Can Attentional Retraining to Healthy Food Reduce Consumption of Unhealthy Food?

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Dissertation submitted in partial fulfilment of the requirements of Cardiff Metropolitan University for the degree of Bachelor of Science
Declaration

I hereby declare that this dissertation is the result of my own independent investigation under the supervision of my tutor. The various sources to which I am indebted are clearly indicated. This dissertation has not been accepted in substance for any other degree, and is not being submitted concurrently for any other degree.
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I would like to thank my parents, sister and brother for supporting me throughout my whole degree and believing that I could accomplish anything I put my mind to. If it was not for them pushing me forward at every step, I do not think I could have completed this journey. I am thankful for the loving family I have, and am eternally grateful for the support my bampy always gave me. He always believed in me and I know he would be truly upset that he could not see me finish my degree. I hope I have made you all proud.

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Abstract

Literature has predominately focused on the idea that attentional biases to food cues are a significant predictor of food consumption (Boutelle et al, 2014). This insight has allowed research to examine how attentional bias modification can be used to reduce consumption of health harming substances (Kemps et al, 2014). Logically, attentional bias modification has been applied to food cues (Boutelle et al, 2014), with modified visual probe tasks being the most widely used procedure (Kemps, Tiggemann, & Hollitt, 2014). However, research examining this notion have largely used unhealthy food cues to retrain attention (Kemps et al, 2010, Kemps, Tiggemann, & Hollitt, 2014, Hardman et al, 2013, Boutelle et al, 2014), thus leaving a gap in literature that examines the effects of healthy food cues. Therefore, the aim of the present study was to build upon the limited research examining the effects of attentional bias and healthy food cues, and to determine if an individual’s food consumption is influenced as a result. It was hypothesised that an attend healthy condition would have a decreased attentional bias to unhealthy food cues after training, in addition to an attend neutral condition showing no change in attentional bias to unhealthy food cues. Furthermore, it was hypothesised that the attend healthy condition would have a lower food consumption than the attend neutral condition, in a later tasting session. Thirty participants (18 females and 12 males) were recruited for the study. Participants first completed three visual probe tasks consisting of pre-training, training, and post-training. After completion, participants were asked to take part in a tasting session. A two-way ANOVA was carried out to assess the changes in attentional bias in both conditions. Results indicated that although the attend healthy condition demonstrated a decrease in attentional bias to unhealthy food cues, it was not a significant change. Additionally, the attend neutral condition showed an increase in attentional bias towards unhealthy food cues, with results being significant. To assess food consumption in both conditions, a t-test was conducted which found that the attend healthy condition consumed less than the attend neutral condition. However, these results were also not significant. In conclusion, although some of the methods used in the current study have limitations, it has provided further insight into the influence of healthy food cues on attentional bias and food consumption. Future research should aim to eliminate the current limitations of the study to investigate the full effects of healthy food cues on attentional bias and food consumption.
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1.0 Introduction

1.1 Attentional Bias and Food Cues

Attentional bias has been described as ‘a form of cognitive bias that involves preferential attention to a single type of information’ (MacLeod & Mathews, 2012, p.191). This results in individuals attending to personally relevant information over neutral information (Smeets et al, 2009). Therefore, attentional bias towards food cues causes individuals to pay an increased attention to food cues in their environment, compared to neutral stimuli (Veenstra et al, 2010). Traditionally, attentional bias is calculated by comparing individual reaction times for salient stimuli to reaction times for neutral stimuli (Tapper et al, 2010).

A central concept of attentional bias in cognitive theory relates to how thinking structures are organised by schemas, which are efficient structures of knowledge with the purpose of redirecting attention, perception, and the processing of information (Williamson et al, 1999). A schema exists for all information in memory and cognitive processing, and is believed to occur automatically with no conscious action or attention (Williamson et al, 1999). This results in biased schematic cognition that becomes involved in all functions related to the dominant schema (i.e. attention, judgement, memory, and body image) (Williamson et al, 1999).

Early examination of attentional bias was based on addictive behaviours, with emerging literature now demonstrating how attentional bias is involved in different lifestyle behaviours (Kemps et al, 2014). A vast amount of research has demonstrated that addictive behaviours are characterised by attentional biases towards drug-related stimuli (Field & Cox, 2008), which results in an increased likelihood of a conditioned response (Attwood et al, 2008). Evidence that attentional biases for addictive behaviours produce a conditioned response, has been explained through several mechanisms (Townshend & Duka, 2001, Attwood et al, 2008, Bradley et al, 2003, Mogg & Bradley, 2002, Field & Cox, 2008). A main mechanism found was schemas (Mogg & Bradley, 2002). Due to schemas being a central concept of attentional bias, it results in drug using behaviours to be difficult to impede in the presence of drug-related cues (Townshend & Duka, 2001). To add to this, cravings have been found to reinforce properties of drug-related cues and cause an increased preoccupation for said cues (Townshend & Duka, 2001). Further mechanisms include the incentive sensitisation theory, whereby relevant stimuli guide individuals towards the incentive through salience (Bradley et al, 2003), resulting in drug-taking to acquire motivational salience (Townshend & Duka, 2001), and drug-related cues becoming highly attractive (Mogg & Bradley, 2002). Thus, activating reward systems that determine the reward value of drug-related cues and their ability to motivate behaviour (Field & Cox, 2008). These mechanisms identified in addictive behaviours, can be applied to different areas of behaviour such as eating patterns, and provide useful insight into attentional
Researchers have identified and distinguished two subcomponents of attentional bias for food cues by using paradigms such as the dot-probe paradigm (Smeets et al, 2009). Generally, the first subcomponent of biased attentional processing is a heightened vigilance for food cues (Hollitt et al, 2010). Heightened vigilance is involved in early stages of attentional processing of information and results in increased initial orienting, engagement, or speeded detection to food cues (Smeets et al, 2009). The second subcomponent is delayed disengagement (Hollitt et al, 2010). Delayed disengagement has been identified in late attentional processing which can also result in a greater maintained attention or increased distraction (Smeets et al, 2009). This means that individuals will find it difficult to disengage their attention from food cues (Hollitt et al, 2010). Based on these two subcomponents, a positive attentional bias score would indicate a fast response to target stimuli (heightened vigilance), whereas a negative score could be the result of slow responses to target stimuli (delayed disengagement) (Tapper et al, 2010).

