The Relationship Between Trait Eating Behaviours and Food-Related Attentional Biases

by

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Abstract

Attentional bias (AB) refers to the tendency to selectively attend to (orientation towards) and/or hold attention on (slowed disengagment from) disorder-relevant stimuli. Females with eating-related concerns are thought to preferentially process threatening stimuli, which in turn is thought to maintain and exacerbate eating concerns. The aim of the present thesis was to explore AB for threatening stimuli in females characterised by restrained, external or emotional eating, and those with high levels of (non-clinical) eating psychopathology. This was carried out with the intention of identifying cognitive processes that contribute to eating behaviours in females, in order to assess the relevance of an attention training (AT) programme for reducing such biases.

A pilot study assessed orientation/slowed disengagement, for mood and food words amongst females with high/low levels of restraint. Forty females completed a modified Stroop task with three conditions. Food and mood conditions included sequences of five words (‘target’ food/mood followed by four neutral). The neutral condition consisted of all neutral words. Performance did not significantly differ according to high/low restraint groups. All participants took longest to colour-name word position 2 (demonstrating slowed disengagement lasting one consecutive trial). However, this pattern was also found in the neutral condition. Methodological limitations were then addressed in study one. High/low restrained eaters (*n*=48) completed a modified Stroop where ‘targets’ (food, interpersonal threat, animal) were presented prior to four neutral words. Participants were slow to disengage from ‘targets’ (slowest for word position 2) in all conditions. Patterns of responding indicated that restrained eaters might take longer to disengage (i.e. the carry-over effect from the food word seemed to last longer than one trial). However, more neutral words in the sequence were needed to assess this. As slowed disengagement from animals also arose, a categorical effect may have occurred.

Study two explored attention processing of food using modified Stroop and dot probe tasks. In the Stroop task ‘targets’ (food, interpersonal threat, household objects) were presented prior to six matched neutral words. This task revealed no evidence of AB. No significant pattern of differences between restrained (*n*=29)/unrestrained eaters (*n*=31) emerged; however, binge eating scores were significantly negatively correlated with response times. A dot probe task with food/neutral picture pairs also revealed no evidence of AB. Both restrained/unrestrained eaters had negative mean interference scores indicating avoidance of food. None of the following eating behaviours significantly correlated with AB: restraint, disinhibition, external eating, emotional eating and non-clinical eating psychopathology.

Study three employed a further modified dot probe task based on image ratings. There was no evidence of AB, and no significant relation between task performance and restrained, emotional or external eating. 2000ms bias scores (assessing disengagement) were significantly negatively correlated with eating psychopathology and age, suggesting that those with high levels of non-clinical eating psychopathology attentionally avoid food stimuli and that younger females are slower to disengage attention from food (although found within a limited age range).

Study four employed further modified Stroop and dot probe tasks, and assessed whether AB mediates the negative mood-eating relationship. Participants were allocated to negative or neutral mood conditions. No evidence of AB was found with the dot probe, but greater levels of emotional eating were associated with slower responding. In the Stroop task, all participants displayed an orientation bias towards food. Emotional eating and drive for thinness (DFT) scores were significantly positively correlated with food word colour-naming times but only amongst participants in a negative mood. However, those with high levels of external eating showed greater AB towards food when in a neutral mood. Highly emotional eaters in a negative mood showed a greater desire to eat than those in a neutral mood but did not increase in food intake. Furthermore, those with a high DFT (in a negative mood) showed no evidence of increased desire to eat or food intake. AB was not significantly related to subjective appetite or food intake. Therefore, AB does not seem to mediate the negative-mood eating relationship.

The present thesis provides important suggestions for modifications of Stroop and dot probe tasks targeting orientation and disengagement. A modified Stroop has been more sensitive at detecting food AB than the dot probe. Implications of biased attention processing are discussed in relation to the development of harmful eating behaviours, and the present findings have important implications for developing programmes to prevent eating disorders amongst ‘at-risk’ females (e.g. through AT or training ‘at-risk’ females how to effectively cope with negative mood).

Keywords: Attentional Bias, Attention Training, Dietary Restraint, Emotional Eating, External Eating, Eating Psychopathology, Stroop, Dot Probe.

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Publications and Conference Presentations

Publications

Wilson, C., & Wallis, D.J. (2013). Attentional Bias and Slowed Disengagement from Food and Threat Stimuli in Restrained Eaters Using a Modified Stroop Task. *Cognitive Therapy and Research*, *37*(1), 127-138.

Papers in Preparation

Wilson, C., Wallis, D.J., & Meyer, C. (*under review*). Attention Training: A Useful Tool for Eating Disorder Treatment?

Wilson, C., & Wallis, D.J. (*in preparation*). Attentional bias and slowed disengagement from food and threat using modified Stroop and dot probe tasks.

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Wilson, C., & Wallis, D. J. (*in preparation*). Attentional biases in females with clinical and non-clinical eating-related concerns: A review of the literature.

Conference Publications

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Additional Presentations

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Abbreviations

AB	Attentional Bias
AN	Anorexia Nervosa
ANOVA	Analysis Of VAriance
AT	Attention Training
BAI	Beck Anxiety Inventory
BCQ	Body Checking Questionnaire
BDI-II	Beck Depression Inventory-II
BES	Binge Eating Scale
BIAQ	Body Image Avoidance Questionnaire
BIS	Barratt Impulsiveness Scale
BITE	Bulimic Investigatory Test-Edinburgh
BMI	Body Mass Index
BN	Bulimia Nervosa
BSQ	Body Shape Questionnaire
BULIT-R	Bulimia Test-Revised
CBT	Cognitive Behavioural Therapy
DEBQ	Dutch Eating Behaviour Questionnaire
DEBQ-R	Dutch Eating Behaviour Questionnaire-Restraint Subscale
DSM	Diagnostic and Statistical Manual of Mental Disorders
DFT	Drive For Thinness
EAT	Eating Attitudes Test
ED	Eating Disorder
EDE-Q	Eating Disorder Examination-Questionnaire
EDI	Eating Disorder Inventory
EDI-2	Eating Disorder Inventory 2
EDNOS	Eating Disorder Not Otherwise Specified
ERP	Event Related Potential
HADS	Hospital Anxiety and Depression Scale
IPT	Interpersonal Psychotherapy
ISI	Inter-Stimulus Interval
MANOVA	Multivariate ANalysis Of VAriance
NPS-F	Negative Physical Self-Fatness Scale
PANAS	Positive and Negative Affect Scale
PASTAS	Physical Appearance State and Trait Anxiety Scale

PASW	Predictive Analysis Software
POMS	Profile of Mood States
PSE	Present State Examination
RS	Restraint Scale
RSES	Rosenberg Self-Esteem Scale
RSI	Response-Stimulus Interval
RT	Response Time
SD	Standard Deviation
SEQ	Self-Esteem Questionnaire
SES	Socioeconomic status
SPSS	Statistical Package for the Social Sciences
SRC	Stimulus Response Compatibility
STAI-T	State-Trait Anxiety Inventory-Trait Scale
TFEQ	Three Factor Eating Questionnaire
TFEQ-D	Three Factor Eating Questionnaire-Disinhibition Subscale
VAS	Visual Analogue Scale

Chapter One: General Introduction

Attentional biases in females with clinical and non-clinical eating-related concerns: A review of the literature

This chapter will outline findings from a body of research that explores biases in attention amongst females with disordered eating attitudes and/or behaviours. Attentional bias (AB) refers to the tendency to selectively attend to and/or hold attention on certain information in the environment. Females who display forms of disordered eating are thought to preferentially process certain types of information, such as food, body, and emotionally threatening stimuli. Many cognitive psychologists have posited that in turn, this preferential processing of information which is threatening to the individual, maintains and exacerbates harmful eating behaviours. This chapter outlines research findings from studies exploring AB in relation to eating attitudes and behaviours that were located following a thorough literature review. The aim of this search was to assess methodological issues arising from this type of research, which participant groups display these biases, and what types of information these participants are most likely to preferentially process. The research questions in the present thesis are formed based on the findings from this review.

1.1. Theories on the Development of Eating Disorders

There are a number of theories on what the risk and maintaining factors for eating disorders (EDs) are. Here are just a few examples: Greenberg and Harvey (1986) hypothesise that dieting and depression lead to binge eating; Smolak, Levine and Gralen (1993) theorise that the cooccurence of stressors during adolesence (weight gain, dating onset, intensified academic demands) predicts eating disturbance; Vohs, Bardone, Joiner, Abramson, and Heatherton (1999) claim that perfectionism, body dissatisfaction and low self-esteem lead to bulimic pathology; Fairburn's (1997) cognitive model theorises that appearance overevaluation maintains the cycle of extreme dieting and bulimic pathology; and the dual pathway model (Stice, Nemeroff, & Shaw, 1996) argues that sociocultural pressure to be thin leads to internalisation of the thin ideal, leading to body dissatisfaction, which then leads to dieting and negative affect, which finally leads to bulimic pathology. Stice's (2002) meta-analysis outlined the robust evidence base for the following risk factors for EDs: body mass, sociocultural pressure to be thin, and body dissatisfaction, and the following as both risk and maintaining factors for EDs: thin-ideal internalisation, negative affect, and perfectionism. However, they note that these factors all had generally small effects, implying that there may be other important risk/maintenance factors. Not acknowledged in Stice's meta-analysis is the role of information processing biases. In the 1990s cognitive/information-processing theories of EDs emerged (e.g. Vitousek & Hollon, 1990; Williamson 1996; Williamson, Muller, Reas, & Thaw, 1999). These theories emphasise the role of schemata. A schema is viewed as a highly efficient knowledge structure that directs attention, perception and how information is processed (Vitousek & Hollon, 1990; Williamson et al., 1999). These schemata are also believed to influence thoughts, affect and behaviour (this can be in a way that is maladaptive). Schemata are described as providing a template for evaluating daily experiences, prescribing a simple set of rules for seeking safety/avoiding danger, and reducing the complexity of forming attributions about the past and expectations for the future. Markus (1977) defines self-schemata as "cognitive generalisations about the self, derived from past experience, that organise and guide the processing of self-related information contained in the individual's social experiences" (p.64). Vitousek and Hollon (1990) claimed that ED patients develop organised cognitive structures (schemata) that centre on an overconcern with body size and eating. These disordered schemata are hypothesised to contain stereotyped, affectively loaded and overvalued information concerning weight and eating. The operation of these schemata (which can be readily activated by external and internal cues) is thought to maintain ED symptomatology. These schemata are presumed to direct the person's attention to body and food stimuli (e.g Williamson, 1996; Williamson et al., 2004). AB is one type of information processing bias resulting from these schemata, and is believed to play a role in both the causation and maintenance of EDs (and dysfunctional eating behaviours amongst individuals with non-clinical eating/body-related concerns e.g. Williamson et al., 1996).

1.2. Attentional Bias

Posner and Peterson (1990) define AB as the propensity to look for, and be attentive to certain information in the environment. More specifically AB is the tendency to selectively attend to disorder-relevant stimuli, with ED sufferers being more likely to give priority to body- and food-related information (Smeets, Roefs, van Furth, & Jansen, 2008). Williamson, Muller, Reas, and Thaw (1999) further define this food and body information as that which is threatening to the individual. Individuals with EDs are afraid of gaining weight and will therefore process stimuli preferentially if it is related to fatness, e.g. high-calorie foods. Such biases are believed to reinforce concerns of the individual and lead to action. High-fat foods are overly represented in the visual food environment as such foods are heavily advertised (Hoek & Gendall, 2006). Hollitt, Kemps, Tiggemann, Smeets and Mills (2010) point out that for restrained eaters, being automatically drawn to such an abundance of food cues may act as a reminder of their restriction, making it difficult for them to maintain their diet. This can also be applied to clinical ED patients; for example if an individual struggling with binge eating is drawn to a large number of food cues on a daily basis, this is likely to increase the urge to binge. For restrictive patients such as those diagnosed with anorexia nervosa (AN), dwelling on body-related information in the environment such as thin models in adverts, may promote dysfunctional beliefs about their own body size and encourage further restriction.

There are a number of theories as to what causes AB (for a review see Field & Cox, 2008). Robinson and Berridge's (1993) incentive-sensitisation theory claims that repeated administration of a desired substance (e.g. food) produces a dopaminergic response that becomes sensitised with each new time it is eaten. This causes it to be perceived as salient and acquires strong motivational properties. This leads to a goal and a strong subjective craving for the food. In turn, this leads to the food grabbing attention, becoming attractive and being 'wanted'. The relationship between craving and AB for the craved item is believed to be bidirectional in causation (e.g. Kavanagh et al., 2005), with impulsive decision-making and/or poor inhibitory control thought to mediate the experience of craving and AB (Field & Cox, 2008). Another theory of what causes AB is called the theory of current concerns (Klinger, 1975, 1977, 1987, 1996; Klinger & Cox, 2004). A current concern is defined as a person's motivational state between the point of beginning to pursue a goal and attaining it. Throughout the goal pursuit the motivational state is believed to bias cognitive processing towards goal-related stimuli. Field and Cox (2008) present an integration of these theories. This integrated model claims that substance-related AB, subjective craving, and expectations of the opportunity to use a substance (or eat a certain food) are interrelated reactions to substance-related stimuli that develop through classical conditioning. This classical conditioning is believed to occur as a consequence of repeated pairings of the subjective affects of perceived availability of a substance (unconditioned stimulus) and contingently presented environmental cues (conditioned stimulus). This leads to the development of a conditioned response to substance-related cues. Field and Cox (2008) argue that conditioned responses only develop after individuals realise that the substance-related cues predict the availability of the substance. Therefore, conscious expectancy is thought to lead to a conditioned response (which includes AB). After conditioned responses are established they are thought to be mediated by perception of availability.

There are two main sub-components of AB (Fox, Russo, Bowles, & Dutton, 2001; Posner & Peterson, 1990; Smeets et al., 2008): initial orientation of attention towards stimuli (early/automatic attention processing), and slowed disengagement from stimuli, which concerns a difficulty withdrawing attention (later more elaborative processing/attentional dwelling). This chapter provides an overview of the large body of research that has investigated ABs in ED patients and in females with eating-related concerns (e.g. restrained eaters). A number of tasks have been employed in order to measure AB, but there are two main tasks in use; the Stroop task and the dot probe task.

1.2.1. Stroop Task

The Stroop task is the most frequently used AB measurement in eating psychopathology research (45 out of the 81 studies reviewed in this chapter employed a Stroop task). In the original task, Stroop (1935) asked participants to name the print colour of incongruent colour words, whilst inhibiting the automatic tendency to read the colour word itself. For example, the word ‘red’ would be printed in yellow and the participant would need to ignore the content of the word and state the printed colour. The inclusion of disorder-relevant and neutral words in modified Stroop tasks has allowed researchers to investigate the presence of biases in attention in clinical patients. In ED research, a bias for food and body words is indicated by delayed colour-naming of these words compared to control words. Although initially favoured, more recently some debate over the usefulness of this task has emerged. Some claim it cannot distinguish between attention directed towards or away from stimuli, or slowed disengagement (e.g. Ainsworth, Waller & Kennedy, 2002; Faunce, 2002; Johansson, Ghaderi & Andersson, 2005; Williams, Mathews & MacLeod, 1996).

1.2.2. Dot Probe Task

A number of researchers have favoured the dot probe task (developed by MacLeod, Mathews & Tata, 1986), which is the second most frequently employed task in eating research (20 out of the 81 studies reviewed in this chapter employed this task). In ED research, this task involves simultaneous presentation of two words/images (one food/body and one neutral) followed by a probe (requiring identifaction) in the same location as one of the previous images. This task is preferred by many AB researchers given its ability to distinguish between attention towards or away from stimuli. A bias towards threatening stimuli is indicated by speeded detection of a probe when it appears in the same location as threat stimuli, and avoidance indicated by speeded detection of a probe in the same location as neutral stimuli. Use of different presentation times of images is also thought to allow for a distinction between orientation and slowed disengagement. For example presentation times of 100ms, 200ms or 500ms are typically considered measures of initial orientation/early attention processing, and presentation times of 1500ms or 2000ms are typically considered measures of slowed disengagement/later processing (e.g. Brignell, Griffiths, Bradley, & Mogg, 2009; Field, Mogg, Zetteler, & Bradley, 2004; Koster, Baert, Bockstaele, & DeRaedt, 2010).

1.2.3. Reviews

Five reviews emerged from the literature review and a summary of their conclusions follow. Firstly, Faunce (2002) concluded that biases for food words are more robust than for body words. Dobson and Dozois (2004) then later concluded that effects for the food Stroop are stronger in bulimia nervosa (BN) than AN patients, and that food Stroop effects are confined to clinical ED samples. Likewise, Lee and Shafran (2004) concluded that biases are less consistent with non-clinical groups (restrained eaters and individuals with a high drive for thinness), and like Faunce (2002) they too concluded that biases are found more consistently with food words. Johansson et al. (2005) found an overall stronger bias towards food and body words in eating disordered females than in non-clinical individuals with food and body concerns, but additionally found those with food and body concerns had a marginally stronger bias towards these words than did normal controls (although not statistically significant). Recently, Giel, Teufel, Friederich, Hautzinger, Enck, and Zipfel (2011b) concluded that ED patients show an AB towards food pictures, and Brooks, Prince, Stahl, Campbell, and Treasure (2011) reviewed 43 studies investigating ABs towards food in AN, BN and restrained eaters. The latter is the largest review conducted to date, which concluded that AB is greater for ED patients than restrained eaters, with BN patients showing the largest AB.

1.2.4. Search Strategy

In the present review, a literature search was conducted using PsychInfo, Science Direct and Web of Science, with a combination of the search terms “attention bias”, “attentional bias”, “selective attention”, “disengagement”, “Stroop”, “dot probe”, and either “eating”, “eating disorder”, “restraint”, “diet”, “external eating”, “overeating”, or “binge”. Articles that assessed the influence of ED pathology, or any eating-related behaviour or attitude, on AB for food, body or threatening stimuli were included. A total of 81 studies were located and these were further subdivided according to clinical studies (further divided according to diagnosis) and non-clinical studies (further divided according to eating behaviour). This is the first review to cover the variety of non-clinical eating attitudes and behaviours that have been researched in relation to AB. The following sections outline research that has investigated the presence of AB in clinical ED patients. Subsequent sections outline research exploring the presence of AB in non-clinical females characterised by eating-related concerns. Later sections also summarise research that has investigated AB towards threat not directly related to eating and body concerns.

<u>1.3. Attentional Biases in Clinical Eating Disorder Patients</u>

1.3.1. Anorexia Nervosa (AN)

AN is characterised by a refusal to maintain a minimal normal body weight for age and height, with a disturbed perception of body size and an intense fear of gaining weight (DSM-IV: APA, 1994). Eighteen located studies have explored the presence of AB in AN patients over the last 20 plus years (see Table 1.1 for a summary of these findings).

1.3.1.1. Stroop Task

Channon, Hemsley, and deSilva (1988) were the first published study to investigate how patients diagnosed with EDs perform on a disorder-relevant Stroop task. They found that AN patients were slower than controls at colour-naming food and body words in a Stroop task, but particularly food words. Ben-Tovim, Walker, Fok, and Yap (1989) later found that AN, BN patients and normal controls, were all slower to colour-name food words than control words, with the strongest interference effect found amongst AN patients. Group differences did not reach significance for colour-naming of body-shape words. However, using the same Stroop task, Ben-Tovim, and Walker (1991) found that AN patients showed significantly more disruption in colour-naming of both food *and* body-shape words than two control groups of adolescents who scored high or low in drive for thinness. Both Cooper and Fairburn (1992) and Cooper and Todd (1997) also found that AN patients displayed an interference effect for both food and body-weight and -shape words. However, again Perpina, Hemsley, Treasure and deSilva (1993) found that AN patients were slower than a control group in colour-naming food words specifically. Furthermore, despite finding an overall interference effect for both food and body-shape words in AN patients compared to controls, Green, McKenna and deSilva (1994) found that this effect only remained constant for food words and habituated over time with body words. This suggests that interference effects for food words are more robust.

Studies up to this point had employed card Stroop tasks; however Sackville, Schotte, Touyz, Griffiths, and Beumont (1998) developed an alternative computer Stroop task with negative body-shape and -weight (e.g. fat), positive body-shape and -weight (e.g. thin), low-calorie food, high-calorie food and neutral words. They found that AN patients were delayed in colour-naming negative and positive shape words, with only a trend toward significant slowing for high-calorie food words. However, in the same year Perpina, Leonard, Treasure, Bond, and Banos (1998) found that AN patients were again slower than controls to colour-name food words and not body words.

Long, Hinton and Gillespie (1994) found that AN patients were significantly slower to colour-name both food and body-size words than control participants, but did not differ from obese restrained participants. However, there were no significant differences between AN patients' time to colour-name the food and body-size Stroop cards than their matched control cards. The same was found after weight normalisation three months later. Lovell, Williams, and Hill (1997) also examined Stroop performance in women who had recovered from AN, finding that such women displayed an interference effect for body-shape words compared to controls, suggesting the possible presence of an enduring cognitive bias in recovered anorexics.

Two later studies have addressed the possible influence of categorised versus uncategorised neutral words on Stroop performance. Green, Corr and DeSilva (1999) discuss the possibility that mere semantic relatedness of words in a category may mean that one word acts as a prime to the next, therefore increasing the interference of each following word. They included body-shape words, high associative strength words (birds), intermediate associative strength words (animals) and low associative strength words (unrelated) in their Stroop task. They found no significant difference between body-shape and high associative strength colour-naming times, with both leading to slower colour-naming than the more unrelated word categories. For the non-ED group there was no difference between the body category and any category of neutral words. However, the lack of difference between the body and high associative strength categories in the AN group could be explained by the inclusion of birds that are classed as food. Such words would therefore also be relevant to patients. The second study to investigate the influence of semantically-related neutral words involved careful selection of animal words so as not to include any animals eaten in Britain (Jones-Chesters, Monsell, & Cooper, 1998). In this study AN patients displayed slowed colour-naming of food and body words, with no such effect found in the high associative strength category.

One final Stroop study was found to be confusing in terms of methodology and therefore little comment can be made about their results, except that it does not seem to suggest the presence of an interference effect in AN patients (Mendlewicz, Nef, & Simon, 2001). In fact it seems that larger effects regarding healthy- and fatty-foods and disliked body parts were found in non-patient controls. It is unclear whether their results are due to a large number of methodological shortcomings. Such methodological limitations of Stroop studies will be discussed in a later subsection.

1.3.1.2. Dot Probe Task

Two studies have also assessed ABs in AN patients using the dot probe task. Blechert, Ansorge, and Tuschen-Caffier (2010) employed a pictorial dot probe task using eye tracking. In their task two photos appeared; one of the individual themselves and one of another participant's body, then after an interval of 150ms or 1100ms (intended to tap into difference stages of attention processing) a green frame appeared around one of the photos and the participant simply needed to look at that picture. They found that AN patients displayed an AB for photos of themselves compared to photos of others (at both time intervals) whereas the control group showed no AB. Furthermore, the more dissatisfied AN patients were with their body, the stronger their AB was.

The most recent study to investigate ABs in AN also used eye tracking with AN patients during a dot probe task. Giel, Friederich, Teufel, Hautzinger, Enck, and Zipfel (2011a) found that all groups (AN patients and non-fasted and fasted control groups) showed initial orienting towards food, and this effect was largest for the AN group. However, they found that the fasted group showed a strong significant tendency to initially fixate on the food picture for longer than the control pictures, and the AN group showed a slight tendency to fixate longer on the control pictures. Regarding attentional disengagement they found that both control groups showed a significant tendency to continually attend to food, but this was not found in the AN group. The authors conclude that AN patients show attentional *avoidance* of food.

1.3.1.3. Other Tasks

Two other located studies have investigated AB in restrictive AN patients (and AN subgroups of Eating Disorder Not Otherwise Specified: EDNOS). Veenstra and de Jong (2011) presented a pictorial Affective Simon Task (also referred to as a Stimulus Response Compatibility Task: SRC) in which a picture (high- or low-fat food or neutral) appears in the middle of the screen and a manikin appears above or below. The participant is then required to move the manikin towards or away from the picture with arrow keys. Contrary to predictions they found that participants responded faster when approaching low-fat foods, and there was no evidence of an orientation bias towards high-fat foods. One possibility for this finding is that the task may have been too difficult as there was a high error rate. Veenstra and de Jong (2012) employed an exogenous cueing task (Posner, 1980) which is very similar to the dot probe but only one image appears either to the left or right, followed by a cue either in the same location (valid trial) or in the opposite location (invalid trial). Veenstra and de Jong presented restrictive AN patients and healthy controls with high-fat, low-fat food and neutral pictures presented for 300, 500 or 1000ms. When pictures were presented for 500ms both restrictive AN patients and healthy controls showed initial attentional avoidance of high-fat food. No significant disengagement effects were found. AN patients' scores on the Eating Disorder Examination-Questionnaire (EDE-Q; Fairburn & Beglin, 1994) were significantly correlated with attentional engagement with low-fat food (i.e. higher scores associated with greater engagement with low-fat food). No biased attentional patterns were found in the 300ms or 1000ms conditions. The researchers explain these findings in relation to their reflection of the eating behaviours of AN patients (i.e. they avoid eating high-fat foods). However, given that healthy controls showed the same pattern this effect cannot be concluded as specific to AN patients.

Table 1.1: AB studies with AN patient samples

Author	Sample	Type of AB	Task	Stimuli	Measures	Key Findings	Support for AB?
Channon et al. (1988)	20 AN; 20 female controls	Orientation	Stroop (card)	FOOD, BODY	Unknown	AN patients were slower than controls at colour-naming food and body words.	Yes
Ben-Tovim et al. (1989)	17 AN; 19 BN; 38 female controls (staff at ED unit)	Orientation	Stroop (card)	FOOD, BODY	DSM-III	AN patients had a greater bias for food than BN patients and controls. No significant differences for body words.	Yes: Food only
Ben-Tovim & Walker (1991)	22 AN; 27 BN; 29 High DFT; 37 Low DFT	Orientation	Stroop (card)	FOOD, BODY	DSM-III, EDI	AN patients showed a greater bias for food and body words than two control groups (high/low DFT).	Yes
Cooper & Fairburn (1992)	12 AN; 12 BN; 12 'normal' dieters; 12 symptom-atic dieters; 12 'normals'	Orientation	Stroop (card)	FOOD, BODY	Unknown	AN patients displayed an AB towards food and body words.	Yes
Perpina et al. (1993)	15 AN; 14 BN; 32 female controls (matched for education & age)	Orientation	Stroop (card)	FOOD, BODY	RS, EDI, DSM-III	AN patients were slower than controls to colour-name food words.	Yes: Food only
Long et al. (1994)	37 AN; 51 obese restrictors;	Orientation	Stroop (card)	FOOD, BODY	DSM-III-R, EDI	AN patients were slower to colour-name food and	Yes

	45 female controls.					body words than controls, but no difference from obese restrictors.	
Cooper & Todd (1997)	12 AN; 12 BN; 18 female controls	Orientation	Stroop (card)	FOOD, BODY	DSM-III-R, EAT, BDI	AN patients had an AB towards food and body words.	Yes
Lovell et al. (1997)	31 AN; 24 BN; 23 Recovered AN; 11 Recovered BN; 33 controls	Orientation	Stroop (card)	FOOD, BODY	DSM-III-R	Recovered AN patients showed greater AB for body words than controls.	Yes: Body only
Sackville et al. (1998)	20 AN; 33 low restraint; 20 high restraint	Orientation	Stroop (computer with voice response)	FOOD (low/high calorie), BODY (negative/ positive)	DSM-IV, RS, EDI-2, EAT, BDI	AN patients had an AB for negative and positive body words and showed a trend towards an AB for high-calorie food words.	Yes
Perpina et al. (1998)	15 AN; 10 BN; 18 controls	Orientation	Stroop (card)	FOOD, BODY	DSM, EDI, RS, HADS, STAI	AN patients were slower at colour-naming food words than controls. No bias for body words.	Yes: Food only
Jones-Chesters et al. (1998)	16 AN; 16 controls (matched for age and social class)	Orientation	Stroop (computer with voice response)	FOOD, BODY, EMOTION, ANIMAL (high associative strength)	DSM-III-R, DEBQ-R, BSQ, EAT, HADS, BDI, SEQ	AN patients had an AB for food and body words and not the high associative strength category.	Yes
Green et al. (1999)	34 AN (restricting type); 39 female controls (matched for age and	Orientation	Stroop (computer with button response)	BODY, (and high associative strength; medium associative strength;	DSM-IV, EDI-2	No significant differences between colour-naming of body and high associative strength words.	Yes: but categorical effect

	SES)			low associative strength)			
Mendlewicz et al. (2001)	16 AN; 16 female controls (matched for age)	Orientation	Stroop (computer with voice response)	FOOD (low and high calorie), BODY (negative and neutral)	DSM-IV, EDI, STAI, BDI	Non-patient controls displayed greater AB for healthy- and fatty-foods and disliked body parts than AN patients.	No
Blechert et al. (2010)	19 AN; 18 BN; 21 female controls	Orientation, disengage-ment	Pictorial Dot Probe and Eye Tracking	BODY (own and others)	DSM-IV; EDE-Q; BIAQ; BCQ; STAI; BDI	AN patients displayed an AB towards their own bodies (at both time intervals). Controls showed no AB.	Yes: orientation and disengagement
Giel et al. (2011a)	19 AN; 38 female controls	Orientation, avoidance, disengage-ment	Eye Tracking	FOOD	DSM-IV	All participant groups showed initial orienting towards food (greatest in AN patients). Control groups were slow to disengage from food, but not the AN group.	Yes: orientation and avoidance (not slowed disengagement)
Veenstra & deJong (2011)	41 AN; 48 restricitve subgroup of EDNOS; 76 female controls (matched on age/education)	Orientation, avoidance	Pictorial SRC	FOOD (high/low fat)	EDE-Q	No evidence of orientation towards high-fat food in AN patients.	No

Veenstra & deJong (2012)	40 restrictive AN; 48 AN subgroups of EDNOS; 76 female controls (matched for age/ education)	Orientation, disengage-ment	Exogenous Cuing Task	FOOD (high/low fat)	EDE-Q	AN patients and healthy controls showed initial attentional avoidance of high-fat food. No significant disengagement effects were found.	No

1.3.2. Bulimia Nervosa (BN)

BN is characterised by episodes of binge eating followed by either self-induced vomiting, use of laxatives/diuretics, fasting or excessive exercise (DSM-IV: APA, 1994). Like AN, it also involves a disturbed perception of body size (DSM-IV: APA, 1994). Seventeen of the studies located investigated AB towards food and/or body stimuli in BN patients (see Table 1.2 for a summary of these studies).

1.3.2.1. Stroop Task

Ben-Tovim et al. (1989) found that BN patients and controls demonstrated an interference effect for food and body-shape words. A larger effect was found in BN patients than controls when colour-naming food words but not shape words. On the other hand, Davidson and Wright (2002) found that BN patients were significantly slower at colour-naming body-size compared to neutral words, with only a trend towards the same effect with food words. However, it should be noted that food disruption scores were greater for BN patients than the control group.

A large number of studies have found similar bias effects for both food and body stimuli. For example, Ben-Tovim and Walker (1991) found that BN patients displayed longer colour-naming times for food and body-shape words than two control groups of adolescents. In addition, Cooper and Todd (1997) found that BN patients showed slowed colour-naming for both food and body-weight words. Cooper and Fairburn (1992), Fairburn, Cooper, Cooper, McKenna, and Anastasiades (1991) and Cooper, Anastasiades, and Fairburn (1992) all found that BN patients took longer to colour-name both food and body words (although these words were combined in the latter two studies meaning that separate response times for food and body words were not analysed). Later, Jones-Chesters et al. (1998) found that BN patients showed large Stroop effects for both food and body words, and also for emotion words. Cooper and Fairburn (1993) also found that eating psychopathology, frequency of purging and general psychopathology, were correlated with both food and body Stroop interference among BN patients.

Interestingly, Perpina et al. (1993) found that AN patients were slower to colour-name a food Stroop, whereas BN patients were slower than the control group in colour-naming a body Stroop, suggesting there may be differences in AB between diagnoses. This is partially supported by Perpina et al. (1998) who found that only AN patients were slower to colour-name food words and showed little interference for body words, and BN patients showed slightly greater interference for body words than AN patients. However, these differences were not statistically significant, and in fact no significant interference was found in the body condition. The argument that biases differ in AN and BN patients is also disputed by the fact that AN patients in this study were found to have a higher skin conductance level for food *and* body stimuli than BN patients, despite displaying little interference for body words.

Five studies located have investigated whether Stroop interference in BN persists after treatment or recovery. The first of these found that an interference effect for food and body-shape and weight words decreased after 18 weeks of successful Cognitive Behavioural Therapy (CBT), Behaviour Therapy or Interpersonal Psychotherapy (IPT; Cooper & Fairburn, 1994). Secondly, Black, Wilson, Labouvie, and Heffernan (1997) found that both BN responders and non-responders to treatment took longer to colour-name food and weight/shape words than control words. However, both responders and non-responders got faster at colour-naming all groups of words post-treatment, suggesting this may simply have been due to practice effects. Carter, Bulik, McIntosh, and Joyce (2000) also found that BN patients were significantly faster at colour-naming all word types post-CBT. Lovell et al. (1997) also examined Stroop interference in recovered patients. They found that women currently suffering from BN were more distracted by body-shape words than women who had recovered and control participants. This suggests that AB does reduce following recovery in BN patients (although as mentioned earlier this was not the case with AN patients in this study). Following on from this, Flynn and McNally (1999) found that current BN, short-term recovered BN and long-term recovered BN groups showed more interference for body words than for animal control words. All groups showed less interference for food words than for the corresponding control words. Current BN sufferers showed the strongest interference from body words and the longer the individual had recovered from clinical BN, the weaker the cognitive bias was.

1.3.2.2. Dot Probe Task

Only one of the seventeen studies located used the dot probe to assess AB with BN patients. Blechert et al. (2010) employed a dot probe in which two photos appeared; one of the individual themselves and one of another person's body. With BN patients they found no significant AB. Although it is of interest to note that the pattern of results was the opposite of that of the AN patients discussed earlier; BN patients tended towards an AB towards other people's bodies. However, we cannot draw firm conclusions given the lack of significant results.

