSN trial (followed by 8 Visual Search trials, and so on) and half of participants start with 8 Visual Search trials (followed by 1 PSN trial, and so on). The post-training measures use this order because the post-training Visual Search will direct participants' attention towards both high and low fat body stimuli which could reduce potential body size adaptation induced by the training Visual Search. An interwoven order should minimise order effects and increase the likelihood of detecting an effect for body size adaptation.

This research also tests whether the results can be replicated outside of a laboratory setting. Therefore, the entire experiment will be conducted using the software Gorilla (https://gorilla.sc/) once in a laboratory setting and once in an online non-laboratory setting. For the laboratory setting, participants will complete the experiment in the Department of Psychology, 4 First Walk (4FW), Macquarie University. For the online non-laboratory setting, participants will be able to access the experiment via an online link and can complete the experiment in a location of their choosing. Different participants will be recruited for each experimental setting.

No files selected

Randomization

For each experiment, the body size that participants are trained to attend toward (high versus low fat) will be block randomised using Gorilla's randomisation node with a balanced 5:5 ratio.

Sampling Plan

Existing Data

Registration prior to creation of data

Explanation of existing data

N/A

Data collection procedures

We aim for recruitment and data collection to take place between November 2019 and April 2020. If data collection is slower than anticipated, then data collection will be extended until October 2020. For the laboratory experiment, self-selection sampling will be used to recruit participants who respond to advertisements on Macquarie University's SONA study signup system as well as flyers posted around the local area and social media posts to psychology groups. Opportunity and snowball sampling will be used to recruit friends of the researcher. For this experiment, participants can choose to be reimbursed with either one hour of course credit or $20 (AUD) for participation. For the online non-laboratory experiment, self-selection sampling will be used to recruit participants who respond to advertisements on Macquarie University's SONA study signup system. These participants will be reimbursed with one hour of course credit for participation. Self-selection sampling will also be used to recruit participants who respond to advertisements on Prolific (https://www.prolific.co/). These participants will be reimbursed with the recommended hourly rate offered by Prolific.

The sample will be restricted to Caucasian women aged 18-35 years. This restriction will be outlined in the experiment advertisements and will be communicated to respondents who express an interest in participating. Only participants who confirm that they meet this criteria will be able to sign up to the experiment on SONA and Prolific. At the start of each experiment, participants will be also be asked to provide their age, gender, and ethnicity, and any participants who do not identify as Caucasian women aged 18-35 years will have their data excluded from analysis.

To ensure that different participants are recruited for the experiment conducted in the laboratory setting and the experiment conducted online in a non-laboratory setting, participants recruited through the SONA study signup system will only be able to sign up to one of the experiments. Participants who respond to advertisements and express an interest in either experiment will be informed that they cannot participate in the experiment if they have previously completed the experiment in the alternate settings (laboratory; online via SONA; online via Prolific). In addition, at the start of each experiment, participants will be asked whether they have previously completed the experiment in the alternate setting. If participants confirm that they have completed the experiment previously in an alternate setting, then their data will be excluded from analysis.

No files selected

Sample size

We aim to recruit 70 participants for the experiment conducted in the laboratory setting (35 participants per condition) and 150 participants for the experiment conducted online in the non-laboratory setting (75 participants per condition). If participants are excluded from analysis, then additional participants will be recruited to meet the target sample size.

Sample size rationale

A power analysis was conducted using G*Power v3.1.9.2 to determine the required sample size for the laboratory experiment to find an effect for the primary outcome (ΔAB). This experiment is based on a similar attention modification experiment designed by Dondzilo, Rieger, Palermo, and Bell (2018) who found a medium effect size ($d = 0.49$) for ΔAB with the participants trained to attend toward thin bodies. Using this effect size, the power analysis showed that 35 participants would be required per condition to provide one sample t-tests with 80% power to detect an effect at an alpha level of 5%. Therefore, 70 participants will be recruited for the laboratory experiment (35 per condition).

This power analysis was repeated for the online experiment conducted in a non-laboratory setting. The effect size found by Dondzilo et al. (2018) was reduced by a third ($d = 0.33$) to accommodate for the additional variation that is expected to be present in the results for the online non-laboratory experiment. This power analysis showed that 75 participants would be required per condition to provide one sample t-tests with 80% power to detect an effect at an alpha level of 5%. Therefore, 150 participants will be recruited for the online non-laboratory experiment (75 per condition).

Stopping rule

Data collection will be terminated once the target sample size has been recruited or on September 30th 2020.

Variables

Manipulated variables

The manipulated variable is the size of the body stimuli that participants are trained to attend toward (high versus low fat). To create the high and low fat body stimuli, ten photographs have been obtained from previous research on female Caucasian participants who provided written consent for their photographs to be used in future research. For each identity, Psychomorph was used to create a high and low fat version based on prototypes that differed in body fat mass by 12kg (Sturman, Stephen, Mond, Stevenson, & Brooks, 2017). All body stimuli used in the current experiment will have their face covered with a black square to prevent adaptation to facial rather than body size.

Participants will have their attention trained using a training version of the Visual Search task that is based on the version designed by Talbot, Smith & Cass (2019). The task is completed on a computer and consists of 360 trials presented in 6 blocks of 60 trials with a 15 second break between each block. Each trial starts with a fixation cross presented for 1000ms in the centre of the screen. The fixation cross then disappears, and eight body stimuli (four high fat and four low fat) appear on the screen with their centres equidistant from the fixation cross location. Each body stimulus is paired with a short oblique bar that is located immediately adjacent to the body stimulus. The centre of each bar is located equidistant from the fixation cross location. For each trial, one “target” bar will be present and randomly orientated at either a horizontal or vertical angle. The remaining 7 “distractor” bars will be randomly oriented at either 80°, 100°, 170°, or 190°. For each trial, participants are required to detect whether there is a horizontal or vertical bar present. Participants are instructed to respond as fast as possible by pressing the appropriate keys (“p” for vertical or “q” for horizontal) on the computer keyboard. For participants trained to attend to high (low) fat body stimuli, the target bar will be paired with a high (low) fat body stimulus at random on 100% of the trials. The 7 distractor bars will be paired at random with the remaining 7 body stimuli.

No files selected

Measured variables

Change in attentional bias (ΔAB):

To measure attentional bias, all participants will complete a pre- and post-training assessment version of the Visual Search. The pre- and post-training Visual Search trials are identical to the training Visual Search; however, for each trial the target bar will be paired at random with each body stimulus. Therefore, the target bar has an equal probability of being paired with either a high or low fat body stimulus. The body stimuli for the pre- and post-training Visual Search trials will be a different set of ten identities to those used for the training Visual Search; however, the stimuli will be obtained using the same approach. Participants will complete 80 trials for both the pre- and post-training Visual Search. Participant response times will be used to calculate a pre- and post-training attentional bias score (see section titled 'Indices'). ΔAB will be calculated by subtracting the pre-training Visual Search attentional bias score from the post-training Visual Search attentional bias score; therefore, a positive (negative) ΔAB means that participants directed more attention toward low (high) fat body stimuli after the training than before.

Change in point of subjective normality (ΔPSN):

To measure body size adaptation, participants' PSNs will be obtained with a version of the method of adjustment used by Stephen, Bickersteth, Mond, Stevenson, and Brooks (2016). During the task, participants will be presented with ten body stimuli one at a time in a random order. The ten body stimuli be the same identities as those used for the pre- and post-training Visual Search trials and therefore will be different identities to those used for the training Visual Search. From each identity's original photograph, a further 12 images have been made using Psychomorph to vary the body fat mass ±6 equidistant increments from the original photograph up to and including the high and low fat versions used for the pre- and post-training Visual Search (Sturman, Stephen, Mond, Stevenson, & Brooks, 2017). Participants will initially be presented at random with one of the thirteen versions of a single identity. Participants will then be able to cycle through the 13 versions of the identity by pressing ‘p’ on the keyboard to move to the next largest version of the body and pressing ‘q’ on the keyboard to move to the next smallest version of the body. Once participants reach the largest body size, pressing ‘p’ will move them to the smallest version of the body. Likewise, once participants reach the smallest body size, pressing ‘q’ will move them to the largest version of the body. Therefore, participants will be able to manipulate the person’s body size by continually cycling through the thirteen versions of the identity. Participants will be instructed to click the mouse to select the version of the body that they think looks the most “normal”. Clicking the mouse will move the participant onto the next identity, and the participant will be able to repeat the process until they have selected a “normal” body size for each of the 10 identities. The mean fat mass chosen as “normal” for the 10 identities will be calculated to produce each participant’s PSN score. This task will be completed pre- and post-training. ΔPSN will be calculated by subtracting the pre-training PSN score from the post-training PSN score. A positive (negative) ΔPSN means that the body size participants perceived to be “normal” was higher (lower) after the training than before.

Change in body dissatisfaction (ΔBD):

Body dissatisfaction will be measured using a modified version of the body shape satisfaction scale originally designed by Pingitore, Spring, and Garfieldt (1997). The scale requires participants to rate their satisfaction with eighteen parts or features of their body. Participants are asked to respond based on their feelings “at this moment” to increase the likelihood of detecting changes in state body dissatisfaction caused by the Visual Search (Thompson, 2004). Participants’ responses will be measured using a slider scale rather than a Likert scale to minimise the likelihood that participants will remember and reproduce their pre-training responses when completing the post-training scale. Response options for each of the eighteen items will range from 0-100 (100 as “Very dissatisfied” and 0 as “Very satisfied”). A body dissatisfaction score will be calculated by summating the responses for all eighteen items; therefore, a higher score will indicate greater body dissatisfaction. All participants will complete the body shape satisfaction scale pre- and post-training. ΔBD will be calculated by subtracting the pre-training body dissatisfaction score from the post-training body dissatisfaction score. A positive (negative) ΔBD means that participants’ body dissatisfaction has increased (decreased).

Additional measures

At the start of the experiment, participants will provide their age and have their BMI (kg/m²) calculated. Participants completing the experiment in the laboratory setting will have their BMI measured using a Tanita SC-330 body composition analyser. Participants completing the experiment in a non-laboratory setting will be asked to self-report their height and weight for their BMI to be calculated. Any analysis conducted with these data will be exploratory rather than confirmatory.

No files selected

Indices

Change in attentional bias (ΔAB):

To calculate the pre-and post-training attentional bias scores, mean response times will be calculated on trials where participants responded correctly. Mean response times when the target bar is paired with a low fat body stimulus will be subtracted from the mean response times when the target bar is paired with a high fat body stimulus. Therefore, a positive attentional bias score represents an attentional bias to low fat body stimuli and a negative attentional bias score represents an attentional bias to high fat body stimuli. ΔAB will be calculated by subtracting the pre-training Visual Search attentional bias score from the post-training Visual Search attentional bias score

Change in point of subjective normality (ΔPSN):

The pre- and post-training PSN scores will be calculated by averaging the fat mass chosen as “normal” for the 10 identities. ΔPSN will be calculated by subtracting the pre-training PSN score from the post-training PSN score.

Change in body dissatisfaction (ΔBD):

To calculate a body dissatisfaction score, participant responses for all eighteen items on the body shape satisfaction scale will be summated; therefore, a higher score will indicate greater body dissatisfaction. ΔBD will be calculated by subtracting the pre-training body dissatisfaction score from the post-training body dissatisfaction score.