Recent research has indicated that a complex neural circuitry, including the cortical and subcortical brain regions, controls cognitive and behavioural responses to food cues and therefore influences food intake (Hou et al, 2011). The ventral tegmental area (VTA), ventral striatum, and the nucleus accumbens (NAc) (all situated within the mesocorticolimbic dopamine system) mediate the processing of reward and pleasure, with dopamine playing a vital role in influencing communication between said structures (Field & Cox, 2008). The incentive sensitisation theory states that the repeated pairings of food cues as well as the reward value associated with food intake, results in attentional biases for specific food cues (Boutelle et al, 2014). Therefore, the motivational and reward value of food cues (i.e. the sight or smell of food) are attributed to classical conditioning (Kakoschke et al, 2014). Due to the motivational and reward value of food cues being paired through classical conditioning, it elicits the expectancy of food availability and causes attentional bias and subjective cravings towards food cues (Field & Cox, 2008). These integrated networks of brain regions provide an equilibrium between involuntary stimulus-driven processes (bottom-up processing), and reflective goal-driven processes (top-down processing) (Hou et al, 2011). These processes determine the reward value of food cues, the cognitive response to said cues, and behaviours (Hou et al, 2011).

Multiple studies have identified significant correlations between attentional bias and food related cravings (Smeets et al, 2009). Multiple research has demonstrated how attentional bias and craving are mutually excitatory, with an increase of one causing an increase in the other (Hardman et al, 2013, Field & Cox, 2008). For example, attention bias towards food cues may cause craving, whereas cravings could result in attentional bias for food cues (Werthmann et al, 2011). Individual differences
in cognitive avoidance strategies, impulsivity, and impaired inhibitory control are all factors which can influence attentional bias and cravings (Field & Cox, 2008). Bouteille et al (2014) suggests that attentional bias in vulnerable individuals not only grabs attention, but results in cravings which influences consumption. These, cravings are said to be maintained through high-fat foods being viewed as more rewarding, resulting in individuals automatically noticing and attending to related food cues (Werthmann et al, 2011). Additionally, the “attention grabbing powers” of food cues can elicit approach behaviour towards them (Werthmann et al, 2011). This therefore suggests that individuals overeat as attention directed towards food cues results in fixation, which in turn increases motivation towards food and cravings. Thus, attentional bias for food cues could allow insight into the cognitive mechanisms that influence overeating (Hepworth et al, 2010).

1.2 Attentional Bias and Eating Patterns
Selective attention towards food cues have been related to motivational state, thus it could be argued that it is a subcomponent of dysfunctional eating patterns (Veenstra et al, 2010). It is believed that individuals have high levels of concern over what they eat and body shape, which results in attentional biases (Lee & Shafran, 2004). This may result in an individual directing their attention to disliked body parts when looking in the mirror (Lee & Shafran, 2004). Biases associated with eating disorders are specific to self-referenced eating and body shape, with the biases being a primary function of the obsession with thinness and the fear of becoming fat (Williamson et al, 1999).

Researcher has suggested that those suffering from eating disorders differ from non-sufferers in several ways, including enhanced processing for food and weight-related words, enhanced memory for schema-consistent information (Lee & Shafran, 2004), and body shape (Faunce, 2002). These schemas are believed to be dysfunctional and highly elaborate due to the overconcern with food, weight and body image (Israeli & Stewart, 2001, Williamson et al, 1999). The overuse of these biases can contribute to the self-destructive and maladaptive behaviour observed in sufferers of eating disorders (Williamson et al, 1999, Israeli & Stewart, 2001). These behaviours include hypervigilance and orientation towards threat related cues, in addition to avoidance techniques (Lee & Shafran, 2004). The “threat” identified for sufferers of eating disorders are food cues and self-esteem issues (Lee & Shafran, 2004). Evidence supporting this stems from Williamson et al (1999) who found sufferers of bulimia had an increased level of anxiety after eating large quantities, yet a reduced level after purging. Furthermore, research has demonstrated that sufferers of eating disorders direct attention to high-calorie photos, but direct attention away from low-calorie photos (Veenstra et al, 2010), with reaction times to thin physique related words being slow when compared to words relating to a larger physique (Rieger et al, 1998).
Many people try to control their body weight by restricting food intake, with most failing to do so in the long term (Van Koningsbruggen et al, 2011). It has been found that overeating is often the result of breaking dietary restraint (Williamson et al, 1999). Those high in dietary restraint demonstrate an attentional bias towards forbidden foods (Israeli & Stewart, 2001). Additionally, research has shown that restrained eaters who are exposed to food cues will have an increased food consumption (Fedoroff et al, 2003). Restrained eating, also known as chronic dieters (Stewart & Samoluk, 1997), refers to the attempts to refrain from eating (Braet & Van Strien, 19997), and implies there is a conscious determination and effort exerted to restrict food intake, and calories to control body weight (Elfhag & Morey, 2008). Restrained eaters are the most unsuccessful in controlling food consumption as although they continuously monitor their food intake, they are highly responsive to external food cues which disrupts eating regulation (Stewart & Samoluk, 1997). This is problematic as restraint may result in cravings as the individual had to develop and maintain strategies to control their food intake, which may imply that achievement orientation may be essential (Elfhag & Morey, 2008). Examination of food cues on self-regulation in restrained eaters has demonstrated that their appetitive reactions to the perception of food is stronger than in those who are not dieting (Papies et al, 2008). Additionally, chronic dietary restraint was associated with selective processing of food cues but not when food restraint was short-term (Stewart & Samoluk, 1997).