1.3.2.3. Other Tasks

Mobbs, Van der Linden, d'Acremont, and Perroud (2008) also investigated attention in BN patients. Although not having directly assessed AB, their findings are still relevant to the current discussion. They gave BN patients and controls an adaptation of the go/no-go affective shifting task with body and food stimuli. This task is a measure of the ability to shift attention from one stimulus to another (as opposed to either orientation or disengagement), and responses are thought to represent inhibition and discrimination. In this task words are rapidly presented one by one in the centre of the screen and participants are required to respond to targets by pressing the space bar as quickly as possible whilst withholding responses to distracters (with either the food/body or object words intermittently being the target). They found that BN patients had poorer discrimination and inhibition ability than controls, especially when the targets were related to food, showing that food stimuli capture attention and are processed more efficiently in BN patients.

Table 1.2: AB studies with BN patient samples

Author	Sample	Type of AB	Task	Stimuli	Measures	Key Findings	Support for AB?
Ben-Tovim et al. (1989)	17 AN; 19 BN; 38 female controls (staff at ED	Orientation	Stroop (card)	FOOD, BODY	DSM-III	Larger AB found in BN patients than controls when colour-naming food words but not body	Yes: Food only

	unit)					words.	
Ben-Tovim & Walker (1991)	22 AN; 27 BN; 29 High DFT; 37 Low DFT	Orientation	Stroop (card)	FOOD, BODY	DSM-III, EDI	BN patients displayed longer colour-naming times for food and body words than two control groups.	Yes
Fairburn et al. (1991)	24 BN; 50 female controls; 24 male controls	Orientation	Stroop (card)	FOOD, BODY (mixed together)	None reported	BN patients took longer to colour-name food/body words than controls.	Yes
Cooper & Fairburn (1992)	12 AN; 12 BN; 12 ‘normal’ dieters; 12 symptomatic dieters; 12 ‘normals’	Orientation	Stroop (card)	FOOD, BODY	Unknown	BN patients took longer to colour-name both food and body words than controls.	Yes
Cooper et al. (1992)	36 BN; 18 female controls	Orientation	Stroop (card)	FOOD, BODY (mixed together)	DSM-III-R, EAT, BDI	BN patients took longer to colour-name food/body words than controls.	Yes
Cooper & Fairburn (1993)	75 BN	Orientation	Stroop	FOOD, BODY (mixed together)	DSM-III-R, EAT, EDE-Q, BSQ, PSE, BDI	Eating psychopathology and frequency of purging were correlated with food and body Stroop interference amongst BN patients.	Yes
Perpina et al. (1993)	15 AN; 14 BN; 32 female controls (matched for education/ age)	Orientation	Stroop (card)	FOOD, BODY	RS, EDI, DSM-III	AN patients were slower to colour-name a food Stroop, whereas BN patients were slower than the control group in colour-naming a body Stroop.	Yes: Body only
Cooper & Fairburn (1994)	75 BN patients in a treatment	Orientation	Stroop (card)	FOOD, BODY	Unknown	AB for food and body words decreased after 18	Yes

	trial					weeks of successful CBT, Behaviour Therapy or IPT.	
Cooper & Todd (1997)	12 AN; 12 BN; 18 female controls	Orientation	Stroop (card)	FOOD, BODY	DSM-III-R, EAT, BDI	BN patients showed an AB towards both food and body-weight words.	Yes
Lovell et al. (1997)	31 AN; 24 BN; 23 Recovered AN; 11 Recovered BN; 33 controls	Orientation	Stroop (card)	FOOD, BODY	DSM-III-R	Women currently suffering from BN were more distracted by body words than women who had recovered and controls.	Yes: Body only
Black et al. (1997)	16 BN; 29 female controls	Orientation	Stroop (computer with button response)	FOOD, BODY	DSM-IV, RS	BN treatment responders and non-responders took longer to colour-name food and body words than control words, and got faster at colour-naming all words post-treatment.	Yes
Perpina et al. (1998)	15 AN; 10 BN; 18 controls	Orientation	Stroop (card)	FOOD, BODY	DSM, EDI, RS, HADS, STAI	BN patients showed greater interference for body words than AN patients (although non-significant). No significant interference found in the body condition.	No
Jones-Chesters et al. (1998)	16 BN; 16 controls (matched for weight, age and social class)	Orientation	Stroop (computer with voice response)	FOOD, BODY, EMOTION, ANIMAL (high associative strength)	DSM-III-R, DEBQ-R, BSQ, EAT, HADS, BDI, SEQ	BN patients showed large Stroop effects for food, body words, and emotion words.	Yes
Flynn &	15 current	Orientation	Stroop	FOOD	DSM-IV,	Current BN, short-	Yes:

McNally (1999)	BN; 15 short-term recovered (6 mths-4yrs) BN; 15 long-term recovered (+4yrs) BN; 13 non-dieting controls		(computer with voice response)	(high-calorie), BODY	BULIT-R, RS	term and long-term recovered groups showed more interference for body words than control words (strongest AB found in current BN group). All showed less interference for food words than control words.	Body only
Carter et al. (2000)	98 BN undergoing CBT	Orientation	Stroop (card)	FOOD, BODY (mixed together)	DSM-IV	BN patients were significantly faster at colour-naming all word types post-CBT.	Yes
Davidson & Wright (2002)	25 BN; 46 female controls	Orientation	Stroop (computer voice response and button response compared)	FOOD, BODY	DSM-III-R, EAT	BN patients were significantly slower at colour-naming body compared to neutral words, with only a trend towards the same effect with food words.	Yes: Body only
Mobbs et al. (2008)	18 BN; 18 female controls (matched for age/ education)	Orientation	Affective Shifting Task	FOOD, BODY	DSM-IV, STAI, EDI-2, BDI-2	BN patients had poorer discrimination and inhibition than controls, especially when the targets were related to food.	Yes
Blechert et al. (2010)	19 AN; 18 BN; 21 female controls	Orientation, disengage-ment	Pictorial Dot Probe and Eye Tracking	BODY (own and others)	DSM-IV; EDE-Q; BIAQ; BCQ; STAI; BDI	BN patients tended towards an AB towards other people's bodies (but non-significant).	No

1.3.3. Mixed ED Diagnoses

EDNOS refers to an ED which does not meet all of the criteria for AN or BN (DSM-IV: APA, 1994) and is the most commonly diagnosed ED in outpatient settings (e.g. Fairburn, Cooper, Bohn, O'Connor, Doll, & Palmer, 2007). Three studies have included an EDNOS patient group in their sample; however, these patients have always been grouped with AN and/or BN patients (hence samples were not purely EDNOS). Such studies will be discussed in this subsection (excluding one study: Veenstra & deJong, 2011, which is discussed in subsection 1.3.1.3 given that only AN subgroups of EDNOS were grouped with AN patients and findings were discussed in relation to restrictive AN specifically). A number of early investigations exploring AB among ED patients grouped AN and BN patients into one ED group, again leaving it impossible to separate out effects for these different diagnoses. Other studies found no differences between performance of AN and BN patients and so made overall conclusions. The findings of seven studies that fit these descriptions will be discussed in the following subsections (see Table 1.3 for a summary of these findings).

1.3.3.1. Stroop Task

Walker, Ben-Tovim, Paddick and McNamara (1995) gave a patient group (AN and BN patients) a modified Stroop task with images. The stimuli consisted of drawings of female figures (thin to obese) and control stimuli consisting of sports balls in different colours. The patient group took significantly longer than the control group to colour-name the figures than the balls. Stormark and Torkildsen (2004) also employed a computerised pictorial Stroop task with ED patients, whilst also comparing performance on a word Stroop task. They found that the ED group (AN and BN) were significantly slower to colour-name food and negative emotion words compared to neutral words, a pattern not found in the control group. The ED group were also slower for the food and negative emotion pictures compared to neutral pictures, whereas the control group were only slower for the negative emotion pictures compared to neutral.

1.3.3.2. Dot probe task

Rieger, Schotte, Touyz, Beumont, and Griffiths (1998) were the first to employ a dot probe task with ED patients. They found that both AN and BN patients directed their attention away from positive shape words (e.g. thin) and towards negative shape words (e.g. fat). Shafran, Lee, Cooper, Palmer and Fariburn (2007) also explored biases for food pictures using a dot probe task. Pictures reflected positive eating (low-calorie food), negative eating (high-calorie food), neutral eating (eating and preparation of food), positive shape (slim bodies/body parts) negative shape (plumper bodies/body parts), neutral shape (body parts less associated with weight and shape), and weight (weighing scales/people being weighed). In their first study ED patients (AN, BN, EDNOS) showed an AB towards negative eating stimuli but away from positive eating stimuli. Patients also demonstrated an AB towards weight stimuli. Biases were significantly greater than for anxious controls and those with high-, mid- and low-shape concern. They also found that the greater the core ED psychopathology, the greater the bias with negative eating stimuli. In a second study ED patients (AN, BN, EDNOS) again displayed an AB towards negative eating stimuli and away from positive eating stimuli. They also directed their attention towards negative shape and weight stimuli. The findings across these two studies demonstrate that ED patients have robust and reliable ABs for eating and weight stimuli, an effect not as strong regarding body-shape stimuli.

Shafran, Lee, Cooper, Palmer and Fairburn (2008) further investigated whether biases are modified by treatment. A subset of 31 of the sample from their 2007 study received 20 weeks of CBT. They found that bias scores for positive and negative eating stimuli reduced significantly after treatment, with no effects for shape stimuli. They also found significant positive correlations between changes on EDE-Q scores and changes in bias for negative shape and negative eating stimuli.

Lee and Shafran (2008) used the same dot probe stimuli as used previously (Shafran et al., 2007; 2008) whilst additionally acknowledging the role of temporal factors by adding a condition in which the inter-stimulus-interval (ISI) duration (i.e. the time between the stimuli disappearing and the probe appearing) was 2000ms. In the original 500ms ISI dot probe task they found information processing biases in ED patients (AN, BN, EDNOS) for negative and positive eating stimuli, negative and neutral shape stimuli and weight stimuli, but with the ISI of 2000ms they only found significant effects regarding the weight stimuli. In their correlational analyses they found a moderately significant correlation between bias scores for negative eating stimuli and over-evaluation of weight, shape, and control over eating, suggesting that greater core ED psychopathology leads to greater AB for negative eating stimuli.

1.3.3.3. Other Tasks

Smeets et al. (2008) employed a visual search task, which differentiates between speeded detection (increased orienting towards relevant stimuli) and distraction (slowed disengagement from relevant stimuli). In their version of the task a 5x4 matrix of 20 words appeared and the participant indicated whether there were 20 words of the same category or whether there was one from a different category. The matrix could include one disorder-relevant target word among 19 neutral distractor words (assessing speeded detection), or one neutral target word among 19 disorder-relevant distractor words (assessing slowed disengagement). They found that ED patients (AN and BN) showed evidence of speeded detection of body-related information, but not increased distraction. ED patients, on the other hand, showed evidence of increased distraction by high-calorie food words but not speeded detection. This suggests that the type of AB displayed by ED patients varies according to the type of stimuli.

Table 1.3: AB studies with general ED samples

Author	Sample	Type of AB	Task	Stimuli	Measures	Key Findings	Support for AB?
Walker et al. (1995)	20 AN/BN; 20 female controls (matched for age)	Orientation	Pictorial Stroop (card)	BODY	DSM-III-R	The patient group took significantly longer than the control group to colour-name the body than the neutral stimuli.	Yes
Rieger et al. (1998)	16 BN; 16 AN; 32 female controls	Orientation, avoidance	Dot Probe (computer with voice response)	BODY (negative and positive), EMOTION (negative and positive)	EDI-2, BSQ, RS, BDI, PASTAS	ED patients directed their attention away from positive shape words (e.g. thin) and towards negative shape words (e.g. fat).	Yes
Stormark & Torkildsen (2004)	7 AN; 6 BN; 7 EDNOS; 24 female controls	Orientation	Pictorial Stroop Task (computer with button response)	FOOD, NEGATIVE EMOTION	EDE-Q, ICD-10	The ED group were slower to colour-name food and negative emotion words/pictures compared to neutral words/pictures.	Yes
Shafran et al. (2007) Study 1	3 AN; 6 BN; 14 EDNOS; 19 high anxiety; 23 high shape concern; 21	Orientation, avoidance	Pictorial Dot Probe Task	FOOD (positive, negative, neutral), BODY (positive,	DSM-IV, EDE-Q, BAI, BDI-2	ED patients had an AB towards negative eating stimuli but away from positive eating stimuli. Patients had an AB	Yes

	moderate shape concern; 31 low shape concern			negative and neutral shape, and general weight)		towards weight stimuli. AB was significantly greater than all other participant groups.	
Shafran et al. (2007) Study 2	50 EDNOS; 27 BN; 5 AN; 44 female controls	Orientation, avoidance	Pictorial Dot Probe Task	FOOD (positive, negative, neutral), BODY (positive, negative and neutral shape, and general weight)	EDE-Q	ED patients had an AB towards negative eating stimuli and away from positive eating stimuli. They also directed their attention towards negative shape and weight stimuli.	Yes
Shafran et al. (2008)	31 ED receiving treatment (18 EDNOS; 13 BN); 24 on wait-list (15 EDNOS; 6 BN; 3 AN)	Orientation, avoidance	Pictorial Dot Probe Task	FOOD (positive, negative, neutral), BODY (positive, negative and neutral shape, and general weight)	EDE-Q	Bias scores for eating stimuli reduced significantly after treatment, with no effects for shape stimuli. Changes on EDE-Q scores were significantly correlated with changes in bias for negative shape/eating stimuli.	Yes
Lee & Shafran (2008)	3 AN; 6 BN; 14 EDNOS; 19 high anxiety; 31 low shape concern; 21 moderate shape concern; 23 high shape concern	Orientation, avoidance	Pictorial Dot Probe Task	FOOD (positive, negative, neutral), BODY (positive, negative and neutral shape, and general weight)	EDE-Q, BAI, BDI-2	With a 500ms ISI ED patients had an AB towards negative and positive eating stimuli, negative and neutral shape stimuli and weight stimuli, but with the ISI of 2000ms they had an AB for weight stimuli only.	Yes
Smeets et al. (2008)	22 AN restrictive; 24 AN purging; 22 BN; 60 controls	Orientation, disengage-ment	Visual Search Task (words)	FOOD, BODY	DSM-IV, RS, EDE-Q, EDI-2, BSQ, BDI	ED patients oriented towards body stimuli, and were slow to disengage from food stimuli.	Yes

1.4. Attentional Biases in Sub-Clinical and Non-Clinical Participants

1.4.1. Restraint/ Disinhibition

Restrained eating is the tendency for an individual to restrict their food intake in order to control their body weight (Herman & Mack, 1975). This is the most commonly researched non-clinical eating behaviour in relation to AB. Whereas restraint refers to conscious control of food intake, disinhibition refers to the breakdown of this cognitive control (Riener, Schindler, & Ludvik, 2006) in which the individual overeats and ‘counter-regulates’ (a term used to describe the tendency for restrained eaters to eat more after consuming a preload than after no preload e.g. Lowe, Foster, Kerzhnerman, Swain, & Wadden, 2001). A number of researchers have investigated whether ABs for food and body stimuli found in clinical ED patients are also present among restrained and/or disinhibited eaters. Twenty-three located studies are outlined below (see Table 1.4 for a summary of these studies).

1.4.1.1. Stroop Task

Two early studies have leant initial support to the possibility of AB being present in restrained eaters. Although not specifically looking at the measured construct of restraint, Cooper and Fairburn (1992) found that symptomatic dieters showed a colour-naming interference effect for food, body-weight and shape words. Later, Perpina et al. (1993) also compared groups according to high scores on the Restraint Scale (RS: Herman, Polivy, Pliner, Threlkeld, & Munic, 1978). They found that restrained eaters were slower than unrestrained eaters to colour-name food words. However, the high restraint group included clinical patients so conclusions for non-clinically restrained eaters cannot be separated out in this study.

Green and Rogers (1993) were the first researchers to have included a non-clinical group of restrained eaters. In their computerised Stroop task they found that highly restrained eaters according to scores on the Dutch Eating Behaviour Questionnaire (DEBQ; Van Strien, Fijters, Bergers, & Defares, 1986) were slower to colour-name food and body words than neutral words, and compared to low and medium restrained eaters. The interference was a function of restraint as opposed to self-reported dieting behaviour. Mahamedi and Heatherton (1993) also looked at the effect of restraint on body and food Stroop performance across two studies. They found no effect of restraint or a high-calorie preload on food interference. They did, however, find that the preload led to increased interference for body words, an effect larger for restrained eaters. In contrast, Overduin, Jansen and Louwerse (1994) found that restrained eaters are slow to colour-name food words (regardless of whether they had received an appetizer or not), whereas unrestrained eaters showed greater colour-naming interference if they had received an appetizer only. They found no differences between restrained and unrestrained eaters regarding interference for body words and no effect of receiving an appetizer on colour-naming of body words.

Long et al. (1994) aimed to investigate food and body Stroop performance in overweight restrained eaters. Obese restrictors and controls completed food and body-shape Stroop cards faster than control cards, contrary to expectations. However, a number of methodological shortcomings in this study may have accounted for these unexpected results (as will be discussed in a following methodological critique of Stroop investigations).

Huon and Brown (1996) aimed to further assess the robustness of food and body Stroop interference with female dieters with high scores on the restraint subscale of the Three Factor Eating Questionnaire (TFEQ; Stunkard & Messick, 1985). They failed to find a significant difference between colour-naming times of body and neutral words, or between anxiety-provoking body words and non-anxiety provoking body words. They did, however, find greater interference for food words than their matched neutral words.

Black et al. (1997), as mentioned previously with regard to their findings with BN patients, also investigated biases among restrained eaters. They found that restrained eaters, unrestrained eaters and BN patients showed interference for food and weight/shape words compared to control words, with BN patients only shown to be slightly slower than restrained eaters. Francis, Stewart and Hounsell (1997) found that restrained eaters showed greater interference for forbidden (i.e. high-calorie) and non-forbidden (low-calorie) food words than unrestrained eaters, and compared to animal words. Likewise, Stewart and Samoluk (1997) found that high and medium restrained eaters took longer to colour-name forbidden food cards than a control card, with no bias found in unrestrained eaters.

Sackville et al. (1998), as noted previously in relation to their findings with AN patients, also divided students into restrained or unrestrained eaters. However, in their food and body Stroop task they found few differences in overall performance between high and low restraint groups. Jansen, Huygens, and Tenney (1998) also found that highly restrained eaters showed neither automatic nor later controlled processing biases for body words. In contrast, however, low restrained eaters showed a colour-naming interference effect for body words and highly restrained eaters did not. These results do not support the presence of either early or late processing biases for body stimuli in restrained eaters.

Lattimore, Thompson and Halford (2000) later administered a food and body Stroop task to school-aged girls. They found that restrained eaters aged 14 and 15 showed a colour-naming interference effect for food, but 12-13 year old unrestrained eaters also showed this interference effect for food. They failed to find any interference for body words. Tapper, Pothos, Fadardi, and Ziori (2008) later separated participants into high disinhibition/low restraint and high restraint/low disinhibition groups. They found a significantly greater interference effect for food compared to neutral words in a card Stroop, which was largest for British participants (compared to those from Greece and Iran). Restraint significantly predicted this effect, and the results showed a trend towards an effect of disinhibition.

1.4.1.2. Dot Probe Task

As described earlier, Rieger et al. (1998) employed a dot probe task with clinical ED patients, but additionally divided a sample of students into high and low restraint groups. They found no significant AB among the high restraint group; however, the AB scores reported suggest that the high restraint group had a tendency to direct their attention towards negative shape words, whereas the low restraint group tended to direct attention away. Both the high and low restraint groups also appeared to have a slight tendency to direct their attention towards positive shape words. Boon, Vogelzang, and Jansen (2000) conducted a dot probe task with food words as well as body words, finding neither attention towards nor cognitive avoidance of food or body stimuli in restrained or unrestrained eaters.

Papies, Stroebe and Aarts (2008) recently found that after food exposure restrained eaters displayed an AB towards palatable food words, which depended on the perceived hedonic rating of the foods. This effect was not found in unrestrained eaters. In their second experiment they added an extra condition in which diet primes were briefly presented before the word pairs in the dot probe task. Again they found that restrained eaters in the food exposure condition displayed an AB towards palatable food, but they also found that those in the diet prime condition did not display an AB towards food.

A published abstract has also shed some light on ABs in restrained and disinhibited eaters. Maalouf and Yeomans (2010) found that only those high in disinhibition showed an AB towards food words, and no effect of restraint was found. Those high in disinhibition also consumed more snacks after the task. In contrast, Ahern, Field, Yokum, Bohon, and Stice (2010) found that both restrained *and* unrestrained eaters displayed an AB towards food.

1.4.1.3. Other Tasks

A number of other tasks have also been employed in the investigation of AB in restrained and/or disinhibited eaters. For example, Ahern et al. (2010) found that all participants were faster to approach than avoid appealing and non-appealing foods in an SRC task (as described earlier), with no effect of restraint. However, Veenstra and deJong (2010) who also employed an SRC task found that only high scorers on the RS showed enhanced approach tendencies for both low- and high- fat foods.

Veenstra, deJong, Koster and Roefs (2010) employed an exogenous cuing task, and to further differentiate between initial orientation bias and disengagement they included two presentation durations of stimuli: 500ms and 1500ms. They found that restrained and unrestrained eaters showed initial avoidance of high-fat foods compared to neutral stimuli in the 500ms condition. Correlational analyses also revealed that disinhibited eaters showed slower attentional engagement for high-fat food and no evidence of difficulty disengaging from high-fat food. No significant effects were found in the 1500ms condition, indicating that there were no disengagement effects. Hollitt et al. (2010) also differentiated between orientation and disengagement in their investigation. Following Smeets et al. (2008) they employed a visual search task with high-calorie food and neutral words. They found evidence of speeded detection of food but no evidence of slowed disengagement among restrained eaters, directly contrasting with the findings of Smeets et al (2008).

One final investigation worth mentioning is that of Meule, Lukito, Vogele, and Kubler (2011), who although they did not include a direct measure of AB, do make conclusions relevant to the current discussion. In their study they employed an XY task (Garavan, Ross, Murphy, Roche, & Stein, 2002) in which participants press a button for every target that is different to the previous one, while high-calorie food pictures or neutral pictures surround the target. They found that restrained eaters were slower than unrestrained eaters when high-calorie food pictures appeared, which was thought to reflect an AB towards food. Given that they did not increase in error when exposed to food cues, the researchers further claimed that restrained eaters were able to disengage from food cues. However, they acknowledge that one cannot conclude on the exact mechanisms of AB and disengagement using their task, but their speculative conclusions are worthy of note nonetheless.

Table 1.4: AB studies with restrained and/or disinhibited eaters

Author	Sample	Type of AB	Task	Stimuli	Measures	Key Findings	Support for AB?
Cooper & Fairburn (1992)	12 AN; 12 BN; 12 'normal' dieters; 12 symptomatic dieters; 12 'normals'	Orientation	Stroop (card)	FOOD, BODY	Unknown	Symptomatic dieters had an AB towards food and body words.	Yes
Perpina et al. (1993)	15 AN; 14 BN; 32 female controls (matched for education/ age)	Orientation	Stroop (card)	FOOD, BODY	RS (scores 16+ high restraint), EDI	Restrained eaters were slower than unrestrained eaters to colour-name food words.	Yes: Food only
Green & Rogers (1993)	55 females (27 low-medium restraint; 15 high restraint; 13 current dieters)	Orientation	Stroop (computer with button response)	FOOD, BODY	DEBQ (median-split?), EAT, BSQ	Only highly restrained eaters had an AB for food and body stimuli.	Yes
Mahamedi & Heatherton (1993)	47 females (half allocated to preload condition)	Orientation	Stroop (card)	FOOD, BODY	RS (16+ high restraint)	Preload led to increased interference for body words: this effect was largest for restrained	Yes: Body only

						eaters.	
Overduin et al. (1994)	51 females (26 high restraint; 25 low restraint): half allocated to preload condition	Orientation	Stroop (computer with voice response)	FOOD (high-calorie), BODY	RS (median-split)	Restrained eaters had an AB for food; unrestrained eaters only had an AB for food after a preload. No effects for body words.	Yes: Food only
Long et al. (1994)	37 AN; 51 obese restrained eaters; 45 female controls.	Orientation	Stroop (card)	FOOD, BODY	TFEQ-R, EDI	Obese restrictors and controls completed food and body Stroop cards faster than control cards.	No
Huon & Brown (1996)	30 female dieters (high restraint)	Orientation	Stroop (card)	FOOD (high and low calorie), BODY (positive and negative)	TFEQ-R (13+ for high restraint), EDI	No significant difference between colour-naming of body and neutral words, or between negative/positive body words. Dieters showed greater interference for food than neutral words.	Yes: Food only
Black et al. (1997)	16 BN; 29 female controls (16 high restraint, 13 low restraint)	Orientation	Stroop (computer with button response)	FOOD, BODY	RS	Restrained eaters, unrestrained eaters and BN patients showed interference for food and body words compared to control words, with BN patients only slightly slower than restrained	Yes

						eaters.	
Francis et al. (1997)	28 females (14 high restraint; 14 low restraint)	Orientation	Stroop (computer with voice response)	FOOD (low and high calorie)	RS (16+ high restraint)	Restrained eaters showed greater interference for high/low calorie food words than unrestrained eaters, and compared to animal words.	Yes
Stewart & Samoluk (1997)	25 females; 7 males (11 high restraint; 10 medium restraint; 11 low restraint): half allocated to food-deprivation condition	Orientation	Stroop (card)	FOOD (high-calorie), ALCOHOL	RS (16+ high restraint; 11-15 medium restraint; 0-10 low restraint)	High and medium restrained eaters took longer to colour-name a food than a control card, with no bias found in unrestrained eaters.	Yes
Sackville et al. (1998)	20 AN; 33 low restraint; 20 high restraint	Orientation	Stroop (computer with voice response)	FOOD (low/high calorie), BODY (negative/ positive)	DSM-IV, RS, EDI-2, EAT, BDI	Few differences in overall performance between high and low restraint groups.	No
Jansen et al. (1998)	28 females (15 high restraint; 13 low restraint)	Orientation, disengage-ment	Stroop (computer with voice response)	BODY	RS (median-split: 11)	Restrained eaters showed neither automatic nor later controlled processing biases for body words. But low restrained eaters showed an AB towards body words.	No
Rieger et	16 BN; 16	Orientation,	Dot Probe	BODY	EDI-2, BSQ,	Restrained	Yes

al. (1998)	AN; 32 female controls (divided into high/low restraint)	avoidance	(computer with voice response)	(negative and positive), EMOTION (negative and positive)	RS (15+ high restraint), BDI, PASTAS	eaters had a (non-significant) tendency to direct attention towards negative shape words, whereas the low restraint group tended to direct attention away.	
Lattimore et al. (2000)	152 females (69 aged 12-13; 83 aged 14-15)	Orientation	Stroop (card)	FOOD, BODY	DEBQ-R (median split: 2.71), EDI	Restrained eaters aged 14-15 showed an AB towards food, but 12-13 year old unrestrained eaters also showed an AB towards food. No AB for body words.	Yes: Food only
Boon et al. (2000)	59 females (30 low restraint; 29 high restraint)	Orientation, avoidance	Dot Probe	FOOD, BODY	RS (median split: 13)	No evidence of AB towards or cognitive avoidance of food or body stimuli in restrained or unrestrained eaters.	No
Tapper et al. (2008)	224 male/ female students (UK, Greece, Iran): divided into high disinhibition/ low restraint and high restraint/low disinhibition groups	Orientation	Stroop (card)	FOOD (mixture of low and high calorie)	DEBQ-R, DEBQ Emotional and External Eating scales combined: scores dichotomised above/below 3.	Significant bias for food compared to neutral words, largest for British students. Restraint significantly predicted AB, trend towards an effect of disinhibition.	Yes

Papies et al. (2008) Study 1	104 students (male and female) randomly assigned to pre-exposure or non-exposure to food conditions	Orientation, avoidance	Dot Probe	FOOD (high-calorie)	RS	After food exposure restrained eaters had an AB towards food, which depended on the perceived hedonic rating of the foods. Not found in unrestrained eaters.	Yes
Papies et al. (2008) Study 2	138 students (male and female) randomly assigned to pre-exposure, pre-exposure plus diet prime, or non-exposure to food conditions	Orientation, avoidance	Dot Probe	FOOD (high-calorie)	RS	Restrained eaters in the food exposure condition displayed an AB towards food, but those in the diet prime condition did not display an AB towards food.	Yes
Maalouf & Yeomans (2010) Study 1	50 females (divided into high/low restraint/ disinhibiton)	Orientation, avoidance	Dot Probe	FOOD (high-calorie)	Unknown	Those high in disinhibition had an AB towards food. No effect of restraint was found.	Yes: disinhibition only
Maalouf & Yeomans (2010) Study 2	88 females (divided into high/low restraint/ disinhibiton)	Orientation, avoidance	Dot Probe	FOOD (high-calorie)	Unknown	Those high in disinhibition again had an AB towards food and consumed more snacks.	Yes: disinhibition only
Ahern et al. (2010)	63 females (divided into high and low	Orientation, avoidance	Dot Probe and SRC	FOOD (high/low calorie)	DEBQ-R	All displayed an AB towards food in the dot probe.	No

	restraint)					All were faster to approach than avoid foods in the SRC task, with no effect of restraint.	
Veenstra & deJong (2010)	Female students: 28 high restraint; 27 low restraint	Orientation, avoidance	SRC	FOOD (high/low calorie)	RS (highest quartile 14+ high restraint; lowest quartile 7 and below low restraint), DEBQ	Only restrained eaters showed approach tendencies for both low- and high- fat foods.	Yes
Veenstra et al. (2010)	28 high restraint; 27 low restraint	Orientation, disengage-ment	Exogenous Cuing Task	FOOD (high/low calorie)	RS (highest quartile 14+ high restraint; lowest quartile 7 and below low restraint), DEBQ	Restrained and unrestrained eaters avoided high-fat foods. Disinhibited eaters showed slower attentional engagement for high-fat food. No disengagement effects.	No
Hollitt et al. (2010)	78 females (38 high restraint; 40 low restraint)	Orientation, disengage-ment	Visual Search Task	FOOD (high calorie)	DEBQ-R (median split: 3)	Restrained eaters had an AB towards food but no evidence of slowed disengagement.	Yes: orientatio n only
Meule et al. (2011)	61 females	Orientation, disengage-ment	XY Task	FOOD (high calorie)	RS	Restrained eaters had an AB towards food but were able to disengage.	Yes: orientatio n only

1.4.1.4. Methodological Limitations of Restraint Research

One key concern in AB research with restrained eaters is that the concept of restraint is often mixed up with the separate concept of disinhibition. This is mostly through the use of the RS to measure restraint. There is evidence that individuals scoring high on the RS include both successful and unsuccessful dieters (Soetens, Braet, Dejonckheere, & Roets, 2006) and food is likely to lead to different attention processing in inhibited and disinhibited restrainers. Many researchers have recently critiqued the use of the RS and have pointed towards the DEBQ as an improved assessment of restraint. This is because it measures restraint and tendency to overeat separately (through three separate subscales: Restraint, Emotional Eating and External Eating). In contrast, the RS confounds restraint with disinhibition (e.g. Placanica, Faunce, & Job, 2002; Tapper et al., 2008). The majority of the studies discussed have employed the RS as an indication of restraint only, or have referred to it as a measure of disinhibition/overeating (e.g. Veenstra & deJong, 2010). Such studies cannot comment on the separate contributions of restraint and disinhibition on AB.

1.4.2. External Eating

Another aspect of eating behaviour that has been researched in relation to AB is external eating. This is defined as an increased tendency to eat in response to external cues, such as sight or smell of food rather than in response to internal hunger state (e.g. Hou, Mogg, Bradley, Moss-Morris, Peveler & Roefs, 2011). Five studies have explored AB for food/body stimuli amongst external eaters and are outlined below (see Table 1.5 for a summary of these studies).

1.4.2.1. Stroop Task

Johansson, Ghaderi and Andersson (2004) were the first to investigate the relationship between external eating and attention processing of food and body stimuli. They found no significant differences between high and low external eaters on a Stroop task with high-calorie and negative body words, although there was a trend for an interference effect for food words. Later, Newman, O'Connor and Conner (2008) measured participant's stress levels, given that high external eaters are thought to increase snack intake when stressed. High and low external eaters completed a Stroop task with food words (both high- and low-calorie), with half of the participants allocated to a stress condition. They found that both low and high external eaters in both the stress and no-stress conditions displayed a colour-naming interference for food words, with low external eaters in the no-stress condition unexpectedly showing the greatest interference effect. However, when responses to snack words alone (as opposed to meal words) were examined they found that high external eaters tended to show a greater interference effect in the stress condition than the no-stress conditions, whereas low external eaters tended towards the opposite pattern.

1.4.2.2. Dot Probe Task

Johansson et al. (2004) also found that high external eaters directed their attention away from high-calorie food words and low external eaters directed attention towards these words in a dot probe task. Brignell et al. (2009), however, found that high external eaters showed a significantly greater AB for food than low external eaters, and this remained significant after controlling for desire to eat.

Hou et al. (2011) point out that previous studies looking at the relationship between external eating and AB towards food have not assessed impulsivity. They found that external eating and AB for food pictures were significantly correlated; however, this did not remain significant after controlling for impulsivity. This requires replication, but this initial finding may suggest that impulsivity is a greater predictor of AB towards food than external eating.

1.4.2.3. Other Tasks

Brignell et al. (2009) employed an SRC task to assess attention processing in external eaters. They found that high external eaters had a significantly greater approach bias for food than low external eaters. Nijs, Franken, and Muris (2009) assessed attention processing by measuring event related potentials (ERPs) to provide further insight into the processing of external eaters. They found enlarged P300 amplitude (widely accepted as an index of selective attention) in high external eaters as opposed to low external eaters in response to looking at food pictures only (and not when looking at positive or neutral images). This suggests an AB towards such self-relevant stimuli.

Table 1.5: AB studies with external eaters

Author	Sample	Type of AB	Task	Stimuli	Measures	Key Findings	Support for AB?
Johansson et al. (2004)	43 females (22 high external eaters; 21 low external eaters)	Orientation, avoidance	Stroop (computer with voice response) and dot probe	FOOD (high-calorie) BODY (negative)	DEBQ (external scale median split: 3.6), EAT, BSQ, RSES	Stroop: no significant differences between high/low external eaters, but a trend towards an AB for food. Dot Probe: external eaters avoided high-calorie food, non-external eaters had an AB towards food.	No
Newman et al. (2008)	66 male/female participants (36 high external eaters; 30 low)	Orientation	Stroop (computer with voice response)	FOOD	DEBQ (external eating scale: top and bottom 20%), stress levels, STAI	Low and high external eaters in both stress and no-stress conditions had an AB towards food.	No
Brignell et al. (2009)	19 high external eaters; 24 low (male and female)	Orientation, avoidance	Dot Probe and SRC	FOOD (high and low calorie mixed together)	DEBQ (external scale: those close to the median excluded), desire to eat	Dot Probe: high external eaters had a significantly greater AB for food than low external eaters. SRC: high external eaters had a significantly greater approach bias for food than low external eaters.	Yes
Nijs et al. (2009)	49 females (24 low external eaters; 25 high external)	Orientation	EEG whilst viewing food images	FOOD (high-calorie)	ERPs	Enlarged P300 amplitude in high external eaters in response to food pictures only.	Yes
Hou et al. (2011)	29 females, 13 males	Orientation (but used 2000ms	Dot Probe	FOOD (high and low calorie	DEBQ-External, Impulsivity	External eating and AB for food were significantly	Yes (but impulsivity a stronger

presentation time: often used to assess disengage-ment)	mixed together)	(BIS)	correlated but this did not remain after controlling for impulsivity.	predictor?)