No files selected

Analysis Plan

Statistical models

Data collected from the laboratory and online non-laboratory experiment will be analysed separately using the following data analysis plan.

To test Hypotheses 1-3, one-sample t-tests for each condition (high fat and low fat conditions) and for each DV (ΔAB, ΔPSN, and ΔBD) will be conducted against a value of zero to analyse the effect of the training Visual Search on ΔAB, ΔPSN, and ΔBD. Hypothesis 1 will be supported if participants trained to attend to low (high) fat body stimuli demonstrate a significantly positive (negative) ΔAB. Hypothesis 2 will be supported if participants trained to attend to low (high) fat body stimuli demonstrate a significantly negative (positive) ΔPSN.

Hypothesis 3 will be supported if participants trained to attend to low (high) fat body stimuli demonstrate a significantly positive (negative) ΔBD.

To compare the results for the data collected in the laboratory and online non-laboratory setting, bootstrap resampling will be used with 2000 samples to compute 95% confidence intervals for each effect size. Hypothesis 4 will be supported if participants trained in a laboratory setting demonstrate greater effect sizes for ΔAB, ΔPSN, ΔBD with non-overlapping confidence intervals when compared to participants trained in a non-laboratory setting.

No files selected

Transformations

N/A

Inference criteria

A standard $p<.05$ criterion will be used to interpret the results of the one sample t-tests and the Holm-Bonferroni method will be used to adjust for multiple comparisons (Holm, 1979).

Data exclusion

Participants will be excluded from the analysis if they terminate the experiment before completion, take longer than 90 minutes to complete the experiment, or if their response accuracy is less than 60% on the pre-and post-training Visual Search trials. At the start of each experiment, participants will be asked whether they have previously completed the experiment in the alternate setting (laboratory; online via SONA; online via Prolific). If participants confirm that they have completed the experiment previously in an alternate setting, then their data will be excluded from analysis. Individual pre- and post-training Visual Search trials in which the participant responded incorrectly will be excluded from analysis. Individual pre- and post-training Visual Search trials will also be excluded from analysis if the participant's reaction time is less than 200ms or more than 2.5 standard deviations above the participant's mean reaction time.

Missing data

Casewise deletion will be used to handle missing data.

Exploratory analysis

N/A

Other

References

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Appendix H

Experiment 1 (Visual Search Task): Pre-training Descriptive Statistics

Table H

Descriptive Statistics for Age, BMI, Pre-training Attentional Bias Score, Pre-training PSN score, and Pre-training Body Dissatisfaction Score for Each Condition and Experiment Setting.

			Age (years)			BMI (kg/m²)			Pre-training Attentional Bias Score			Pre-training PSN score			Pre-training Body Dissatisfaction Score		
Experiment	Condition	*N*	*M*	*SD*	95% CI	*M*	*SD*	95% CI	*M*	*SD*	95% CI	*M*	*SD*	95% CI	*M*	*SD*	95% CI
Online	High Fat	75	23.89	4.71	[22.81, 24.98]	24.48	7.21	[22.82, 26.14]	52.31	188.13	[9.03, 95.59]	11.34	4.05	[10.41, 12.27]	924.75	317.43	[851.71, 997.78]
	Low Fat	75	23.59	4.84	[22.47, 24.70]	25.61	10.73	[23.14, 28.07]	-38.85	302.79	[-108.52, 30.81]	11.37	3.50	[10.57, 12.18]	909.75	280.69	[845.17, 974.33]
Laboratory	High Fat	30	21.1	3.58	[19.77, 22.44]	22.86	4.74	[21.10, 24.63]	-18.12	182.22	[-86.15, 49.93]	12.18	3.17	[11.00, 13.36]	737.43	208.06	[659.74, 815.12]
	Low Fat	30	21.00	3.72	[19.61, 21.39]	24.24	7.00	[21.63, 26.85]	37.15	219.80	[-44.93, 119.22]	11.01	4.86	[9.20, 12.83]	815.53	381.50	[673.08, 957.99]

Note. CI refers to confidence intervals.

Appendix I
Experiment 1 (Visual Search Task): Histograms and Normal Q-Q Plots for Each Condition and Experiment Setting