Food cues exert a strong influence on the eating patterns of restrained eaters, resulting in individuals to become more responsive to food cues and eating more after being primed with the sight, smell or thought of food (Papies et al, 2008, Fedoroff et al, 2003). To add to this, research examining functional perceptions suggest that tempting food cues can trigger enjoyment in restrained eater, resulting in attentional bias as well as dysfunctional size perception of food (Van Koningsbruggen et al, 2011). Exposure to food cues have been suggested to cause a cognitive reaction in restrained eater which trigger thoughts about food and inhibit mental representations of dieting goals (Papies et al, 2008). As a result, restrained eaters have a similar response to high-caloric food cues to those who are external eaters, overweight or obese (Kakoschke et al, 2014). However, restrained eaters are only likely to over eat if exposed to food cues (Van Koningsbruggen et al, 2011), with the foods consumed being the same as the food cues they were exposed to (Fedoroff et al, 2003). Thus, providing support for the concept that attentional bias to food cues is influenced by thoughts about specific food types, which match the individual’s current orientation rather than the restrained eaters current dieting goal (Papies et al, 2008).

Although research has found that food cues can result in attentional bias towards specific foods, Smith & Rieger (2009) found that negative shape and weight attentional biases resulted in intensified body dissatisfaction which in turn increased dietary restrictions. As a result, these
findings provide insight into the effects of attentional biases, and how attentional retraining may be a useful intervention to improve individual’s representations of their body image and reduce dieting (Smith & Rieger, 2009).

The western environment has been labelled as ‘obesogenic’ (Kakoschke et al, 2017) with the environment being a crucial factor that has influenced the development of this imbalance (Werthmann et al, 2011). This is due to individuals consuming too many foods high in fat, salt and sugar, and not enough fruit and vegetables (Kakoschke et al, 2017). This type of environment leads to individuals being confronted with attractive food cues frequently, which causes the temptation to indulge (Werthmann et al, 2011). The risk of chronic health problems such as obesity, has increased due to this unhealthy behaviour (Kakoschke et al, 2014).

Statistics have estimated that 35% of adults are classified as overweight, in addition to 11% being classified as obese (Kakoschke et al, 2017). Foods high in fat are problematic due to them being highly palatable, energy-dense and being overly represented through advertisement (Werthmann et al, 2011). Food cues not only arrive through advertisement but through television, internet usage and print (Castellanos et al, 2009). For example, in a study by Folkvord et al (2015) it was found that children who played an advergame promoting energy-dense snacks ate more than children in a control condition. However, susceptibility to food cues in the environment are not equal to every individual (Werthmann et al, 2011), with the trait characteristic of external eating (responding to external cues such as smell and sight) being a vulnerable factor for overeating (Hou et al, 2011).

Several neurocognitive and behaviour mechanisms have been found to influence overeating, with attentional bias to food cues being a significant predictor of food consumption (Boutelle et al, 2014). All individuals are susceptible to attentional bias, however individuals with ineffective response inhibition are more likely to give in to temptations (Nederkoorn et al, 2010). As a result, these individuals eat more which causes body mass to increase, and leads to becoming overweight or obese (Nederkoorn et al, 2010, Kemps et al, 2015). Supporting evidence comes from Nederkoorn et al (2010) who found that participants with preferences to unhealthy food had low inhibitory capacity, therefore gaining the most weight.

Unhealthy food cues are deemed attractive (Kakoschke et al, 2014) and rewarding in overweight and obese individuals (Werthmann et al, 2011), which causes attention to be captured automatically (Kakoschke et al, 2014). As a result, foods that are high in fat and sugar release dopamine in the VTA and NAc in the same way as addictive drugs (Field & Cox, 2008) and cause hyper-sensitivity in the reward system (Boutelle et al, 2014). Consequently, attention becomes biased and drives food consumption with the process occurring implicitly, without conscious awareness (Kakoschke et al, 2014). The ability of food cues to interact with the brains reward system and motivated behaviour,
suggests that attentional bias is the most significant component that results in a high percentage of individuals becoming overweight or obese (Castellanos et al, 2009).

In addition, factors such as hunger are known to influence attentional bias and cause differences in consumption between normal weight individuals and those who are overweight (Nijs et al, 2010). Due to hunger providing a powerful motivational force, it results in not only physiological and affective changes, but also modulates certain aspects of cognition such as attention (Piech et al, 2010). Studies have provided evidence that hunger can increase attentional bias to food cues if enough time is given (Piech et al, 2010). Mogg et al (1998) had participants fast for twenty-four hours before taking part in their study. It was found that fasting participants were slower at naming the colours of food-related words when compared to non-fasting participants. Additionally, Mogg et al (1998) asked participants to refrain from eating in the interval between their last meal the day before and participation. Results from this study also demonstrated a higher attentional bias to food cue in fasting participants, compared to non-fasting participants. Thus, demonstrating support for hunger-related processing bias.

These pieces of evidence provide insight into the key factors that influence individuals to have a greater attentional bias towards food cues (Kemps et al, 2015), with dysfunctions within these factors likely underlying the predisposition to overeat (Hou et al, 2011).