1.4.3. General Eating Psychopathology

A number of researchers have also investigated the role of eating psychopathology (in non-clinical samples) in predicting AB towards food and/or body stimuli. The aspects of eating psychopathology that have been investigated in AB research include bulimic symptoms in non-clinical women, a general drive for thinness (DFT) and general body dissatisfaction. Twelve studies have explored AB in these participants groups (see Table 1.6 for a summary of these studies).

One study was located in which the predictive value of overall eating psychopathology on AB was assessed. Using eye gaze data Jansen, Nederkoorn and Mulkens (2005) found that a group of non-clinical high EDE-Q scorers spent more time looking at self-identified ‘ugly’ body parts on pictures of themselves than on their identified ‘beautiful’ body parts. On others, however, they focused on their beautiful body parts. The opposite pattern was found among low scorers.

1.4.3.1. Bulimic Symptoms

1.4.3.1.1. Stroop Task

One study looked specifically at the predictive value of bulimic symptoms in non-clinical women on attention processing of food and body words (Formea & Burns, 1996). These authors separated female participants into a non-bulimic-non-depression group, a depressed-non-bulimic group and a bulimic group (according to high scores on the Bulimia-Test-Revised; Thelen, Farmer, Wonderlich, & Smith, 1991). They found that only the bulimic group took significantly longer to colour-name food, body-shape and -weight words than control words. There was also a tendency for the bulimic group to make more errors than controls on disorder-related words.

1.4.3.2. Drive for Thinness

1.4.3.2.1. Stroop Task

DFT, as measured by the Eating Disorder Inventory (EDI; Garner, Olmstead & Polivy, 1983), is defined as excessive concern with dieting, preoccupation with weight and an extreme DFT. A few studies have looked at the influence of DFT in non-clinical populations on attention processing of food and/or body stimuli. Firstly, Ben-Tovim and Walker (1991) found no differences between adolescents with high and low DFT on food and body-shape Stroop cards. Perpina et al. (1993), however, found that a high DFT group were slower than a low DFT group to colour-name body words, but found no differences between groups in colour-naming of food words. However, the high-DFT group included clinical participants so it cannot be concluded that these biases are present in non-clinical individuals with a high DFT.

Green, Elliman, Rogers, and Welch (1997) later found that those high in DFT were slower to colour-name body-shape words than neutral words, but only when a picture of chocolate was present during the task. Food words were colour-named slower than neutral words overall and this effect was not predicted by DFT. It is also worth noting that Sackville et al. (1998) carried out correlations between DFT scores on the EDI and Stroop interference. They found that these scores were significantly correlated with interference for both negative and positive body-shape words, but again DFT was not correlated with food interference. However, Lattimore et al. (2000) found that individuals with a high DFT took significantly longer to colour-name food words compared to neutral words, but this was not found in the low DFT group. There was no effect on colour-naming body words, directly contrasting with previous findings.

1.4.3.2.2. Other Tasks

Hewig, Cooper, Trippe, Hecht, Dipl-Ing, Straube, and Miltner (2008) measured eye gaze of individuals high and low in DFT. They found that compared with those low in DFT, those high in DFT looked longer and more often at the waist, hips, arms and legs of images of men and women. The authors conclude that those high in DFT have an AB towards body parts associated with assessing change in weight.

1.4.3.3. Body Dissatisfaction

1.4.3.3.1. Dot Probe Task

Three studies have assessed the effect of body dissatisfaction on AB towards body stimuli. Smith and Rieger (2010) allocated participants to one of three induction conditions: body dissatisfaction induction (involving a vignette read to the participant who was required to imagine they were the person involved who was being criticised about their body), mood induction vignette and a neutral vignette. A dot probe task with negative body-weight and -shape words was then administered. They found that despite successfully inducing body dissatisfaction, there was no difference between biases for weight/shape words in participants in the body dissatisfaction condition compared to those in the neutral condition. In contrast, Glauert, Rhodes, Fink and Grammer (2010) investigated AB towards bodies in already body-dissatisfied women. They found that when a thin body and a fat body were presented in a dot probe task for either 500ms or 150ms, all participants displayed an AB towards thin bodies which was not predicted by body dissatisfaction scores. However, after making the thin image less extreme, they found that body dissatisfaction was significantly negatively correlated with bias towards thin bodies.

More recently Gao, Wang, Jackson, Zhao, Yi Liang and Chen (2011a) assessed orientation towards and disengagement from fat- and thin-related words (presented for 1000ms) in a dot probe task whilst tracking eye movements. They found that weight-dissatisfied women had more initial fixations on fat words than did control participants (but groups did not differ in frequency of initially fixating on thin words). Through looking at dot probe data alone they found that weight-dissatisfied women were faster to respond to probes in the same location as fat words than thin words, and in comparison to control participants. Weight-dissatisfied women were slower than control participants to disengage from fat words, but these group differences were not statistically significant. The authors argue that the lack of significant differences between groups in terms of disengagement biases may have been due to presenting images for only 1000ms whereas previous researchers have used longer durations such as 2000ms when assessing ability to disengage (e.g. Castellanos, Charboneau, Dietrich, Park, Bradley, Mogg, & Cowan, 2009).

1.4.3.3.2. Other Tasks

Gao, Deng, Chen, Luo, Hu, Jackson and Chen (2011b) measured ERPs whilst body-dissatisfied and control women viewed fat, thin and neutral words. They found that for weight dissatisfied women only, amplitudes associated with both early attention processing (N100, N170) and later attention processing (P3) were sensitive to body words. These effects were greater for fatness-related words.

None of the studies discussed in this section have assessed the influence of body dissatisfaction on processing of food stimuli. Given that overall food biases have been found more consistently in eating research this requires investigation.

Table 1.6: AB studies with eating psychopathology samples

Author	Sample	Type of AB	Task	Stimuli	Measures	Key Findings	Support for AB?
Ben-Tovim & Walker (1991)	22 AN; 27 BN; 29 High DFT; 37 Low DFT	Orientation	Stroop (card)	FOOD, BODY	DSM-III, EDI (DFT subscale)	No differences between high/low DFT groups on food and body Stroop cards.	No
Perpina et al. (1993)	15 AN; 14 BN; 32 female controls (high/low DFT)	Orientation	Stroop (card)	FOOD, BODY	EDI	The high DFT group had an AB towards body words, but not food words.	Yes: body only
Formea & Burns (1996)	22 bulimic; 25 non-bulimic non-depressed; 12 depressed non-bulimic	Orientation	Stroop (computer with voice response)	FOOD (high-calorie), BODY	BDI, BULIT-R	Only the bulimic group took significantly longer to colour-name food and body words than control words.	Yes
Green et al. (1997)	72 females (high/low DFT: allocated to chocolate condition, picture of chocolate condition or	Orientation	Stroop (computer with button response)	FOOD (high-calorie), BODY	EDI, DEBQ	High DFT: slower to colour-name body words than neutral, only when a picture of chocolate was present. Food words were colour-named slower than neutral but this was not	Yes

	control)					predicted by DFT.	
Sackville et al. (1998)	20 AN; 33 low restraint; 20 high restraint	Orientation	Stroop (computer with voice response)	FOOD (low/high calorie), BODY (negative/ positive)	DSM-IV, RS, EDI-2 (DFT), EAT, BDI	DFT was significantly correlated with interference for negative and positive body words, but not with interference for food words.	Yes: body only
Lattimore et al. (2000)	152 females (69 aged 12-13; 83 aged 14-15)	Orientation	Stroop (cards)	FOOD, BODY	DEBQ-R, EDI (DFT)	High DFT group took significantly longer to colour-name food words compared to neutral. There was no effect on colour-naming body words.	Yes: Food only
Jansen et al. (2005)	13 eating symptom-atic; 13 'normal' controls	Orientation, disengage-ment	Eye gaze	BODY (ugly/ beautiful body parts)	EDE-Q	Eating symptomatic group spent more time looking at 'ugly' body parts on themselves than on their 'beautiful' parts. On others, they focused on their beautiful parts. The opposite pattern was found among controls.	Yes
Hewig et al. (2008)	51 male/female participants (high/low DFT)	Orientation	Eye gaze	BODY	EDI-2	Those high in DFT had an AB towards body parts associated with assessing change in weight.	Yes
Smith & Rieger (2010)	54 females (allocated to either body dissatisfact-ion, mood or neutral conditions)	Orientation, avoidance	Dot Probe	BODY (negative)	PASTAS, BSQ	No differences between conditions in colour-naming of body words.	No
Glauert et al. (2010) Study 1	49 female students	Orientation, avoidance	Dot Probe	BODY (thin and fat)	BSQ	All participants displayed an AB towards thin bodies, which was not predicted by body	No

						dissatisfaction.	
Glauert et al. (2010) Study 2	50 female students	Orientation, avoidance	Dot Probe	BODY (thin and fat: less extreme than study 1)	BSQ	Body dissatisfaction was significantly negatively correlated with AB towards thin bodies.	Yes
Gao et al. (2011a)	20 weight-dissatisfied women; 20 female controls	Orientation, disengage-ment	Dot Probe and eye tracking	BODY (fat and thin)	NPS-F	Weight-dissatisfied women: significantly greater orientation bias for fat words than female controls, and slow to disengage from fat words (but non-significant)	Yes
Gao et al. (2011b)	17 body dissatisfied women; 15 female controls	Orientation, disengage-ment	ERPs	BODY (fat and thin)	NPS-F	Weight dissatisfied women: amplitudes associated with both early and later attention processing were sensitive to body words (particularly fat words).	Yes

1.4.4. Overweight/Obesity

Six studies have explored the effect of being overweight/obese on AB for food and/or body stimuli (see Table 1.7 for a summary of these studies).

1.4.4.1. Stroop Task

Braet and Crombez (2003) found that obese children had greater interference when colour-naming food words compared to normal-weight children. However Phelan, Hassenstab, McCaffery, Sweet, Raynor, Cohen and Wing (2010) found no significant difference between obese and normal-weight adults on a food Stroop.

1.4.4.2. Dot Probe Task

Castellanos et al. (2009) gave obese and normal-weight participants a dot probe task to complete whilst assessing eye movements. They found that obese adults, in both fasted and satiated states, displayed an enhanced initial orientation towards and maintained attention on food (compared to normal-weight individuals). Nijs, Muris, Euser, and Franken (2010) gave participants a dot probe task whilst recording eye movements and electrophysiological brain activity. They found that overweight/obese participants displayed an enhanced automatic orientation towards food in a hungry state (compared to a satiated state, and compared to a normal-weight group). There were no differences between groups or conditions in maintained attention. Werthmann, Roefs, Nederkoorn, Mogg, Bradley, and Jansen (2011) also measured eye movements during a dot probe task and found that overweight participants showed more frequent initial orientations towards food, but showed reduced holding of attention on food. Craving was also found to be positively correlated with initial orientation bias.

1.4.4.3. Other Tasks

Graham, Hoover, Ceballos and Komogortsev (2011) explored whether high body mass index (BMI) influences attention processing of high-calorie sweet and savoury foods in comparison to low-calorie foods. They presented participants with pairs of images (either high-calorie sweet and high-calorie savoury, high- and low-calorie sweet, or high- and low-calorie savoury) and measured eye movements. They found that the high BMI group were more likely than the low BMI group to initially fixate on low-calorie foods. They also found that the high BMI group decreased in pupil diameter when looking at high-calorie sweet foods compared to high-calorie savoury foods. These results were contrary to predictions, and possible reasons for this include not controlling for hunger prior to the task, and not including an actual task requiring concentration from the participants. Rather, pictures were simply presented to participants meaning that they may have not been paying attention to the food images, thus reducing likelihood of encoding.

Table 1.7: AB studies with overweight/obese samples

Author	Sample	Type of AB	Task	Stimuli	Measures	Key Findings	Support for AB?
Braet & Crombez (2003)	34 male/female children undergoing CBT for severe obesity; 40 matched controls	Orientation	Stroop (computer with voice response)	FOOD (mixture of high and low calorie), NEGATIVE EMOTION	DEBQ, BMI	Obese children had greater interference when colour-naming food words compared to normal-weight children.	Yes
Castellanos et al. (2009)	36 females (normal-weight or obese): allocated to fasted or fed conditions	Orientation, disengage-ment	Dot Probe and eye tracking	FOOD (high/low calorie)	BMI, TFEQ, DEBQ	Both fasted and satiated obese adults displayed an AB towards and slowed disengagement from food.	Yes
Phelan et al. (2010)	15 long-term weight-loss maintainers; 19 normal weight; 14 obese	Orientation	Stroop (computer with button response)	FOOD (high/low calorie)	BMI, TFEQ	No significant differences between obese and normal-weight adults on a food Stroop.	No
Nijs et al. (2010)	40 normal-weight; 26 overweight/ obese (allocated to hunger or satiety)	Orientation, disengage-ment (although used 500ms presentation often used to assess orientation)	Dot probe, eye tracking, EEG	FOOD (high-calorie)	DEBQ, BMI	Obese participants had an AB towards food when in a hungry state.	Yes
Werthmann et al. (2011)	22 overweight/ obese; 29 normal weight	Orientation, disengage-ment	Dot probe and eye tracking	FOOD (high-calorie)	BMI	Overweight participants showed more initial orientations towards food, but showed reduced holding of attention on food.	Yes: orientation only

Graham et al. (2011)	36 females (high/low BMI)	Orientation	Eye tracking	FOOD (high-calorie sweet, high-calorie savoury, low calorie)	BMI, RS	High BMI: initially fixated on low-calorie foods, and decreased in pupil diameter when looking at high-calorie sweet compared to high-calorie savoury foods.	No

1.5. Negative Mood

It is possible that negative mood causally influences biased processing of food, given that both clinically eating disordered and non-clinical females with eating-related concerns increase eating in response to negative mood. A large body of naturalistic research has shown that negative mood precedes binge eating episodes in bulimic patients (e.g. Davis, Freeman, & Garner, 1988; Davis, Freeman & Solymon, 1985; Johnson & Larson, 1982), particularly eating of snacks and desserts in such mood-induced binge episodes (Davis et al., 1988). Naturalistic studies have also shown that restrained eaters overeat in response to stress (e.g. Wardle, Steptoe, Oliver, & Lipsey, 2000), both dieters and non-dieters increase intake of snack foods as opposed to meal foods under stress (Oliver & Wardle, 1999), with chocolate and ice cream being found as preferable comfort eating foods among females (Wansink, Cheney, & Chan, 2003). Restrained eaters are also found to report significant weight gain after onset of depression (Polivy & Herman, 1976). In addition, restrained eaters are found to increase intake in response to negative emotion or stress induced in the lab (e.g. Baucom & Aiken, 1981; Cools, Schotte, & McNally, 1992; Epel, Lapidus, McEwen, & Brownell, 2001; Frost, Goolkasian, Ely, & Blanchard, 1982; Heatherton, Herman, & Polivy, 1991; Mitchell & Epstein; 1996; Polivy & Herman, 1999; Polivy, Herman, & McFarlane, 1994; Ruderman, 1985; Rutledge & Linden, 1998; Schotte, Cools, & McNally, 1990; Wallis & Hetherington, 2004).

A recent finding may suggest that AB acts as a mediating factor in the negative mood-eating relationship. Hepworth, Mogg, Brignell and Bradley (2010) found that induced negative mood increased AB towards, and slowed the ability to disengage, from food in a dot probe task (with 500ms and 2000ms presentation durations). Furthermore, AB correlated with emotional, external and restrained eating scores on the DEBQ. Negative mood also increased subjective appetite. The authors conclude that “negative affect increases the reward value of food cues and activates the food reward system, which, in turn, increases motivation to eat, as reflected by increased subjective appetite and attention being captured by food cues” (p.139). Additionally, Rofey, Corcoran and Tran (2004) found that negative mood and bulimic symptoms interacted to predict AB towards food words in a Stroop task (see Table 1.8 for an overview of these studies).

Table 1.8: AB studies assessing the influence of mood

Author	Sample	Type of AB	Task	Stimuli	Measures	Key Findings	Support for AB?
Rofey et al. (2004)	165 females	Orientation	Stroop (computer with button response)	FOOD (high-calorie)	BULIT-R, PANAS	Negative mood and bulimic symptoms interacted to predict AB towards food.	Yes
Hepworth et al. (2010)	80 females (37 assigned to neutral; 43 assigned to negative)	Orientation, disengage-ment	Dot Probe	FOOD (high and low calorie mixed together)	DEBQ, BDI-II, VAS, POMS	Negative mood increased AB for food. AB correlated with restraint, external and emotional eating. Negative mood increased appetite.	Yes

1.6. Ego threat biases

It has been claimed that focusing on food concerns alone provides an incomplete explanation of eating psychopathology (McManus & Waller, 1995) because this only addresses the superficial presentation of the problem (Ainsworth et al., 2002). Grilo, Shiffman and Carter-Campbell (1994) suggest that greater focus should be on the role of emotion and threat in relation to eating. Heatherton, Herman and Polivy (1991) conclude that ego threats (threats to self-esteem and emotional stability) are more likely to lead to overeating than physical threats. This is because ego threats lead to intolerable negative affect and a need to escape from it which is achieved through cognitive narrowing, which in turn leads to disinhibition of behaviours such as eating (Heatherton & Baumeister, 1991). In this model, bingeing reflects an attempt to escape from self-awareness through the blocking of negative emotions and cognitions. Heatherton and Baumeister (1991) stress the importance of internal ego threats in the cause of emotional states that lead to the need to reduce awareness. Others focus on external events such as loss or sexual conflict (Lacey,

1986) or victimisation (Root & Fallon, 1989). From looking at the escape from self-awareness model of bulimia and the hypothesised role of internal and external ego threats in the onset of bulimic symptoms, it can be concluded that biased processing of threat in bulimia is important to investigate.

Interpersonal threat (i.e. threat to self-esteem from others) is also very relevant to the concerns of individuals with restrictive tendencies. Interpersonal stress is a vital contributor to EDs as, for example, problematic interpersonal relationships are thought to be a key maintaining factor for AN (Schmidt & Treasure, 2006), with IPT found to be a largely successful treatment for AN (e.g. McIntosh, Bulik, McKenzie, Luty, & Jordan, 2000). Interpersonal difficulties are also found to precede binge eating in restrained individuals (Tanofsky-Kraff, Wilfley, & Spurrell, 2000), and experimental studies show that ego-threatening stimuli in a Stroop task leads to overeating in restrained eaters (e.g. Lattimore & Maxwell, 2004; Wallis & Hetherington, 2004). Such findings stress the importance of investigating potential biases for threats unrelated to eating and the body, but still relevant to those with bulimic and restrictive tendencies. Researchers have indeed begun to investigate ABs for such threats described, and this initial research is outlined below (see Table 1.9 for a summary).

There are five main types of threat investigated: sociotropy (social isolation/rejection), autonomy (personal control), physical threat, ego threat from others (i.e. interpersonal threat) and ego threat from self. Waller, Watkins, Shuck and McManus (1996) found significant correlations between AB towards self-directed ego threats in a Stroop task and the Bulimia, Social Insecurity and Ineffectiveness subscales of the EDI. When divided into high and low EDI scorers, it was found that participants in the high bulimia group had a significantly larger bias towards self-directed ego threats. McManus, Waller and Chadwick (1996) extended this investigation to a clinical group of BN patients. They found that BN patients took longer to colour-name all five types of threat than control words, whereas the comparison women were only significantly slower to name sociotropy and ego-self threat words. Furthermore the BN group were significantly more distracted than the comparison women by autonomy, discomfort anxiety and ego-self threat words, with ego-others threat words approaching significance. They also found that ego-self threat bias was significantly correlated with frequency of bingeing, vomiting and Bulimic Investigatory Test-Edinburgh (BITE; Henderson & Freeman, 1987) scores.

Using an anagram task with ego self-threat and ego other-threat words, Waller and Meyer (1997) later found that high scorers on four subscales of the EDI (ineffectiveness, interpersonal distrust, interoceptive awareness and social insecurity) took longer to process ego-self-threat words. Meyer, Serpell, Waller, Murphy, Treasure and Leung (2005) also found slower processing of ego threat anagrams in ED patients, which was stronger for BN patients.

Meyer, Waller and Watson (2000) gave 50 females a visual search task that measured the time taken to identify the presence of a target word (threat or neutral) in an array of words. They found that women with bulimic attitudes were slower to respond to self-directed ego-threats, and there were no links with restriction. However, Quinton (1998) found an overall bias for all threat words compared to neutral words in dieters and non-dieters. Later in 2004, Quinton also found biases for these threats in bulimic, anorexic and non-clinical women, and concluded that threat information is also relevant to restrictors and non-clinical groups.

Johansson, Lundh, and Andersson (2005) also found that body dissatisfied women have a larger delay in colour-naming performance-related threat than interpersonal threat words (equivalent to ego-threat from others), after being primed with a thin ideal image. However, they only focused specifically on body dissatisfaction, therefore a bias for interpersonal threat words cannot be ruled out from those with general bulimic and restrictive tendencies.

More recently Harrison, Sullivan, Tchanturia and Sullivan (2010a) hypothesised that anger is a highly threatening emotion for ED patients and thought to contribute to disordered eating. They found that an ED group (AN and BN) had longer colour-naming times for angry faces than neutral faces in a pictorial Stroop task, with no differences between diagnoses. This emphasises the importance of interpersonal stimuli in attention processing of ED patients. Harrison, Tchanturia and Treasure (2010b) also found that AN patients had an AB towards angry faces in a Stroop task, whereas recovered anorexics did not, suggesting these difficulties are removed when the individual recovers from the disorder.

Table 1.9: Studies assessing biased attention processing of ego threatening stimuli

Author	Sample	Type of AB	Task	Stimuli	Measures	Key Findings	Support for AB?
Waller et al. (1996)	80 females (aged 16-26)	Orientation	Stroop (computer: method of response unknown)	Sociotropy, Autonomy, Physical, Ego threat from others, Self-directed ego threats	EDI	The high bulimia group had a significantly larger bias towards self-directed ego threats.	Yes: self-directed ego threats only
McManus et al. (1996)	Unknown	Orientation	Stroop (form unknown)	Sociotropy, Autonomy, Physical, Ego threat from others, Self-directed ego threats	BITE	BN patients had an AB for all threat words; controls only had an AB for sociotropy and ego-self threats.	Yes
Waller & Meyer (1997) Study 1	30 females	Orientation	Anagram solution task (card)	Food, General Threat	EDI	High scorers on the EDI took longer to process food and threat words than controls.	Yes
Waller & Meyer (1997) Study 2	50 students (male and female)	Orientation	Anagram solution task (card)	Physical, Ego self, Ego others	EDI	High scorers on four subscales of the EDI (ineffectiveness, interpersonal distrust, interoceptive awareness and social insecurity) took longer to process ego-self-threat words.	Yes: ego-self threat only.
Quinton (1998)	81 female non-dieters; 19 female dieters	Orientation	Stroop (card)	Threat (different categories mixed together)	EAT	Dieters and non-dieters had an AB towards all threat words.	Yes
Meyer et al. (2000)	50 females	Orientation	Visual search task	Ego-Self Threats	EDI	Women with bulimic attitudes were slower to respond to self-directed ego-threats.	Yes: women with bulimic attitudes only
Quinton (2004)	15 AN; 15 BN; 33 controls	Orientation	Threat Processing Task (identify presence/	Sociotropy, Autonomy, Physical, Ego threat from others,	DSM-IV	Bulimic, anorexic and non-clinical women had an AB for all threats.	Yes

			absense of word in an array)	Self-directed ego threats			
Johansson et al. (2005)	87 females	Orientation	Stroop (computer with voice response)	Interpersonal threat, Performance threat	BDI, BSQ, EAT, RSES, STAI	Body dissatisfied women had an AB towards performance related threat after being primed with a thin ideal image.	Yes: performance threat only
Meyer et al. (2005)	50 ED (28 AN; 22 BN); 50 female controls	Orientation	Anagram solution task (card)	Food, Ego Threat	DSM-IV, EDI	ED patients were slower to process ego threat anagrams than control participants (strongest for BN patients).	Yes
Harrison et al. (2010a)	190 females (50 AN; 50 BN; 90 healthy controls)	Orientation	Pictorial Stroop (computer with voice response)	Angry Faces	DSM-IV, EDE-Q	ED group had longer colour-naming times for angry faces than neutral faces.	Yes
Harrison et al. (2010b)	175 females (50 AN; 35 recovered AN; 90 healthy controls)	Orientation	Pictorial Stroop (computer with voice response)	Angry Faces	DSM-IV, EDE-Q	AN patients had an AB towards angry faces whereas recovered anorexics did not.	Yes

<u>1.7. Methodological Limitations</u>

1.7.1. Overall Methodological Limitations

A number of methodological limitations across the Stroop and dot-probe studies reviewed emerged from the literature review. Concerns arose from the food and body words chosen in some investigations; for example, some researchers have included in their food category a range of actual food words alongside general eating words such as ‘dinner’ or ‘picnic’ (e.g. Channon et al., 1988; Davidson & Wright, 2002; Long et al., 1994; Mahamedi & Heatherton, 1993; Stormark & Torkildsen, 2004). Such general eating words are less likely to induce a bias given the lack of reference to an actual food item. There is further concern with grouping both low- and high-calorie foods into one category (e.g. Tapper et al., 2008) given that these foods are likely to differ in their effect on restrained eaters, disinhibited eaters or ED patients. This is due to high-calorie foods being forbidden in their nature and therefore having high desirability. Regarding body stimuli, words chosen are often subjective in their reference to body size or shape e.g. 'monstrous' (Long et al., 1994), 'ponderous' or 'thick' (Jansen et al., 1998). Body parts selected as being disliked are also subjective, for example Mendlewicz et al. (2001) included 'nose' as a disliked body part. Therefore, a key methodological point to consider is how stimuli are selected. Getting ratings of words and images from patients or women displaying the variable of interest is recommended to ensure that stimuli fit into the categories they are intended to represent.

Another issue regards inadequate matching of participant and control groups. For example, Long et al. (1994) and Ben-Tovim and Walker (1991) did not match their groups according to age. An additional problem in the study by Perpina et al. (1998) was the inclusion of staff at an ED unit in a control group. Such individuals may also have displayed a bias towards ED-related stimuli given their familiarity with such stimuli. Among restraint research, in some cases there has also been no inclusion of an unrestrained control group (e.g. Huon & Brown, 1996).

One major methodological weakness of a large number of studies, particularly in relation to investigating food biases, is not accounting for hunger. Hunger has been found to induce a bias towards food stimuli in a number of investigations (e.g. Channon & Hayward, 1990; Mogg, Bradley, Hyare & Lee, 1998; Placanica et al., 2002). Therefore, checking for the influence of hunger may have enlightened equivocal results in some cases. However, even in some investigations where hunger has been assessed it has been measured after completion of the task (e.g. Jones-Chesters et al., 1998). This does not indicate whether hunger before the task affected their performance, and hunger may have increased after exposure to food in the task.

There are also concerns regarding when questionnaires are administered to participants. For example, in some studies (e.g. Cooper et al., 1992; Cooper & Fairburn, 1993) eating questionnaires were administered prior to completing an AB task, which may have primed their concerns before completing the task.

A further concern which relates particularly to the ego-threat literature, is that of not accounting for anxiety or depression (e.g. McManus et al., 1996). Given that anxiety and depression are often associated with threat biases it is important to establish whether these symptoms account for the bias found, as opposed to eating psychopathology.

Additionally a number of researchers have not counterbalanced the order of food, body and neutral conditions/blocks in their tasks (e.g. Black et al., 1997; Cooper & Fairburn, 1992; Fairburn et al., 1991; Long et al., 1994; Mendlewicz et al., 2001). In the ego threat literature, a number of researchers have also not counterbalanced the order of threat categories (e.g. McManus et al., 1996; Waller et al., 1996). This is problematic as the participant may get fatigued or bored throughout the task and this may alter response times in later blocks. The issue of counterbalancing is also relevant to any dot probe study including different versions of the task. For example, Lee and Shafran (2008) did not counterbalance the order of two different ISI duration conditions.

One final overall methodological issue to consider concerns the optimal type of stimuli included in tasks. A large number of researchers (e.g. Shafran et al., 2007) believe that words as opposed to images limit ecological validity, whilst images are believed to be a more sensitive index of AB than words (e.g. Shafran et al., 2007).

1.7.2. Methodological Limitations of Stroop Research

A number of methodological shortcomings specific to Stroop studies were noted. Such limitations may have accounted for inconsistent/null results. A number of early studies (e.g. Ben-Tovim et al., 1989; Ben-Tovim & Walker, 1991; Carter et al., 2000; Channon et al., 1988; Cooper & Fairburn, 1992; Green et al., 1994; Huon & Brown, 1996; Long et al., 1994; Mahamedi & Heatherton, 1993; McManus et al., 1996; Quinton, 1998) employed the card version of the Stroop task, with response times for a list of words on a card being timed by the researcher using a stopwatch. By using this method, as opposed to the more recently employed computerised version of the task, some argue it is unknown as to whether the Stroop effect is item-specific or whether it is a result of a cumulative effect of a sequence of words (Jones-Chesters et al., 1998). It is also worth noting that this method does not allow for an exclusion of errors (Jones-Chesters et al., 1998). Davidson and Wright (2002) also point out that in using a card Stroop with one list of target words, the participant may increase in anxiety which could globally affect their performance. They also point out problems with the experimenter timing colour-naming given that they are not blind to participant group or the hypothesis. The card method, therefore, is not objective or accurate. On the other hand, with the computerised version of the task, experimenter expectancy effects are removed. There are also methodological concerns with employing a voice-response method which is considered to be less reliable than a button-press response (Davidson & Wright, 2002). This is important to note given that a number of investigations reviewed employed a voice-response method (e.g. Black et al., 1997; Francis et al., 1997; Johansson et al., 2004; Jones-Chesters et al., 1998; Mendlewicz et al., 2001).

A further methodological issue concerns the use of target (e.g. food and body) words. For example, a number of early studies combined food and body words onto one card (e.g. Carter et al., 2000; Cooper et al., 1992; Fairburn et al., 1991), which leaves it impossible to distinguish between biases for these separate stimuli. Bias scores could reflect a bias only for food stimuli, or could be a result of combined food and body words which may not remain when separated out. There are additional methodological concerns regarding neutral/control words. For example, the majority of early clinical Stroop studies have not included a category of neutral words (e.g. Fariburn et al. 1991), and therefore one cannot rule out the mere inclusion of a single semantic category causing the pattern of response. Some categories of neutral stimuli may also not be considered entirely unrelated to ED concerns. For example, Walker et al. (1995) used sports balls as neutral stimuli; however, these are exercise-related and therefore potentially relevant to the body concerns of ED patients.

1.8. Attention Training

Attention training (AT) involves systematic, experimental manipulation of AB using computerised attention tasks. Studies demonstrating the presence of AB among eating disordered patients may persuade us towards the relevance of an AT programme for such individuals. However, the usefulness of AT can only be established by demonstrating a causal or maintaining basis of AB to the disorder. Studies that have shown AB to be present in eating disordered patients do not allow the assessment of causation (i.e. whether AB causes disorder symptoms), but merely suggest a relation between disorder symptoms and AB (Amir, Beard, Burns, & Bomyea, 2009). However, cognitive models theorise that elimination of a threat bias should lead to reductions in disorder symptoms (e.g. MacLeod & Rutherford, 2004; Schmidt, Richey, Buckner, & Timpano, 2009).

MacLeod, Rutherford, Campbell, Ebsworthy and Holker (2002) found that it might be possible to eliminate AB directly through experimentally manipulating attention. They gave individuals with normal anxiety levels a dot probe task where an emotionally negative and a neutral word were presented simultaneously for 500ms, with half the participants given the probe always in the location of the negative word and the other half always in the location of the neutral word. This was designed to induce a temporary AB toward or away from negative stimuli. After training, participants carried out the traditional dot probe, were given an impossible anagram task and were assessed on negative mood state. Those in the Attend Negative training condition were faster to detect probes in the same location as negative stimuli, with the opposite in the Attend Neutral condition. Furthermore, the Attend Negative group reported greater elevated negative mood after the stressful task. The Attend Neutral group displayed no negative emotional response to the stress task, and the training also reduced anxiety and depression ratings in this group. Following this study, a growing body of research has explored the effect of AT on various disorder symptoms. Researchers have mostly followed the basic AT design of MacLeod et al. (2002); however, variations are found in stimulus type (e.g. words or pictures), stimulus presentation duration, AB measurement, and conditions (e.g. some have included a non-training control condition).

A number of investigations have demonstrated that AT reduces AB for disorder-relevant stimuli and correspondingly reduces disorder symptoms. For example AT has been found to reduce anxiety (e.g. Amir et al., 2009; Hazen, Vasey & Schmidt, 2008), social anxiety (e.g. Amir, Weber, Beard, Bomyea & Taylor, 2008; Li, Tan, Qian & Liu, 2008; Schmidt et al., 2009) and depression (e.g. Wells & Beevers, 2010). In addition it has been found to reduce alcohol consumption in alcoholics (e.g. Schoenmakers, de Bruin, Lux, Goertz, Van Kerkhof & Wiers, 2010).

AT has not yet been adequately applied to the EDs. However, three studies have attempted to investigate its applicability. Engel, Robinson, Wonderlich, Meier, Wonderlich, Crosby, et al. (2006) successfully manipulated attention towards or away from the locations of body weight/shape words. They tested 73 'normal' female students with an adapted version of the original MacLeod et al. (2002) task with body and neutral words, presented for 800ms. ED behaviours were assessed using the

EDI-2 only at post-training, therefore the impact of AT on change in EDI-2 scores could not be assessed. They found that those in the avoidance training condition had higher EDI-2 scores generally (but only significantly higher for the bulimia subscale), and concluded that avoidance of disorder-relevant stimuli is in fact *not* helpful for ED patients. Their conclusions are questionable given the positive findings for avoidance training in other disorders, and methodological limitations of the study (such as not measuring questionnaire scores before training, and therefore not knowing whether the questionnaire scores they obtained were higher to begin with or whether they increased due to AT). One also cannot conclude from this study that the questionnaire scores were due to induced changes in AB, as AB was not measured either before or after training, leaving their conclusions open to scrutiny.