Figure I1

Histogram for ΔAB for the High Fat Condition in the Online Setting

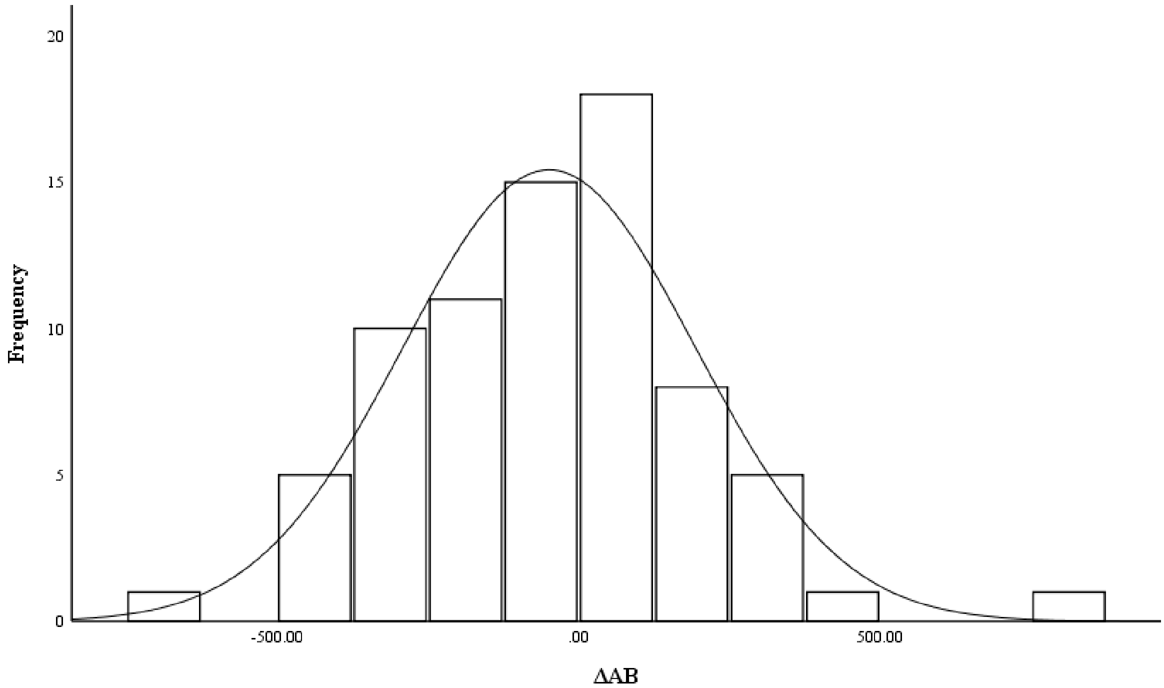


Figure I2

Normal Q-Q Plot for ΔAB for the High Fat Condition in the Online Setting

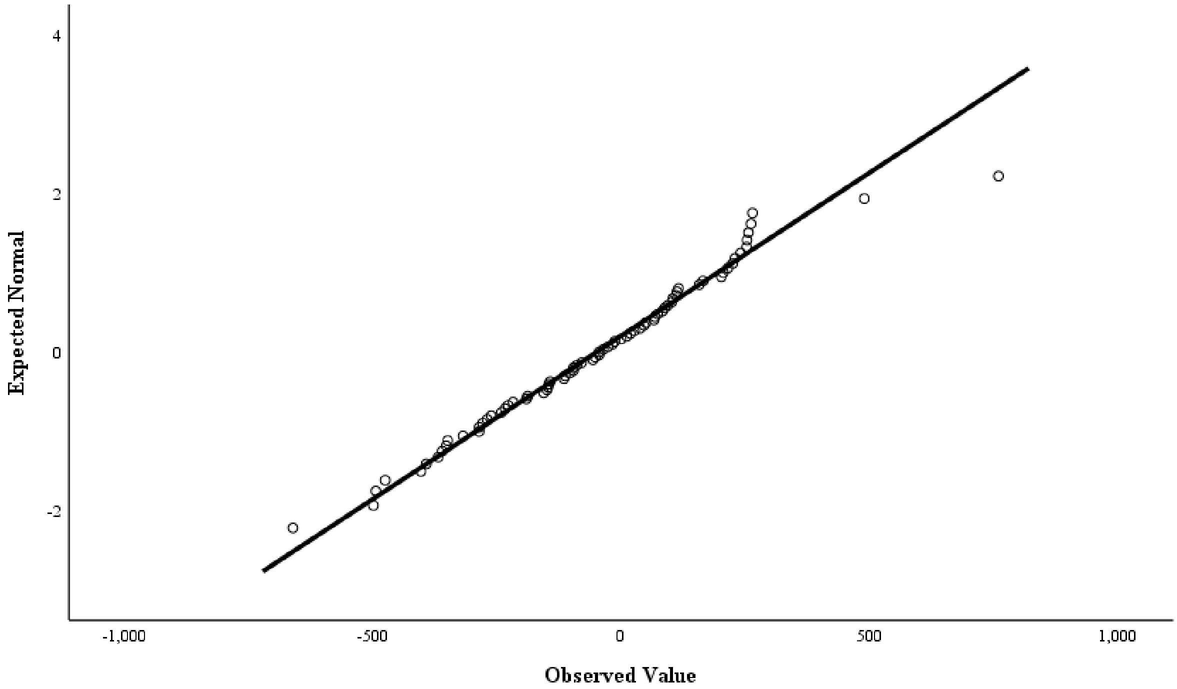


Figure I3

Histogram for ΔAB for the Low Fat Condition in the Online Setting

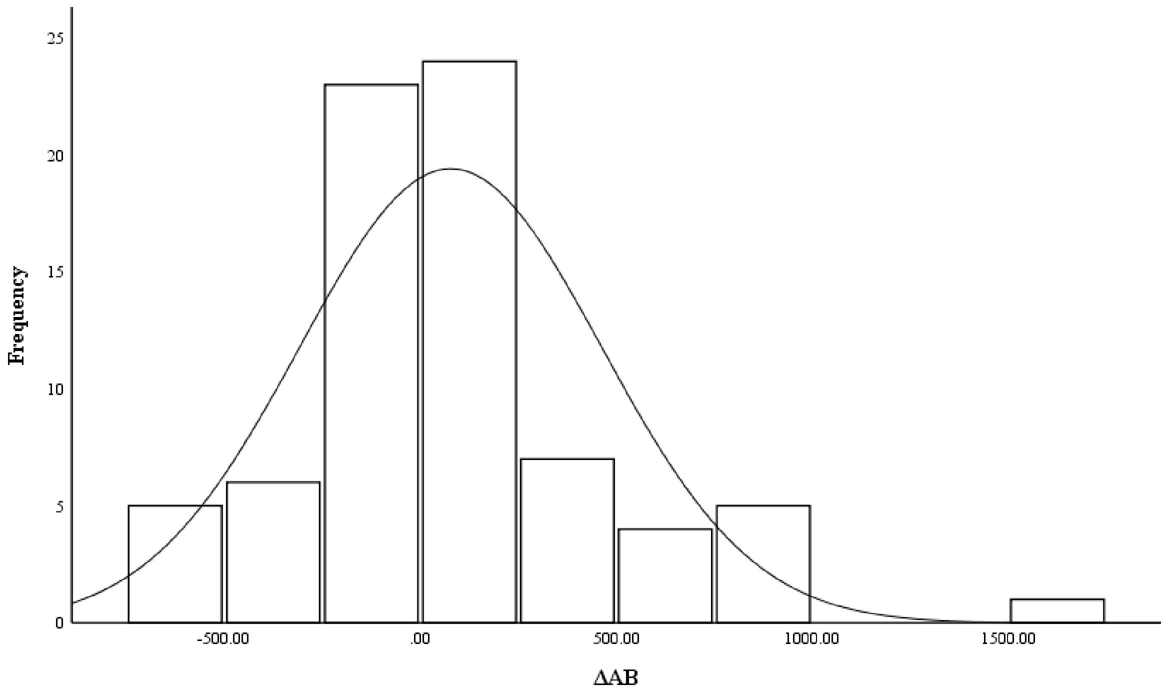


Figure I4

Normal Q-Q Plot for ΔAB for the Low Fat Condition in the Online Setting

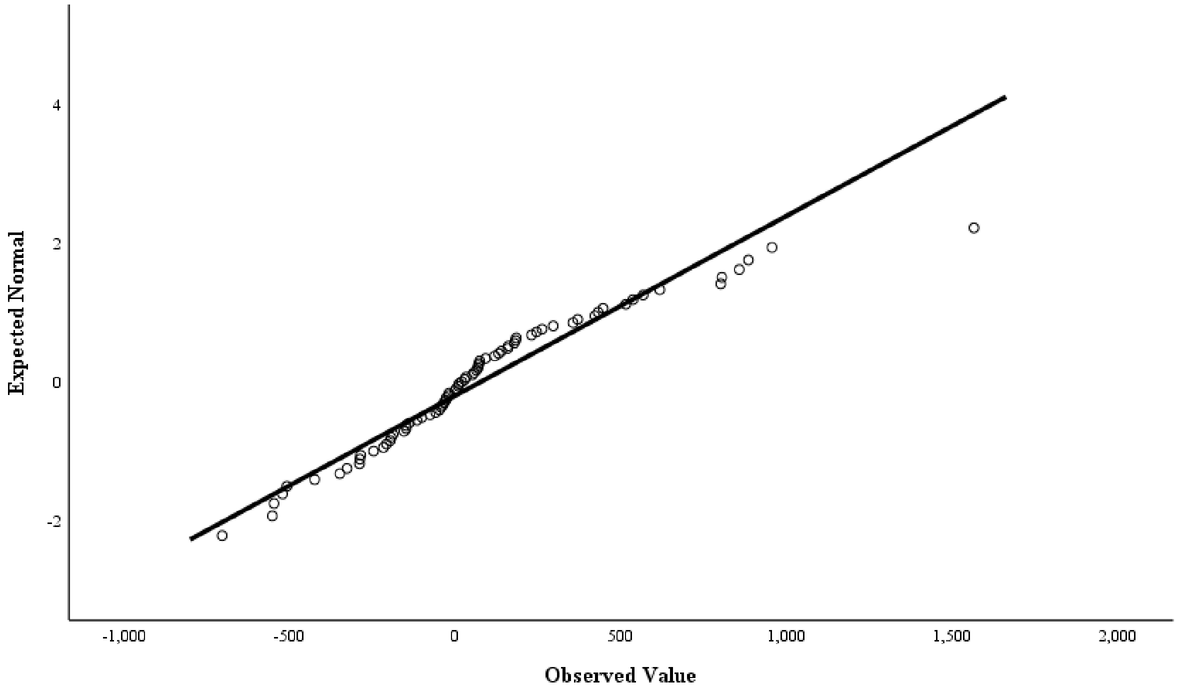


Figure I5

Histogram for ΔAB for the High Fat Condition in the Laboratory Setting