1.3 Attentional retraining

Research has examined how attentional bias modification can be used to reduce consumption of health harming substances (Kemps et al, 2014). As a result, attentional bias modification programs have been used in anxiety and substance abuse (Boutelle et al, 2014) throughout the past decade and have shown to be promising (Kemps, Tiggemann, & Holliitt, 2014). These programmes work by improving the ability to disengage attention from cues, by retraining attention (Boutelle et al, 2014) away from maladaptive biases through the repeated practice of avoiding specific cues (Kemps, Tiggemann, & Holliitt, 2014). Thus, attentional bias is gradually shifted away from or towards specific cues (Kemps, Tiggemann, & Holliitt, 2014).

For example, Kerst and Waters (2014) asked participants to complete four daily assessments on smoking behaviour. These assessments included three attentional retraining’s (AR group) or three control trainings (control group), in addition to an evaluation of attentional bias. The AR group’s assessments consisted of training the individuals attention away from drug related cues, whereas the control group’s assessments consisted of no training. It was found that in the AR group attentional bias towards drug related cues reduced during the week period, whereas in the control group there was no change. In addition to this, the AR group had reduced ratings of cravings after being shown pictures relating to smoking. However, although the effects of attentional bias
modification have shown to work effectively, evaluation of long lasting effects are yet to be examined thoroughly. For example, in a study by Kemps et al (2015) long lasting effects of attentional bias modification was examined with results indicating that effects diminish after a twenty-four-hour period.

Logically, attentional bias modification has been applied to food cues (Boutelle et al, 2014), with modified visual probe tasks being the most widely used procedure (Kemps, Tiggemann, & Hollitt, 2014). Visual probe tasks have used objective methodology to gain insight into individual differences in attentional bias, which allows assessments not to be reliant on subjective self-reports (Hou et al, 2011). Findings from these types of studies have demonstrated support for attentional biases towards specific cues (Smeets et al, 2009). Visual probe tasks assess attentional bias by presenting pairs of stimuli (target vs control) simultaneously via a computer screen, which is then followed by a probe replacing one of the stimuli (Townshend & Duka, 2001). This allows the effects of attentional preferences to be measured from individual reaction times (Castellanos et al, 2009). To measure the individual’s reaction time, they are asked to respond to the probe as quickly as possible with response anomalies being interpreted as attentional bias towards a specific stimulus (Townshend & Duka, 2001).

Visual probe tasks have increased awareness about attentional bias and how they are present for various health harming behaviours such as, smoking, heavy drinking and varied drug usage (Attwood et al, 2008). Furthermore, the increased awareness of attentional bias in health harming behaviours has allowed a vast amount of attentional retraining studies to examine, and demonstrate how manipulation of attention can affect food consumption (Kemps et al, 2015).

To retrain attention, researchers modify their visual probe tasks so that the probe replaces a target stimuli or neutral stimuli in a greater number of trials, to train participants attention towards a specific stimulus (Hardman et al, 2013). For example, Townshend and Duka (2001) presented evidence to support attentional bias in heavy drinkers by either training participants to attend attention towards, or away from alcohol cues. By doing so, those attending to alcohol cues would have had the probe replacing alcohol cues in a greater number of trials, whereas those attending attention away from alcohol cues would have had the probe replacing non-alcohol cues on more trials. Because of this modification, it was found that participants trained to attend to alcohol cues had an increased attentional bias towards alcohol cues, whereas those in the avoid alcohol condition showed a decrease in attentional bias. This research was extended further whereby alcohol consumption was measured, with the avoid alcohol condition drinking less beer than the attend alcohol condition. A criticism of this study is that although the study tested for attentional bias in alcohol, the consumption aspect of the study only investigated beer. This could therefore limit the
range of individuals these findings could apply to (i.e. those who do not drink beer) as they could have been fixating their attention on different alcoholic beverages. Studies that have evaluated attentional bias and food consumption using visual probe tasks have generally found the same findings. For example, Boutelle et al (2014) found that participants trained toward food had a higher attentional bias than those trained to avoid food, and the control group. These findings were consistent with Hardman et al (2013) who also gained the same results, and where similar to findings of Kemps, Tiggemann, and Hollitt (2014) and Kemps et al (2014). Instead of participants showing a higher attentional bias in the attend condition compared to the avoid condition, Kemps, Tiggemann, and Hollitt (2014) and Kemps et al (2014) found that attentional bias for those in the avoid condition decreased. This difference may be due to Kemps, Tiggemann, and Hollitt (2014) and Kemps et al (2014) using obese women who they described to have a higher attentional bias towards food cues. Thus, those trained towards food would be more inclined to attend to food due to their existing predisposition. Additionally, there were differences in consumption between Boutelle et al (2014) and Hardman et al (2013), but similarities between Boutelle et al (2014) and Kemps et al (2014). Where Boutelle et al (2014) found that those trained to attend to food had an increased calorie consumption, Hardman et al (2013) gained the opposite results so that those attending to food had, a lower consumption when given the opportunity to consume cake. These differences in findings may be a result of inconsistent methodology. Boutelle et al (2014) recruited children between 8 and 12 whereas Harman et al (2013) recruited undergraduate students who are usually of the age 18 and above. Furthermore, Kemps et al (2014) used obese women. Generally, at the age of 18 and over, individuals tend to show more restraint whereas children, when given the chance, are likely to target high calorie foods. To add to this, as stated by Kemps, Tiggemann, and Hollitt (2014), obese women have a higher predisposition to food cues, which could explain the higher consumption. Furthermore, Boutelle et al (2014) only used 288 trials yet, Harman et al (2013) used 768 trails. This may imply that attentional biases are harder to create in adults than children. There are limited studies that have evaluated attentional retraining to healthy food cues. However, those who have examined the effects, have found consistent findings. Both Kakoschke et al (2017) and Kakoschke et al (2014) trained participants towards healthy foods or unhealthy foods. In both studies, the results demonstrated that those attending to healthy food cues had a greater attentional bias towards healthy food and a decreased attentional bias towards unhealthy foods, even after having the initial tendency to attend to unhealthy food cues. However, where Kakoschke et al (2017) did not measure food consumption, Kakoschke et al (2014) did. It was found that participants attending to healthy foods had an increased consumption of healthy foods than
unhealthy foods. Although both studies are consistent, these findings could be the result of both studies having similar methodologies.