Smith and Rieger (2006, 2009) are the only other authors to date to have also published research on AT in relation to eating behaviours. Smith and Rieger (2006) found initial support for a causal role of AB in exacerbating body dissatisfaction. A non-clinical sample was trained to attend to negative body words (e.g. fat), neutral targets (e.g. car) or negative emotion words (e.g. hate), presented in pairs for 500ms. They were then given a body image challenge in which they were required to look at 10 adverts and rate their agreement with statements prompting them to focus on appearance, body comparison, or aesthetic qualities of the advert. AB induction was successful for all groups, and participants in the shape/weight group had significantly higher mean body dissatisfaction scores than both of the other groups.

Later, Smith and Rieger (2009) also included food stimuli and assessed the effect of AT on dietary restriction. They trained ‘normal’ females to attend towards one of the following: positive body words (e.g. ‘thin’), negative body words (e.g. ‘fat’), positive (low-calorie) food words (e.g. ‘salad’), or negative (high-calorie) food words (e.g. ‘chocolate’). They measured the impact on AB immediately after training and then administered the same body image challenge and a food selection task (presented as a market research study in which participants were explicitly asked to choose between evaluating low-fat or full-fat biscuits). After this they were assessed on questionnaire measures of body dissatisfaction and restraint. The induction of the bias was successful, and the Attend Negative Body group scored significantly higher on state body dissatisfaction compared to the neutral group. There was a significant effect on food selection for only the Attend Negative Food group, such that the odds of choosing the low-fat over the full-fat biscuit was almost five times higher across all individuals in this group, compared with the neutral. Corresponding with the claims of a number of other researchers (e.g. Mathews & MacLeod, 2002) they conclude that selective attention towards negative shape and food words acts as a cognitive vulnerability factor that modifies later processing of threatening body and food information (such as engaging in social comparison when viewing media images of thin women or choosing foods).

Smith and Rieger (2009) concluded that biases towards negative shape and weight stimuli negatively affected body dissatisfaction, and that biases towards negative food stimuli lead to greater dietary restriction, pointing towards the usefulness of an AT program that reduces these biases. However, given that they did not assess body dissatisfaction and restraint before AT, conclusions cannot yet be drawn as to whether AT towards positive stimuli, or simply away from negative stimuli, can modify body image and dietary restriction. Further consideration is also needed with regard to what food and body stimuli are being classed as positive and negative. There may be a danger in classing words such as ‘thin’ and ‘salad’ as ‘positive’, as opposed to ‘fat’ and ‘chocolate’ as ‘negative’. Further investigation would be needed with regard to any possible harmful effects of training attention towards such ‘positive’ words in clinical samples. There is potential to bias people towards a thin ideal which could be harmful in the case of, for example, those suffering with AN. It may be that training attention away from all body and food stimuli may be more beneficial in clinical groups, as opposed to trying to categorise stimuli into positives and negatives. Further investigation into which stimuli is appropriate in training for non-disordered and ED patients is needed. Further clarification with non-ED patients will help to inform interventions for clinical patients.

1.9. Summary

In summary, there has been a vast amount of research into the influence of various forms of eating behaviours and attitudes on attention processing of food, body and ego threatening stimuli. Sixteen studies found that AN patients display an AB for food and/or body words compared to only two that did not find evidence of an AB in AN patients (see Table 1.1). Out of the 17 studies located only two found no significant AB in BN patients (see Table 1.2). As can be seen in clinical research there is a much larger support basis for AB for food than body stimuli, as concluded by a number of previous reviewers (e.g. Faunce, 2002; Lee & Shafran, 2004). In studies that have compared food and body ABs in AN patients, there is greater support that food biases are more robust than body biases (as found in five studies) than vice versa (found in two studies: see Table 1.1). However, five studies have also found little difference between these biases (see Table 1.1). When looking separately at food and body findings, 11 studies found than AN patients have an AB for food, compared to only three studies who did not find this (see Table 1.1). Regarding biases towards body stimuli, eight studies found that AN patients have an AB for body stimuli with five studies found not to be so supportive (see Table 1.1). In BN research there is less support for the claim that food biases are more robust. Only two located studies found a larger AB effect for food stimuli compared to body stimuli, with the majority (eight studies) finding comparable biases for food and body stimuli (see Table 1.2). Three located studies found slightly larger interference effects for body stimuli than food (see Table 1.2). When ED patients with different diagnoses are grouped together further support is found for a bias towards food (e.g. Shafran et al., 2007, 2008; Stormark & Torkildsen, 2004; Walker et al., 1995) and slowed disengagement from food (Smeets et al., 2008), with some further evidence of a bias towards body stimuli (Rieger et al., 1998; Shafran et al., 2007, 2008; Smeets et al., 2008).

Biases have been found more consistently in clinical ED patients than in non-clinical participants grouped according to restraint, external eating, and non-clinical eating psychopathology. The presence of AB in females with these non-clinical attitudes/behaviours remains ambiguous; however, the large number of methodological shortcomings in such research may account for null or inconsistent findings. Further research with refined methodological design is required to investigate whether restrained eaters, external eaters and those with various aspects of non-clinical eating psychopathology do actually display consistent ABs towards food. Looking at the vast amount of studies exploring the existence of AB in restrained eaters, it can again be seen that biases are greater and more consistent for food stimuli than body stimuli. Fifteen of the studies located found AB for food in restrained eaters (see Table 1.4), although it should be noted that two of these studies found this effect in unrestrained eaters as well (Ahern et al., 2010; Black et al., 1997). This is compared to only five studies that did not find evidence of AB for food in restrained eaters (see Table 1.4). On the other hand, only three located studies found evidence of AB for body stimuli in restrained eaters with one study finding this effect in unrestrained eaters also, compared to nine studies finding no evidence of AB for body stimuli in restrained eaters (see Table 1.4).

Regarding biases towards ego threatening stimuli, research is still in its early days. There is not the same amount of research as with food and body stimuli. Although initial research is supportive of the presence of ABs towards ego threats in both clinical and non-clinical individuals, clarification is still required regarding whether this effect is restricted to women with bulimic or restrictive tendencies. Furthermore, it remains to be seen whether clinical ED patients and non-clinical women with eating-related concerns are also slow to disengage from ego threatening stimuli. A much larger body of research has measured AB towards food, body or threatening stimuli than has investigated slowed disengagement from such stimuli. This is concerning given that in a number of other disorders slowed disengagement as opposed to initial orientation has been demonstrated to be the dominant bias in attention (e.g. Fox et al., 2001; Van Damme, Crombez, & Notebaert, 2008). Preliminary findings that have explored these two sub-components of attention in eating research have been conflicting. In one study AN and BN patients were slow to disengage from high-calorie food words, with no evidence of an orientation bias (Smeets et al., 2008), and in another AN patients have been found to orient towards food followed by avoidance, with no evidence of slowed disengagement (e.g. Giel et al., 2011a). Further conflicting these findings, Blechert et al. (2010) found AN patients had both an AB towards and slowed disengagement from photos of their own body. Restrained eaters have also been found to initially orient towards food but not be slow to disengage (Hollitt et al., 2010), and in another instance found to initially *avoid* high-fat food, again with no evidence of difficulty disengaging (Veenstra, deJong, Koster & Roefs, 2010). Further research is required in order to clarify which of these sub-components of AB is more dominantly found in these individuals. Research is also required on whether external eaters and those with non-clinical eating psychopathology are also slow to disengage from food stimuli (some initial research has explored this with body stimuli).

1.10. Aims of the Thesis

It is important to explore biases in attention processing given that biases for food and body stimuli are thought to maintain and exacerbate dysfunctional eating behaviours and attitudes. Initial research has shown that AT can successfully modify AB and correspondingly alter eating attitudes and behaviours. Further exploration of the nature of AB regarding food and ego threatening stimuli will help to inform whether AT would be beneficial for ED patients, and/or non-clinical females with eating-related concerns. The primary aims of the research in this thesis are to further explore AB for food stimuli (as biases for food are more pronounced than body stimuli) and ego threatening stimuli in non-clinical females characterised by restrained, external or emotional eating, and those with high levels of non-clinical eating psychopathology. The exact nature of AB (i.e. orientation or slowed disengagement) will be explored with modified Stroop and dot probe tasks with the aim of optimising the measurement of AB. This will help uncover the cognitive processes that contribute to eating behaviours in females, with the aim of informing an AT programme for reducing such biases.

This research begins by employing modifications of the Stroop task to compare processing of food and interpersonally threatening stimuli in restrained and unrestrained eaters. The pilot study aimed to assess the usefulness of a modified Stroop task (based on an original design by McKenna & Sharma, 2004) for distinguishing between orientation and disengagment biases for food and negative emotion stimuli. Following this, study one aimed to clarify ambiguous findings from the pilot where all participants (restrained and unrestrained eaters) were slow to disengage from food, negative emotion and neutral stimuli. Improvements were made to the design of this earlier investigation. Study two extended this research with further modifications to the Stroop task, and through the inclusion of a dot probe task with original food photos. The influence of various eating behaviours and attitudes which have previously been found to influence attention processing of food stimuli was assessed. Study three utilised a further modified dot probe task based on food image ratings and study four additionally explored the influence of negative mood on attention processing of food and subjective appetite and food intake.

Chapter Two: Methodology

2.1. Introduction

The aim of this chapter is to provide an overview of the procedures and measures that were employed in the following experimental chapters. Some measures are commonly used across studies, whereas others are specific to particular investigations. Further methodological details specific to individual studies are provided in the methodology section of each chapter.

2.2. Ethics and Recruitment

For each of the studies carried out, ethical approval was gained from the Loughborough University Ethical Advisory Committee. For each study participants were provided with an information sheet explaining what the study would entail, assured of their right to withdraw at any time and assured of confidentiality of data. After being given the opportunity to ask any questions about the study following reading the information sheet, participants provided written informed consent. After taking part, participants were fully debriefed as to the purpose of the study. In the pilot study and study one the majority of participants were students at Loughborough University recruited via posters, web-based advertisement and department email lists. In study two all participants were students from Loughborough University recruited primarily via a research participation scheme for first year psychology, human biology and ergonomics students. In study three, again, all participants were students from Loughborough University recruited via email. In study four participants were recruited via department email lists, word-of-mouth, the research participation scheme, and through the Loughborough University Community Newsletter.

2.3. Participants, Demographics and Exclusion Criteria

All participants were female. In all studies the inclusion criteria were that participants should be aged between 18 and 45, not colour blind, not currently diagnosed with an eating disorder, and either English was their first language or they were highly proficient in the English language. Prior to recruitment, participants completed a general health and demographics questionnaire focusing on their age, height and weight, whether they are dyslexic, colour blind, have an eating disorder or mood disorder, are currently dieting and how frequently they diet (see Appendix 1). In study four participants were also asked whether they have any food allergies to ensure that it was safe for them to consume the study foods. In this study, therefore, a further criterion for participating was that participants should be able to consume the test foods with no ill effects (e.g. dislike, allergy or intolerance). Due to the nature of the mood induction in this study, participants currently diagnosed with/receiving treatment for a mood disorder were also excluded.

2.4. Attentional Bias Measurements

2.4.1. Stroop Tasks

The original Stroop task (Stroop, 1935) required participants to name the ink colour of incongruent colour words, whilst inhibiting the automatic tendency to read the colour word itself (e.g. the word ‘blue’ printed in red). Colour-naming times of incongruent colour words were longer compared to colour-naming of meaningless letter strings (e.g. ‘XXXXX’) printed in various colours. Later modifications using disorder-relevant and control words allowed researchers to investigate the presence of attentional biases (ABs) in clinical patients. For example, it has been found that anxious participants are slower at colour-naming threat words than neutral words (e.g. Martin, Williams & Clark, 1991; Mathews & MacLeod, 1985; Mogg, Mathews & Weinman, 1989), depressed participants are slower to colour-name negative words than neutral and positive words (e.g. Gotlib & McCann, 1984), spider-phobic participants are slower to colour-name spider-related words (e.g. Watts, McKenna, Sharrock, & Trezise, 1986) and patients diagnosed with panic disorder are slower to colour-name catastrophe-related words (e.g. McNally et al., 1994; for a review of the emotional Stroop literature see Williams, Mathews & MacLeod, 1996). The Stroop task has also been modified in order to assess biases in attention processing of food and body words among eating disorder (ED) patients and non-clinical groups with various forms of eating psychopathology (for reviews of the literature see Brooks, Prince, Stahl, Campbell & Treasure, 2011; Dobson & Dozois, 2004; Lee & Shafran, 2004). The Stroop task is the most frequently used measure of AB in eating psychopathology research (out of the 81 located studies reviewed in Chapter One, 45 employed a Stroop task).

Some claim that the Stroop task cannot distinguish between attention directed towards/ away from stimuli, or slowed disengagement (e.g. Ainsworth, Waller & Kennedy, 2002; Faunce, 2002; Johansson, Ghaderi, & Andersson, 2005; Williams et al., 1996); however, an adaptation of the task in which these sub-components of attention can be distinguished has been described by McKenna and Sharma (2004). In this modified version, colour-naming times of emotion words are compared with colour-naming times of neutral stimuli presented directly following emotion words. An automatic orientation bias towards emotion words is demonstrated by a slower colour-naming time for the emotion word itself, whereas slowed disengagement is demonstrated by a delayed colour-naming time of a neutral word directly following the emotion word. This work demonstrated that the presentation of emotional stimuli in a Stroop task disrupts the processing of subsequent neutral stimuli, a carryover effect which lasts for one following trial. The Stroop tasks employed in the present research involve further modifications of McKenna and Sharma's (2004) Stroop task, through the inclusion of food and interpersonally threatening words, and through varying the number of neutral words following target words. The specific tasks used in each investigation are outlined in relevant chapters. All tasks were computerised versions, in which the stimulus words were presented individually on a black background until the participant responded to the colour using a key press. Words were presented in equal frequency in red, blue, green or yellow (four keys on the computer keyboard were labelled with relevant colours in the pilot study, study one and study two, and a response box with four coloured keys was used in study four). A computerised Stroop task is preferred to the card method given its ability to allow for exclusion of errors and its more accurate measure of reaction time (as opposed to being timed using a stopwatch). Button-press response is also generally considered a more reliable method of response than voice-response, and a four-button response box allows even more accurate measurement of reaction time than keyboard response (e.g. Davidson & Wright, 2002).

The food words selected for the Stroop tasks were a combination of sweet and savoury high-calorie appealing food words (e.g. 'cake' and 'chips'). The majority of AB research with food stimuli in a Stroop task has included high-calorie foods only, and a combination of sweet and savoury foods with both clinical (Ben-Tovim et al., 1989; Ben-Tovim & Walker, 1991; Black et al., 1997; Flynn & McNally, 1999; Jones-Chesters et al., 1998) and non-clinical groups (Formea & Burns, 1996; Green et al., 1997; Johansson et al., 2004; Lattimore et al., 2000; Mahamedi & Heatherton, 1993; Overduin et al., 1994; Stewart & Samoluk, 1997). Mahamedi and Heatherton (1993) speculate that interference might occur only if foods are forbidden, and Knight and Boland (1989) found that restrained eaters disinhibit only when anticipating a forbidden food, and would therefore be likely to preferentially process such foods. As noted in Chapter One, Williamson, Muller, Reas, and Thaw (1999) claim that biased information processing will occur with food information that is threatening to the individual. Therefore, individuals afraid of gaining weight are only likely to display biased processing of high-calorie foods because these threaten weight gain. Ataya, Adams, Mullings, Cooper, Attwood and Munafo (2012) found that Cronbach's α for their alcohol Stroop and dot probe tasks was low (<0.7) and Field and Christiansen (2012) have commented that this may have been due to the wide range of alcohol-related stimuli in these tasks: beer, wine and spirits (whilst the individual may only drink beer, for example). Henceforth, given the importance of only including stimuli which are relevant to the participant group, and that emotional and restrained eaters tend to over-consume high-calorie snack foods (e.g. Oliver & Wardle, 1999; Wansink, Cheney, & Chan, 2003), it would be expected that only such stimuli will consistently 'grab' attention. However, it should be noted that three Stroop studies have compared interference for high- and low-calorie foods and found similar interference for both sets of words (Francis et al., 1997; Huon & Brown, 1996; Mendlewicz et al., 2001). On the other hand, Sackville et al. (1998) found a larger colour-naming interference effect for high-calorie than low-calorie foods. Using a dot probe task Shafran et al. (2007; 2008) also found that ED patients display an AB towards high-calorie foods and direct their attention *away* from low-calorie foods. This distinction of attention towards and away from stimuli is not possible with the type of Stroop task employed by the researchers who found similar interference with both low- and high-calorie words. Therefore, it is possible that low-calorie foods caused long response times because participants were directing their attention away from them. No published study located has investigated whether AB is restricted to only sweet or only savoury foods.

The ego-threat words selected for the tasks were interpersonal such as 'rejected' and 'criticised'. Such words were included in the Stroop tasks in studies one and two because focusing on food concerns alone is thought to provide an incomplete explanation of eating psychopathology (e.g. McManus & Waller, 1995), with a greater focus needed on the role of emotion and threat (Grilo, Shiffman, & Carter-Campbell, 1994). Five main types of threat words have been included in Stroop tasks in eating research: sociotropy (social isolation/rejection), autonomy (personal control), physical threat, ego threat from others (i.e. interpersonal threat) and ego threat from self. As explained in Chapter One, ego threats lead to intolerable negative affect and a need to escape from it which is achieved through cognitive narrowing, which in turn leads to disinhibition of eating (Heatherton & Baumeister, 1991). Interpersonal threat (i.e.

threat to self-esteem from others) is particularly relevant to individuals with restrictive tendencies (see Chapter One for research studies demonstrating this). The interpersonal threat words selected in the current research consisted of a combination of words used in earlier studies, e.g. 'criticised' from Waller and colleagues' (1996) ego threat from others category, 'dismissed', 'blamed' and 'ignored' from Johansson, Lundh and Andersson's (2005) interpersonal threat category, and 'embarrassed' and 'hated' from MacLeod, Mathews and Tata's (1986) socially threatening category. Other interpersonally threatening words were located by the researcher (e.g. 'undermined').

The Stroop task in the pilot study included three conditions: 'Food', 'Mood' and 'Neutral' (non-categorical). The task included three different categories of words: four high-calorie food words e.g. 'chips' and 'biscuit', four negative mood words e.g. 'upset' and 'crying', and neutral words such as 'tower' and 'bishop'. All words were matched for word length and frequency in the English language using Leech, Rayson and Wilson's (2001) written and spoken word frequencies (5-7 letters). The words appeared in a sequence of five, beginning with a target word (food or mood word) followed by four neutral words, with the neutral condition consisting of groups of five neutral words. The Stroop tasks in studies one and two included three conditions: 'Food', 'Interpersonal Threat' and a categorical 'Neutral' condition. In study one the target words in the neutral condition were animals, as used in a number of food Stroop studies (e.g. Francis et al., 1997; Rofey et al., 2004; Sackville et al., 1998). In the second study, household objects (e.g. 'curtains' and 'carpet') were used given that they are more 'neutral' compared to words such as 'tiger', which may have elicited fear. In study four only 'Food' and 'Neutral' (household object) conditions were included.

The words were presented in a pseudo-randomised order, with no word or colour appearing consecutively, and conditions were counterbalanced (except in the pilot study). In studies one to four each target word was individually matched according to length, initial letter and written and spoken frequency (Leech, Rayson, & Wilson, 2001) with four (study one) or six (studies two and four) neutral words that followed them. The word frequencies of Kucera and Francis (1967) were not used because these frequencies are taken from American English. The word frequencies of Johansson and Hofland (1982) were not used as they only account for written frequency, whereas Leech, Rayson and Wilson's (2001) frequencies represent both written and spoken English. It is important to match stimuli for frequency as words that are more familiar to participants are found to produce greater Stroop interference (Warren, 1972; 1974).

In the pilot study each target word was presented four times and the neutral words were counterbalanced: 80 words were included in each condition (240 words in total: see Appendix 2 for a full list of words). In study one there were 12 target words and 48 neutral words in each of the three conditions (180 words in total; see Appendix 3 for a full list of words) and in study two there were 12 target and 72 neutral words in each of the three conditions (252 words in total; see Appendix 4 for a full list of words). In study four there were 8 target and 48 neutral words in each of the conditions and each word was seen twice (224 trials in total; see Appendix 5 for a full list of words). In order to familiarise participants with the task, 16 practice trials were included in which rows of 'XXXXX' were presented in each of the four possible colours at the beginning of the task. All word stimuli were presented in the middle of the screen in Tahoma of 72pt font size. In the pilot study and study one the Stroop Task was presented in a single session using EPrime® stimulus presentation software and in the second and fourth studies the task was presented using SuperLab® 4.5 software (Cedrus Corporation, 1991-2007; Phoenix, Arizona).

Following a number of previous food Stroop studies (e.g. Green, Corr & deSilva, 1999; Green, Elliman, Rogers & Welch, 1997), no response-stimulus interval (RSI) was included in the Stroop tasks in the pilot study and studies one and two. Studies employing an emotional Stroop task that have shown robust interference effects have not included an interval between trials (e.g. McKenna, 1986; McKenna & Sharma, 1995). However, a large number of Stroop studies have employed an RSI, using variable lengths of time: 32ms (McKenna & Sharma, 2004; Sharma & McKenna, 2001; Wallis & Hetherington, 2004); 500ms (e.g. Flynn & McNally, 1999; Jansen, Huygens, & Tenney, 1998); 1000ms (e.g. Nijs et al., 2010; Newman et al., 2008; Sackville et al., 1998; Seddon & Waller, 2000); 1500ms (e.g. Jones-Chesters et al., 1998); 2000ms (e.g. Davidson & Wright, 2002; Johansson et al., 2004; Lavy & van den Hout, 1993; Overduin et al., 1994); 3000ms (e.g. Formea & Burns, 1996); and even as long as 5500ms (e.g. Francis et al., 1997). Sharma and McKenna (2001) directly compared the effect of RSI duration on emotional Stroop performance. In their first experiment they compared five RSI durations: 400ms, 240ms, 160ms, 80ms and 32ms, finding that emotional interference decreased with an increase in RSI. In their second experiment they compared 32ms RSI and 1000ms RSI and found that emotional interference occurred only in the 32ms RSI condition. They attributed this to a rapid assignment of priority to deal with threat when threat and time pressure are combined, claiming it is possible that "time pressure is critical either in producing the emotional Stroop effect or in observing it" (p.479). Sharma and McKenna (2001) also point out that the emotional lingering effect they demonstrated in 1986 (and then later went on to demonstrate in 2004) is only likely to be observed at shorter RSIs given that there is then less time between the preceding response and the subsequent stimulus. A RSI of 32ms was added in study four based on the recommendations of McKenna and Sharma (2004) whose Stroop design formed the basis of the tasks in this PhD.

2.4.2. Development of the Stroop Task

2.4.2.1. Food Words

Ratings of how appealing females found the food words in the Stroop task in study two were collected following the completion of study two. Female students were given 100mm visual analogue scales (VAS) ranging from '*not at all appealing*' to '*extremely appealing*' and were instructed to mark on the line how appealing they found each food word (see Figure 2.1 for an example VAS). Forty-four female students completed ratings of the 12 food words. The mean rating was 57.15 (*SD*=12.67) indicating that, overall, the words were considered to be moderately appealing. However, looking at individual word means, it was found that four words were rated on average below 50: 'sugar' (mean=48.89, *SD*=26.05); 'pie' (mean=41.55, *SD*=29.03); 'cream' (mean=32.77, *SD*=28.83); and 'butter' (mean=27.86, *SD*=25.02). See Appendix 6 for all ratings.

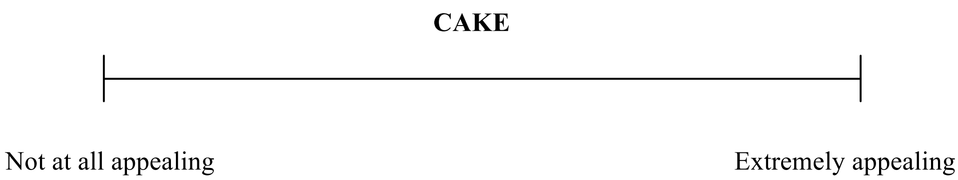

Figure 2.1: Food word VAS

2.4.2.2. Ego Threat Words

Following the completion of study two, 97 female students completed ratings of the interpersonally ego threatening words in the Stroop task used in study two. Each word was rated on a five point Likert scale: 1) negative, 2) slightly negative, 3) neutral, 4) slightly positive, 5) positive. A Likert rating was deemed more appropriate given that the use of VAS would require choosing a degree of emotionality for participants to rate between (e.g. *‘not at all emotional’* to *‘extremely emotional’*, or *‘not at all negative’* to *‘extremely negative’*). If asking to rate emotionality this would not provide insight into whether they found the image negative or positive, and asking to rate in terms of negativity may have primed respondents to rate the images as negative. A criterion of a mean rating of <2 (i.e. no more than 1 away from a completely negative rating) was deemed an appropriate cut off for an image to be considered negative. The overall mean was 1.45 (*SD*=.56) indicating that words were perceived to be negative. No individual word mean ratings were anything other than negative (all <1.63; see Appendix 7 for all ratings).

2.4.2.3. Neutral Words

Ninety-seven female students also rated each of the household objects with the same Likert scale as described previously. A criterion of a mean rating of 3±1 (3 being a completely neutral rating) was deemed an appropriate cut off for an image to be considered neutral. The overall mean was 3.2 (*SD*=.43) and all individual word means were as expected (see Appendix 8 for all ratings). Using a paired t-test, it was found that ego threatening words were rated significantly more negatively than household objects ($t(96)=-21.3$, $p<.001$).

In order to rate the large number of neutral words that were matched with each target word in study two (six per target word), 53 females were given half of the words each and in two possible orders as an attempt to exclude any order effect. Using the same five-point Likert scales, the mean rating was 3.15 (*SD*=.27) indicating that the words were considered to be neutral. However, looking at individual word ratings there were 13 (out of 216) words rated on average >1 away from 3 (see Appendix 9 for a list of these word ratings).

2.4.2.4. Changes in Study Four

Based on the Stroop word ratings, changes were then made in study four: the four food words rated with a mean <50 and their matched neutral words were excluded; the matched neutral words from the food and household object conditions which were rated greater than 3±1 were replaced; and in order to have an equal number of stimuli in the two conditions four household objects were excluded. Three household objects rated the furthest away from 3 were excluded (pillow: mean rating=3.6; bath: mean rating=3.8; photo: mean rating=3.48), in addition to the word ‘sink’ (rated slightly negatively; 2.76) given that this has multiple meanings and could therefore be considered negative.

2.4.3. Dot Probe Task

A second frequently employed measure of AB is the dot probe task (MacLeod et al., 1986). The original task involved simultaneous presentation of two words (one threat and one neutral) for 500ms on a computer screen, followed by a probe (a small dot) in the same location as one of the previous stimuli. On seeing the dot the participant was required to press a button in response. A bias towards threatening stimuli was indicated by speeded detection of a probe in the same location as threat stimuli, and avoidance indicated by speeded detection of a probe in the same location as neutral stimuli. Words appeared one above the other, and the threat word (and the probe) could appear with equal probability in either spatial location. In the original study it was found that anxious participants shifted their attention towards threat, whereas control participants shifted their attention away from threat. In later research this task has been modified in a number of ways. Images have been used instead of words, participants have been required to identify a probe (between two options) instead of merely detecting it, stimuli have been presented side-by-side instead of above and below, and different presentation times of stimuli have been used. Differing presentation times are thought to allow for a distinction between orientation and slowed disengagement. For example, presentation times of 100ms, 200ms or 500ms are typically considered to measure initial orientation/early attention processing, whilst 1500ms or 2000ms presentations are considered to assess slowed disengagement/later processing (e.g. Brignell, Griffiths, Bradley, & Mogg, 2009; Field, Mogg, Zetteler, & Bradley, 2004; Koster, Baert, Bockstaele, & DeRaedt, 2010). However, there is some debate as to which sub-component of AB 500ms presentation assesses (e.g. Cooper & Langton, 2006; Field et al., 2004).

Studies using the dot probe task have shown that anxiety patients have an AB towards threat (e.g. MacLeod et al., 1986; Mogg, Mathews & Eysenck, 1992) and clinically depressed individuals have an AB towards negative stimuli (e.g. Bradley, Mogg & Lee, 1997; Mathews, Ridgeway & Williamson, 1996; Mogg, Bradley & Williams, 1995). More recently, the dot probe task has been adapted to show that ED patients have biased attention processing of food and body stimuli (e.g. Rieger et al., 1998; Shafran et al., 2007; 2008). Furthermore, modifications of the task have provided evidence of such ABs in non-clinical females characterised by eating-related concerns (e.g. Brignell et al., 2009; Papies et al., 2008).

The dot probe tasks in the present research were presented on a 19 inch screen desktop computer using SuperLab® software. Food (and matched neutral) pictures were presented instead of words in order to achieve greater ecological validity. Original photographs of food and paired neutral objects were presented, and these were chosen based on foods used in previous research and on participant ratings (as described in the following subsection 2.4.4). Pictures were presented side-by-side with the edges 4cm apart. They were, on average, 9cm in height and 10cm in width; however, some taller objects (e.g. chocolate milkshake and hot chocolate) were 10cm in height and 8.5cm in width. Participants were sat at a normal seating distance between 50 and 100cm from the computer monitor (e.g. Occupational Safety and Health Administration; Jaschinski-Kruza, 1991). Two conditions were presented: one where all the picture pairs were presented for 200ms and the other where they were presented for 2000ms (presentation times as used by previous researchers in order to distinguish between orientation and disengagement, e.g. Field et al., 2004). Participants were instructed to focus on a fixation cross that was presented in the centre of the screen for 500ms. This was prior to picture presentation. Probe identification, as opposed to mere detection, was required in order to ensure greater concentration in the task. Probes (":" or "..") appeared in the location of the food and neutral images in equal frequency and remained on screen until the participant responded or until 2000ms had elapsed if no response was made in this time.

In all studies food pictures were sweet or savoury high-calorie appealing foods. In order to check that there were no differences in processing of these foods, comparisons were conducted between interference for sweet and savoury images. These analyses revealed no differences (as reported in relevant chapters). A number of dot probe studies have included only high-calorie/appealing food items (e.g. Johansson et al., 2004; Papies et al., 2008); however, a comparable number have grouped high- and low-calorie foods into one category (e.g. Brignell et al., 2009; Hepworth et al., 2010; Hou et al., 2011). Following the finding that individuals process high- and low-calorie foods differently (e.g. Shafran et al., 2007; 2008), this is not advised. Neutral images consisted of objects closely matching the food item in size, shape, complexity and colour (where possible) and were photographed against the same background as the food item.

Each condition of the task (200ms/2000ms presentations) began with 24 practice trials (neutral/neutral picture pairs e.g. a torch and a stapler). In studies two and three, 20 food/neutral picture pairs were repeated eight times in each of the conditions (seen 16 times overall), with each picture appearing four times on the left and four times on the right, and the probe appearing four times in the same location as the food picture (congruent trial), and four times in the same location as the neutral picture (incongruent trial). Overall, there were 368 trials (48 practice and 320 experimental), which took approximately 15 minutes to complete. In study four, five images rated the least appealing by a large sample of women (as discussed below) were excluded. Therefore, in this task 15 images were repeated eight times in each of the two conditions, producing a total of 48 practice and 240 experimental trials.

2.4.4. Dot Probe Stimuli Ratings

Following completion of study two, the 20 food images included in the dot probe task in study two (see Appendix 10 for examples) were rated by female students using 100mm VAS scales ranging from *'not at all appealing'* to *'extremely appealing'* (pictures were presented using PowerPoint 2007). These photos were: bagel with cream cheese; biscuits; burger; cake; cheese on toast; chocolate; cooked breakfast; chocolate milkshake; nachos; popcorn; spaghetti bolognaise; sweets; chips; cupcake; onion rings; hot chocolate; pizza; doughnut; cheesecake; toffee pudding. The mean rating for the food images gained from 44 females was 58.34 (*SD*=14.95) indicating that the images were found to be moderately appealing. However, looking at individual image ratings, four food images were rated below 50 (see Appendix 11 for image ratings and Figure 2.2. for examples of images rated below 50). 44 female students rated the objects that were paired with the food images in the dot probe using a Likert scale: 1) negative, 2) slightly negative, 3) neutral, 4) slightly positive, 5) positive. Again a Likert rating was deemed more appropriate given that the use of VAS would require choosing a degree of emotionality for participants to rate between (e.g. *'not at all emotional'* to *'extremely emotional'*, or *'not at all negative/positive'* to *'extremely negative/positive'*). As previously, a criterion of a mean rating of 3±1 (with 3 being a completely neutral rating) was deemed an appropriate cut-off for an image to be considered as neutral. The mean rating was 3.11 (*SD*=.27) showing that the images were rated as neutral. However, when looking at the individual mean image ratings, one image was rated >1 away from 3 (see Appendix 11 for image ratings).

Figure 2.2: Examples of food images rated as unappealing along with their matched neutral objects

Following the food image ratings, additional photos were taken and further ratings were obtained from a new set of participants who were 11 female staff members at Loughborough University (see Appendix 12 for image rating data). These ratings then informed the selection of the 20 food/neutral picture pairs in study three (see Appendix 13 for example image pairs from this task). In study three participants (*n*=60) were also asked to rate the images following completion of the task. Food images were rated as moderately appealing (mean=53.43, *SD*=13.43; see Appendix 14 for image ratings). Following study three, food ratings were combined from the different groups of females to produce an overall rating of the 20 images used in study three (see Appendix 15 for a full list of these ratings). Given that the dot probe tasks in studies two and three were considered to be too long leading to participants getting bored, the five food images rated the least appealing were excluded in study four (see Appendix 16 for example images from study four).