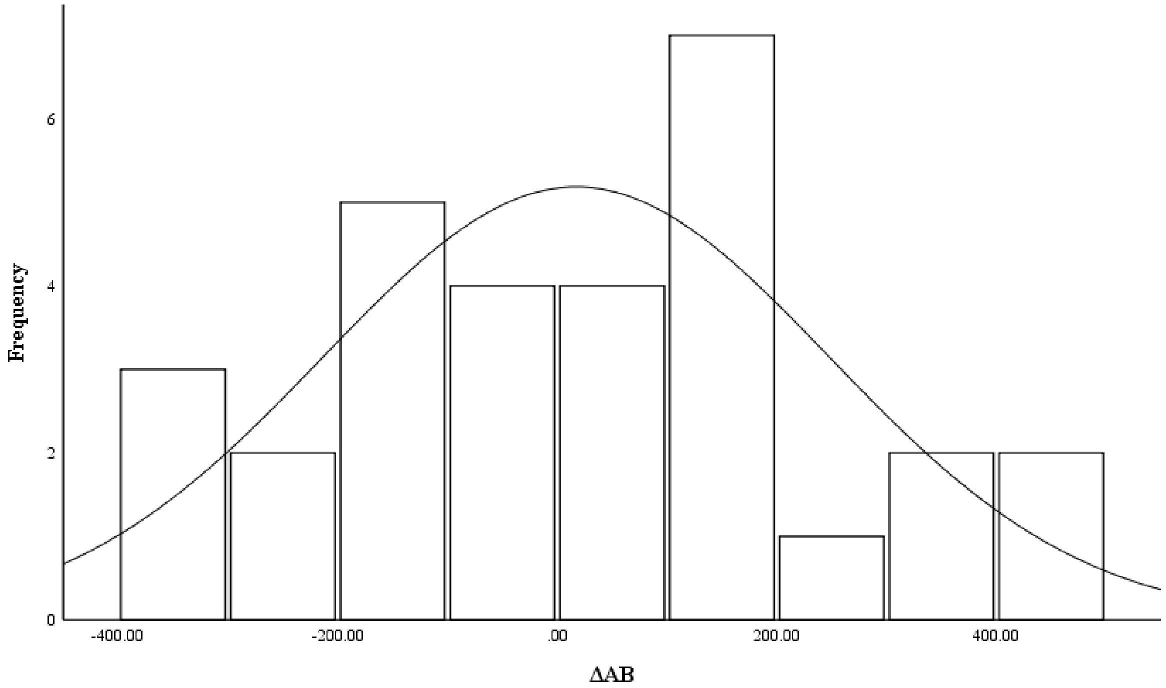


Figure I6

Normal Q-Q Plot for ΔAB for the High Fat Condition in the Laboratory Setting

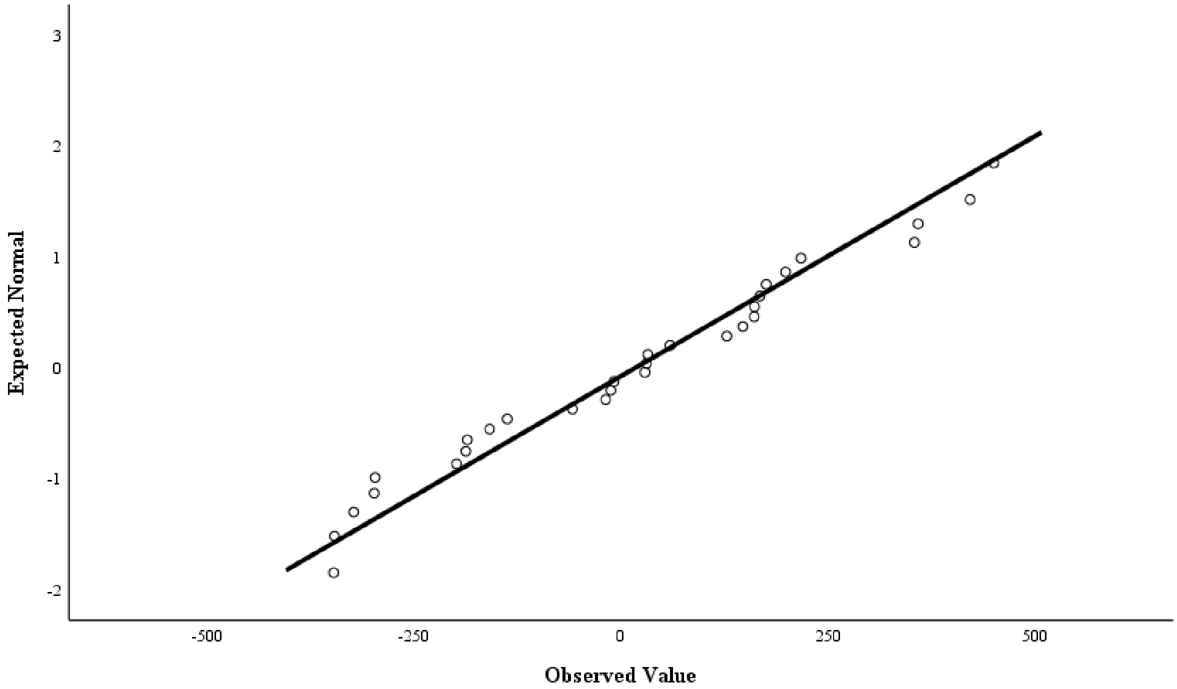


Figure I7

Histogram for ΔAB for the Low Fat Condition in the Laboratory Setting

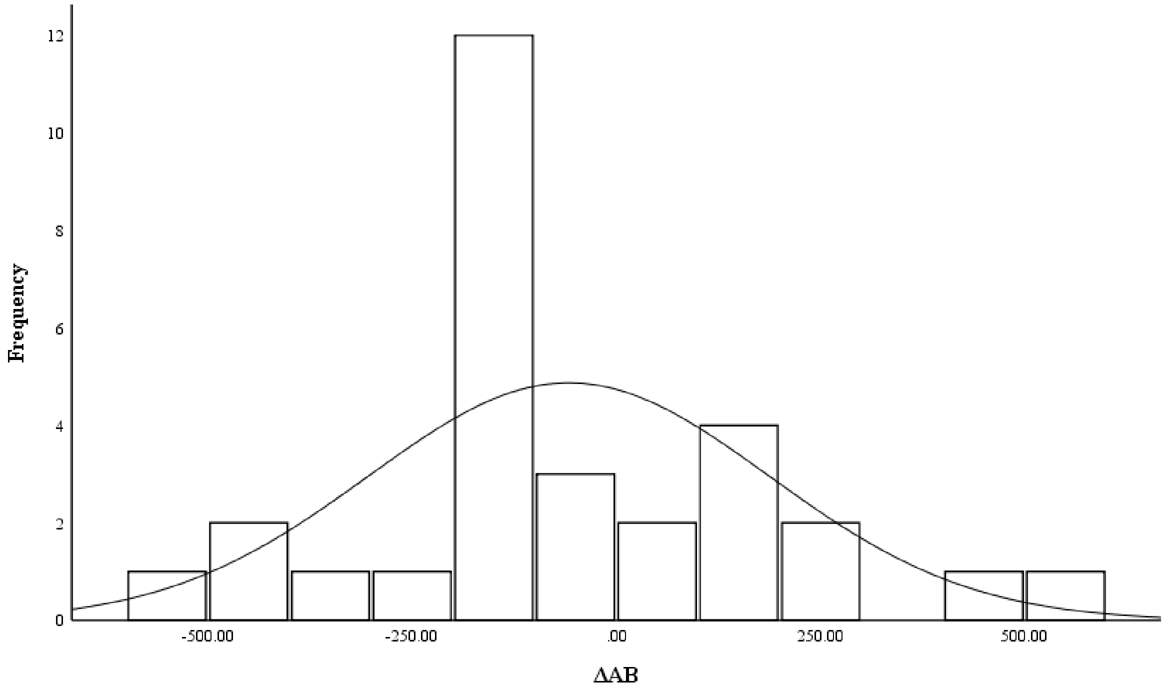


Figure I8

Normal Q-Q Plot for ΔAB for the Low Fat Condition in the Laboratory Setting

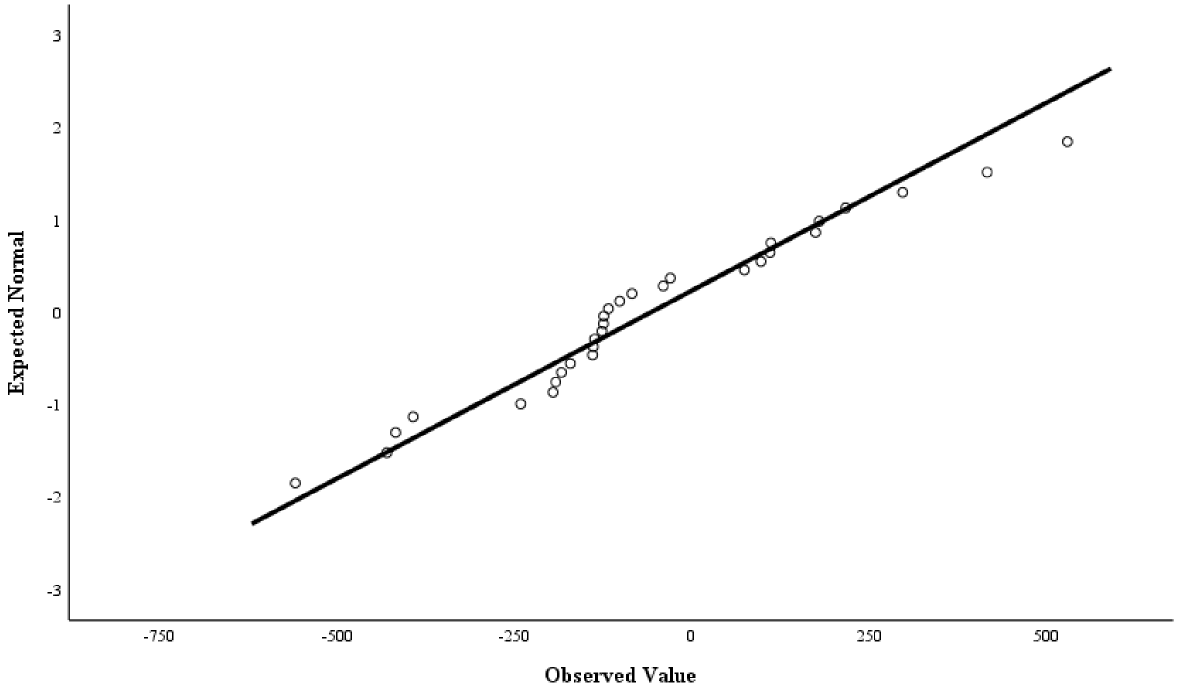


Figure I9

Histogram for ΔPSN for the High Fat Condition in the Online Setting

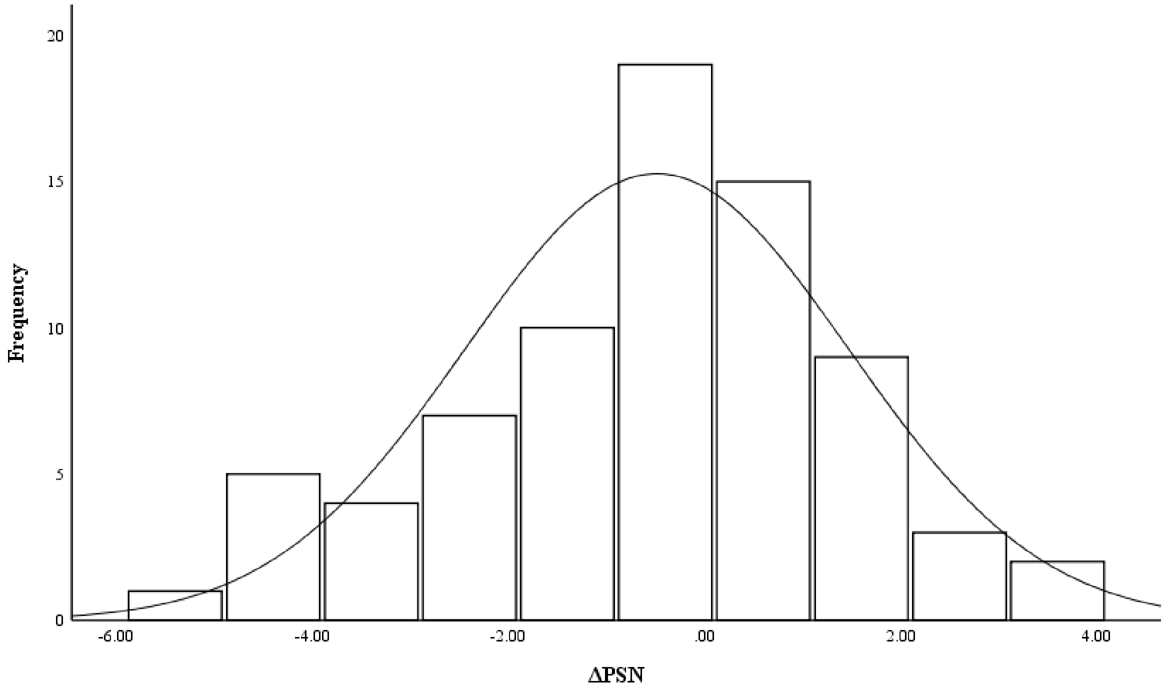


Figure I10

Normal Q-Q Plot for ΔPSN for the High Fat Condition in the Online Setting