1.4 Rationale, Aim and Hypotheses

A vast amount of literature has explained how attentional biases are formed, and stated that they are a key component of many eating patterns. However, literature that addresses how attentional bias influences eating patterns is lacking. The main assumption that attentional bias and cravings are mutually excitatory (Hardman et al, 2013, Field & Cox, 2008) is believed to be the likely cause of food self-administration (Field & Cox, 2008), as it plays a central role in food consumption and control over intake (Werthmann et al, 2011). Furthermore, literature that has examined the role of attentional bias on food consumption, have mainly used food-related words rather than pictures (Castellanos et al, 2009). This leaves opportunity to branch out and examine whether the sight of food can result in subjective cravings, as proposed by Kakoschke et al (2014) and Field and Cox (2008). Additionally, despite attentional modification being shown as effective (Kemps et al, 2010, Kemps, Tiggemann, & Hollitt, 2014, Kerst and Waters, 2014), there are limited studies that have trained attention towards healthy food cues. Those who have, have used visual probe tasks to train participants towards healthy food images or unhealthy food images (Kakoschke et al, 2014, Kakoschke et al, 2017). Therefore, this provides further opportunities for development within literature associated with attentional bias and healthy food cues.

Thus, the aim of this research is to build upon the limited findings evaluating attentional bias and healthy food cues. The study will do so by exploring if a modified attentional retraining task, that requires participants to allocate attention towards healthy food images or to non-food images, can influence the consumption of unhealthy food. It is predicted that participants in an attend healthy condition will show a reduced attentional bias towards unhealthy food cues. In addition, it is predicted that participants in an attend neutral condition will show no change in attentional bias towards unhealthy food cues. Lastly, it is predicted that those in the attend healthy condition will have a lower food consumption than participants in the attend neutral condition, in a later taste task.
2.0 Method

2.1 Design

The current study adopted an experimental design to assess if attentional retraining can modify attentional bias to food cues. Two independent variables (IVs) were manipulated, both consisting of two levels. The first IV was the training condition (attend healthy cues and attend neutral cues) which was between subjects, whereas the second IV was time (pre-training and post-training), measured in milliseconds (ms) which was within subjects. The dependant variable (DV) was attentional bias towards food cues which was also measured in ms.

2.2 Sample

A sample consisting of 18 females and 12 males (N=30) were recruited through an opportunity sample. Participants were either recruited via the Cardiff Metropolitan University participant panel or through personal contacts of the researcher. Participant’s ages ranged from 18 to 30, with the mean age of 21.17 and a standard deviation of 2.34. Participants were randomly assigned to either an ‘attend healthy’ group (N=15) or an ‘attend neutral’ group (N=15). There were equal numbers of males (N=6) and females (N=9) in both conditions.

2.3 Materials

2.3.1 Visual Dot Probe Task

A visual dot probe task was designed for this study. A total of 30 picture pairs (food and non-food objects) were presented for 200ms in two blocks of 110 trials. The first 10 trials acted as a practice session which contained 5 picture pairs. This was followed by a further 100 trials containing 25 picture pairs. In both blocks, each of the 25 picture pairs had four different presentations. These presentations consisted of; experimental stimulus displayed on the left, followed by the probe displayed on the left; experimental stimulus displayed on the left, followed by the probe displayed on the right; experimental stimulus displayed on the right, followed by the probe displayed on the right; experimental stimulus displayed on the right, followed by the probe displayed on the left. The probe (small dot) replaced both food and non-food objects with equal frequency in both blocks of 110 trial. Each of the 110 presentations of picture pairs were randomised with the probe remaining on screen until the participant responded. If the probe appeared on the left side of the screen, participants had to respond by pressing the ‘F’ key, whereas if the probe appeared on the right side of the screen, participants had to respond by pressing the ‘J’ key. Reaction time (RT) to the 110 trials was measured in ms.
2.3.2 Attentional Retraining Task Healthy Condition

A modified visual dot probe task was designed for the healthy retraining task. This task consisted of 16 picture pairs (healthy food and non-food objects) presented for 200ms across 54 trials. The first 10 trials acted as a practice session and contained 5 picture pairs. After completing the practice session, a further 44 trials followed containing 11 picture pairs. Each of the 11 picture pairs followed the same four presentations as the visual dot probe task (see section 2.3.1). However, the probe only replaced healthy food images. RT of the 54 trials was measured in ms.

2.3.3 Attentional Retraining Task Neutral Condition

A modified visual dot probe task was also designed for the neutral retraining task. Similarly, to the healthy retraining task, the same number of trials and picture pairs were used. These picture pairs were presented for 200ms and had four different presentations. Alternatively, the probe only replaced non-food images. RT for this task was also measured in ms.

2.3.4 Taste Test

Participants were provided with 50 grams of ready salted crisps, 50 grams of chocolate buttons and 5 cookies (equivalent weight of 51 to 55 grams) in separate bowls. Each bowl was weighed before and after the tasting session to measure food consumption. Additionally, a taste test rating form was provided for participants to rate how much they liked each snack food on a likert scale of 1 to 10 (1 being extremely like and 10 being extremely dislike).