2.5. Mood Induction Procedures

Autobiographical recall is one of the most commonly used methods of inducing negative mood and is considered one of the most effective (e.g. Baker & Gutterfreud, 1993, cited in Jallais & Gilet, 2010). Mood induction via music has also been found to be extremely effective; for example, Sutherland, Newman and Rachman (1982) successfully induced a negative mood in all of their participants using music. Musical mood inductions are advantageous compared to other methods because they provide less opportunity for participants to display demand characteristics (Goldstein & Willner, 2002), are more effective in achieving the preferred mood (Sutherland et al., 1982) and impose fewer attentional demands on the participant (Clark, 1983). Combined mood induction procedures are found to be the most effective procedures in inducing negative mood (e.g. Bower, 1981; Westermann, Spies, Stahl, & Hesse, 1996). Successful combinations involve a primary induction that occupies foreground attention (e.g. autobiographical recall) and a secondary one in the background (e.g. music). A number of studies have found that a specific combination of negative music and recall of sad autobiographical memories successfully induces negative mood (e.g. Heene, De Raedt, Buysse, & Van Oost, 2007; Hepworth et al., 2010; Hernandez, VanderWal, & Spring, 2003; Marzillier & Davey, 2005; Van Der Does, 2002). Study four of the present thesis assessed the effects of experimentally induced negative mood on biased attention towards and slowed disengagement from food. A combined music and autobiographical memory retrieval induction was chosen. Participants were told in advance that they would be asked to write about one or more sad memories (or one or more neutral/ non-emotional memories such as carrying out a daily routine) and were asked beforehand to have something in mind to write about. In the laboratory session participants were provided with a booklet and pen and asked to write in detail about either a recent unhappy memory (negative condition) or an ordinary event (neutral condition). In the negative mood condition this was carried out whilst listening to Barber's Adagio for Strings via headphones for five minutes (found to successfully induce a negative mood in a number of previous studies e.g. Eich & Metcalfe, 1989; Fox, Knight, & Zelinski 1998; Hernandez et al., 2003; Heene et al., 2007; Morrow & Nolen-Hoeksema, 1990). In the neutral condition participants were played five minutes of music consisting of Chopin's Waltzes numbers 11 and 12 played consecutively via headphones, as this has been used successfully to maintain a neutral mood in a number of studies (e.g. Heene et al., 2007; Marzillier & Davey, 2005; Startup & Davey, 2001; Wood, Saltzberg, & Goldsamt 1990).

2.6. Measurement of Food Intake

2.6.1. 'Taste Test'

Food intake was assessed in the Loughborough University Eating Behaviour Laboratory in study four. Studying food intake in the laboratory allows assessment under controlled circumstances free from 'social chaos' in the natural environment, allowing the isolation of specific factors and studying their effects on appetite (e.g. Blundell, de Graaf, Finlayson, Halford, Hetherington, King & Stubbs, 2009). Study four involved assessment of ad libitum food intake during a 'taste test.' Test foods were chocolate (Cadbury's chocolate finger biscuits, Cadbury's chocolate buttons) and crisps (McCoy's flame-grilled BBQ steak crisps, Pringles Original flavour), given that a number of studies have shown that females prone to eating in response to stress/negative mood tend to eat high-fat, highly palatable foods when experiencing negative mood (e.g. Haynes, Lee & Yeomans, 2003; Heatherton, Herman, & Polivy, 1991; Lattimore, 2001; Wallis & Hetherington, 2004). During the 'taste test' participants were asked to rate on VAS scales of pleasantness and sweetness/saltiness (ranging from '*not at all*' to '*extremely*') the two high-fat sweet snacks and two high-fat savoury snacks. 100g of chocolate buttons (525 kcal), 14 chocolate finger biscuits (approximately 75g: 420 kcal), 50g of McCoy's crisps (258.5 kcal) and 50g of Pringles (262 kcal) were presented. Participants were told that once they had completed their ratings they could eat as much as they like, as the food could not be used with other participants due to sanitary concerns (following Shapiro & Anderson, 2005). This procedure lasted 10 minutes (following e.g. Cavallo & Pinto, 2001; Fay & Finlayson, 2011; Herman & Mack, 1975; Jansen et al., 2008; Royal & Kurtz, 2010; Shapiro & Anderson, 2005). This taste test procedure has been employed in a number of investigations exploring the effect of stress/mood on actual eating behaviour (e.g. Baucom & Aiken, 1981; Cavallo & Pinto, 2001; Dingemans, Martjin, Jansen & van Furth, 2009a; Dingemans, Martjin, van Furth, & Jansen, 2009b; Guertin & Conger, 1999; Habhab, Sheldon & Loeb, 2008; Jansen et al., 2008; Laessle & Schulz, 2009; Lattimore & Maxwell, 2004; Levine & Marcus, 1997; Royal & Kurtz, 2010; Rutledge & Linden, 1998; Turner, Luszczynska, Warner, & Schwarzer, 2010; Wallis & Hetherington, 2004; Yeomans & Coughlan, 2009; Zellner, Saito & Gonzalez, 2006).

2.6.2. Food Recall Diary

In study four participants were instructed to have a normal meal (either breakfast or lunch depending on the time of the lab session between 12pm and 5pm) two-to-three hours prior to attending the lab and drink only water following this. To assess adherence to this instruction participants completed a food recall diary at the start of the lab session. This required participants to record all food and drink that they had consumed that day, the time it was consumed and how much they had consumed. Similar procedures of assessing food instruction adherence have been used in other investigations exploring stress/negative mood-induced eating (e.g. Cavallo & Pinto, 2001; Epel et al., 2001; Goldfield, Adamo, Rutherford & Legg, 2008; Heatherton, Polivy, Herman & Baumeister, 1993; Lattimore & Maxwell, 2004; Levine & Marcus, 1997; Wallis & Hetherington, 2004). With time it is has been shown that accuracy of memories for foods eaten declines rapidly. For example, after one week less than 55% of foods are recalled (e.g. DeAngelis, 1988). However, in shorter time periods this accuracy is increased. For example, 24 hour recall of food intake has been found to provide accurate estimates of intake (e.g. Fries, Green, & Bowen, 1995; Woteki, 1992) with Fries et al. (1995) finding that participants who had been given set snacks to eat on one day, were able to recall 80% of the snacks they had consumed the following day (with 76% of the total amount eaten recalled accurately). In addition such recall has been found to compare well with weighed records of intake (e.g. Bingham, Gill, Welch, Day, Cassidy, Khaw et al., 1994). Further increased accuracy would be expected in recall of foods eaten on the same day, as was required in the present thesis.

2.7. Measures of Appetite

2.7.1. Visual Analogue Scales (VAS)

Hunger, fullness and desire to eat were measured using VAS ratings. The following questions were asked: 'How **hungry** do you feel **right now**?', 'How **strong** is your **desire to eat right now**?' and 'How **full** do you feel **right now**?' Each question was followed by a 100mm horizontal line with two extreme end points labelled as '*not at all*' at the left end, and '*extremely*' at the right end (see Figure 2.3). Participants were asked to mark with a vertical line at the point on the line that best described how they were feeling. In study four VAS measures of liking (subjective feelings of pleasure) and wanting (subjective feelings of intent or desire) for the study foods (chocolate and crisps) were also administered following the mood induction. These were based on Finlayson, King and Blundell's (2008) VAS in which participants' rate from '*not at all'* to '*extremely*' the following statements for each study food: "how pleasant would it be to experience a mouthful of chocolate/crisps right now?" (a measure of liking) and "how much do you want some chocolate/crisps right now?" (a measure of wanting). During the 'taste test' in study four participants were provided with VAS measures of the pleasantness, sweetness/saltiness of each of the study foods (ranging from '*not at all'* to '*extremely*').

VAS provide greater insight into eating/appetite than can be obtained from food intake data alone (Blundell et al., 2009), are quick and easy to use, have been found to be reliable and valid for appetite research (e.g. deGraaf, 1993; Flint, Raben, Blundell, & Astrup, 2000; Raben, Tagliabue & Astrup, 1995; Stubbs, Hughes, Johnstone, Rowley, Reid, Elia et al., 2000) and provide flexibility given that the questions and anchors can be modified to suit the manipulation and experimental design (Blundell et al., 2009).

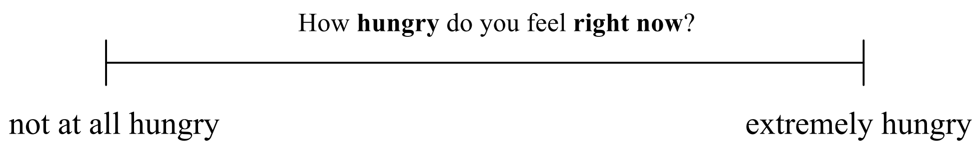

Figure 2.3: A hunger visual analogue scale

2.8. Measures of Eating Behaviour

2.8.1. Dutch Eating Behaviour Questionnaire (DEBQ: Van Strien, Frijters, Bergers, & Defares, 1986)

The DEBQ (see Appendix 17) consists of 33 items with three subscales: restrained eating (items 1-10), emotional eating (items 11-23) and external eating (items 24-33). Participants are required to answer each question with '*never*', '*seldom*', '*sometimes'*, '*often*', or '*very often*' (scored from 1-5). One item on the external eating scale is reversed scored. The final score for each scale is the mean of all the items within that scale. The restrained eating subscale measures the tendency for an individual to restrict their food intake in order to control their body weight (Herman & Mack, 1975) including items assessing deliberate, planned weight control. The emotional eating subscale assesses the desire to eat excessively in response to states of emotional arousal (e.g. anxiety). The external eating subscale measures susceptibility to eating in response to external food cues regardless of internal states of hunger or satiety. All three subscales of the DEBQ have high internal consistency, factorial validity and stability over time (Braet & van Strien, 1997; Van Strien et al., 1986) and Cronbach's α for various samples ranges between .79 and .81 for the external eating subscale and .92 and .95 for the emotional and restrained eating subscales (Van Strien et al., 1986). As stated by Lowe and Thomas (2009) the rigorous development process of the DEBQ resulted in scales with high internal consistency, with the scales appearing to be equally reliable in normal-weight and obese individuals.

In this thesis participants were categorised into high and low restrained eating groups according to median-split scores on the Restraint Scale of the DEBQ (DEBQ-R). It may be argued that using a median-split may result in diminished power (e.g. Cohen, 1988) and although converting continuous variables into categories is not an error it is often considered 'bad practice' by statisticians (Altman & Royston, 2006; Bell, Olivier & King, 2012; Harris, Reeder, & Hyun, 2011). However, this is a valid technique and often used in AB research (e.g. Ahern, Field, Yokum, Bohon, & Stice, 2010; Lattimore, Thompson & Halford, 2000). In order to account for criticisms of the median-split approach (e.g. diminished power, loss of information, inflation of the type I error rate; Bell et al., 2012), eating measures of interest were also used as continuous variables to supplement such analysis. For example, in studies two, three and four, the three constructs of the DEBQ were assessed as continuous variables, providing a more precise examination of individual differences. The DEBQ was used in all of the experimental studies in the present thesis.

A number of researchers have used the DEBQ-R to assess restraint in AB research (e.g. Green & Rogers, 1993; Tapper, Pothos, Fadardi, & Ziori, 2008). However, another frequently used measure in the literature is the Restraint Scale (RS; Herman, Polivy, Pliner, Threlkeld, & Munic, 1978). Given the recognised problem with the construct validity of the RS (i.e. it confounds restraint with disinhibition e.g. Placanica, Faunce, & Job, 2002; Tapper et al., 2008), the DEBQ-R was chosen in the present thesis given that it is a measure of restraint alone. Therefore, the major advantage of the DEBQ-R over the RS is that it reflects "pure" dietary restraint (Lowe & Thomas, 2009).

2.8.2. Eating Disorder Inventory-2 (EDI-2: Garner, 1991)

The EDI-2 measures psychological and behavioural traits commonly associated with anorexia and bulimia nervosa. The three eating-related subscales were used in the present thesis (see Appendix 18). The Drive For Thinness (DFT) subscale measures excessive concern with dieting, preoccupation with weight and an extreme drive for thinness (seven items). Items in this subscale reflect both a desire to lose weight and a fear of weight gain. The Bulimia subscale measures the tendency towards bingeing (i.e. uncontrollable overeating) and purging (the impulse to engage in self-induced vomiting) consisting of seven items. The Body Dissatisfaction (BD) subscale measures dissatisfaction with body shape and weight and reflects the belief that specific body parts associated with increased "fatness" at puberty (e.g. hips, thighs) are too large (9 items). The scale consists of a total of 23 statements and respondents are required to indicate if each statement is true about them '*always*', '*usually*', '*often*', '*sometimes*', '*rarely*' or '*never*'. Items are scored from 0 to 3 (with the most extreme response scoring 3, the adjacent response scoring 2, the next response scoring 1 and the final three responses scoring 0). Scores are totalled for each subscale. For the Bulimia subscale scores above two have previously been considered as high (e.g. Waller, Watkins, Shuck & McManus, 1996). For the DFT subscale scores above seven have been considered as high, and below two considered as low (e.g. Ben-Tovim & Walker, 1991).

The EDI-2 eating-related subscales have shown high test-retest reliabilities with strong stability over time in both ED patients and non-clinical samples (e.g. McCarthy, Simmons, Smith, Tomlinson, & Hill, 2002; Thiel & Paul, 2006). In the validation paper of the original EDI (Garner, Olmstead & Polivy, 1983) the authors reported α coefficients of .85 for the drive for thinness subscale (in both clinical and non-clinical samples), .90 (clinical) and .83 (non-clinical) for the bulimia subscale, and .90 (clinical) and .91 (non-clinical) for the body dissatisfaction subscale. More recently, Garner (2004) reported high internal consistency coefficients amongst clinical ED patients for the drive for thinness subscale (ranging from .81-.93), the bulimia subscale (ranging from .63-.93), and the body dissatisfaction subscale of the EDI-2 (ranging from .88-.93). In addition Garner (2004) reported high test-retest reliability for each of these subscales (drive for thinness=.95; bulimia=.94; and body dissatisfaction=.95). Finally, Tasca et al. (2003) also reported test-retest reliabilities ranging between .67 and .82 for all of the EDI-2 subscales over a 16-week period.

The EDI has been frequently employed in AB research when an assessment of clinical or non-clinical eating psychopathology has been required (e.g. Ben-Tovim & Walker, 1991; Green et al., 1997; Maner, Holm-Denama, Van Orden, Gailliot, Gordon, & Joiner, 2006; Meyer et al., 2005; Placanica et al., 2002; Waller & Meyer, 1997). The EDI-2 was employed in all of the experimental studies in the present thesis.

2.8.3. Binge Eating Scale (BES: Gormally, Black, Daston & Rardin, 1982)

Binge eating can be defined as ingesting large amounts of food within short time periods alongside fears of not being able to stop eating (Gormally et al., 1982) with the amount eaten, frequency of episodes and degree of emotionality experienced indicating severity. The BES (see Appendix 19) encompasses both behavioural manifestations of a binge episode (such as eating in secret) and feelings/cognitions following a binge (e.g. shame, guilt, helplessness). It also assesses the severity of each characteristic. It produces scores between 0 and 46, with scores above 27 indicating severe binge eating, and below 17 indicating mild or no binge eating (Greeno, Marcus, & Wing, 1995; Marcus, Wing, & Lamparski, 1985). Although the scale was originally intended as a measure of binge eating in obese individuals, Gormally et al. (1982) found that binge eating scores were not correlated significantly with percentage overweight and concluded that serious binge eating is not necessarily associated with obesity, therefore this is suitable for use with non-obese individuals. The scale contains 16 items and respondents are required to choose one statement from three or four options, that best describes the way they feel about the problems they have controlling their eating behaviour. Scores range from 0-3 for each item. The scale is found to have high internal consistency (Freitas, Lopes, Appolinario, & Coutinho, 2006: α=.89; Gormally et al., 1982), good test-retest reliability (Timmerman, 1999: α=.87 over a 2-week period) and moderate associations with binge eating severity as measured by food records (Timmerman, 1999). Further advantages of this scale are that it is easy to administer and quick and simple to score (Tasca, Krysanski, Demidenko & Bissada, 2009). The BES was employed in study two of the present thesis.

2.8.4. Three-Factor Eating Questionnaire-Disinhibition (TFEQ-D: Stunkard & Messick, 1985)

Whereas restraint refers to conscious control of food intake, disinhibition refers to the breakdown of this cognitive control (Riener, Schindler, & Ludvik, 2006). The TFEQ (see Appendix 20) consists of two parts. Part one consists of a number of statements, which should be answered either TRUE or FALSE. Part two requires respondents to answer questions by choosing one of four options (‘*never’*, ‘*rarely’*, ‘*often’* and ‘*always’*). Respondents score either 0 or 1 for each item. The disinhibition subscale of the TFEQ consists of 16 items, with a maximum score of 16. Scores between 0 and 8 indicate low disinhibition, whereas scores from 12-16 suggest high disinhibition (Stunkard & Mesick, 1985). The TFEQ-D is found to have high internal reliability (e.g. .80: Simmons, Smith & Hill, 2002), test-retest reliabilities (.80: Stunkard & Mesick, 1985) and has been found to correlate highly with overeating in a lab study of food intake (Shrager, Wadden, Miller, Stunkard, & Stellar, 1983). The TFEQ was employed in study two of the present thesis as a general measure of disinhibition (in addition to the specific external and emotional eating aspects of disinhibition assessed using the DEBQ).

2.9. Measures of Mood

2.9.1. Mood Visual Analogue Scales (VAS)

State measures of mood were taken in study four using VAS ratings of sadness, anxiety and happiness, as well as the Positive and Negative Affect Scale as described in the following subsection 2.9.2. The advantages of using VAS are discussed in subsection 2.7.1.

2.9.2. Positive and Negative Affect Scale (PANAS: Watson, Clark, & Tellegen, 1988)

The PANAS is a 20-item measure of negative and positive affect (see Appendix 21). Positive affect refers to the extent of which a person feels enthusiastic, active and alert, whilst negative affect refers to a state of distress which covers a range of negative mood states such as anger, contempt, disgust, guilt, fear and nervousness (Watson et al., 1988). The positive affect scale includes the following 10 adjectives: attentive, interested, alert, excited, enthusiastic, inspired, proud, determined, strong and active. The negative affect scale includes the following 10 adjectives: distressed, upset, hostile, irritable, scared, afraid, ashamed, guilty, nervous and jittery. The PANAS requires participants to choose an answer from a five-point scale (*not at all, a little, moderately, quite a bit, extremely:* scored 1-5) to indicate the extent to which they have experienced each adjective in a specified time frame. In study four of the present thesis participants were asked how they were feeling at that precise moment, in order to enable assessment of change in mood throughout the experiment. The positive and negative affect scales are brief, easy to administer and score. Separate scores for negative and positive affect are calculated, with a maximum possible score of 50 on each scale. Watson et al. (1988) reported alpha reliabilities ranging from .86 to .90 for the positive affect scale, and between .84 and .97 for the negative affect scale. Crawford and Henry (2004) reported reliabilities of .89 for the positive affect scale, and .85 for the negative affect scale. The scale is also found to have acceptable test-retest reliability (Watson et al., 1988) and is found to be reliable and valid regardless of participant population and time frame used (Watson et al., 1988).

2.9.3. Beck Depression Inventory II (BDI-II: Beck, Steer, & Brown, 1996)

The BDI is a widely used 21-item self-report measure of affective, cognitive and somatic symptoms of depression, producing scores between 0 and 63. The respondent is required to choose from four possible choices for each item (scored 0-3) the one that best describes how they have been feeling during the last two weeks. Respondents' scores are totalled and, for the original BDI (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961), scores fall into one of five score ranges: normal range: 0-9; mild depression: 10-15; mild-moderate depression: 16-19; moderate-severe depression: 20-29; and severe depression: 30-63. The BDI is found to have robust psychometric properties (Beck, Steer & Garbin, 1988; Beck & Steer, 1993) and past reports indicate strong construct validity and reliability of the measure in psychiatric and non-psychiatric samples (e.g. Beck et al., 1988 reported alpha reliabilities of .86 for psychiatric patients and .81 for non-psychiatric participants). The amended BDI (BDI-II; Beck, Steer, & Brown, 1996: see Appendix 22) has the same number of questions and the same method of response (with four possible choices scoring from 0-3 with a maximum possible score of 63). The score ranges, however, are slightly altered, with a score of 0-13 indicating minimal depression, 14-19 indicating mild depression, 20-28 indicating moderate depression, and 29-63 indicating severe depression. The BDI-II has high test-retest reliability (α=.93) and high internal consistency (α=.92) in clinically depressed outpatients (Beck, Steer, Ball, Ranieri, 1996). It also demonstrates high internal consistency amongst college students (α=.93) as well as outpatients (α=.92; Beck, Steer & Brown, 1996). Dozois, Dobson and Ahnberg (1998) also found that the BDI-II has high levels of internal consistency (α=.91) in a university student sample. It is well noted that the BDI-II has consistently indicated above-satisfactory reliability and validity (e.g. Chan, Napolitano, & Foster, 2009). This measure was not originally intended to serve as a diagnostic tool but rather it was designed to detect the presence and severity of depressive symptoms (Chan et al., 2009). The BDI-II was used in the pilot study, studies one, two and four to account for any influence depressive symptoms may have on AB and to check there were no significant group differences in depression scores.

2.9.4. Hospital Anxiety and Depression Scale (HADS: Zigmond & Snaith, 1983)

The HADS (see Appendix 23) provides a reliable, valid, and practical tool for identifying and quantifying anxiety and depression (excluding severe psychopathological symptoms and physical symptoms of psychological distress). The scale contains 14 items, which makes it easy to administer and well accepted (Herrmann, 1997). The respondent is required to choose between four options that best describes how they have been feeling the past week (scores range from 0-3 for each item). Seven items assess anxiety and seven items assess depression (respondents can score a maximum of 21 for anxiety and for depression). Scores fall into one of four ranges: normal (0-7), mild (8-10), moderate (11-15) and severe (16-21). This scale has acceptable internal consistency, factorial validity and retest reliability in clinical samples and in the general population (e.g. Bjelland, Dahl, Haug, & Neckelmann, 2002; Hermann, 1997). Bjelland et al. (2002) concluded that the HADS has the same properties when applied to samples from the general population. Hermann (1997) reviewed validation studies of the HADS and reported that alpha coefficients for the anxiety subscale range between .8 and .90, and for the depression subscale range between .81 and .90. The HADS was used in study three to account for the influence of depression and anxiety scores on AB and to check for possible group differences. This measure was used instead of the BDI-II and State Trait Anxiety Inventory to reduce the length of the questionnaire pack in this study.

2.9.5. State Trait Anxiety Inventory-Trait Scale (STAI-T: Speilberger, Gorsuch, & Lushene, 1970)

The STAI-T (see Appendix 24) is a 20 item self-report measure of trait anxiety symptoms and produces a range of scores between 20 and 80, with higher scores indicating greater anxiety. Trait anxiety refers to how anxiety manifests itself over time, and is thought to be relatively stable. Respondents are asked to circle on a four-point scale (‘*almost never’*, ‘*sometimes*’, ‘*often*’ and ‘*always*’) how they generally feel in terms of each statement (e.g. ‘I feel pleasant’). According to Spielberger (1983) the trait anxiety scale possesses adequate psychometric characteristics, reporting test-retest reliabilities for college students from .73 to .86. Test-retest coefficients of .84 for men and .76 for women, and internal consistencies between .86 and .92 have been reported (Spielberger et al., 1970). This scale is found to have high internal consistency (.89) and re-test reliability (.88) across a large number of studies with a variety of populations (Barnes, Harp & Jung, 2002). Alpha reliabilities between .89 and.90 and test-retest reliabilities between .86 and .66 have also been reported over two week and three-month periods (Jacobs, Latham, & Brown, 1988; Spielberger et al., 1970). In addition, Kabacoff, Segal, Hersen, and Van Hasselt (1997) reported an internal consistency alpha of .90 for the trait scale. This measure was used in the pilot study, studies one, two and three to ensure individual differences in AB are not due to differences in trait anxiety.

2.10. Height and Weight Measurements

Height and weight were measured using a stadiometer (Leicester Height Measure, Seca Limited) and portable scales (Seca, Germany). Participants were asked to remove their coats and shoes prior to measurement. Body Mass Index (BMI) was calculated by dividing weight (kg) by height (metres) squared.

2.11. Statistical Software and Analyses

Quantitative data analysis was carried out using PASW Statistics version 18 (SPSS inc., USA). Checks were carried out to ensure that parametric assumptions were met. Histograms were assessed to ensure normal distribution via a bell-shaped curve. The mean and median for each condition/group were checked for similarity, and the mean and standard deviation (SD) were compared (to ensure that the mean was greater than the SD). Skewness and kurtosis statistics were checked (skewness and kurtosis statistics were converted into z-scores by dividing the statistic by its standard error: a value greater than 1.96 was considered to reflect non-normal distribution, following e.g. Field, 2005). In order to assess whether the distribution as a whole deviated from a comparable normal distribution, the Kolmogorov-Smirnov test was carried out. If this test was non-significant then the distribution of the sample was considered to be not significantly different from a normal distribution. However, if it was significant the distribution was considered to be non-normal. Box plots and z-score statistics were also used to locate any outliers. Errors and outliers were also removed from reaction time data by locating and removing response latencies above two SDs from the mean score for each individual. In addition, any response times below 200ms or above 2000ms were removed from the dot probe reaction time data.

The majority of statistical analysis in this thesis consisted of mixed measures ANOVA, with any significant main effects or interactions followed up with Bonferroni corrected pairwise comparisons. Assumptions of sphericity were also checked and where violated Greenhouse-Geisser correction was employed. There is no non-parametric alternative to a mixed measures ANOVA, and data used in ANOVA should be normally distributed. However, this is not inflexible (Field, 2005) and ANOVA is robust to violations of its assumptions. For example, simulation studies using a variety of non-normal distributions have shown that the false positive rate is not affected very much by moderate deviations from normality (Glass, Peckham & Sanders, 1972; Harwell, Rubinstein, Hayes & Olds, 1992; Lix, Keselman & Keselman, 1996). Schmider, Ziegler, Danay, Beyer, and Buhner (2010) also investigated the robustness of ANOVA against violations of the underlying assumption of normally distributed data. Their results give strong support for the robustness of ANOVA under application of non-normally distributed data (they found that both the empirical type I error α and the empirical type II error β remain constant under application of non-normal distributions). It is reasonable to conclude "all in all, the findings speak for the robustness of ANOVA concerning violations of the normality assumption and the lack of valuable alternatives" (Schmider et al., 2010). Therefore, mixed ANOVA were carried out whether data were normally distributed or non-normally distributed. For reviews on the evidence for the robustness of ANOVA see Glass et al. (1972) and Harwell et al. (1992).

To check for any differences between groups (e.g. restrained and unrestrained eaters) on potential confounding variables (e.g. depression) MANOVA was carried out; however, when data did not meet parametric assumptions, Mann Whitney *U* tests were employed. To explore relationships between variables (e.g. questionnaire scores and reaction time), Pearson's product moment correlations were carried out, except when parametric assumptions were not met, in which case Spearman's rho was employed. Specific analyses for each study are outlined in depth in each chapter.

Chapter Three: Pilot Study
Attentional bias and slowed disengagement from food and negative stimuli in restrained eaters using a modified Stroop task

3.1. Introduction

Attentional bias (AB) is defined as the propensity to look for, and be attentive to certain information in the environment (Posner & Peterson, 1990). More specifically, it is the tendency to selectively attend to disorder-relevant stimuli (e.g. Mathews & MacLeod, 2005), and modified versions of the Stroop task (Stroop, 1935) have been frequently used to study such biases. The original Stroop colour-naming task required participants to report the ink colour of a word whilst inhibiting the automatic tendency to report the word itself (an incongruent colour). Modifications of this task permit the assessment of colour-naming times for disorder-relevant and neutral words. In such tasks biased attention is inferred from increased response latencies for disorder-related words compared to non-disorder words, hence demonstrating a capture of attention by such stimuli.

Much of the work on AB in psychopathology has focused on anxiety and depression. Beck and Clark (1997) claim that ABs in anxiety occur in the initial registration of stimuli, also referred to in later research as orientation, automatic or fast biases. Such automatic orientation biases involve an initial orientation of attention towards stimuli. More recently, automatic orientation biases have also been demonstrated in restrained eaters and among the eating disorders (EDs). According to cognitive models, eating disordered individuals have elaborated dysfunctional schemata about eating and body appearance, leading to biased information processing which is thought to maintain the disorder (e.g. Vitousek & Hollon, 1990). ED sufferers are more likely to give priority to body- and food-related information which is related to fatness given their fear of weight gain (Smeets et al., 2008; Williamson, Muller, Reas, & Thaw, 1999). Food and Body Stroop tasks have been developed, with interference (i.e. slowed colour-naming) observed in both anorexia nervosa (AN) and bulimia nervosa (BN) patients for both word categories (e.g. Ben-Tovim & Walker, 1991; Cooper & Fairburn, 1992; Perpina, Hemsley, Treasure, & DeSilva, 1993; Sackville, Schotte, Touyz, Griffiths, & Beumont, 1998). This interference is found more consistently with food words (e.g. Lee & Shafran, 2004). The extent to which this applies to non-clinical levels of disordered eating is less clear.

There is some debate as to whether orientation biases towards food and body stimuli are restricted to individuals with clinically diagnosed EDs (e.g. Dobson & Dozois, 2004). Limited research has been carried out with non-clinical samples, and has tended to investigate biases amongst restrained eaters. This research has found some support for orientation biases towards food and body stimuli using the Dutch Eating Behaviour Questionnaire (DEBQ; Van Strien, Frijters, Bergers, & Defares, 1986) to assess restraint (e.g. Green & Rogers, 1993; Tapper, Pothos, Fadardi, & Ziori, 2008). However, some studies using the Restraint Scale (RS; Herman, Polivy, Pliner, Threlkeld, & Munic, 1978) have not found such an effect (e.g. Jansen, Huygens, & Tenney, 1998; Sackville et al., 1998). Many have argued that this is due to problems with the construct validity of the RS as it confounds restraint with disinhibition (e.g. Placanica, Faunce, & Job, 2002; Tapper et al., 2008), whereas the restraint scale of the DEBQ is a measure of restraint alone. Other investigations with non-clinical samples have found a positive association between high drive for thinness (DFT) and bias for food words (Perpina et al., 1993), but others have failed to do so (e.g. Ben-Tovim & Walker, 1991). However, Perpina et al. (1993) included both non-clinical and clinical participants in their high DFT group, limiting conclusions regarding non-clinical concerns. Cooper and Fairburn (1992) also failed to find a significant difference between dieting and control groups in performance on a food Stroop, which could suggest that significant food Stroop effects cannot be found in non-clinical groups. A Stroop interference effect has, however, been found in food deprived individuals (Channon & Hayward, 1990) and dieters and non-dieters following a preload (Mahamedi & Heatherton, 1993). Furthermore, Black, Wilson, Labouvie, and Heffernan (1997) found a significant interference effect for food and body words in restrained *and* unrestrained eaters, as well as BN patients, demonstrating that findings from non-clinical Stroop research are equivocal.

Automatic orientation biases have more recently been differentiated from slowed disengagement, which concerns a difficulty withdrawing attention from a stimulus (later, more elaborative processing/attentional dwelling). An increasing number of researchers have found slowed disengagement to be the dominant bias, particularly with regard to anxiety (e.g. Fox et al., 2001; Van Damme et al., 2008). These studies have used alternative measures of AB (e.g. the exogenous cuing task), and some researchers argue that the Stroop task cannot be used as a measure of slowed disengagement (e.g. Fox et al., 2001; Cisler et al., 2007). However, McKenna and Sharma (2004) have demonstrated that the Stroop task can measure slowed disengagement (referred to as a slow effect). McKenna (1986) previously demonstrated a lingering effect in an emotional Stroop task using a blocked presentation, finding that when emotional words precede a session of neutral words, an interference effect (i.e. slowed colour-naming) was observed on the neutral words. They concluded that disruptive effects of emotional stimuli persist beyond their presentation in this task. McKenna and Sharma (2004) later explored the impact of mixing emotional and neutral stimuli using a pseudorandom design. In a series of experiments they found consistent evidence for slowed disengagement from emotional stimuli as opposed to automatic orientation biases. Their findings indicate that the presentation of emotional stimuli in a Stroop task disrupts the processing of subsequent stimuli, which lasts for one following trial; however, this has been explored only with emotional words (as opposed to, for example, food words) and requires replication.

The distinction between orientation and disengagement biases has recently been addressed in ED research. Using a visual search task, Smeets et al. (2008) found evidence for facilitated orientation towards body stimuli and slowed disengagement from high-calorie food stimuli, suggesting that the exact nature of AB also depends on the type of stimuli involved. Given that slowed disengagement was found to be the dominant bias in relation to food stimuli, it would be interesting to see if this effect can be replicated using McKenna and Sharma's (2004) Stroop design. This chapter reports an initial pilot study investigating the use of a modified Stroop task as a method of assessing orientation bias and disengagement in relation to food stimuli in restrained eaters. In addition, this pilot study attempts to replicate McKenna and Sharma's (2004) emotional Stroop disengagement effect (i.e. slowed disengagement from negative mood stimuli).

The aim of this pilot study was to clarify previous ambiguous findings concerning AB for food amongst restrained eaters, by assessing both subcomponents of AB (orientation/disengagement) using a modified version of McKenna and Sharma's (2004) Stroop task. It was hypothesised that a high restraint group (compared to a low restraint group) would be slow to disengage from high-calorie food words, demonstrated through a longer colour-naming time for a neutral word directly following a food word (compared to the food word itself and later neutral words in a sequence). It was also hypothesised that a general disengagement effect from negative mood words would be found across all participants in a modified Stroop task, demonstrated through a longer response time (RT) for a neutral word directly following a negative mood word (hence replicating the findings of McKenna and

Sharma, 2004). Finally it was hypothesised that there would be no difference between word position RTs in a neutral condition (with all neutral words).

3.2. Method

3.2.1. Participants

Forty female participants were recruited at Loughborough University to participate in a study on individual differences in attention to words. All participants were classed into high and low restraint groups according to median-split scores on the restraint scale of the DEBQ. The high restraint group consisted of 19 females and the low restraint group consisted of 21 females (median=2.2), with those scoring on the median being categorised into the low group. All participants were aged between 18 and 34, with a mean age of 21.28 years (*SD*=3.01) and a mean body mass index (BMI) of 21.57 (*SD*=3.04). Due to some demographic and questionnaire data not meeting parametric assumptions, Mann Whitney *U* tests were carried out in order to compare restraint groups. High and low restraint groups did not differ in age, BMI, depression and bulimic symptoms; however the high restraint group had significantly higher DFT, body dissatisfaction and anxiety scores than the low restraint group (see Table 3.1).