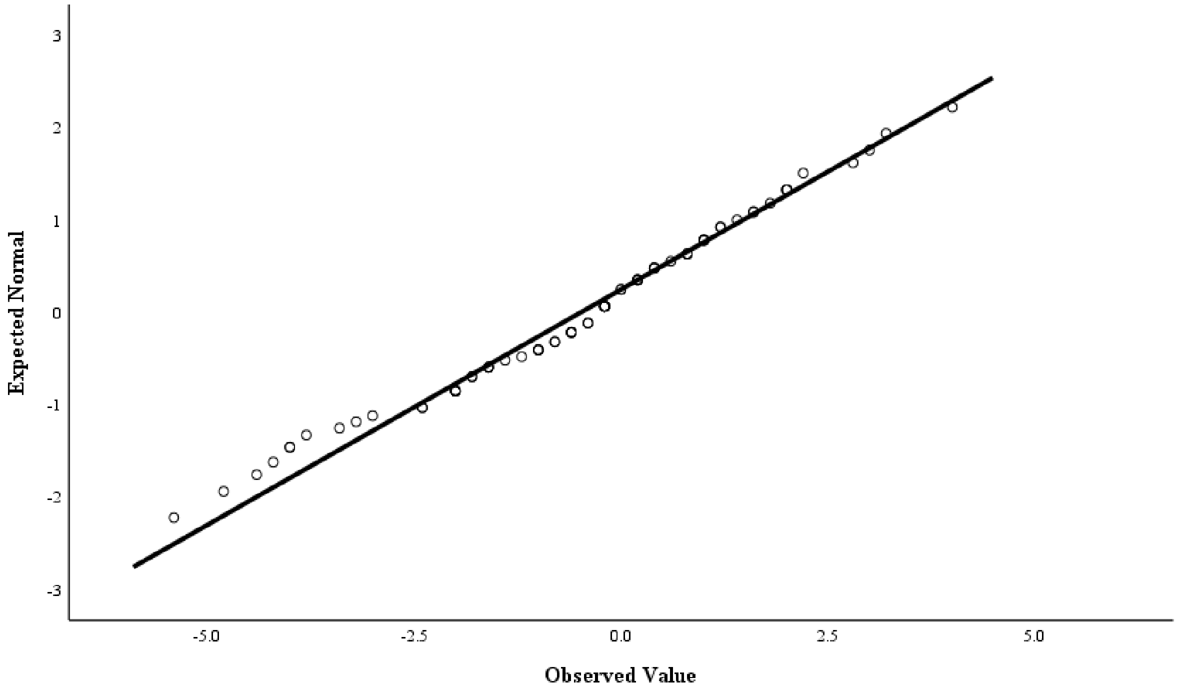


Figure I11

Histogram for ΔPSN for the Low Fat Condition in the Online Setting

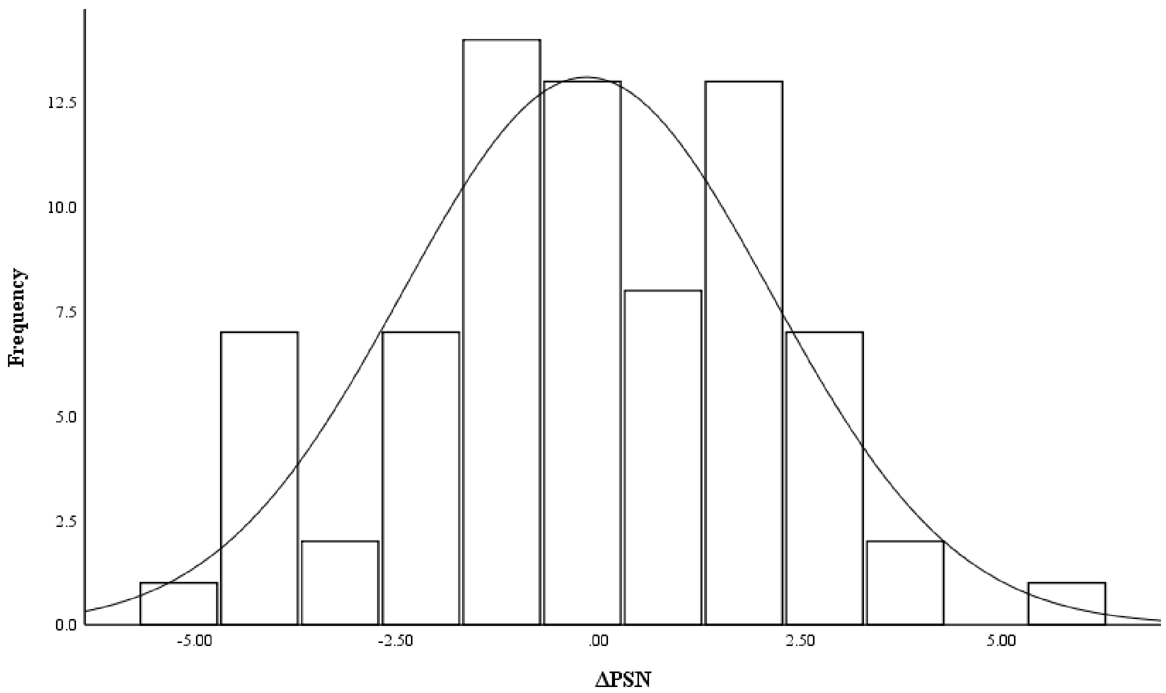


Figure I12

Normal Q-Q Plot for ΔPSN for the Low Fat Condition in the Online Setting

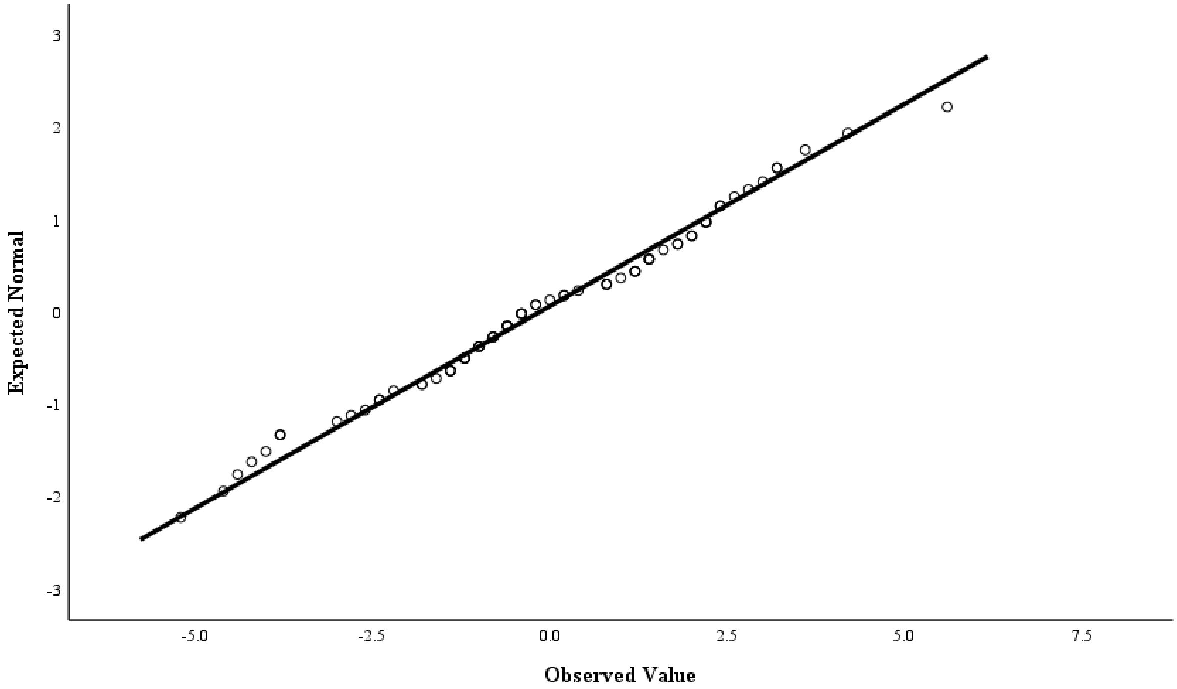


Figure I13

Histogram for ΔPSN for the High Fat Condition in the Laboratory Setting

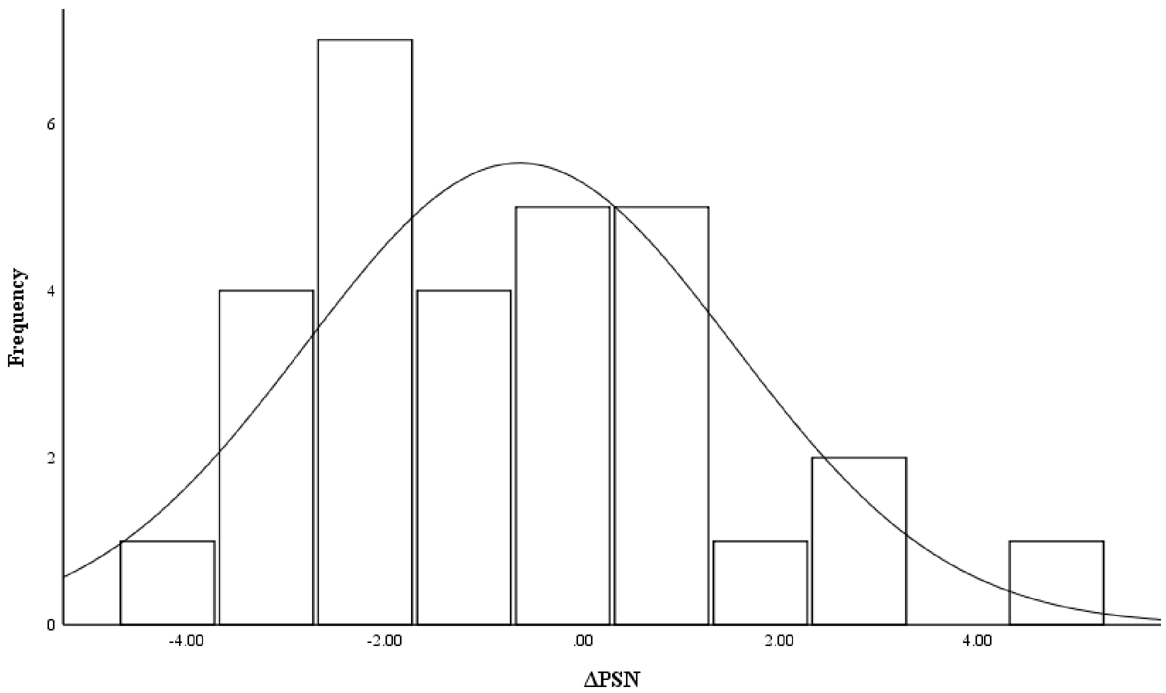


Figure I14

Normal Q-Q Plot for ΔPSN for the High Fat Condition in the Laboratory Setting

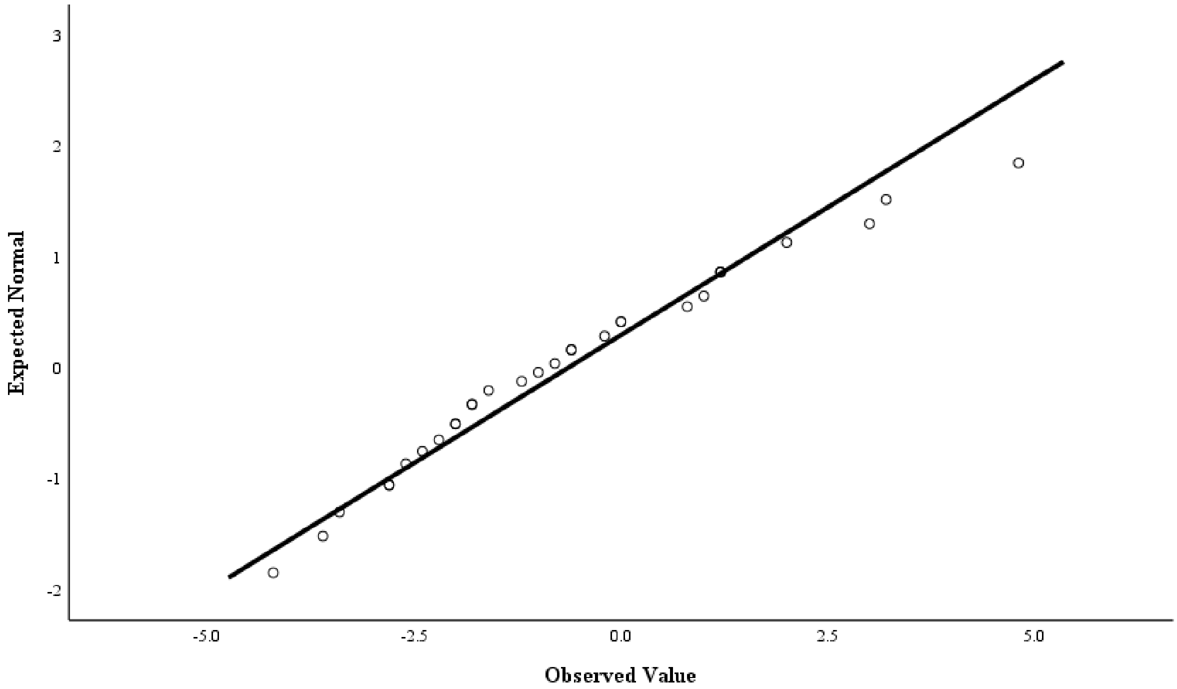