2.4 Procedure

The experiment was conducted at Cardiff Metropolitan University in a laboratory cubicle. The sessions on average lasted thirty minutes. Upon arrival, participants received an information sheet (See appendix 1) detailing what would happen during the study, and a consent form (See appendix 2) which they had to read thoroughly and sign. After gaining consent, participants were also given verbal information as to what to expect from the study. To reduce the chance of participants guessing the purpose of the experiment, certain aspects of the study were disguised. Participants were informed that the study aimed to look at whether attentional bias to food cues can affect mood.

Participants were then randomly assigned to either the attend healthy or attend neutral condition. Both attend healthy and attend neutral conditions were first asked to complete a visual dot probe task to gain baseline scores of attentional biases to food cues (See section 2.3.1). Both conditions then received attentional training; the attend healthy condition completed a modified visual dot probe task that trained their attention to healthy food images (See section 2.3.2), whereas the attend neutral condition completed a modified visual dot probe task that trained their attention to
non-food images (See sections 2.3.3). At the end of training both the attend healthy and attend neutral condition completed the visual dot probe task for a second time. Participants were asked to take part in a tasting session where they were provided with three different snack foods (See section 2.3.4). Information regarding allergens present in the snack foods were provided in the participant information sheet and consent form. Participants were informed to eat as much of the snack food as they wished, and to rate each snack food based on how much they liked them on the provided rating form (See appendix 4). Following the completion of the tasting sessions, participants were provided with a debrief form (See appendix 3). Each snack food was weighed after participation to measure food consumption (grams) (See figure 2.1 below).

Fig 2.1 Example of Experimental Procedure

2.5 Method of Analysis
To analyse the data for the current study a 2 (training condition: attend healthy vs attend neutral) x 2 (time: pre-training vs post-training) ANOVA was used to assess the main effect of attentional bias towards food cues. This also allowed the analysis to explore the interaction between two IVs (training condition and time). Additionally, an independent T-test was used to assess whether there was a significant difference in food consumption (grams) between the two training conditions. IBM SPSS 22.0 statistical programme was used to conduct both analyses.

2.6 Ethical Considerations
Ethical approval was granted by the Cardiff Metropolitan University Ethics Committee on the 30/11/17 (Reference Number: 9694). Participants were provided with an information sheet and consent form before participating in any part of the study. However, certain aspects of the study were disguised from participants on the information sheet. Participants were asked to tick each box and sign the consent form to demonstrate they understood what was expected of them, and that they understood the exclusion criteria listed. Exclusion criteria included those who have or are currently suffering from an eating disorder, and those who are allergic to the following allergens; milk, gluten, soya, wheat. Additionally, those who are currently dieting are excluded. Each participant was informed of their right to withdraw and were given a debrief form to explain the
true aims of the study. The debrief form contained support information for participants who may have been affected by the study.
3.0 Results

3.1 The Impact of Training on Attentional Bias to Healthy Food Cues and Neutral Cues

Examination of the descriptive statistics demonstrates a difference between the attend healthy and attend neutral conditions in both pre-training and post-training attentional bias scores. For example, results for pre-training in the attend healthy condition was M= -10.03, SD= 13.12 and in post-training was M= -1.35, SD= 21.70 (see figure 3.1 below). These findings suggest that prior to attentional retraining, participants had a high attentional bias towards unhealthy food cues. However, after completing the attentional retraining task participant’s attentional bias dramatically reduced, with the spread of scores increasing.

![Figure 3.1: Mean Attentional Bias Scores and Standard Deviation for Attend Healthy Condition in Pre-training and Post-training](image)

On the other hand, scores at pre-training for the attend neutral condition was M= .53, SD= 36.48 and at post-training was M= -17.76, SD= 47.69 (see figure 3.2 below). Compared to the attend healthy condition, individuals in the attend neutral condition started with a low attentional bias towards unhealthy food cues prior to attentional retraining. Yet, after the completion of the attentional retraining task, individuals attentional bias increased, with their spread of scores also increasing.
3.2 Statistical Analysis of Two-Way ANOVA

A mixed 2x2 ANOVA was conducted with a between subject’s variable of training (attend healthy vs attend neutral) and a within subject variable of time (pre-training vs post-training). The DV was attentional bias to food cues. Through analysis the Levene’s test indicated that the assumption of homogeneity of variance has not been violated for pre-training (F(1,28)= .08, p> .05), but had been violated for post-training (F(1,28)= .01, P< .05). There was no significant main effect of time (F(1, 28)= .65, MSE= 345.26, p> .05), in addition to the main effect of training also not being significant (F(1, 28)= .08, MSE= 128.07, p> .05). However, the interaction between time and training was found to be significant (F(1, 28)= 5.097, MSE= 2728.675, p< .05). Planned comparisons were also conducted to explore this interaction; it was found that in the attend neutral condition there was a significant effect of time, with participants demonstrating a higher attentional bias to unhealthy food cues post-training than pre-training (p< .05). Although attentional bias was lower post-training for the attend healthy condition, this difference was not significant (p> .05).

3.3 Trainings Effect on Food Consumption

Mean consumption (grams) was found to be higher in the attend neutral condition (M= 13.73, SD= 7.76) compared to the attend healthy condition (M= 9.93, SD= 6.43) (see figure 3.3 below).
Figure 3.3 Mean Food Consumption and Standard Deviation for Attend Healthy and Attend Neutral Conditions

An independent t-test was conducted to compare the total amount of food consumed by each training condition (one-tailed). There was no significant main effect of food consumption between both training conditions (t= 1.46, df= 28, p> .05).
4.0 Discussion

4.1 Summary of Hypotheses and Results
The current study aimed to expand upon literature surrounding attentional bias and healthy food cues using a modified visual probe task, in addition to evaluating the effects of attentional bias on food consumption. This is due to literature focusing on attentional bias and unhealthy food cues, thus limiting research on the effects of healthy food cues. It was hypothesised that the attend healthy condition would demonstrate a reduced attentional bias to unhealthy food cues after training, in addition to the attend neutral condition showing no change in attentional bias towards unhealthy food cues after training. Furthermore, the study hypothesised that the attend healthy condition would have a lower food consumption than the attend neutral condition in a later taste test. However, although the results supported the hypothesis of the attend healthy condition having a reduced attentional bias towards unhealthy food cues after training, the results were not significant. Additionally, the attend healthy condition did have a lower food consumption than the neutral condition showing support for the hypothesis, yet these results were also not significant. The third hypothesis was not supported, as the attend neutral condition demonstrated an increase in attentional bias towards unhealthy food cues rather than no change, with results being significant.