Table 3.1: Participant characteristics of high and low restraint groups

Measure	Low Restraint *M* (SD)	High Restraint *M* (SD)	*U*	*z*	*p*
Age (years)	21.62 (3.97)	20.89 (1.37)	191.5	-.223	.823
BMI	20.77 (2.47)	22.44 (3.42)	137.5	-1.68	.093
Restrained eating (DEBQ)	1.75 (0.38)	3.13 (0.57)	.000	-5.41	.000*
DFT (EDI-2)	.33 (.73)	5.63 (6.04)	74	-3.68	.000*
Bulimia (EDI-2)	.48 (.75)	1.53 (2.63)	154.5	-1.38	.167
Body Dissatisfaction (EDI-2)	4.95 (6.38)	10.74 (6.14)	84.5	-3.12	.002*
Depression (BDI)	8.00 (7.42)	8.95 (3.27)	165	-.94	.348
Trait anxiety (STAI-T)	40.52 (10.20)	45.95 (5.58)	119.5	-2.17	.030*

Note: BMI = body mass index = weight in kg/height in m²; DEBQ = Dutch Eating Behaviour Questionnaire; EDI-2 = Eating Disorder Inventory-2; DFT = Drive for Thinness Subscale; BDI = Beck Depression Inventory; STAI-T = State-Trait Anxiety Inventory Trait version; * p<0.05.

3.2.2. Materials

3.2.2.1. Dutch Eating Behaviour Questionnaire: Restraint Subscale (DEBQ: Van Strien, Fijters, Bergers, & Defares, 1986)

Restrained eating concerns the tendency for an individual to restrict their food intake in order to control their body weight (Herman & Mack, 1975). This was measured using the 10-item restrained eating subscale of the DEBQ, with higher scores indicating greater levels of restriction. This subscale has high internal consistency and factorial validity (e.g. Braet & Van Strien, 1997; Van Strien et al., 1986).

3.2.2.2. Eating Disorder Inventory-2 (EDI-2: Garner 1991)

The EDI-2 measures psychological and behavioural traits common to AN and BN using three subscales: the DFT subscale which measures excessive concern with dieting, preoccupation with weight and an extreme DFT; the Bulimia subscale which measures the tendency towards bingeing and purging; and the Body Dissatisfaction subscale which measures dissatisfaction with body shape and weight. Higher scores on each scale indicate greater levels of each trait. This measure has high test-retest reliability and stability over time in both clinical and non-clinical samples (e.g. Thiel & Paul, 2006; Wear & Pratz, 2006).

3.2.2.3. State Trait Anxiety Inventory-Trait Scale (STAI-T: Speilberger, Gorsuch, & Lushene, 1970)

The STAI is a 20-item self-report measure of anxiety symptoms and produces a range of scores between 20 and 80, with higher scores indicating greater anxiety. Trait anxiety refers to how anxiety manifests itself over time, and is thought to be relatively stable. The trait scale requires individuals to indicate on a four-point scale how they generally feel in terms of 20 statements. This scale has high internal consistency, reliability and stability (e.g. Barnes, Harp & Jung, 2002; Jacobs, Latham, & Brown, 1988; Spielberger et al., 1970).

3.2.2.4. Beck Depression Inventory (BDI: Beck, Ward, Mendelson, Mock, & Erbaugh, 1961)

The BDI is a widely used 21-item self-report measure of affective, cognitive and somatic symptoms of depression, producing scores between 0 and 63. Higher scores indicate greater levels of depression. The BDI is found to have robust psychometric properties (e.g. Beck & Steer, 1993; Beck, Steer & Garbin, 1988) with past reports indicating strong construct validity and reliability (e.g. Beck et al., 1988; Fydrich, Dowdall, & Chambless, 1992).

3.2.2.5. Modified Stroop Task

All participants completed 'Food', 'Mood' and 'Neutral' conditions of the Stroop task. The task was presented in a single session using EPrime stimulus presentation software. This was a computerised version of the task, in which the stimulus words were presented individually in the centre of a 19-inch screen until the individual responded to the colour using a key press. The words were presented in red, blue, green or yellow (colours were presented in equal frequency) and participants were required to press the corresponding colour key on the keyboard. The words were presented against a black background, in block capitals in the centre of the screen. The task began with 16 practice trials consisting of rows of 'XXXXX' in each of the four colours. The task included three different categories of words: four high-calorie food words e.g. 'chips' and 'biscuit', four negative mood words e.g. 'isolated' and 'crying', and neutral words such as 'tower' and 'bishop'. All words were matched for word length and frequency in the English language using Leech, Rayson and Wilson's (2001) written and spoken word frequencies (5-7 letters; see Appendix 2 for a full list of words included). The words were presented in a pseudo-randomised order, with no word or colour appearing consecutively. The words appeared in a sequence of five, beginning with a target word (food or mood word) followed by four neutral words, with the neutral condition consisting of groups of five neutral words. Each target word was presented four times and the neutral words were counterbalanced. Eighty words were included in each condition (240 words in total). See Table 3.2 for an example of word order in the task.

Table 3.2: Example word order in the food condition

Position	Words: 'Targets' repeated four times, neutral words counterbalanced.			
1	**Chips**	**Chips**	**Chips**	**Chips**
2	Conform	Consist	Glance	Tower
3	Consist	Glance	Tower	Conform
4	Glance	Tower	Conform	Consist
5	Tower	Conform	Consist	Glance

3.2.3. Procedure

Participants were recruited by email and word-of-mouth and did not receive any incentive to take part. The study was approved by the Loughborough University Ethical Advisory Committee. Participants were invited to take part in a study on individual differences in attention, and were tested individually in an experimental cubicle. They were provided with an information sheet explaining that the study would involve a computer test assessing attention to words, the completion of questionnaires to measure mood and appetite variables, and the measurement of height and weight. After reading the information sheet and being given the opportunity to ask any questions, participants signed the consent form. Participants were then given standardised verbal instructions on the computer task, and followed the on-screen instructions and carried out the task. After completing the computer task each participant filled in the questionnaire pack (DEBQ, EDI-2, BDI, STAI-T), and on completion the experimenter asked permission to take height and weight measurements. Finally each participant was thanked for their participation and debriefed as to the purpose of the study. Altogether the procedure lasted approximately 30 minutes.

3.2.4. Data analysis

For each of the food, negative mood and neutral conditions of the Stroop task, errors were removed so that only trials in which the target colour was identified correctly were included in the analysis. The mean percentage of errors across participanrs was 1.97% (0.65% errors in the Food condition; 0.64% errors in the Mood condition; 0.68% errors in the Neutral condition). Therefore participants had a mean of 98.03% correct responses in the task. Response latencies above or below two standard deviations (SDs) from the mean RT for each condition, for each individual participant, were also removed. A mean of 3.6% of responses met this criterion and were therefore removed (0.96% in the Food condition; 1.02% in the Mood condition; 1.62% in the Neutral condition).

The dependent variable was RT, and the independent variables were restraint group, Stroop condition and word position. Each condition was analysed separately in a 2 (group: high/low restraint) x 5 (word position) mixed measures ANOVA. Where sphericity was violated Greenhouse Geisser correction was employed (although uncorrected degrees of freedom are reported in the text).

Hypotheses were tested using the RT data, with a delayed RT for the target food or negative mood word demonstrating an orientation bias towards the word, and a delayed RT for the neutral word directly following the target food or negative mood word (position 2) showing slowed disengagement from the target word (compared to faster RTs for subsequent neutral words in the sequence). To account for significant group differences, analyses were repeated with DFT, body dissatisfaction and anxiety as covariates. An α level of 0.05 was taken to be significant.

3.3. Results

3.3.1. Food Stroop

A 2 (high/low restraint) x 5 (word position) ANOVA revealed a significant main effect of word position: $F(4, 152)=24.79$, $p<.001$, $\eta p^2=.40$. Follow-up Bonferroni corrected pairwise comparisons revealed no significant difference between RTs for word positions 1 and 2 ($p=.520$). However, RTs for position 2 were significantly longer than for positions 3, 4 and 5 (all $p<.01$: see Figure 3.1). Despite there being no significant difference between word position 1 and 2 RTs, there was no clear orientation bias towards the food word as there were no significant differences between word position 1 RTs and RTs at positions 3 ($p=1.000$) and 4 ($p=.076$). Participants were significantly faster to colour-name words in position 5 than all other word positions (all $p<.001$). Contrary to predictions, there was no significant main effect of restraint: $F(1, 38)=.1.00$, $p=.754$, $\eta p^2=.003$, and no significant position x restraint interaction: $F(4, 152)=1.32$, $p=.264$, $\eta p^2=.034$. The significant group differences in DFT, body dissatisfaction and anxiety were accounted for in a subsequent covariate analysis and the results remained unchanged[1]. There were no significant main effects of DFT, body dissatisfaction and anxiety, and no significant interactions between these measures and word position (all *p*>.05).

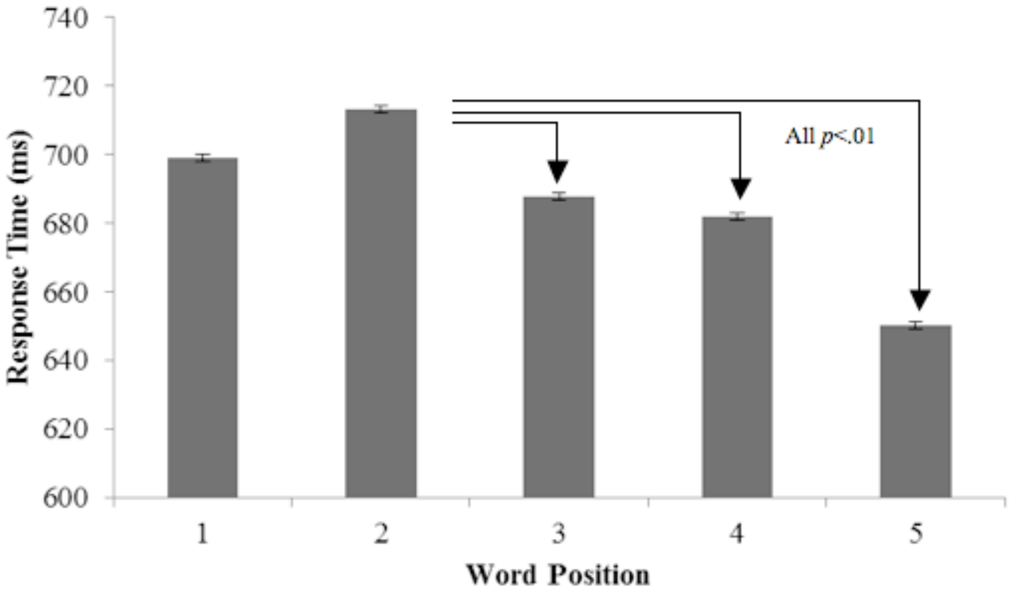

Figure 3.1: Mean (±SEM) response time at each word position in the food condition

3.3.2. Negative Mood Stroop

In a 2 (high/low restraint) x 5 (word position) ANOVA Mauchly's sphericity was violated and so Greenhouse Geisser correction was employed. This revealed a significant main effect of word position: $F(4, 152)=42.64$, $p<.001$, $\eta p^2=.53$. Follow-up Bonferroni corrected pairwise comparisons revealed that RTs for word position 2 were significantly longer than for all other word positions (all $p<.05$: see Figure 3.2). There was no consistent evidence of an orientation bias towards the mood word as RTs for word position 1 did not significantly differ from position 3 ($p=.696$), although they were significantly longer than at positions 4 and 5 (both $p<.001$). RTs for word position 5 were significantly quicker than RTs at all other word positions (all $p<.001$). There was no significant main effect of restraint: $F(1, 38)=.561$, $p=.46$, $\eta p^2=.015$, and no significant position x restraint interaction, $F(4, 152)=.562$, $p=.69$, $\eta p^2=.015$. The significant group differences in DFT, body dissatisfaction and anxiety were

[1] With covariates included:- word position: $F(4,140)=3.122$, $p=.017$, $\eta p^2=.082$; position x restraint: $F(4,140)=1.124$, $p=.348$, $\eta p^2=.031$; restraint group: $F(1,35)=.017$, $p=.897$, $\eta p^2=.000$. Correlations between DFT and word positions 1-5 (DV): r_s ranged between .137 and.252 (all $p>.05$); correlations between BD and word positions 1-5: r_s ranged between -.035 and -.171 (all $p>.05$); correlations between anxiety and word positions 1-5: r_s ranged between .001 and -.134 (all $p>.05$). Covariates included due to significant restraint group differences in scores.

accounted for in a subsequent covariate analysis and the results remained unchanged[2]. There were no significant main effects of DFT, body dissatisfaction and anxiety, and no significant interactions between these measures and word position (all *p*>.05).

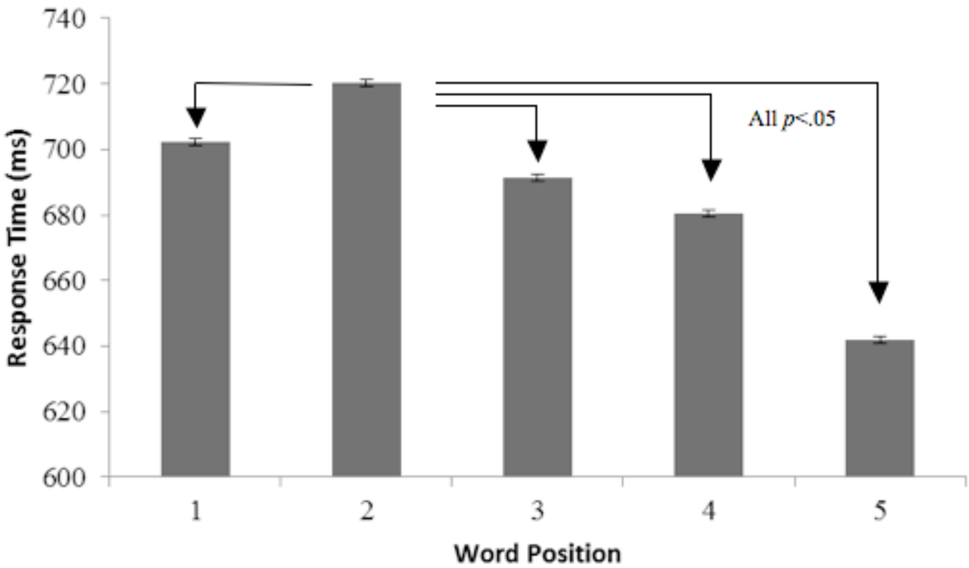

Figure 3.2: Mean (±SEM) response time at each word position in the mood condition

3.3.3. Neutral Stroop

A 2 (high/low restraint) x 5 (word position) ANOVA revealed a significant main effect of word position: $F(4, 152)=33.15$, $p<.001$, $\eta p^2=.47$. Follow-up Bonferroni corrected pairwise comparisons revealed that RTs for word position 2 were significantly longer than for all other positions (all $p<.01$: see Figure 3.3). In addition, RTs for word position 5 were significantly faster than for all other word positions (all $p<.001$). There was no significant main effect of restraint: $F(1, 38)=.7$, $p=.41$, $\eta p^2=.018$, and no significant position x restraint interaction: $F(4, 152)=.88$, $p= .475$, $\eta p^2=.023$. The significant group differences in DFT, body dissatisfaction and anxiety were accounted for in a subsequent covariate analysis and the main effect of word position

[2] With covariates included:- word position: $F(4,140)=5.891$, $p=.001$, $\eta p^2=.144$; position x restraint: $F(4,140)=.648$, $p=.591$, $\eta p^2=.018$; restraint group: $F(1,35)=.639$, $p=.430$, $\eta p^2=.018$. Correlations between DFT and word positions 1-5 (DV): r_s ranged between .101 and .225 (all $p>.05$); between BD and word positions 1-5: r_s ranged between -.031 and -.150 (all $p>.05$); and between anxiety and word positions 1-5: r_s between -.023 and -.165 (all $p>.05$).

remained only marginally significant: $F(4, 140)=2.7$, $p=.047$, $\eta p^2=.072$. There were no other significant effects[3].

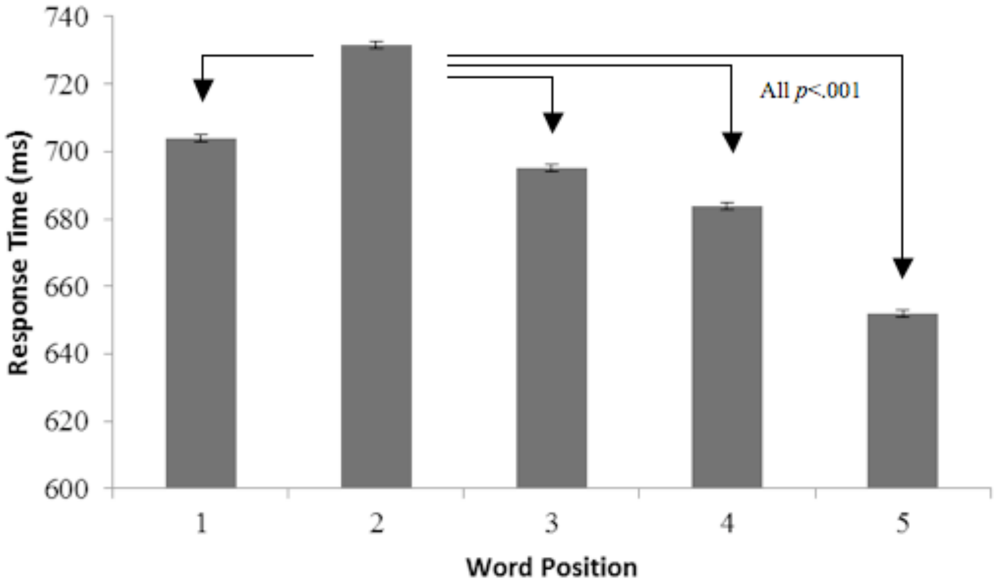

Figure 3.3: Mean (±SEM) response time at each word position in the neutral condition

3.3.4. Summary

In summary, performance did not significantly differ according to restrained eating group in any Stroop condition. However, word position was found to be highly significant across all conditions, with words in position 2 consistently receiving the longest colour-naming times. This indicates that slowed disengagement from the target words occurred, an effect lasting for one consecutive word followed by a gradual speeding up of colour-naming until the next target word. No clear orientation bias towards the food and mood words was demonstrated, and despite some indication of a greater delay in colour-naming these words compared with later neutral words in the sequence, this was not consistent. Therefore, the slowed disengagement effect seems to be far more robust. However, contrary to predictions this pattern of response was found in the neutral condition, showing that this may not have been due to the use of a specific word category.

[3] With covariates included:- position x restraint: $F(4,140)=1.436$, $p=.235$, $\eta p^2=.039$; restraint group: $F(1,35)=.479$, $p=.494$, $\eta p^2=.013$. Correlations between DFT and word positions 1-5 (DV): r_s ranged between .015 and .171 (all $p>.05$); between BD and word positions 1-5: r_s ranged between -.134 and -.222 (all $p>.05$); and between anxiety and word positions 1-5: r_s ranged between .026 and -.096 (all $p>.05$).

3.4. Discussion

The aim of this pilot study was to explore biased attention processing of food (both orientation and disengagement) amongst restrained eaters using a modified version of McKenna and Sharma's (2004) Stroop task. It was hypothesised that highly restrained eaters (compared to unrestrained eaters) would be slow to disengage their attention from high-calorie food words. As expected, it was found that participants were slowest to colour-name a neutral word directly following a food word (word position 2) in the food condition (demonstrating slowed disengagement from the food word lasting for one consecutive word). However, RTs for the food word itself (word position 1) were not significantly longer than all other word positions, hence indicating there was no orientation bias towards food. This supports the previous finding that slowed disengagement is the dominant bias in relation to food stimuli (e.g. Smeets et al., 2008). This study has the potential to aid in clarifying previous ambiguous results exploring AB amongst restrained eaters. Previous food Stroop investigations have only assessed orientation biases towards food, but it may be that such biases are not as robust as disengagement effects. However, the present findings do not suggest that restraint is a predictor of slowed disengagement from food, as both restraint groups demonstrated this effect (consistent with earlier findings e.g. Black et al., 1997).

It was also hypothesised that a general disengagement effect from negative mood words would be found across all participants and this was supported. Therefore, McKenna and Sharma's (2004) finding that participants are slow to disengage from negative emotion words in a modified Stroop task has been replicated. As in the food condition, there was no evidence of an orientation bias towards the negative mood words. Finally it was also hypothesised that there would be no difference between word position RTs in the neutral condition (with all neutral words). However, the pattern of a longer RT at word position 2 was also found in the neutral condition, in which no target food or negative mood word was included. This limits conclusions regarding the food and mood conditions as it may suggest that the pattern of responding was not dependent on the type of word displayed.

One methodological consideration from both the present and previously reported study in which both restrained and unrestrained displayed biased processing of food (Black et al., 1997) is that hunger was not measured or controlled for. Hunger may have been a greater predictor of slowed disengagement from food than restraint as it is frequently acknowledged as a confounding variable in research into food-related biases (e.g. Lee & Shafran, 2004; Mogg, Bradley, Hyare & Lee, 1998; Placanica et al., 2002). The lack of difference between restraint groups may also be due to low questionnaire scores on the restraint subscale of the DEBQ. Tapper et al. (2008), for example, dichotomised scores above or below a score of 3 on the restraint scale of the DEBQ, whereas here scores were dichotomised above or below 2.2 (below the mid-score on the scale). It is possible that unrestrained eaters were placed in the high restraint group, reducing the likelihood of observing group differences. Alternatively, it is open to question whether the lack of difference between restraint groups was due to the mere inclusion of a non-clinical group with eating concerns (as studies noted previously have struggled to find consistent results with such samples). Finding the same pattern of response to word positions in the neutral condition may be explained by other limitations of this pilot study. For example, the order of conditions was not counterbalanced and it has previously been stated that it is very important to counterbalance the order of presentation of target and control stimuli (e.g. Lee & Shafran, 2004). It is possible that fatigue, boredom or practice effects may have occurred throughout the task, and this is important to note as the neutral task was always last in the sequence. Participants may have ended up in a pattern of response based on the previous conditions - a possible explanation for the pattern of response in the neutral condition. Potential monotony effects may also explain why the RTs in the neutral task were the longest overall. Another limitation of the task is that the neutral words were viewed more often than the target words. There were four target words and four neutral words in the food and negative mood conditions, but each target word was only presented four times whereas the neutral words were repeated 16 times (after each of the different target words). The added frequency of these words may have impacted upon RT. Such methodological limitations leave this study in need of modification and replication.

In conclusion, this initial pilot study demonstrates that the Stroop task can distinguish between separate sub-components of AB for food, hence replicating and extending the findings of McKenna and Sharma (2004). Despite finding no differences between restrained and unrestrained eaters, there is promise for studies with larger samples with higher questionnaire scores, to find significant group differences. These findings imply an extended use of the Stroop task in attention research with non-clinical groups characterised by non-clinical eating traits; however, further research is needed into the best task design, participant groups, and stimuli used in order to fully reap the benefits of its use in eating research. These initial findings further point out the importance of assessing slowed disengagement when investigating attention processing of food stimuli. The use of a modified Stroop task as a measure of slowed disengagement is still in its early days, particularly with regard to food stimuli. The current study design holds promise for further informing the field of attention research in non-clinical and clinical groups of individuals with eating concerns. This is important given the expected role of AB in the maintenance of ED symptoms. Further investigation into how best to measure biases in attention in eating groups, and which sub-component holds the dominant bias, is essential to informing how best to retrain attention in such individuals.

Chapter Four: Study One
Attentional bias and slowed disengagement from food and interpersonal threat in restrained eaters using a modified Stroop task

4.1. Introduction

The aim of the present chapter was to address the methodological limitations of the pilot study in order to more effectively explore attentional bias (AB) amongst restrained eaters (the results of this chapter have been published: Wilson, C., & Wallis, D. (2013). Attentional bias and slowed disengagement from food and threat stimuli in restrained eaters using a modified Stroop task. *Cognitive Therapy and Research, 37*(1), 127-138: see Appendix 25). As already described, AB refers to the tendency to selectively attend to disorder-relevant stimuli (e.g. Mathews & MacLeod, 2005) and consists of two sub-components: initial orientation of attention towards and slowed disengagement from stimuli (e.g. Posner & Peterson, 1990; Smeets, et al., 2008). Modified versions of the Stroop task (Stroop, 1935) have shown that both anorexia nervosa (AN) and bulimia nervosa (BN) patients (e.g. Ben-Tovim & Walker, 1991; Perpina, Hemsley, Treasure, & DeSilva, 1993) and highly restrained eaters (e.g. Green & Rogers, 1993; Tapper, Pothos, Fadardi, & Ziori, 2008) have an automatic orientation bias towards food. However, some studies using the Restraint Scale (RS; Herman, Polivy, Pliner, Threlkeld, & Munic, 1978) to assess restraint have not found such an effect with restrained eaters (e.g. Jansen, Huygens, & Tenney, 1998; Sackville et al., 1998). Furthermore, Black et al. (1997) found a significant interference effect for food words in a Stroop task in restrained *and* unrestrained eaters, demonstrating that findings from non-clinical Stroop research are equivocal.

An increasing number of researchers have found slowed disengagement (i.e. attentional dwelling) to be the most robust sub-component of AB, particularly with regard to anxiety (e.g. Fox et al., 2001). Some researchers argue that the Stroop task cannot be used as a measure of slowed disengagement (e.g. Cisler, Ries, & Widner, 2007; Fox et al., 2001), however, as noted in Chapter Three McKenna and Sharma (2004) have demonstrated that the Stroop task can measure slowed disengagement through mixing target and neutral stimuli. In eating disorder (ED) research, Smeets et al. (2008) found that ED patients are slow to disengage from high-calorie food stimuli (but did not have an orientation bias towards such stimuli). Given that slowed disengagement was found to be the dominant bias in relation to food stimuli, the pilot study described in Chapter Three investigated whether slowed disengagement from food could be demonstrated using a modified version of McKenna and Sharma's (2004) Stroop task. The adapted task assessed orientation biases towards food and mood (negative emotion) stimuli through assessment of colour-naming times for food and mood 'target' words, and slowed disengagement through colour-naming times for neutral words which followed each 'target'. Performance on the task did not differ significantly between high and low restrained eaters, but for all participants the word immediately following the 'target' food or mood word consistently produced the longest response time (RT). This indicates slowed disengagement lasting for one consecutive word. However, contrary to predictions, this pattern was found in a neutral condition also, showing that this pattern may not have been due to the use of a specific word category. These inconclusive findings may have been due to a number of methodological limitations. For example hunger was not accounted for, scores on the restraint subscale of the Dutch Eating Behaviour Questionnaire (DEBQ-R; Van Strien, Fijters, Bergers, & Defares, 1986) were low, the order of conditions was not counterbalanced (leaving performance open to fatigue, monotony or practice effects), and there was no inclusion of a neutral category. Such methodological limitations leave this study in need of modification and replication.

ABs towards stimuli other than food are also associated with forms of disordered eating. Previous research has identified a relationship between bulimic attitudes and ego-threat biases (e.g. Meyer, Waller, & Watson, 2000; Waller, Watkins, Shuck, & McManus, 1996). Waller et al. (1996) found that bulimic, but not restrictive tendencies were related to a bias for self-directed ego threat. Quinton (2004), however, observed biases for ego threats to self and ego threats from others in bulimic, anorexic and non-clinical individuals, which indicates that threat information is also relevant for non-clinical groups. Meyer et al. (2000) found that bulimia, according to scores on the Eating Disorder Inventory-2 (EDI-2; Garner, 1991), was associated with an ego threat bias; however, they did not find this among women with restrictive tendencies. Johansson, Lundh, and Andersson (2005) also found that high scorers on the Body Shape Questionnaire (BSQ; Cooper, Taylor, Cooper, & Fairburn, 1987) had a larger delay in colour-naming performance-related threat than interpersonal threat words (equivalent to ego threat from others), after being primed with a thin ideal image. However, they focused specifically on body dissatisfaction; therefore, a bias for interpersonal threat words cannot be ruled out from those with general bulimic and restrictive tendencies.

Findings regarding ABs for different types of ego threat among women with bulimic and restrictive tendencies are inconsistent. Some researchers have found evidence for AB towards all types of ego threat in both bulimic and restrictive women; others have found evidence only amongst those with bulimic tendencies or for only certain types of ego threat. These biases seem to be found less consistently amongst those with restrictive tendencies; therefore, further investigation is required in order to develop firm conclusions regarding the degree to which such individuals are distracted by these stimuli. In particular, biases are expected in relation to ego threat from others (interpersonal threat) in restrictive individuals, as interpersonal difficulties are found to precede binge eating in such individuals (e.g. Tanofsky-Kraff, Wilfley, & Spurrell, 2000). Furthermore, experimental studies show that presentation of ego threatening stimuli in a Stroop task leads to overeating in restrained eaters (e.g. Lattimore & Maxwell, 2004; Wallis & Hetherington, 2004), and interpersonal difficulties are given a key role in the aetiology and maintenance of AN. For example, Interpersonal Psychotherapy (IPT) is found to be largely successful for treatment of AN (e.g. McIntosh, Bulik, McKenzie, Luty, & Jordan, 2000). Given the relationship between interpersonal difficulties, restraint and overeating, it is expected that restrained eaters will be more distracted by stimuli signifying ego threat from others than by neutral stimuli.

The overall aim of the present study was to investigate, in restrained eaters, AB for food stimuli and stimuli signifying ego threat from others. This was carried out using a modification of the present researchers' pilot Stroop task designed to address its limitations (controlling for hunger, counterbalancing order of conditions, matching neutral words according to each individual target word, including a single neutral category of words in the neutral condition). It was hypothesised that compared with the low restraint group, those high in restraint would be slow to disengage from food and interpersonal ego threat target words indicated by a longer RT for a neutral word in position 2 (i.e. directly following a 'target' word). This effect was not expected in the neutral (animal) condition. As slowed disengagement was found previously to be the more robust sub-component of AB, it was hypothesised that this, but not an orientation bias, would again be found in the food and ego threat conditions. This study (and the initial pilot) are novel in their application of McKenna and Sharma's (2004) Stroop task design to food stimuli, and are important because the findings from food-related AB research have been equivocal using current methods of assessment. Given that disengagement is emerging as the key component in food biases, a modified Stroop task may be more informative than the original version of the task in exploring AB. By utilising the Stroop as a measure of disengagement this study will help optimise the assessment of AB, a factor that is thought to maintain and exacerbate certain eating behaviours and which may be informative in the treatment of various clinical disorders. This is shown through the success of attention training (AT) programs for anxiety and depression in particular (for reviews of some of this literature see Bar-Haim, 2010; Hakamata, Lissek, Bar-Haim, Britton, Fox, Leibenluft et al., 2010; MacLeod, Koster & Fox, 2009). Clarifying the mechanisms involved in biased attention processing of food stimuli may help to inform potential AT programs for the alteration of certain problematic eating behaviours.

4.2. Method

4.2.1. Participants

Forty-eight female university students participated in a study on individual differences in attention to words. Participants were recruited by email, fliers around the University and word-of-mouth, and did not receive any incentive to take part. The study was approved by the Loughborough University Ethical Advisory Committee. The inclusion criteria were that participants should not be colour blind, not currently being treated for an ED, and either English was their first language or they were highly proficient in the English language. Participants were categorised into low (n=25) and high (n=23) restraint groups based on median-split scores on the restraint subscale of the DEBQ (median=2.6, with those scoring on the median categorised as low restraint). All participants were aged between 18 and 32, with a mean age of 21.81 years (SD=2.99) and a mean body mass index (BMI) of 22.43 (SD=2.97). Due to demographic and questionnaire data not meeting parametric assumptions, Mann Whitney U tests were carried out in order to compare restraint groups. There were no significant differences between groups in age, BMI, hunger, desire to eat, time since last meal, depression and trait anxiety (see Table 4.1). High and low restrained eaters differed significantly on restraint scores, indicating that they represented independent groups. Highly restrained eaters also had significantly higher scores on the Drive For Thinness (DFT) subscale of the EDI-2.

Table 4.1: Participant characteristics of low and high restraint groups

Measure	Low Restraint *M* (SD)	High Restraint *M* (SD)	*U*	*z*	*p*
Age (years)	21.44 (2.18)	22.22 (3.68)	284	-.074	.941
BMI	22.81 (3.48)	21.99 (2.26)	250	-.533	.594
Hunger	35.62 (26.67)	25.02 (20.91)	225.5	-1.28	.200
Desire to eat	34.92 (25.41)	24.33 (21.91)	207.5	-1.65	.099
How long since last meal (mins)	198.60 (224.06)	115.75 (88.71)	227	-1.25	.210
DFT (EDI-2)	.68 (1.07)	5.04 (5.00)	114	-3.73	.000*
Bulimia (EDI-2)	.48 (.77)	1.13 (2.65)	273.5	-.346	.730
Body Dissatisfaction (EDI-2)	5.04 (5.50)	6.91 (5.87)	225.5	-1.29	.198
Restrained eating (DEBQ)	2.07 (.42)	3.19 (.35)	.000	-5.94	.000*
Depression (BDI-2)	8.92 (6.90)	9.35 (6.12)	260	-.569	.569
Trait anxiety (STAI-T)	40.48 (8.83)	42.26 (9.25)	246	-.857	.391

Note: BMI = body mass index = weight in kg/height in m²; EDI-2 = Eating Disorder Inventory-2; DFT = Drive for Thinness Subscale; DEBQ = Dutch Eating Behaviour Questionnaire; BDI-2 = Beck Depression Inventory-2; STAI-T = State-Trait Anxiety Inventory Trait version; * $p<0.05$.

4.2.2. Materials

4.2.2.1. Dutch Eating Behaviour Questionnaire: Restraint Subscale (DEBQ: Van Strien, Frijters, Bergers, & Defares, 1986)

Restrained eating is the tendency for an individual to restrict their food intake in order to control their body weight (Herman & Mack, 1975). This was measured using the 10-item restrained eating subscale of the DEBQ (for further details on this measure and its psychometric properties see Chapter Two Subsection 2.8.1). This subscale has high internal consistency and factorial validity (e.g. Braet & Van Strien, 1997; Van Strien et al., 1986). High internal consistency was also found in the present sample (Cronbach's α = .84). In this study, participants were categorised into high and low restrained eating groups according to median-split scores on this scale. Some have argued that using a median-split may result in diminished power (e.g. Cohen, 1988) but this is a valid technique and often employed in AB research (e.g. Ahern, Field, Yokum, Bohon, & Stice, 2010; Lattimore, Thompson & Halford, 2000).