Figure I15

Histogram for ΔPSN for the Low Fat Condition in the Laboratory Setting

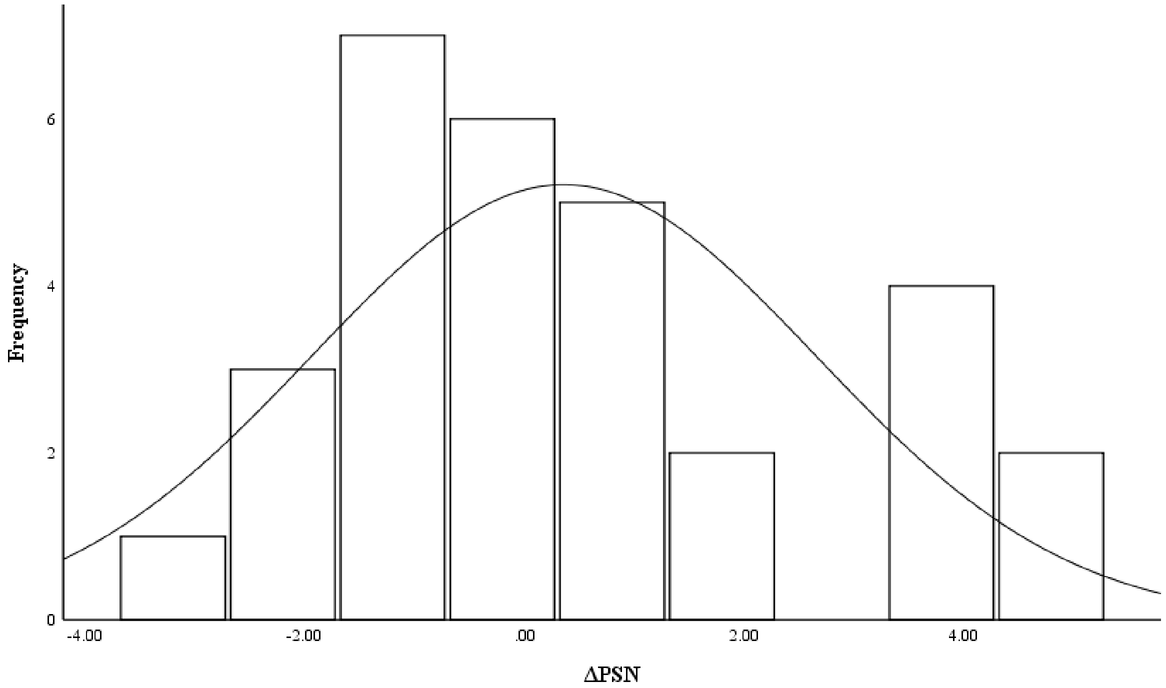


Figure I16

Normal Q-Q Plot for ΔPSN for the Low Fat Condition in the Laboratory Setting

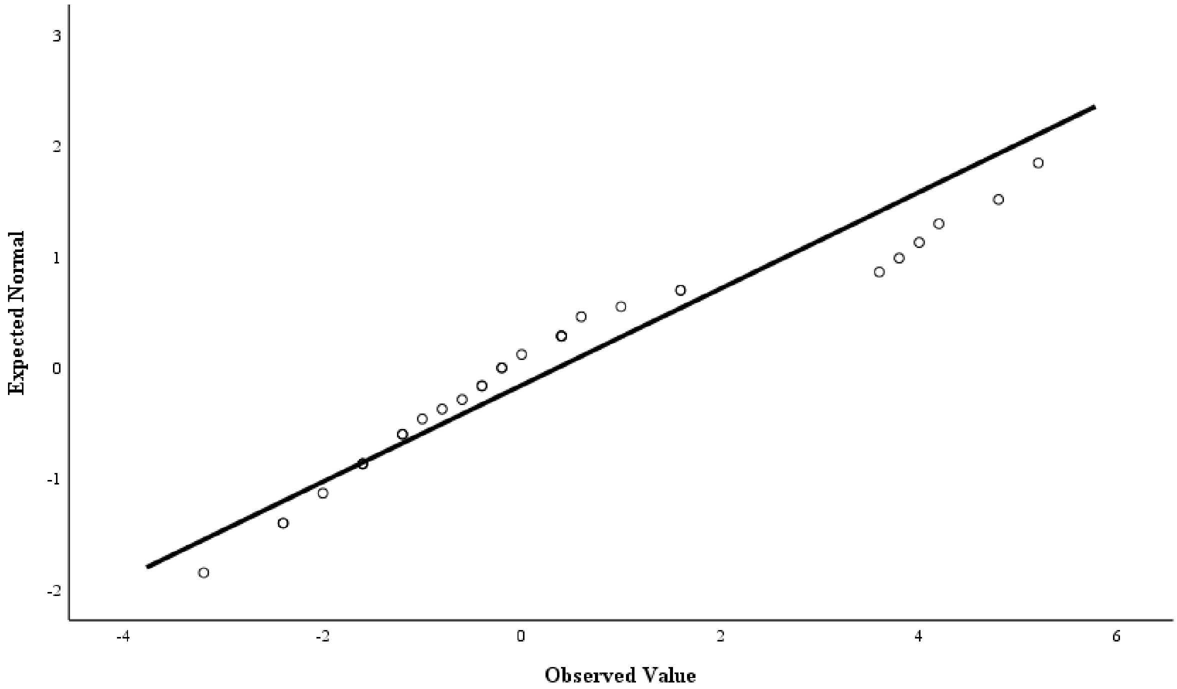


Figure I17

Histogram for ΔBD for the High Fat Condition in the Online Setting

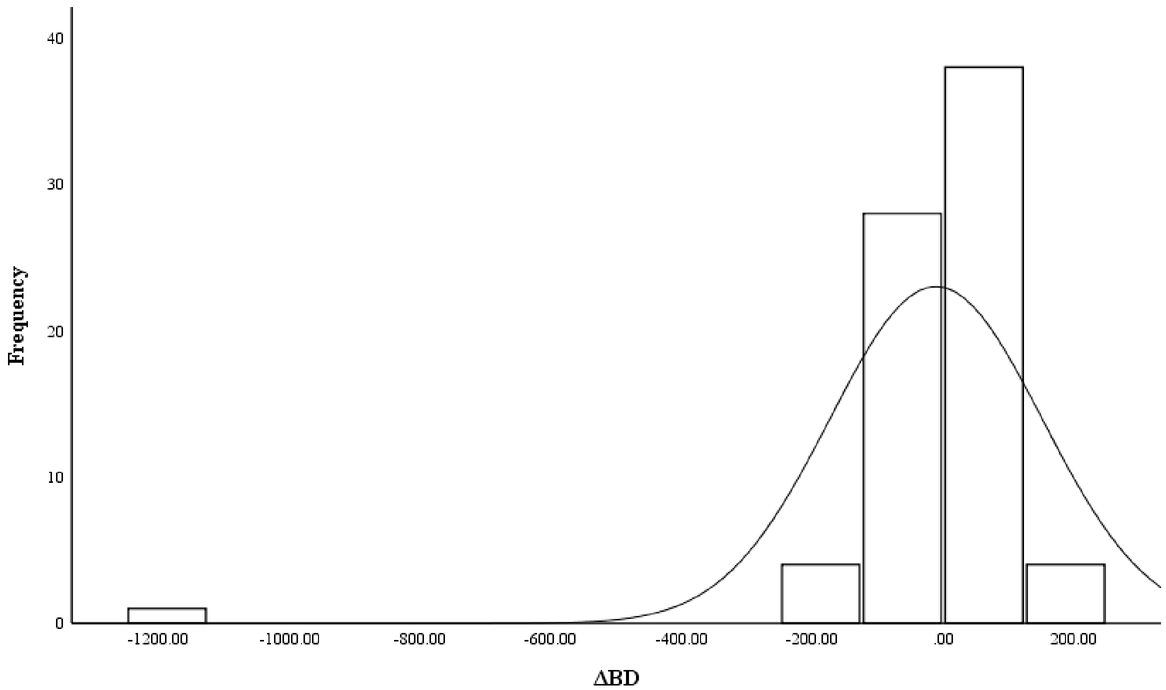


Figure I18

Normal Q-Q Plot for ΔBD for the High Fat Condition in the Online Setting

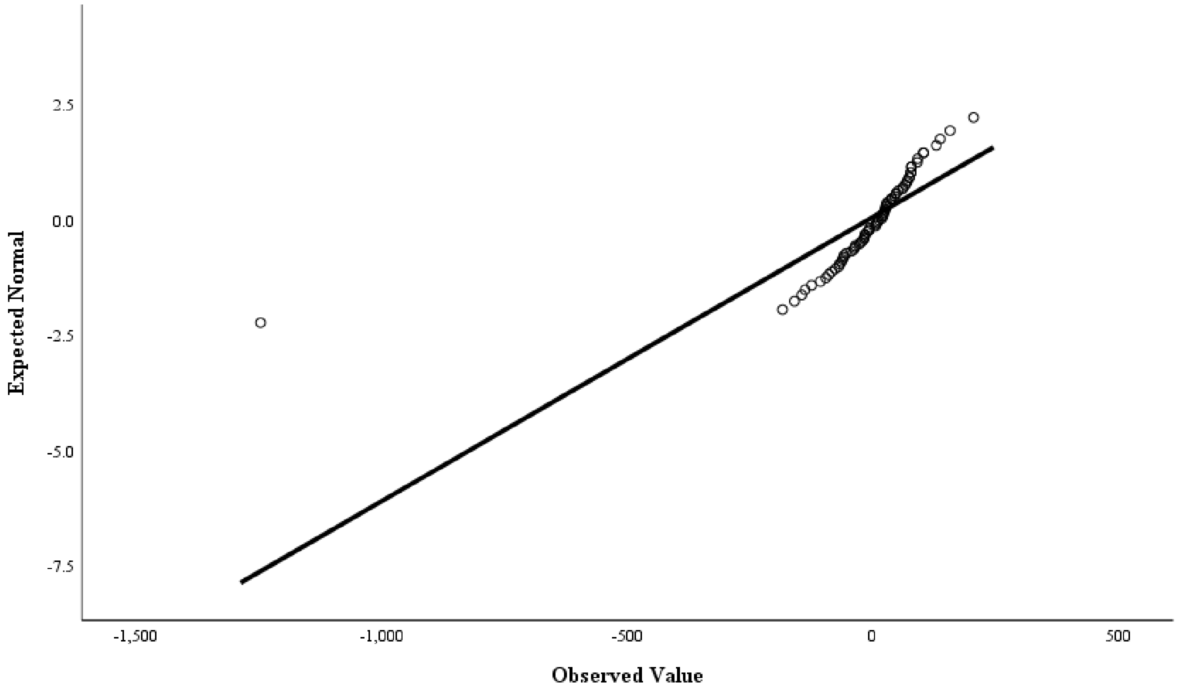


Figure I19

Histogram for ΔBD for the Low Fat Condition in the Online Setting