4.2 Comparison of Current Findings to Previous Literature
In reference to previous research and the current study, there is reason to believe that healthy food cues can reduce attentional bias and the consumption of unhealthy foods. Similar studies have found that participants attending to healthy food cues show an increased attentional bias to healthy food cues, and a decreased attentional bias for unhealthy foods (Kakoschke et al, 2017, Kakoschke et al, 2014). Furthermore, this change in attentional bias influenced food consumption whereby participants had a higher consumption of healthy foods compared to unhealthy foods (Kakoschke et al, 2014). Therefore, it is expected that the current study also found that participants in the attend healthy condition had a reduced attentional bias towards unhealthy food cues, in addition to having a lower food consumption than the attend neutral condition. Although the current study has many differences in methodology when compared to previous studies (i.e. number of training conditions, types of images presented during the task, snack foods used for the tasting session, and recruiting both males and females), findings from each study show support for one another. Thus, it can be argued that training attention to healthy food cues can reduce an individual’s attentional bias towards unhealthy food cues, as well as their consumption of unhealthy foods, whether they are conscious of the effect or not (Williamson et al, 1999, Elfag & Morey, 2008, Kakoschke et al, 2014).
However, findings gained from the attend neutral condition (i.e. attend to neutral cues and avoid food cues) in the current study contradicted previous research. Evidence so far has indicated that training individuals to avoid food cues, reduces the level of attentional bias directed towards unhealthy food cues (Boutelle et al, 2014, Hardman et al, 2013, Kemps, Tiggemann, & Hollitt, 2014, Kemps et al, 2014). Yet, the current study found that attentional bias increased for individuals in the attend neutral condition. This contradiction may be due to the differences in methodology. The current study presented picture pairs for 200ms whereas previous studies prolonged this presentation to 500ms. A presentation of 500ms would have provided individuals with a better opportunity to identify both pictures, whereas a 200ms time frame may have provided difficulties doing so. Due to individuals having a predisposition to attend to food cues (Hou et al, 2011, Kemps, Tiggemann, & Hollitt, 2014), participants may have identified the food cue rather than the neutral cue during the 200ms. Therefore, rather than attending to the neutral stimuli, participants subconsciously may have attended to the food stimuli. Thus, this could provide an explanation as to why attentional bias increased for these individuals. Additionally, the current study only used 54 trials during training, with previous studies using on average 500 trials more. As a result, the current study may have not provided enough training to modify participants attention and reduce their bias to food cues.

Although the findings of the attend neutral condition did not support previous studies using visual probe tasks, they did relate to literature based on restrained eating. For example, those dieting often try to avoid food. However, this avoidance results in an increased attentional bias towards forbidden foods (Israeli & Stewart, 2001), with the sight, smell or thought of food influencing their response to food cues (Papies et al, 2008, Fedoroff et al, 2003). Therefore, attentional bias may have increased for the attend neutral condition, as the presentation of food cues during the task influenced their responses in the same mannerism as restrained eaters. For example, by training participants in the attend neutral condition to neutral cues, it meant that participants would have to avoid the food cues. As a result, participants attention increased for the forbidden cues (i.e. food) without conscious effort.

4.3 Considerations and Future Research

As addressed above, there are issues regarding the task as being too short. Given that most visual probe tasks previously conducted consist of roughly 500 or more trials, the present study only using 54 trials during training could be problematic. The use of a small number of trails may have had a subsequent effect on the result of attentional retraining, so that participants attention was not fully trained towards the target stimuli. Future research should attempt to identify if a certain number of trials are needed for effective attentional retraining. This could be of value as although the current
study did not produce a significant effect for those trained towards healthy food cues, there was a clear reduction in attentional bias to unhealthy food cues after using a small number of trials. Thus, attention could be modified in a shorter period than currently believed. Additionally, most studies conducted have used three conditions (i.e. healthy, unhealthy and control). Thus, the current study could have added a third condition whereby participants were trained to neither healthy or neutral stimuli (i.e. control). If this adjustment was made, additional findings may have been produced thus allowing further examinations and comparisons to be made.

A further limitation of the present study is that hunger was not tested for or controlled. Piech et al (2010) stated that hunger can modulate aspects of cognition such as attention, whereby hunger causes an increase in attentional bias toward food cues. Hunger may not only have influenced participants attentional bias to food cues, but could have also affected participants consumption within the tasting task. In addition to hunger, participant’s understanding of the tasting task may have affected the results gained. Many participants did not fully understand what was required of them during the tasting task, even after being provided with detailed instructions. Although participants were told to consume as much of the snack foods provided as they liked and to then rate the snack food, a high percentage often asked if they were required to eat the food. Additionally, a few of the participants rated the snack foods provided but did not consuming any. From weighing each participant’s consumption, it revealed that although there was a significant effect, most participants from both conditions consumed very little of the snack foods provided. This may be the result of participants being asked to consume food in an unnatural environment, which may have adverse effects on their consumption. As a result, tasting tasks should be conducted in a natural environment that is associated with the consumption of food. By doing so, participants may feel comfortable with the idea of consuming food, which could reduce confusion surrounding the task and provide results that are more reflective of individual consumption.