4.2.2.2. State Trait Anxiety Inventory-Trait Scale (STAI-T: Spielberger, Gorsuch, & Lushene, 1970)

The STAI-T is a 20 item self-report measure of trait anxiety symptoms with higher scores indicating greater anxiety. Trait anxiety refers to how anxiety manifests itself over time, and is thought to be relatively stable (for further information on this measure and its psychometric properties see Chapter Two Subsection 2.9.5). This scale is found to have high internal consistency (e.g. Barnes, Harp & Jung, 2002) and high test-retest reliability over two week and three month periods (Jacobs, Latham, & Brown, 1988; Spielberger et al., 1970). High internal consistency was also found in the present sample (Cronbach's $\alpha = .91$).

4.2.2.3. Beck Depression Inventory II (BDI-II: Beck, Steer, & Brown, 1996b)

The BDI is a widely used 21-item self-report measure of affective, cognitive and somatic symptoms of depression (see Chapter Two Subsection 2.9.3 for further details on this measure). The BDI-II is found to have high test-retest reliability and high internal consistency (e.g. Beck, Steer, Ball & Ranieri, 1996a). High internal consistency was also found in the present sample (Cronbach's $\alpha = .86$). Participants' mean score was 9.13 (*SD*=6.47) with a range of 28 (min=0; max=28). This is comparable with normative data published in the BDI-II manual (Beck et al., 1996b): *M*=12.56 (*SD*=9.93).

4.2.2.4. Eating Disorder Inventory 2 (EDI-2: Garner, 1991)

The three eating-related subscales of the EDI-2 (DFT; Bulimia; and Body Dissatisfaction) were employed in the present study. These subscales have demonstrated high test-restest reliability (e.g. Wear & Pratz, 2006), stability (Crowther, Lilly, Crawford, & Shepherd, 2006) and internal consistency (e.g. Espelage, Mazzeo, Aggen, Quittner, Sherman, & Thompson, 2003). For further details see Chapter Two Subsection 2.8.2. High internal consistency was also found in the present sample (DFT = .86; Bulimia = .78; Body Dissatisfaction = .88). Participants' mean score was 2.77 (*SD*=4.41) for the DFT subscale with a range of 16 (min=0; max=16). This is comparable with normative data published in the EDI-2 manual (Garner, 1991): *M*=5.5 (*SD*=5.5). Participants' mean score was .79 (*SD*=1.92) on the Bulimia subscale with a range of 12 (min=0; max=12). This is also comparable with normative data published in the EDI-2 manual: *M*=1.2 (*SD*=1.9). Participants' mean score was 5.94 (*SD*=5.7) on the Body Dissatisfaction subscale with a range of 25 (min=0; max=25). Again this is comparable with the normative data published in the manual: *M*=12.2 (*SD*=8.3).

4.2.2.5. Visual Analogue Scales (VAS)

In order to ensure that the words in the task evoked the intended response, at the end of the experiment participants rated (on 100mm VAS) how appealing they found each food word (ranging from '*not at all appealing'* to '*extremely appealing'*), and how emotional they found each interpersonal ego threat word (ranging from '*not at all negative'* to '*extremely negative'*). Comparisons of these ratings between groups were also carried out. Mean interpersonal ego threat word ratings did not differ between high (74.35 ± 8.57) and low (73.06 ± 9.18) restraint groups (U = 280.5, N_1 = 23, N_2 = 25, p=.885, two-tailed). However, the difference between groups on ratings of food words approached significance (U = 194, N_1 = 23, N_2 = 25, p=.054, two-tailed; unrestrained = 59.91 ± 13.91, restrained = 53.24 ± 10.91). Overall, interpersonal ego threat words were rated as highly negative (mean=73.68) and food words as moderately appealing (mean=56.72).

4.2.2.6. Modified Stroop Task

All participants completed 'Food', 'Ego-threat' and 'Neutral' conditions of the Stroop task, with the order counterbalanced across participants. The task was presented in a single session using EPrime stimulus presentation software. The words were presented individually on screen in red, blue, green or yellow (each colour used in equal frequency) and participants were required to press the corresponding colour key. The task began with 16 practice rows of 'XXXXX' in each of the possible colours. 'Target' food words were high-calorie such as 'cake' and 'chocolate'; 'target' ego-threat words were interpersonal such as 'rejected' and 'criticised'; and 'target' neutral words were animal words such as 'elephant' and 'tiger'. Each 'target' was individually matched according to length, initial letter, and written and spoken frequency in the English language (Leech, Rayson & Wilson, 2001), with four neutral words that followed. There were 12 target and 48 neutral words in each of the three conditions (180 words in total). Words were presented in a pseudo-randomised order, with no word or colour appearing consecutively. They appeared in a sequence of five, beginning with the target word (food, ego threat or animal) followed by four neutral words. See Appendix 3 for a full list of words used.

4.2.3. Procedure

Participants were tested individually in an experimental cubicle to minimise distraction, and given an information sheet explaining that the study involved a computer-based task assessing attention to words, followed by completion of questionnaires on mood and appetite variables. On arrival at the laboratory, participants completed appetite scales. Following this, the experimenter provided standardised verbal instructions on the computer task, then participants followed on-screen instructions and carried out the task, which began with a practice round of 16 rows of 'XXXXX'. After completing the computer task they filled in the questionnaire pack (EDI-2, BDI-II, DEBQ, and STAI-T). On completion and with permission, height and weight measurements were taken. Each participant was thanked for participation and debriefed as to the purpose of the study. The procedure took approximately 30 minutes.

4.2.4. Data Analysis

For each of the food, interpersonal ego threat and neutral conditions of the Stroop tasks, errors were removed so that only trials in which the target colour were correctly identified were included for analysis. The mean percentage of responses that were errors, and therefore removed, was 2.4% (0.87% in the Food condition; 0.79% in the Ego Threat Condition; 0.74% in the Neutral condition). A mean of 97.6% of participant responses were therefore correct. Response latencies above or below two standard deviations (SDs) from the mean RT for each condition, for each individual participant, were also removed. A mean of 4.19% of responses fitted this criterion and were therefore removed (1.43% in the Food condition; 1.5% in the Ego Threat condition; 1.26% in the Neutral condition).

The dependent variable was RT, and the independent variables were restraint group, Stroop condition and word position. Each condition was analysed separately in 2 (group: high/low restraint) x 5 (word position) mixed ANOVA. To account for significant group differences the analyses were repeated with DFT as a covariate. Significant interactions were explored further using separate one-way ANOVA with subsequent Bonferroni pairwise comparisons (within group differences) and Mann Whitney *U* tests (α adjusted for multiple comparisons; significant α set at .01 to account for five comparisons within each condition). Where sphericity was violated Greenhouse Geisser correction was employed (although uncorrected degrees of freedom are reported in the text).

4.3. Results

4.3.1. Food Condition

The main effect of restraint was not significant: $F(1, 46)=.346$, $p=.559$, $\eta p^2=.007$. However, there was a significant main effect of word position: $F(4, 184)=35.380$, $p<.001$, $\eta p^2=.435$, with Bonferroni corrected pairwise comparisons revealing that participants were significantly slower at colour-naming words in position 2 than all other word positions (all $p<.05$) and were significantly faster at colour-naming words in position 5 than all other word positions (all $p<.001$). There was no clear orientation bias towards the food words, as RTs at word position 1 did not significantly differ from colour-naming times at positions 3 ($p=.675$) or 4 ($p=.094$).

There was also a significant restraint group x position interaction: $F(4, 184)=3.098$, $p=.017$, $\eta p^2=.063$. The significant group differences in DFT were accounted for in a subsequent covariate analysis and the results remained unchanged. There was also no significant main effect of DFT or DFT x position interaction (both $p>.05$), indicating that any observed differences were associated with restraint status, but not variations in DFT. The significant restraint group x position interaction was explored further using separate one way repeated measures ANOVA for each restraint group. There was a significant main effect of position for both low restraint, $F(4,96)=20.60$, $p<.001$, $\eta p^2=.46$, and high restraint groups, $F(4,88)=18.30$, $p<.001$, $\eta p^2=.36$ (see Figure 4.1). Bonferroni corrected pairwise comparisons revealed that the high restraint group was significantly faster to colour-name words in position 5 than all other positions (all $p<.01$). However, those in the low restraint group were significantly slower to colour-name words in position 2 than all other word positions (all $p<.05$), and were also significantly faster to colour-name words in position 5 than all other word positions (all $p<.05$).

Word position RTs in the high restraint group were non-normally distributed; therefore Mann-Whitney *U* tests were conducted in order to explore the difference between low and high restraint groups in word position RTs (see Figure 4.1). These revealed no group differences at each position (all tests $p>.01$: significant α set at .01 for multiple comparisons). However, the high restraint group had a notably longer colour-naming time for words in position 4 (mean=726.887 ± 157.427) than the low restraint group (mean=640.490ms ± 105.087; p=.046), and also at position 5 (high restraint mean=703.763 ± 179.188; low restraint mean=614.491 ± 129.886; p=.056).

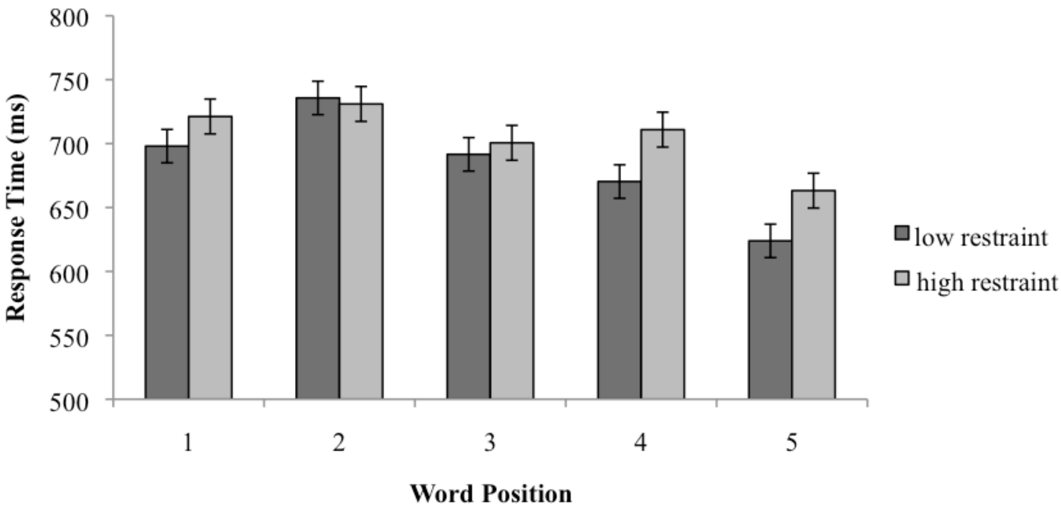

Figure 4.1: Mean (±SEM) response times to words in the food condition for high and low restraint groups

RTs at word positions 1 and 2 were non-normally distributed, therefore Spearman's rho correlations were conducted between restraint scores and colour-naming times for words in the food condition in position 1 (r_s=.034, N=48, p=.819) and position 2 (r_s=-.082, N=48, p=.578), neither of which were significant.

4.3.2. Interpersonal Ego Threat Condition

Although the highly restrained group was slower to respond than unrestrained eaters (restrained=734.674ms, unrestrained=669.402ms), this difference was not significant, $F(1, 46)=2.648$, p=.110, ηp^2=.054. As with the food condition, there was a significant main effect of word position, $F(4, 184)=36.389$, $p<.001$, ηp^2=.442, with Bonferroni pairwise comparisons revealing the same pattern of significant differences from all other word positions for position 2 (all $p<.001$) and 5 (all $p<.05$). Again, there was no clear orientation bias towards the ego threat words, as colour-naming times for word position 1 did not differ significantly from position 3 (p=1.000). A significant position x restraint group interaction, $F(4, 184)=3.583$, p=.008, ηp^2=.072, remained when the analysis was repeated with DFT as a covariate. There was also no significant effect of DFT or interaction between DFT and position (both $p>.05$). Separate one way repeated measures ANOVA revealed significant position effects for both low restraint, $F(4,96)=25.60$, $p<.001$, ηp^2=.52, and high restraint groups,

$F(4,88)=12.60$, $p<.001$, $\eta p^2=.36$ (see Figure 4.2). Bonferroni comparisons revealed, in the low restraint group, that the mean RT for the ego threat words (position 1) was significantly faster than the mean RT for words in position 2 ($p=.010$) and was significantly slower than word positions 4 and 5 ($p<.05$). Colour-naming times for words in position 2 were again significantly slower than at all other word positions ($p<.05$), colour-naming of words in position 4 was significantly faster than position 3 ($p=.041$) and colour-naming of words in position 5 was significantly faster than for positions 1, 2 and 3 (all $p<.001$). The high restraint group was significantly slower to colour-name words in position 2 than words in positions 3, 4 and 5 (all $p<.01$) and colour-naming of words in position 5 was significantly faster than for words in positions 1 and 2 ($p<.05$).

RTs in the interpersonal threat condition amongst the high restraint group were non-normally distributed; therefore Mann-Whitney *U* tests were conducted in order to explore the difference between low and high restraint groups in word position RTs. These revealed no group differences (all $p>.01$: significant α set at .01 for multiple comparisons). However, the high restraint group had a notably longer colour-naming time for words in position 4 (mean=726.887 ± 157.427) than the low restraint group (mean=640.490ms ± 105.087; $p=.046$), and also at position 5 (high restraint mean=703.763 ± 179.188; low restraint mean=614.491 ± 129.886; $p=.056$).

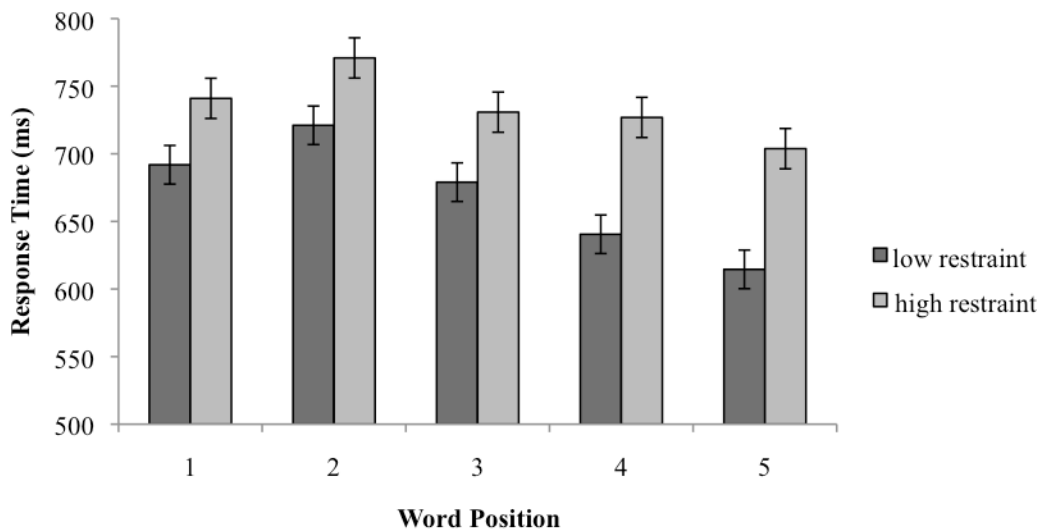

Figure 4.2: Mean (±SEM) response times to words in the ego-threat condition for high and low restraint groups

As RTs in the interpersonal threat condition were non-normally distributed, Spearman's rho correlations were conducted between restraint scores and RTs for words in the interpersonal ego threat condition in position 1 (r_s=.086, N=48, p=.562) and position 2 (r_s=.111, N=48, p=.452), neither of which were significant.

4.3.3. Neutral Condition

Sphericity was violated (p<.001) so Greenhouse Geisser correction was used. The main effect of position was significant, F(4, 184)=21.48, p<.001, ηp^2=.318, with Bonferroni pairwise comparisons revealing the same pattern as found in the other conditions (see Figure 4.3). However, for this condition there was no significant main effect of restraint, F(1, 46)=1.33, p=.225, ηp^2=.020, and no significant interaction between position and restraint group, F(4, 184)=.951, p=.417, ηp^2=.020. Again, these findings remained when the analysis was repeated with DFT as a covariate. There was also no significant effect of DFT or interaction between DFT and position (both p>.05).

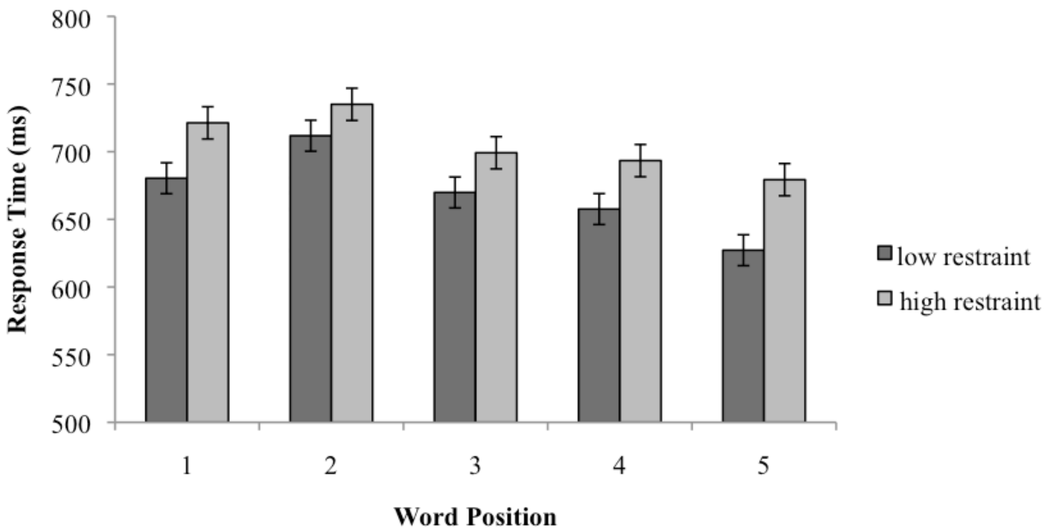

Figure 4.3: Mean (±SEM) response times to words in the neutral condition for high and low restraint groups

4.4. Discussion

This study was conducted with the aim of exploring, using a modified Stroop task design, whether restrained eaters are slow to disengage from food words. It was hypothesised that restrained eaters would demonstrate slowed disengagement from food words, and that this would last for one consecutive trial. Contrary to our expectations (but consistent with our previous findings in the pilot study) a general slowed disengagement effect occurred across all participants and conditions. However, this study provides further support for the claim that slowed disengagement is the dominant bias regarding food stimuli and that this component of attention can be assessed using the Stroop task. Consistent with previous findings there were no significant differences between restraint groups in their overall performance, even with a larger sample and higher restraint scores overall. Hunger was also controlled for and did not explain this effect. In contrast with the pilot study, there was a significant interaction between word position and restraint group in the food condition, but further exploration of this interaction did not find significant differences between groups at each word position. However, when the position effect was analysed for the low and high restraint groups separately, different patterns emerged. It could be postulated that the slowed disengagement effect was restricted to the low restraint group, as only they displayed the expected pattern: a significantly delayed RT for word position 2. On the other hand, given that for the high restraint group Bonferroni comparisons were significant only at position 5, one could very speculatively suggest that carry over effects from the food word lasted longer than a single trial. As sequences of only five words were included in this study, it would be interesting to see whether RTs for highly restrained eaters would continue to speed up if further neutral words were included in the sequence. Therefore, there seems to be an indication of a differential pattern between restraint groups emerging in relation to food stimuli, although it must be noted that this difference was not statistically significant in the current investigation. Caution must be expressed with regard to these speculative conclusions, and further research is needed with a larger sample, and with further neutral words in the sequence, in order to confirm and clarify the interaction between restraint and attentional disengagement from food.

In this study, as there were restraint group differences in DFT, this was accounted for in the analyses and was found not to influence RTs in any condition, supporting the findings of Ben-Tovim and Walker (1991) as opposed to Perpina et al. (1993). This is, perhaps, not surprising given that the current sample was entirely non-clinical.

It was also hypothesised that restrained eaters would be slow to disengage from words denoting ego threat from others. However, again, this slowed disengagement was a general effect across all participants, but there was a significant interaction between restraint and word position. Separate analyses for the position effects for low and high restraint groups revealed that both groups struggled to disengage from interpersonal threat for one consecutive trial. Although not significant, mean RT data showed a trend for restrained eaters to display a longer RT at position 2, suggesting that biases regarding ego threatening stimuli may be found more predominantly in restrictive individuals. However, again, as this was not significant, it would be pertinent to recommend further research before any such conclusions can be made. Such research should be conducted with a larger sample and with individuals who have higher levels of restraint.

Contrary to hypotheses, there was again a significant position effect in the neutral (animal) condition. As the presentation of conditions was counterbalanced, this cannot be explained with reference to order effects. This shows that when using this modified Stroop design to assess slowed disengagement one needs to be wary of such a categorical effect taking place. This categorical effect is, however, contrary to the findings of McKenna and Sharma (2004) who, when using a categorical neutral condition, did not find any differences in word position RTs. However, it is encouraging that no effect of restraint, and no interaction between restraint and word position RTs, occurred in the neutral condition. Rather, these significant effects were unique to the other two conditions, showing some specific effect of restraint on attention to food and interpersonal stimuli.

Despite refinements to the design used in the earlier pilot investigation, further limitations need to be addressed. For example, although food words were found to be appealing and ego threat words were found to be highly negative, animal words were not rated in terms of how neutral they were perceived to be. Although efforts were made to include only animals that are not likely to induce fear, it is possible that some (e.g. ‘tiger’) may have elicited an emotional response and thus the category might not have been entirely neutral. However, previous researchers have also included animal categories in their Stroop tasks (e.g. Flynn & McNally, 1999; Francis, Stewart, & Hounsell, 1997; Rofey, Corcoran, & Tran, 2004; Sackville et al., 1998). Other categories that may be considered more neutral include travel-related words (e.g. Tapper et al., 2008) and stationery (e.g. Jansen et al., 1998). Future research could assign words based on participant ratings of how neutral stimuli are perceived to be in order to ensure that no emotional response is being evoked. Another limitation is that although the order of conditions was counterbalanced, the order of words within each condition was not randomised. In order to rule out order effects as a potential explanation, it would be necessary to randomise the order of neutral words presented following target words. Although the sample size here (*n*=48) was slightly larger than in the pilot investigation (*n*=40), the effect sizes were fairly small in this study and further replication with a larger sample is warranted.

This study demonstrates that the emotional Stroop task design used by McKenna and Sharma (2004) can be utilised successfully with food and interpersonal threat stimuli, thus replicating and extending their findings. In contrast with some claims that the Stroop task cannot assess disengagement of attention (e.g. Cisler et al., 2007; Fox et al., 2001), this work provides evidence that the Stroop task can distinguish between separate sub-components of attention. This work also suggests that biases in attention (in particular slowed disengagement of attention from stimuli) can be demonstrated in non-clinical eating groups, although significant restraint group differences were not found. However, there is promise for studies with larger samples, and as a result greater statistical power, to find significant group differences in non-clinically restrictive individuals given the significant interaction between restraint group and performance on the Stroop task.

These findings suggest an extended use of the Stroop task in attention research with those differing in eating behaviour-related characteristics. However, further study design modifications would be necessary in order to maximise its utility for the study of orientation biases and slowed disengagement in eating behaviour research. The findings imply that research should focus on slowed disengagement in addition to automatic orientation biases when investigating how attention differs for food stimuli. With this focus less ambiguous and inconsistent findings would be expected, given the more robust effect of slowed disengagement here, and in the pilot study. With regard to the current findings, it is acknowledged that there is progress to be made in establishing significant differences between restrained and unrestrained eaters in this slowed disengagement from food. It is unknown whether the lack of significant differences between these groups in this study is due to issues of statistical power, or whether group differences are less likely to be found in those with non-clinical eating concerns. Future research should investigate differences between clinically restrictive, non-clinically restrictive and non-restrictive controls on performance on this modified food Stroop task.

The current finding that individuals are slow to disengage from food stimuli could reflect rumination on food in real-world settings. Cognitive rumination (often defined in relation to depression) can be defined as an individual uncontrollably spending an extensive amount of time thinking, worrying or obsessing about something, often a problem (i.e. being unable to turn thoughts to something else) which affects the individual's normal functioning (e.g. Troop, Holbery & Treasure, 1998; Troop & Treasure, 1997). This concept clearly demonstrates an overlap with the definition of slowed disengagement offered in this thesis: difficulty withdrawing attention from a stimulus (i.e. attentional dwelling). Both concepts involve cognitively dwelling on something for an extended period of time, which in turn is believed to be unhelpful to daily functioning. Cognitive rumination has been found to predict onset of AN and BN (e.g. Troop et al., 1998; Troop & Treasure, 1997) and so such cognitive dwelling is found to predict dysfunctional eating behaviours. A relationship between rumination and AB has also been recently established. Hilt and Pollak (2013) theorised that attentional biases to emotional information maintain ruminative processes, and rumination in turn, reinforces narrow ABs. In their experiment they found that higher depressive symptoms and a bias away from happy faces (in a dot probe task) significantly predicted state rumination. Furthermore, those who disengaged from negative self-referential thinking (i.e. those who did not ruminate) did not display an AB. Those who persisted with negative self-referential thinking (i.e. those who ruminated) displayed a bias away from happy faces. It is suggested that AB precedes the development of rumination, and that rumination narrows attention so that positive information is less likely to be attended to, maintaining a repetitive negative thought process (Hilt & Pollak, 2013). It would be of great interest for future research, to explore the relationship between AB for food and rumination on eating and/or body-related concerns (and the effect of this relationship on eating behaviour). One could hypothesise (from extending the findings of Hilt & Pollak) that there would be a reciprocal relationship between rumination on and AB for food. It would be interesting to explore whether this relationship (if found to exist in empirical research) promotes unhealthy and potentially harmful beliefs about food and leads to unhealthy eating. This would be an interesting avenue for future research, and could help inform interventions for ED patients (e.g. training to stop rumination combined with AT).

In conclusion, the use of a modified Stroop task to measure slowed disengagement from stimuli is still in its infancy, particularly with regard to food and interpersonally ego threatening stimuli. The current study design holds promise for informing the field of attention research in non-clinical and clinical groups of individuals with eating concerns. This is important, given the expected role of ABs in the maintenance of ED psychopathology. Further investigation is necessary to investigate how best to measure biases in attention in those with eating difficulties, and to establish which sub-component is the dominant bias. This would hold implications for the design of attention retraining interventions for such individuals.

Chapter Five: Study Two
Attentional bias and slowed disengagement from food and threat using modified Stroop and dot probe tasks

5.1. Introduction

The aim of the present chapter was to explore attentional bias (AB: orientation/disengagement) for food in non-clinical females characterised by eating-related concerns. This was carried out by addressing limitations of study one by employing a further modified Stroop task, and by extending the measurement of AB by employing a pictorial dot probe task. As previously noted, Food Stroop tasks are the most frequently used measure of AB in eating psychopathology research (see Chapter One). However, some claim that this task cannot distinguish between attention directed towards or away from a stimulus, or slowed disengagement (e.g. Faunce, 2002; Williams et al., 1996). The second most frequently employed measure of AB in eating research is the dot probe task (MacLeod, Mathews & Tata, 1986). This task involves simultaneous presentation of two stimuli (one threat and one neutral) followed by a probe in the same location as one of these stimuli (the location or nature of which needs to be identified). A bias towards threat is indicated by speeded detection of a probe in the same location as threat, and avoidance indicated by speeded detection of a probe in the same location as neutral stimuli. Varying presentation times of stimuli allows for a distinction between orientation and disengagement. For example, presentation times of 100ms, 200ms or 500ms are considered measures of initial orientation (early attention processing), and presentation times of 1500ms or 2000ms are considered measures of slowed disengagement (e.g. Field et al., 2004; Koster et al., 2010).

Using a dot probe task, Shafran et al. (2007) found across two studies that patients diagnosed with anorexia nervosa (AN), bulimia nervosa (BN) and Eating Disorder Not Otherwise Specified (EDNOS) have an orientation bias towards ‘negative’ eating stimuli (unhealthy foods) and away from ‘positive’ eating stimuli (healthy foods). Giel et al. (2011a) have also found that AN patients orient their attention towards food and this is followed by avoidance, not slowed disengagement. However, Smeets et al. (2008), using a visual search task, found that AN and BN patients showed evidence of slowed disengagement from high-caloric food words but *not* an automatic orientation bias towards them. A number of researchers have also investigated whether these ABs are also present in non-clinical groups characterised by eating-related concerns. As dicussed in earlier chapters, Food Stroop tasks have shown that restrained eaters have an orientation bias towards food, although findings are ambiguous. Using the dot probe task, Boon et al. (2000) found no evidence of attention towards or cognitive avoidance of food stimuli in either restrained or unrestrained eaters. In contrast, Maalouf and Yeomans (2010) and Ahern et al. (2010) found that restrained *and* unrestrained eaters displayed an AB towards food. Furthermore, Papies et al. (2008) found that restrained eaters (and not unrestrained eaters) displayed an AB towards food. Hollitt et al. (2010), using a visual search task, also found evidence for speeded detection of food in restrained eaters, but did not find evidence of slowed disengagement, contrary to the findings of Smeets et al. (2008).

Disinhibition, a breakdown of cognitive control over food intake (e.g. Riener, Schindler, & Ludvik, 2006), has also been found to predict AB towards food (e.g. Maalouf & Yeomans, 2010; Tapper et al., 2008). However, *reduced* engagement with food in disinhibited eaters has also been reported (Veenstra, deJong, Koster, & Roefs, 2010). Three studies have also provided evidence of a bias towards food in external eaters compared to non-external eaters (Brignell et al., 2009; Hepworth et al., 2010; Hou et al., 2011). Contrary to this, Johansson et al. (2004) found that external eaters *avoided* attending to food, whereas non-external eaters were biased towards food. Further still, Newman et al. (2008) found evidence of AB towards food in both external *and* non-external eaters. In addition, AB towards food has also been demonstrated in non-clinical females with bulimic symptoms (Formea & Burns, 1996; Rofey et al., 2004) and those with a high drive for thinness (DFT) (Lattimore et al., 2000). However, others have failed to find evidence of AB towards food in such individuals (Ben-Tovim & Walker, 1991; Perpina et al. 1993).

Little research has investigated the predictive value of the ‘symptom’ binge eating (in clinical or non-clinical groups) on AB for food. As noted earlier, much research has demonstrated a relationship between BN, of which binge eating is a key factor, and AB. Cooper and Fairburn (1993) previously found that colour-naming interference is more closely related to severity of specific symptoms than to general BN psychopathology. Svaldi, Tuschen-Caffier, Peyk, and Blechert (2010), using event related potentials (ERPs) and skin conductance measures, also found more elaborative processing of forbidden food pictures in Binge Eating Disorder patients. Therefore, the symptom of binge eating appears to be related to biased attention processing of food.

Heatherton, Herman and Polivy (1991) hypothesise that ego threats (threats to self-esteem) lead to intolerable negative affect and a need to escape from it which is achieved through cognitive narrowing, which in turn leads to disinhibition of eating. Interpersonal threat is particularly relevant to the concerns of individuals with restrictive tendencies, as discussed in Chapter Four. Therefore, biases in the processing of such threats are anticipated in non-clinically restrictive females. Initial research has found that women with non-clinical bulimic attitudes are biased towards words denoting ego threat from self (Meyer et al., 2000; Waller et al., 1996), and BN patients (McManus et al., 1996), AN patients (Quinton, 2004), and dieters and non-dieters (Quinton, 1998), all display an AB towards social threat, threats to autonomy, physical threat, ego threat from self and ego threat from others.

As stated previously, it has been claimed that the Stroop task does not distinguish between orientation and disengagement. However, this has been refuted by McKenna and Sharma's (2004) modified Stroop design. In the pilot study (Chapter Three) and study one (Chapter Four) the present researchers further modified McKenna and Sharma's task design through the inclusion of food 'target' words. In the pilot study, both restrained and unrestrained eaters were slow to disengage in all conditions. A number of modifications were then made in study one, and again all participants were slow to disengage in all conditions. It is of interest nonetheless, that different patterns of responding were found for restrained and unrestrained eaters in the food condition. Unrestrained eaters demonstrated a significantly longer response time (RT) for word position two, whereas the only significant difference between word positions for restrained eaters was a significantly faster RT for word position five. This could reflect slowed disengagement for unrestrained eaters only, or it could suggest that restrained eaters take longer than unrestrained eaters to disengage from food (i.e. the carry-over effect from the food word may have lasted longer). However, in order to confirm this, further neutral words would need to be added to the sequence to see if responses continue to speed up after word five.

The primary aim of the present study was to further investigate attention processing of food stimuli (orientation and slowed disengagement) using both Stroop and dot probe tasks. One specific aim was to clarify previous ambiguous findings (pilot study and study one) using a further modified version of the Stroop task. In the modified task, animal words were replaced with household objects (given that some animal words such as 'tiger' may have evoked a fear response), and each target word was followed by six matched neutral words in order to further clarify the earlier pattern of response by restrained eaters. Using this Stroop task it was hypothesised that restrained eaters (compared to unrestrained eaters) would demonstrate slowed disengagement from food and interpersonal threat, as opposed to an automatic orientation bias. This was not expected in the neutral (household object) condition, where no significant difference between word position RTs or restraint groups, was expected. Given the equivocal findings regarding the predictive value of a wide range of eating behaviours on AB for food, the degree to which the following eating behaviours predicted attention processing was explored: disinhibition, external eating, emotional eating, binge eating and eating psychopathology (DFT, bulimic symptoms, and body dissatisfaction). The influence of possible confounding variables (i.e. other potential explanatory variables in addition to hypothesised predictors, such as baseline hunger) on task performance was also explored. Regarding the dot probe task, it was hypothesised that restrained eaters (compared to unrestrained eaters) would be quicker to detect probes appearing in the same location as food pictures (congruent trials) than neutral pictures (incongruent trials). It was expected that this effect would be more pronounced when pictures were presented for a longer duration (2000ms: assessing later stages of attention processing) compared to a shorter duration (200ms: assessing early stages of attention processing). This was based on the findings from the pilot and study one that slowed disengagement is the more robust sub-component of AB. Data were also analysed using interference scores (incongruent trial minus congruent trial: a positive value indicating AB, a negative value indicating avoidance) and it was hypothesised that restrained eaters would have significantly more positive interference scores than unrestrained eaters. Again, the extent to which the following eating behaviours predicted biased processing was explored: disinhibition, external eating, emotional eating, binge eating and eating psychopathology (DFT, bulimic symptoms and body dissatisfaction). The influence of possible confounding variables (e.g. baseline hunger) on task performance was also explored.