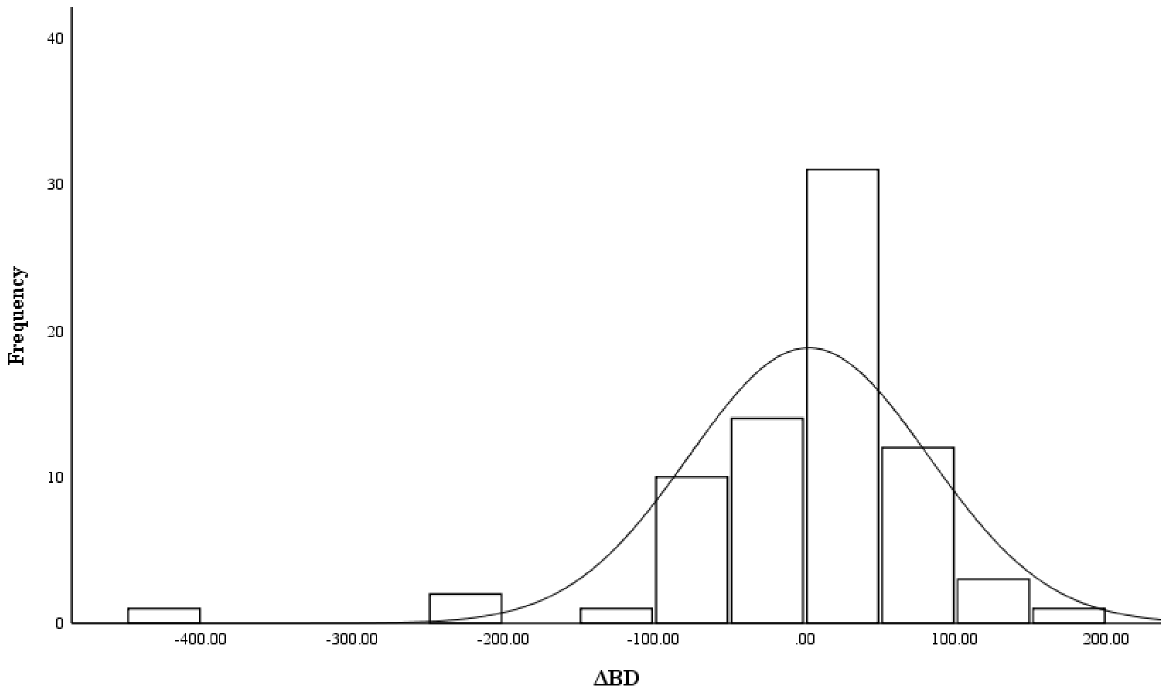


Figure I20

Normal Q-Q Plot for ΔBD for the Low Fat Condition in the Online Setting

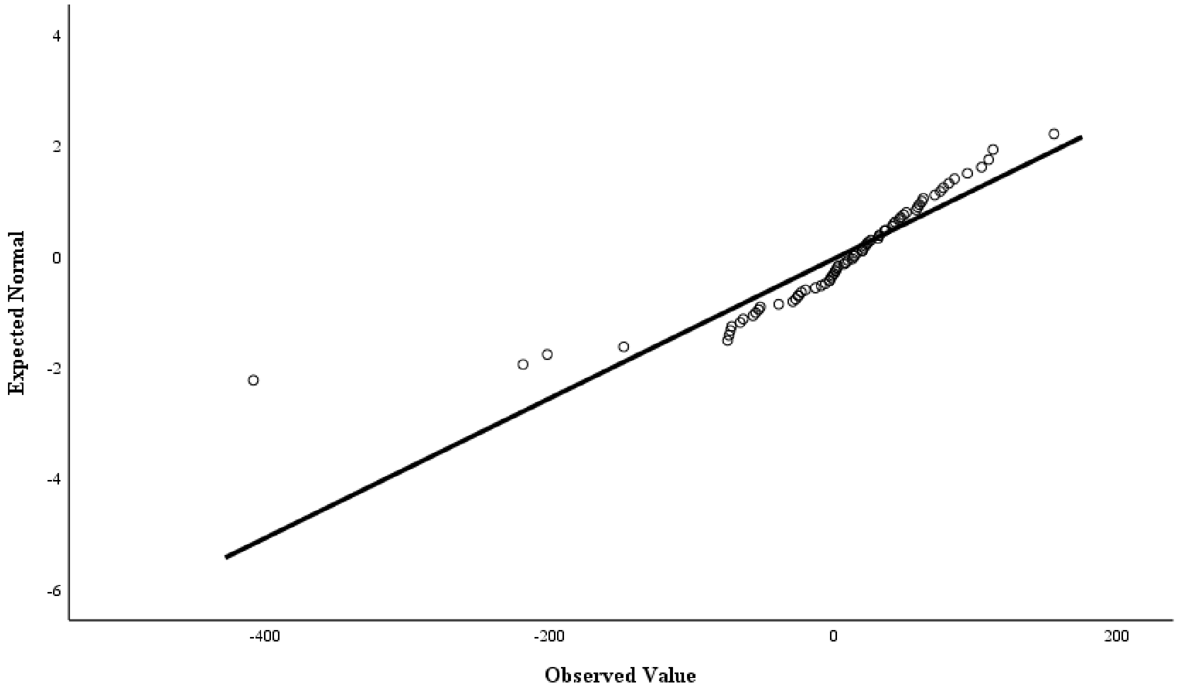


Figure I21

Histogram for ΔBD for the High Fat Condition in the Laboratory Setting

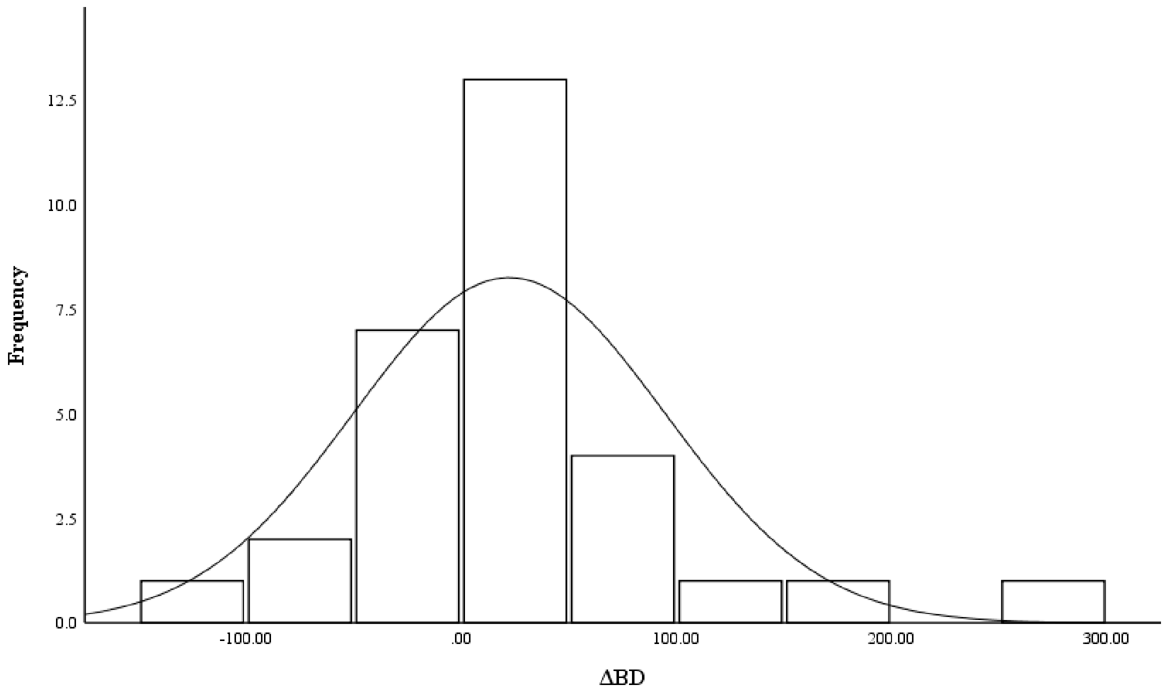


Figure I22

Normal Q-Q Plot for ΔBD for the High Fat Condition in the Laboratory Setting

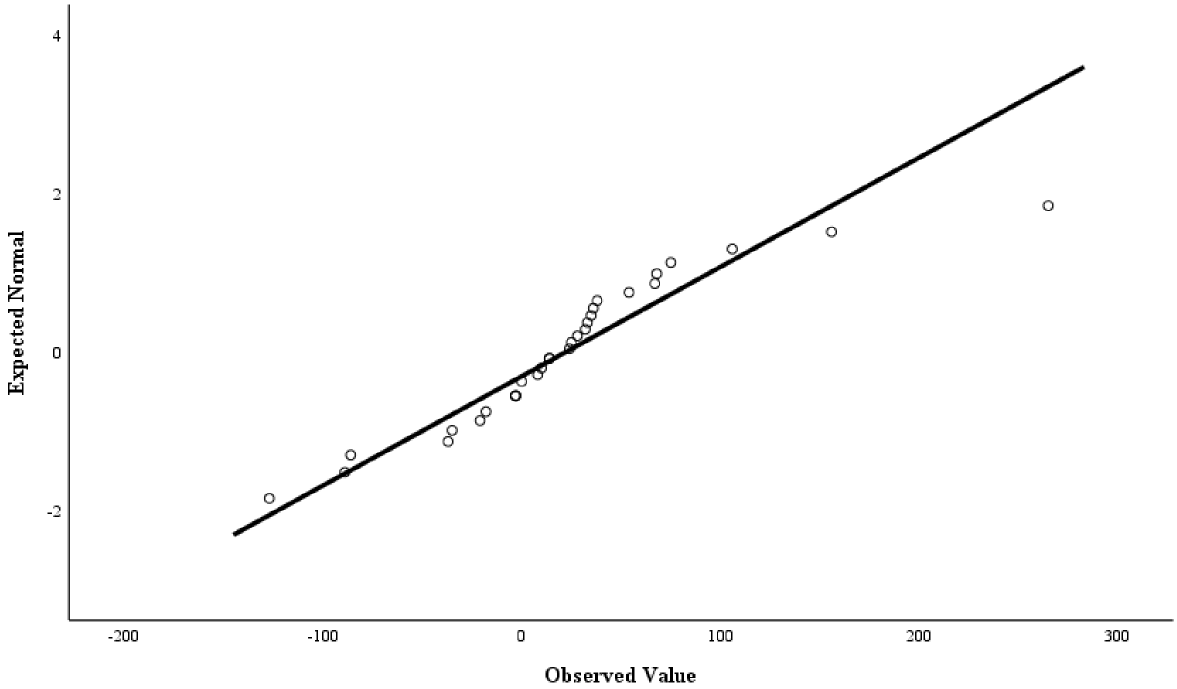


Figure I23

Histogram for ΔBD for the Low Fat Condition in the Laboratory Setting

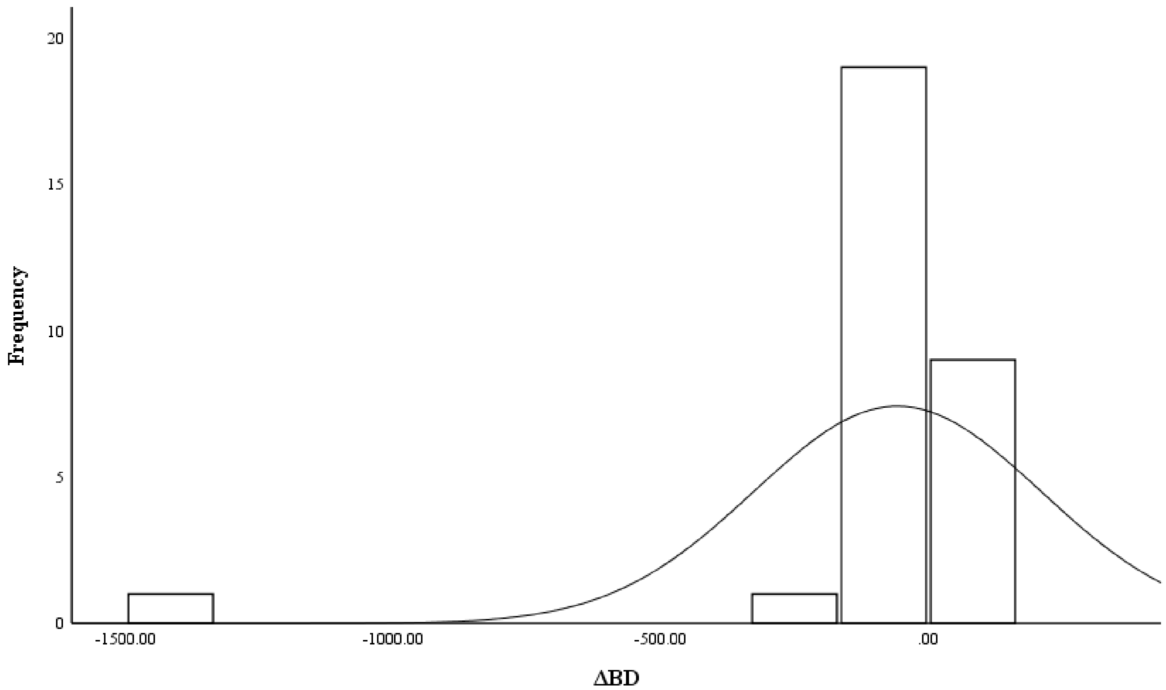
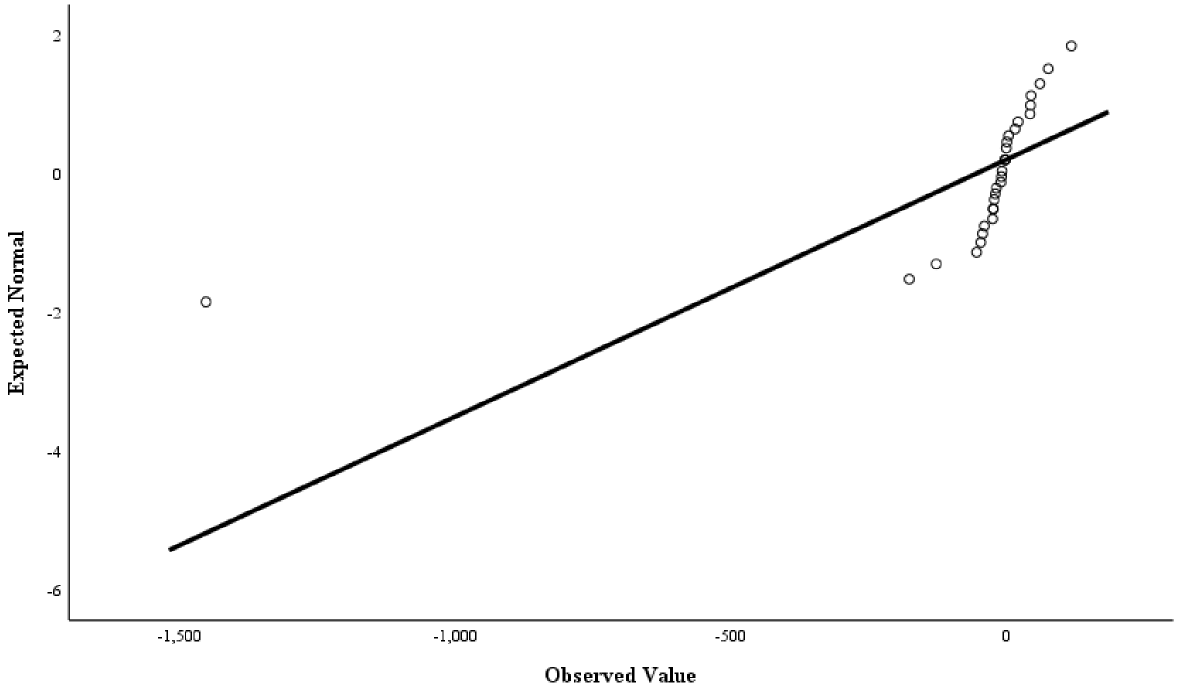