Although there are limitations of the current study, it has provided further insight into the limited research examining the effect of healthy food cues and attentional bias. New research should be conducted to test for longitudinal effects of attentional retraining. At present one study has indicated that the effects of attentional retraining diminish after a twenty-four-hour period (Kemps et al, 2015), with no further studies investigating long term effects. Thus, there is opportunity for research to thoroughly examine whether attentional retraining is long lasting. If training can produce long lasting effects, attentional retraining could be used as an intervention to reduce the risks of chronic health problems within our obesogenic environment.

4.4 Conclusion
The aim of this study was to build upon limited research examining the effects of attentional bias
and healthy food cues, and to determine if an individual’s food consumption is influenced as a result. Results gained from the current study mainly consisted of no significant effects, yet the results indicated that attentional retraining towards healthy food cues can reduce attentional bias to unhealthy food cues and food consumption. It can be concluded that healthy food cues can reduce attentional bias towards food cues, which as a result can influence food consumption. However, due to the limitations highlighted in the current study, future research should focus on creating a natural environment when measuring food consumption. Additionally, research should identify if there is an ideal amount of trials required for attentional retraining, and examine whether attentional retraining can produce long term effects.
5.0 References


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6.0 Appendices
6.1 Appendix 1

**Title of Project: Can Attentional Retraining to Healthy Food Effect Mood and Hunger Levels?**

Participant Information Sheet
Project Reference Number: 9694

The study
Previous research has focused on how attentional retraining can affect an individual’s current mood as well as how it can affect hunger levels. Although there is plenty of evidence that suggests attentional retraining to unhealthy food can reduce mood and increase hunger, there is limited research that examines whether healthy food can have the same or opposite effect. This has come to be important due to the growing issue of mood disorders and how it can alter food consumption.

What would happen if you agree to participate?
The study will require participants to take part in 3 visual dot probe task which will use food images and household items. In addition to this, participants will be asked to participate in a tasting test to examine which foods are the most popular. Snack foods will consist of chocolate chip cookies, ready slated crisps and chocolate buttons which have the following allergens present; Milk, Gluten, Soya, Wheat.

Exclusion criteria
Those who have suffered or are suffering from any eating disorders will be excluded from the study. In addition, those who have any food allergies related to the allergens listed, or dietary requirements will not be involved.

Potential Risk
Images displayed within the experiment may cause some distress to those participating. In addition, the snack food may contain allergens which is why the exclusion criteria stated above has been put in place.
Potential benefits

Benefits are participating in the study involve gaining credits on the participant panel.

Withdrawal, anonymity and confidentiality

To ensure anonymity a number will be assigned to your data collection. The data will then be secured on a password protected laptop that only the supervisor and I will have access to. You can withdraw from the study at any time up to a week after participating. If you wish to withdraw your data please contact the email provided with your assigned number so that your data can be deleted.

If you have any questions about the study, please contact:

6.2 Appendix 2

PARTICIPANT CONSENT FORM

Reference Number: 9694

Participant Name or Study ID Number:

Title of Project: Can Attentional Retraining to Healthy Food Effect Mood and Hunger Levels?

Name of Researcher: Paige Taylor

Participant to complete this section: Please tick each box.

1. I confirm that I have read and understand the information sheet for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.
2. I understand that my participation is voluntary and that I am free to withdraw at any time before leaving the experiment, without giving any reason.

3. I agree to take part in the above study.

4. I confirm I am not allergic to any of the following: Milk, Wheat, Soya, Gluten.

5. I confirm I am not current dieting.

6. I confirm that I do not have an eating disorder (or been diagnosed with an eating disorder in the past).

_______________________________________   ___________________
Signature of Participant                        Date

_______________________________________  __________  __________
Name of person taking consent                  Date

____________________________________
Signature of person taking consent

6.3 Appendix 3

Title of Project: Can Attentional Retraining to Healthy Food Reduce Consumption of Unhealthy Food?

Participant Debrief Form
Project Reference Number: 9694
The Study
Thank you for agreeing to participate in the study. The true aim of this study was to explore if an attentional retraining task which requires participants to allocate attention towards healthy food, can influence the consumption of unhealthy food.

Previous research has focused on how certain food images can grab an individual’s attention more than others. Thus, causing them to have a higher attentional bias to these food cues. Although there is plenty of evidence to demonstrate this with unhealthy food, there is limited research that examine whether healthy food can have the same effect. This has come to be important due to the increase concern of individuals consuming too many substances that are unhealthy, causing an increase in obesity. This study aimed to build on limited research in this area using undergraduate students between eighteen and thirty.

Support
If you have any concerns following this study feel free to contact student services through the ‘finance, mental health and disability appointment request’ tab via Moodle. Alternatively, there are online helplines available at http://www.eatingdisorderssupport.co.uk/help/helpline

If you have any further concerns about any aspect of the study, hseage@cardiffmet.ac.uk or st20078060@outlook.cardiffmet.ac.uk

6.4 Appendix 4

PARTICIPANT FOOD RATING FORM

Reference Number: 9694

Participant Name or Study ID Number:

Title of Project: Can Attentional Retraining to Healthy Food Effect Mood and Hunger Levels?

Name of Researcher: Paige Taylor

___________________________________________________________________

Please rate the following on a scale of 1 to 10 of how much you like each snack food.

CHOCOLATE CHIP COOKIES

Extremely like

Extremely dislike
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**CHOCOLATE BUTTONS**

Extremely like 1 2 3 4 5 6 7 8 9 10 Extremely dislike

**READY SALTED CRISPS**

Extremely like 1 2 3 4 5 6 7 8 9 10 Extremely dislike
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