Figure I24

Normal Q-Q Plot for ΔBD for the Low Fat Condition in the Laboratory Setting



Appendix J

Experiment 1 (Visual Search Task): Results of the Preregistered Analyses Rerun with the Online and Laboratory Data Combined.

Table J1

Results of the Bootstrapped One Sample T-tests Comparing ΔAB, ΔPSN, and ΔBD Against a Value of 0 for Each Condition.

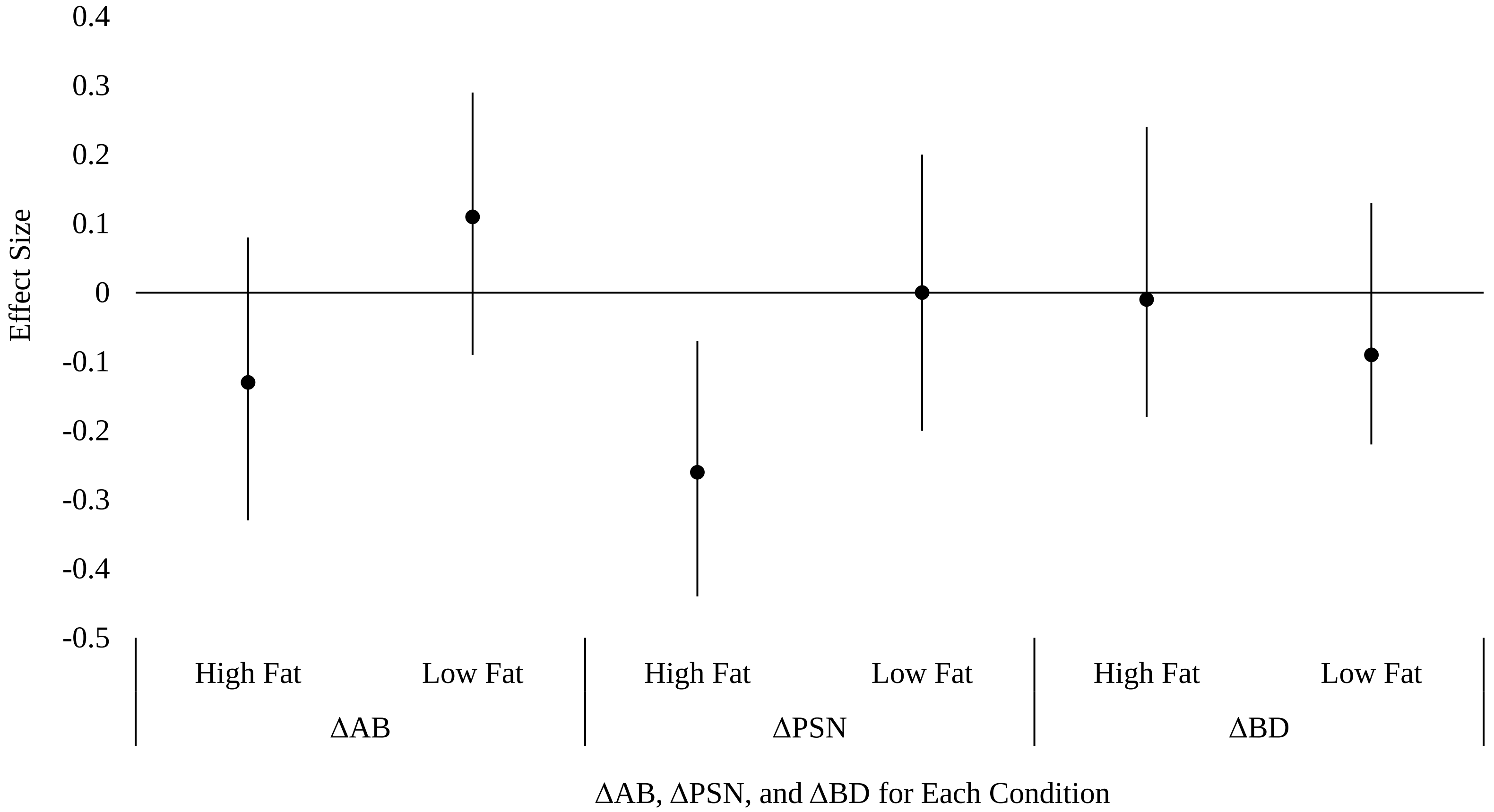
			ΔAB				ΔPSN				ΔBD			
Condition	*N*	df	*M* [95% CI]	*SD*	*t*	*p*	*M* [95% CI]	*SD*	*t*	*p*	*M* [95% CI]	*SD*	*t*	*p*
High Fat	105	104	-30.07 [-73.56, 14.39]	240.04	-1.28	.194	-0.53 [-0.90, -0.14]	2.01	-2.71	.009	-1.52 [-49.68, 16.27]	143.14	-0.11	.790
Low Fat	105	104	38.46 [-25.22, 114.70]	355.40	1.11	.258	-0.00 [-0.43, 0.44]	2.29	-0.02	.969	-14.71 [-64.93, 4.08]	159.43	-0.95	.173

Note. To correct for multiple comparisons, a Holm–Bonferroni criterion was applied, requiring the smallest *p*-value to be less than .008 to be statistically significant (Holm, 1979). No *p*-values were smaller than their Holm Bonferroni criterion and therefore all results were not statistically significant.

Note. CI refers to confidence intervals.

Figure J1

Effect Sizes with their 95% Confidence Intervals for ΔAB, ΔPSN, and ΔBD for Each Condition.



Note. Effect sizes are reported as Cohen's *d* and 95% confidence intervals were estimated using the R package bootES and bootstrap resampling with 2000 samples (Kirby & Gerlanc, 2013).

Table J2

Bayes Factors for the 6 One Sample T-tests Comparing ΔAB, ΔPSN, and ΔBD Against a Value of 0 for Each Condition.

Condition	ΔAB	ΔPSN	ΔBD
High Fat	0.24	3.42	0.11
Low Fat	0.20	1.11	0.17

Note. Bayes factors were calculated using JASP version 0.11.1.0 and the JASP default prior (Cauchy prior, r=0.707; JASP Team, 2020).

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MACQUARIE University SYDNEY·AUSTRALIA

21/10/2019

Dear Dr Ian Stephen,

Reference No:52019573210821

Title: 5732 Dot probe and body adaptation

Thank you for submitting the above application for ethical and scientific review. Macquarie University Human Research Ethics Committee HREC Humanities & Social Sciences Committee considered your application.

I am pleased to advise that ethical and scientific approval has been granted for this project to be conducted by Dr Ian Stephen and other personnel: Dorothea House, Associate Professor Kevin Brooks, Mr Jordan Rogers**.**

Approval Date: 21/10/2019

This research meets the requirements set out in the *National Statement on Ethical Conduct in Human Research* (2007, updated July 2018) (the *National Statement*).

Standard Conditions of Approval:

1. Continuing compliance with the requirements of the *National Statement,* which is available at the following website: http://www.nhmrc.gov.au/book/national-statement-ethical-conduct-human-research

2. This approval is valid for five (5) years, subject to the submission of annual reports. Please submit your reports on the anniversary of the approval for this protocol.

3. All significant safety issues, that adversely affect the safety of participants or materially impact on the continued ethical and scientific acceptability of the project, must be reported to the HREC within 72 hours.

4. Proposed changes to the protocol and associated documents must be submitted to the Committee for approval before implementation.

It is the responsibility of the Chief investigator to retain a copy of all documentation related to this project and to forward a copy of this approval letter to all personnel listed on the project.

Should you have any queries regarding your project, please contact the Ethics Secretariat on 9850 4194 or by email ethics.secretariat@mq.edu.au

The HREC Humanities & Social Sciences Committee Terms of Reference and Standard Operating Procedures are available from the Research Office website at: https://www.mq.edu.au/research/ethics-integrity-and-policies/ethics/human-ethics

The HREC Humanities & Social Sciences Committee wishes you every success in your research.

Yours sincerely,

Dr Karolyn White
Chair, HREC Humanities & Social Sciences Committee

This HREC is constituted and operates in accordance with the National Health and *Medical Research Council's (NHMRC)National Statement on Ethical Conduct in Human Research (2007, updated July 2018*) and the *CPMP/ICH Note for Guidance on Good Clinical Practice*

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21/10/2019

Dear Dr Ian Stephen,

Reference No:52019573310820

Title: 5733 Visual search and body adaptation

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I am pleased to advise that ethical and scientific approval has been granted for this project to be conducted by Dr Ian Stephen and other personnel: Dorothea House, Associate Professor Kevin Brooks, Mr Jordan Rogers**.**

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The HREC Humanities & Social Sciences Committee wishes you every success in your research.

Yours sincerely,

Dr Karolyn White
Chair, HREC Humanities & Social Sciences Committee

This HREC is constituted and operates in accordance with the National Health and *Medical Research Council's (NHMRC)National Statement on Ethical Conduct in Human Research (2007, updated July 2018*) and the *CPMP/ICH Note for Guidance on Good Clinical Practice*