5.2. Method

5.2.1. Participants

Sixty female participants were recruited at Loughborough University to participate in a study on attention processing. Participants were recruited by email, word-of-mouth and through a research participation scheme in which first year psychology, ergonomics and human biology students received course credit. The study was approved by the Loughborough University Ethical Advisory Committee. The inclusion criteria were that participants should be aged between 18 and 45, not colour blind, not currently diagnosed with an eating disorder (ED), and either English was their first language or they were highly proficient in the English language. Participants were classed into low and high restraint groups based on median-split scores on the restraint subscale of the Dutch Eating Behaviour Questionnaire (DEBQ; Van Strien, Fijters, Bergers, & Defares, 1986). The high restraint group consisted of 29 females and the low restraint group consisted of 31 females (median=2.5), with those scoring on the median being categorised into the low group. Due to some demographic data not meeting parametric assumptions, Mann Whitney *U* tests were carried out in order to explore any group differences. Restrained eaters had significantly higher restraint, DFT, body dissatisfaction, binge eating, disinhibition, and depression scores, than unrestrained eaters (see Table 5.1). The mean age of participants was 19.65 years (*SD*=4.15) and their mean body mass index (BMI) was 23.02 (*SD*=4.5).

Table 5.1: Participant characteristics of low and high restraint groups

Measure	Low Restraint *M* (SD)	High Restraint *M* (SD)	*U*	*z*	*p*
Age (years)	19.23 (2.96)	20.1 (5.15)	392.5	-.91	.363
BMI	22.35 (3.7)	23.74 (5.19)	401	-.717	.473
Hunger (VAS)	17.9 (16.07)	20.9 (18.23)	414	-.526	.599
How long since last meal (minutes)	152.42 (221.16)	115.86 (85.33)	432	-.262	.793
Restrained eating (DEBQ)	1.77 (.54)	3.26 (.59)	.000	-6.66	.000*
Emotional eating (DEBQ)	2.63 (.16)	2.87 (.81)	392	-.851	.395
External eating (DEBQ)	3.09 (.68)	3.34 (.59)	365.5	-1.24	.213
Total EDI-2 eating-related subscales	6.97 (7.53)	20.21(10.61)	138.5	-4.61	.000*
DFT (EDI-2 subscale)	1.06 (2.5)	6.14 (4.86)	149	-4.67	.000*
Bulimia (EDI-2 subscale)	.68 (1.19)	1.17 (1.89)	392	-.965	.335
Body Dissatisfaction (EDI-2 subscale)	5.23 (5.78)	12.9 (6.23)	157	-4.34	.000*
Binge eating (BES)	6.74 (5.35)	13.66 (8.97)	223	-3.36	.001*
Disinhibition (TFEQ-D)	5.16 (3.21)	7.45 (3.4)	267.5	-2.71	.007*
Depression (BDI-2)	6.52 (3.95)	11.79 (9.25)	263.5	-2.76	.006*
Trait anxiety (STAI-T)	38.03 (6.23)	42.97 (10.6)	341	-1.61	.108

Note: BMI = body mass index = weight in kg/height in m^2; VAS = 100mm visual analogue scale; DEBQ = Dutch Eating Behaviour Questionnaire; EDI-2 = Eating Disorder Inventory-2; DFT = Drive for Thinness Subscale; BES = Binge Eating Scale; TFEQ-D = Three Factor Eating Questionnaire Disinhibition subscale; BDI-2 = Beck Depression Inventory-2; STAI-T = State-Trait Anxiety Inventory Trait version; * p<0.05.

5.2.2. Materials

5.2.2.1. Dutch Eating Behaviour Questionnaire (DEBQ: Van Strien, Frijters, Bergers, & Defares, 1986)

All three subscales of the DEBQ were administered to participants (see Chapter Two Subsection 2.8.1 for full details on this measure). The restrained eating subscale measures the tendency for an individual to restrict their food intake in order to control their body weight (Herman & Mack, 1975); the emotional eating subscale assesses sensitivity to emotional eating; and the external eating subscale measures sensitivity to external food cues. All three subscales have high internal consistency and factorial validity (e.g. Braet & van Strien, 1997; Van Strien et al., 1986) and Cronbach's α for various samples ranges between .79 and .81 for the external eating subscale and .92 and .95 for the emotional and restrained eating subscales (Van Strien et al., 1986). For the current sample Cronbach's α was .95 for the restrained and emotional eating subscales, and .88 for the external eating subscale.

5.2.2.2. Eating Disorder Inventory-2 (EDI-2: Garner, 1991)

The EDI-2 measures psychological and behavioural traits common to AN and BN. The three eating-related subscales were administered in the present experiment: the DFT subscale; the Bulimia subscale; and the Body Dissatisfaction subscale (see Chapter Two Subsection 2.8.2 for further details on these subscales). The EDI-2 is found to have very high test-retest reliability and acceptable stability over time in both clinical and non-clinical samples (e.g. Thiel & Paul, 2006; Wear & Pratz, 2006). Garner (2004) reported high internal consistency coefficients for the DFT subscale (ranging from .81-.93), the Bulimia subscale (ranging from .63-.93), and the Body Dissatisfaction subscale (ranging from .88-.93). High internal consistency was also found in the present sample for the DFT (.88) and Body Dissatisfaction (.91) subscales, however internal consistency for the Bulimia subscale (.51) was slightly lower. Participants' had a mean score of 3.52 (*SD*=4.58) on the DFT subscale, with a range of 18 (min=0; max=18). This is comparable with normative data published in the EDI-2 manual (Garner, 1991): *M*=5.5 (*SD*=5.50). Participants' had a mean score of .92 (*SD*=1.58) on the Bulimia subscale, with a range of 7 (min=0; max=7). This is again comparable with normative data published in the manual: *M*=1.2 (*SD*=1.90). Finally, participants' had a mean score of 8.93 (*SD*=7.09) on the Body Dissatisfaction subscale, with a range of 27 (min=0; max=27). This is again comparable with normative data published in the manual: *M*=12.20 (*SD*=8.30).

5.2.2.3. Binge Eating Scale (BES: Gormally, Black, Daston & Rardin, 1982)

Binge eating can be defined as ingesting large amounts of food within short time periods alongside fears of not being able to stop eating (Gormally et al., 1982). The BES encompasses both behavioural manifestations of a binge episode and feelings/cognitions following a binge (see Chapter Two Subsection 2.8.3. for further details on this measure). The scale is found to have high internal consistency (Gormally et al., 1982), good test-retest reliability and moderate associations with binge eating severity as measured by food records (Timmerman, 1999). Cronbach's α for the current sample was .91; comparable with previously reported alpha reliability coefficients (e.g. .89: Freitas, Lopes, Appolinario, & Coutinho, 2006).

5.2.2.4. Three-Factor Eating Questionnaire-Disinhibition Subscale (TFEQ-D: Stunkard & Messick, 1985)

Whereas restraint refers to conscious control of food intake, disinhibition refers to the breakdown of this cognitive control (e.g. Riener, Schindler, & Ludvik, 2006). The disinhibition subscale of the TFEQ is found to have high test-retest reliabilities (.80; Stunkard & Mesick, 1985) and has been found to highly correlate with overeating in a lab study of food intake (Shrager, Wadden, Miller, Stunkard, & Stellar, 1983). The TFEQ-D is found to have high internal consistency (e.g. .80: Simmons, Smith & Hill, 2002), with high internal consistency also found in the present sample (α =. 78). See Chapter Two Subsection 2.8.4 for further information on this measure.

5.2.2.5. State Trait Anxiety Inventory-Trait Scale (STAI-T: Spielberger, Gorsuch, & Lushene, 1970)

Trait anxiety refers to how anxiety manifests itself over time, and is thought to be relatively stable. The trait scale of the STAI has been found to display high test-retest reliability and internal consistency across a variety of populations (e.g. Barnes, Harp, & Jung, 2002; Jacobs, Latham, & Brown, 1988; Spielberger et al., 1970). Cronbach's α for the current sample was .91. See Chapter Two Subsection 2.9.5 for further information on this measure.

5.2.2.6. Beck Depression Inventory-II (BDI-II: Beck, Steer, & Brown, 1996)

The BDI-II is a widely used 21 item self-report measure of affective, cognitive and somatic symptoms of depression (see Chapter Two Subsection 2.9.3). The BDI-II is found to have high test-retest reliability and internal consistency (e.g. Beck, Steer, Ball, & Ranieri, 1996; Beck, Steer, & Brown, 1996). High internal consistency was also found in the present sample ($\alpha = .90$). Participants' had a mean score of 9.07 (*SD*=7.46), with a range of 38 (min=0; max=38). This is comparable with normative data published in the BDI-II manual (Beck et al., 1996b): *M*=12.56 (*SD*=9.93).

5.2.2.7. Visual Analogue Scales (VAS)

Baseline hunger and desire to eat were measured using 100mm VAS with two extreme end points labelled '*not at all*' to '*extremely*'. VAS have been found to be reliable and valid for appetite research (e.g. deGraaf, 1993; Flint, Raben, Blundell, & Astrup, 2000; Raben, Tagliabue & Astrup, 1995; Stubbs, Hughes, Johnstone, Rowley, Reid, Elia et al., 2000).

5.2.2.8. Modified Stroop Task

All participants completed 'Food', 'Interpersonal Threat' and 'Neutral' conditions of the Stroop task, with the order counterbalanced across participants. The task was presented using SuperLab software. Words were presented individually in the centre of a 19 inch screen until the individual responded to the colour by pressing the relevant colour key on the keyboard. The words were presented in Tahoma of 72pt font size in red, blue, yellow and green in equal frequency in a pseudo-randomised order, with no colour appearing consecutively. The task began with 16 practice trials consisting of rows of 'XXXXX' in each of the four colours. Food words were high-calorie such as 'cake' and 'chocolate', interpersonal threat words reflected ego threats from others e.g. 'rejected' and 'criticised', and the neutral words were household objects such as 'curtains' and 'carpet'. Each target word was individually matched according to initial letter, length, and written and spoken frequency (Leech et al., 2001) with six neutral words that followed them. There were 12 target and 72 neutral words in each of the three conditions (252 words in total). The pattern of words followed sequences of seven throughout, with the first in the sequence being the target word, followed by six neutral words. The words were presented in a pseudo-randomised order; first the target words were randomised and then the individually matched neutral words for each word were randomised (see Appendix 4 for a full list of words in the task). A mean of 2.48% of responses were errors and were therefore removed (0.71% in the Food condition; 0.97% in the Ego Threat condition; 0.8% in the Neutral condition). RTs above or below two standard deviations (SDs) from the mean, for each individual, were excluded; a mean of 4.52% of responses fitted this criterion and were therefore removed (1.54% in the Food condition; 1.49% in the Ego Threat condition; 1.49% in the Neutral condition).

5.2.2.9. Dot Probe Task

Twenty picture pairs of food and matched neutral stimuli were included in the task, which was presented using SuperLab software. Food pictures were high-calorie appealing food items (e.g. chocolate, burger, popcorn). This is in line with the majority of previous AB studies which have included high-calorie/appealing food stimuli, consisting of both sweet and savoury foods (e.g. Ben-Tovim et al., 1989; Nijs et al., 2009; Stewart & Samoluk, 1997). Neutral images were objects closely matching the food item in size, shape, complexity, number of objects and colour (where possible). All items were placed on a white side plate, main plate or bowl; neutral objects were placed on the same item as the food image it was matched with in order to ensure consistency across the different picture categories. Examples of picture pairs include popcorn and marbles, biscuits and toy cars, spaghetti bolognaise and wool, a bar of chocolate and a calculator (see Figure 5.1 and Appendix 10 for example picture pairs). Pictures were presented on a 19-inch screen with the picture edges 4cm apart. Pictures were on average 9cm in height and 10cm in width; however some taller objects (e.g. chocolate milkshake and hot chocolate) were 10cm in height and 8.5cm in width. Two conditions of the dot probe were presented to participants; one where picture pairs were presented for 200ms (assessing early attention processing: automatic orientation) and the other where they were presented for 2000ms (assessing later attention processing: slowed disengagement). Presentation times were selected based on use by previous researchers in order to distinguish between orientation and disengagement (e.g. Field et al., 2004).

Figure 5.1: Example picture pairs from the dot probe task

Before the task began instructions were displayed on the screen. Following instructions a fixation cross (which participants had previously been instructed to attend to) was displayed in the centre of the screen for 500ms. Following offset of the fixation cross an image was displayed to the left and right of the screen for 200ms or 2000ms. Following offset of the two images a probe (either ":" or "..") appeared in the location of either the previous food or neutral image, which was to be identified by pressing "C" for ":", and N for "..". The probe appeared in the location of the food and neutral images in equal frequency and remained on screen until the participant responded or until 2000ms if no response was made in this time. Each condition of the task (200ms/2000ms) began with 24 practice trials (neutral/neutral picture pairs e.g. a torch and a stapler), followed by 160 test trials (food/neutral picture pairs). The 20 food/neutral picture pairs were repeated eight times in each condition (seen 16 times overall), with each picture appearing four times on the left and four times on the right, and the probe appearing four times in the same location as the food picture (congruent), and four times in the same location as the neutral picture (incongruent). The task consisted of 368 trials (48 practice and 320 experimental) and took approximately 15 minutes to complete. Errors were removed; in the 200ms condition a mean of 5.77% of responses were errors (2.94% in congruent trials; 2.83% in incongruent trials). In the 2000ms condition a mean of 4.27% of responses were errors (2.14% in congruent trials; 2.13% in incongruent trials). RTs below 200ms and above 2000ms were excluded, followed by removing outliers above or below two SDs from the mean score (following procedures of e.g. Bradley, Mogg, White, Groom, & deBono, 1999; Shafran et al., 2007). In the 200ms condition a mean of 3.75% of responses were removed due to being outliers (1.79% in congruent trials; 1.96% in incongruent trials). In the 2000ms condition a mean of 3.96% of responses were removed due to being outliers (1.86% in congruent trials; 2.1% in congruent trials).

5.2.3. Procedure

Participants were tested individually in an experimental cubicle to minimise distraction and given an information sheet explaining that the study involved two computer tasks assessing attention to words and images, followed by completion of questionnaires on mood and appetite variables. On arrival at the laboratory, participants completed a health screen questionnaire and hunger/desire to eat VAS. Following this, the experimenter provided standardised verbal instructions on the first of the two computer tasks (Stroop or dot probe), then participants followed on-screen instructions and carried out the task. After completing the first task participants were provided with verbal instructions on the second task and then followed on-screen instructions. The order of whether the Stroop or dot probe task was seen first, the order of conditions within the Stroop task, and the order in which the 200ms and 2000ms dot probe conditions were seen, were counterbalanced. Following the computer tasks participants filled in the questionnaire pack (DEBQ, EDI-2, BES, TFEQ-D, STAI-T and BDI-II). On completion and with permission, height and weight measurements were taken. Each participant was thanked for participation and debriefed as to the purpose of the study. The procedure took approximately 45 minutes.

5.2.4. Data Analysis

For each of the food, interpersonal threat and neutral conditions of the Stroop task, errors were removed so that only trials in which the target colour was identified correctly were included in the analysis. Outliers above or below two SDs from the mean score were also removed. The dependent variable was RT, and the independent variables were restraint group, Stroop condition and word position. A 2 (group: high/low restraint) x 7 (word position) mixed ANOVA was conducted for each of the three Stroop conditions. Restraint scores were normally distributed, however some RTs at each word position in each condition were non-normally distributed. Hypotheses were tested using the RT data, with a delayed RT to the target food or interpersonal threat word demonstrating an AB towards the word, and a delayed RT for the neutral word following the target word indicating slowed disengagement from the target word (this is compared to RTs for later neutral words in the sequence). Where sphericity was violated Greenhouse Geisser correction was employed (although uncorrected degrees of freedom are reported in the text). An α level of 0.05 was taken to be significant. To investigate which eating variables are related to AB and slowed disengagement, correlations between RTs for word positions 1 and 2 in each condition (representing orientation bias and slowed disengagement) and each eating variable (restraint, disinhibition, external eating, emotional eating, binge eating, DFT, bulimic symptoms and body dissatisfaction) were carried out. Due to some of the mean RTs and questionnaire scores being non-normally distributed, Spearman's rho correlations were conducted. Spearman's correlations were also carried out between RTs at word positions 1 and 2 and hunger, age, BMI, depression and anxiety. These were identified as potential confounds due to previous literature indicating these variables can significantly impact upon AB (e.g. age: Lattimore et al., 2000; BMI: Braet & Crombez, 2003; hunger: Giel et al., 2011a) or can be significantly related to eating psychopathology (e.g. depression: Kaye, Bulik, Thornton, Barbarich, Masters et al., 2004; anxiety: Hudson, Hiripi, Pope Jr, & Kessler, 2007). Correlations were conducted with a view to conducting multiple regression analyses to assess relative contribution of significant factors.

Errors and outliers in the dot probe task were also removed. The dependent variable was RT, and the independent variables were restraint group, congruence and task condition. A 2 (group: high/low restraint) x 2 (congruence: congruent/incongruent trial) x 2 (task condition: 200/2000ms) mixed ANOVA was conducted. Hypotheses were tested using the RT data, with quicker mean RTs for probes in the same location as food pictures (congruent trials) than mean RTs for probes in the same location as neutral pictures (incongruent trials) indicating an AB for food stimuli. An interference score was also calculated for each participant (incongruent trial minus congruent trial: positive value indicating AB towards the food stimuli and a negative value indicating attentional avoidance). The interference scores were analysed in a 2 (group: high/low restraint) x 2 (task condition: 200ms/2000ms) mixed ANOVA. Due to some questionnaire measures and interference scores being non-normally distributed, Spearman's rho correlations were also conducted between each eating variable and the participant's interference scores for each condition. In addition, Spearman's correlations were conducted between interference scores and potential confounds: hunger, age, BMI, depression and anxiety. Again, correlations were conducted with a view to conducting multiple regression analyses to assess relative contribution of significant factors.

5.3. Results

5.3.1. Stroop Task

5.3.1.1. Food Condition

A 2 (group: high/low restraint) x 7 (word position) ANOVA revealed a significant main effect of word position (sphericity was violated so Greenhouse Geisser was used although uncorrected degrees of freedom are reported in the text): $F(6,348)=4.937$, $p<.001$, $\eta p^2=.078$. Bonferroni corrected pairwise comparisons revealed that a significantly longer RT was observed at position 2 than position 7 ($p=.011$), and a significantly longer RT was observed at position 4 than at 5 ($p=.005$) and 7 ($p=.002$). In addition RTs for position 1 were (non-significantly) longer than for positions 5 ($p=.095$) and 7 ($p=.078$).

There was a non-significant main effect of restraint group: $F(1,58)=.025$, $p=.875$, $\eta p^2=.000$. However, there was an approaching significant interaction between restraint group and word position: $F(6,348)=2.118$, $p=.065$, $\eta p^2=.035$ (see Figure 5.2). Given *a priori* predictions that there would be a difference between restrained and unrestrained eaters in RTs, this approaching significant interaction was further explored using separate one way repeated measures ANOVA for each restraint group. There was a significant main effect of position for both low restraint, $F(6,180)=3.37$, $p=.004$, $\eta p^2=.101$, and high restraint groups, $F(6,168)=3.686$, $p=.005$, $\eta p^2=.116$ (see Figure 5.2). Mean RT data showed that the high restraint group took longest to colour-name words in positions 1 (823.23ms) and 2 (825.52ms) than later word positions (3=814.88ms; 4=819.72ms; 5=791.15ms; 6=780.58ms; 7=792.66ms), but Bonferroni pairwise comparisons revealed there were no significant differences between any word position RTs (all $p>.05$). Mean RT data showed that the low restraint group took longest to colour-name words in position 4 (825.26ms) than other word positions (1=805.7ms; 2=806.85ms; 3=800.56ms; 5=781.23ms; 6=815.51ms; 7=778.1ms) but again Bonferroni comparisons revealed there were no significant differences between any word positions (all p>.05). It can be seen in Figure 5.2 that the high restraint group took longer to colour-name the food word and the neutral word following the food word (position 2) than the low restraint group, however independent t-tests did not show significant differences between these groups at word position 1 ($t(58)=-.515$, $p=.608$) or word position 2 ($t(58)=-.530$, $p=.598$).

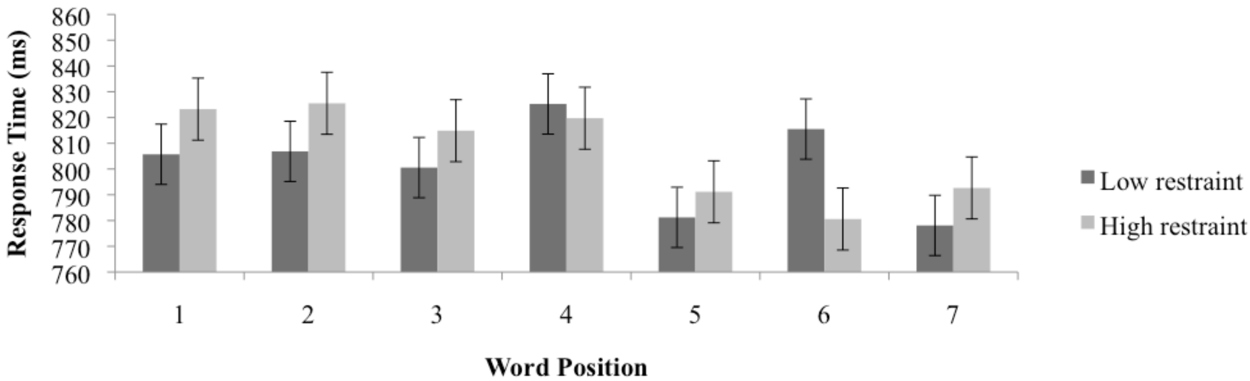

Figure 5.2: Mean (±SEM) response times for high and low restraint groups in the food condition

A series of correlations were conducted between food position 1 and 2 RTs (representing orientation and disengagement) and restraint, disinhibition, external eating, emotional eating, binge eating, eating psychopathology (DFT, bulimia, body dissatisfaction). Spearman's rho was used due to some of the variables not meeting parametric assumptions. These revealed significant negative correlations between binge eating and word position 1 and 2 RTs (see Table 5.2). Correlations conducted between food word position 1 and 2 RTs and potential confounds (age, hunger, BMI, depression and anxiety) were not significant (see Table 5.2).

Table 5.2: Correlations between food position 1 and 2 response times and eating behaviours and confounds

	Restraint		Disinhibition		External Eating		Emotional Eating		EDI-2 Total		DFT		BD	
Word Position	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)
1	-.083	.530	-.064	.628	.041	.754	.086	.514	-.213	.101	-.171	.192	-.247	.057
2	-.062	.636	-.042	.751	-.080	.544	.027	.838	-.142	.280	-.083	.53	-.170	.195

	BN		Binge Eating		Hunger		Age		BMI		Depression		Anxiety	
Word Position	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)
1	.135	.305	-.273*	.035*	.083	.530	-.047	.719	-.188	.151	-.121	.357	.018	.912
2	.081	.536	-.278*	.032*	.094	.476	.01	.94	-.051	.699	-.183	.162	-.040	.760

Note: EDI-2 total = Eating Disorder Inventory-2 total score, DFT = Drive For Thinness, BD = Body Dissatisfaction, BN = Bulimia, BMI = Body Mass Index. *=p<.05.

5.3.1.2. Interpersonal Threat Condition

A 2 (group: high/low restraint) x 7 (word position) ANOVA revealed a significant main effect of position: $F(6,348)=2.813$, $p=.011$, $\eta p^2=.046$. Bonferroni corrected pairwise comparisons revealed that RTs for word positions 1 and 2 were significantly longer than for position 5 ($p<.05$). RTs for position 3 ($p=.074$) and 4 ($p=.067$) were (non-significantly) longer than RTs at position 5. Additionally, RTs at position 6 were (non-significantly) longer than at position 5 ($p=.065$: see Figure 5.3 for mean RTs). Analysis revealed a non-significant main effect of restraint: $F(1.58)=.025$, $p=.875$, $\eta p^2=.000$, and a non-significant restraint x position interaction: $F(6,348)=.645$, $p=.694$, $\eta p^2=.011$. Due to *a priori* hypotheses that there would be a difference between restrained and unrestrained eaters in their RTs, separate repeated measures one way ANOVA were carried out for the low and high restraint groups (although caution is expressed given the non-significant interaction between restraint and position). These revealed a non-significant main effect of position amongst the high restraint group: $F(6,168)=1.296$, $p=.261$, $\eta p^2=.044$), but revealed a significant main effect of position amongst the low restraint group: $F(6,180)=2.199$, $p=.045$, $\eta p^2=.068$. However, follow-up Bonferroni comparisons revealed no significant differences between any word position RTs (all $p>.05$).

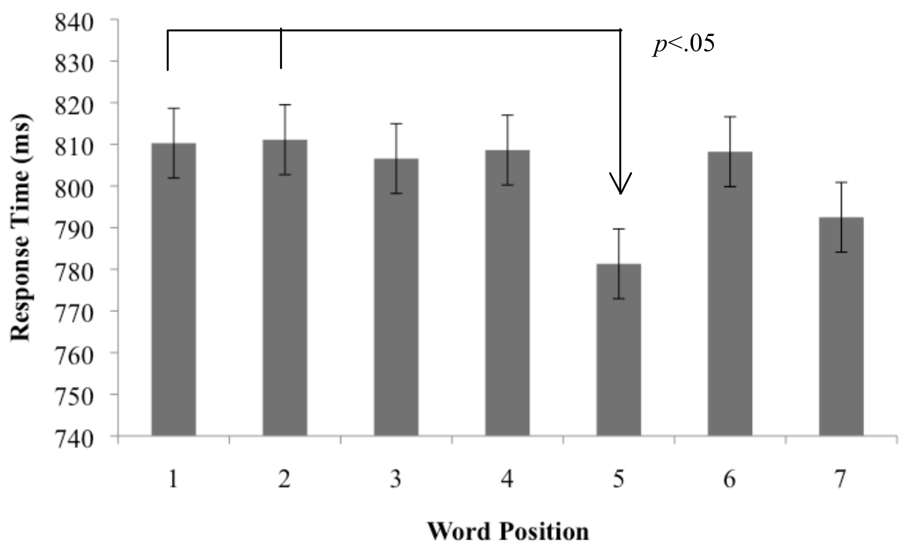

Figure 5.3: Mean (±SEM) response times in the interpersonal threat condition

A series of correlations were conducted between word position 1 and 2 mean RTs and restrained eating, disinhibition, emotional eating, external eating, binge eating, and eating psychopathology (DFT, bulimia and body dissatisfaction). Spearman's rho was used due to some of the variables not meeting parametric assumptions. These revealed significant negative correlations between binge eating and word position 1 and 2 RTs (see Table 5.3). Correlations between RTs and potential confounds (age, BMI, hunger, depression and anxiety) were non-significant (see Table 5.3).

Table 5.3: Correlations between interpersonal threat word position 1 and 2 response times and eating behaviours and confounds

	Restraint		Disinhibition		External Eating		Emotional Eating		EDI-2 Total		DFT		BD	
Word Position	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)
1	-.082	.534	-.168	.2	-.082	.535	-.118	.37	-.133	.311	-.104	.431	-.156	.235
2	-.057	.665	-.113	.389	-.107	.416	-.118	.369	-.125	.343	-.057	.665	-.142	.278

	BN		Binge Eating		Hunger		Age		BMI		Depression		Anxiety	
Word Position	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)
1	.044	.741	-.362*	.004*	.015	.91	.004	.974	-.198	.129	-.039	.768	.1	.449
2	.072	.586	-.352*	.006*	.012	.926	-.066	.615	-.208	.11	-.099	.453	.073	.579

Note: EDI-2 = Eating Disorder Inventory-2 total score, DFT = Drive For Thinness, BD = Body Dissatisfaction, BN = Bulimia, BMI = Body Mass Index. *=p<.05.

5.3.1.3. Neutral Condition

A 2 (group: high/low restraint) x 7 (word position) ANOVA revealed a non-significant main effect of restraint: $F(1,58)=.158$, $p=.693$, $\eta p^2=.003$ and a non-significant interaction between restraint and position: $F(6,348)=1.149$, $p=.333$, $\eta p^2=.019$. There was, however, a significant main effect of position: $F(6,348)=4.136$, $p<.001$, $\eta p^2=.067$ (see Figure 5.4 for word position RTs). Follow-up Bonferroni comparisons revealed that the mean RT for position 4 was significantly longer than for positions 2 ($p=.001$), 3 ($p=.008$), 5 ($p=.005$) and 7 ($p=.027$). In order to assess whether the relationship between binge eating and RT was specific to the food and interpersonal threat conditions, Spearman's correlations between binge eating scores and word position 1 and 2 RTs in the neutral condition were also carried out. Unexpectedly, binge eating scores were significantly negatively correlated with position 1 ($r_s=-.411$, $p=.001$) and position 2 ($r_s=-.262$, $p=.043$) RTs. No other measures were significantly correlated with RTs in the neutral condition (see Appendix 26).

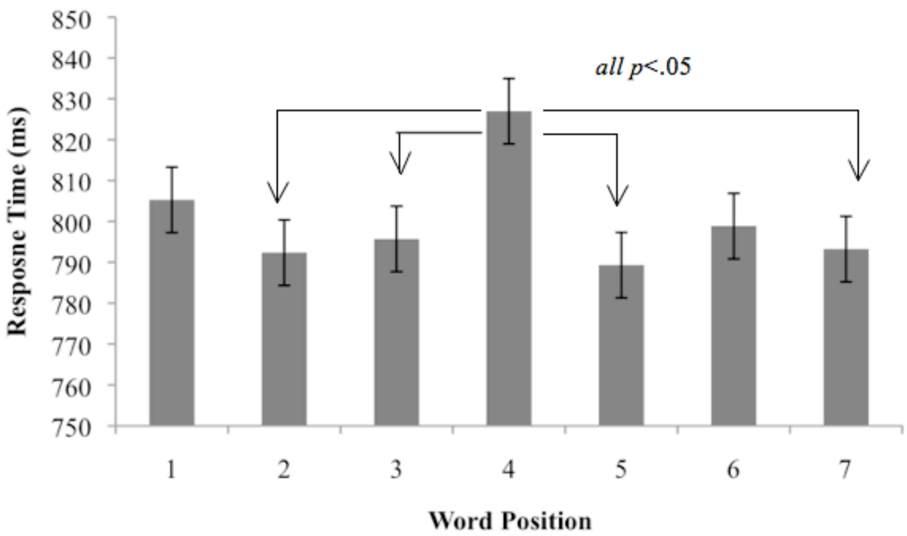

Figure 5.4: Mean (±SEM) response times in the neutral condition

5.3.2. Dot Probe Task

The data of three participants were excluded due to errors in over half of their responses in the dot probe task (two low restraint and one high restraint). A 2 (group: high/low restraint) x 2 (congruence: congruent/incongruent trial) x 2 (task condition: 200ms/2000ms) mixed ANOVA revealed a significant main effect of task condition: $F(1,55)=35.473$, $p<.001$, $\eta p^2=.392$. Participants took significantly longer in the 2000ms condition (mean=641.63ms) than in the 200ms condition (mean=594.71ms).

There were no other main effects or interactions. To see if a significant effect of congruence occurred in one of the conditions separately, further analyses (separate mixed ANOVA for each condition) were carried out. These revealed no significant main effects or interactions. A 2 (group: high/low restraint) x 2 (task condition: 200ms/2000ms) ANOVA with interference scores as the dependent variable revealed a non-significant main effect of restraint: $F(1,55)=.305$, $p=.583$, $\eta p^2=.006$, a non-significant main effect of task condition: $F(1,55)=.178$, $p=.675$, $\eta p^2=.003$, and a non-significant interaction between task condition and restraint: $F(1,55)=.09$, $p=.766$, $\eta p^2=.002$ (see Figure 5.5). As can be seen in Figure 5.5, the interference scores were also in the opposite direction as predicted: all participants had a very slight bias away from food stimuli (i.e. they had negative interference scores).

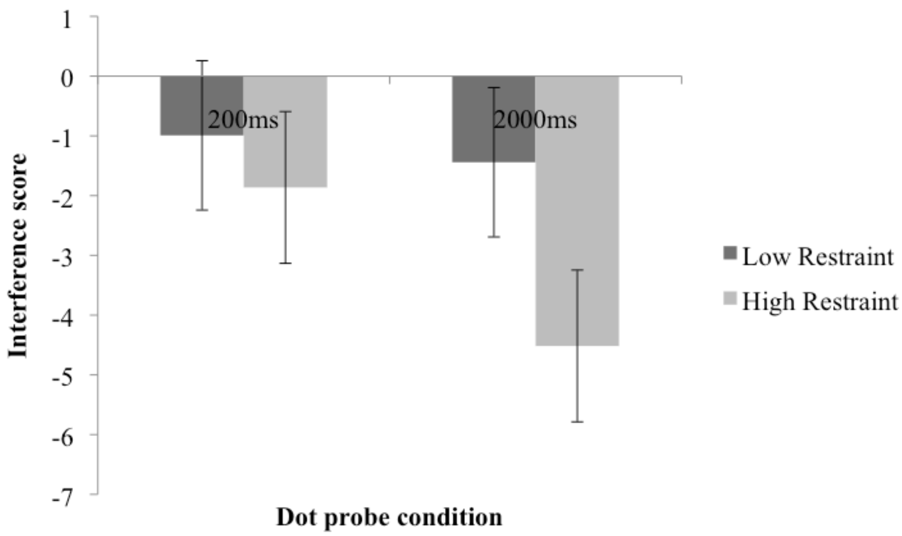

Figure 5.5: Mean (±SEM) interference scores for low and high restraint groups

A series of correlations were conducted between interference scores in each of the conditions (200/2000ms) and restrained eating, disinhibition, external eating, emotional eating, binge eating, and eating psychopathology (DFT, bulimia, body dissatisfaction); none of which were significant (see Table 5.4). Additionally, none of the potentially confounding variables were significantly correlated with interference scores (see Table 5.4).

Table 5.4: Correlations between interference scores and eating behaviours and confounds

	Restraint		Disinhibition		External Eating		Emotional Eating		EDI-2 Total		DFT		BD	
Task Condition	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)
200ms	.003	.983	.027	.84	.033	.806	-.066	.626	-.079	.561	-.062	.645	-.115	.393
2000ms	.024	.858	-.013	.926	.013	.923	-.116	.392	-.072	.595	.008	.953	-.089	.509

	BN		Binge Eating		Hunger		Age		BMI		Depression		Anxiety	
Task Condition	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)
200ms	.08	.554	-.147	.277	-.012	.927	.069	.612	-.213	.111	-.043	.749	.137	.309
2000ms	-.004	.977	.129	.340	.039	.772	.055	.684	.055	.684	-.070	.606	-.112	.407

Note: EDI-2 = Eating Disorder Inventory-2 total score, DFT = Drive For Thinness, BD = Body Dissatisfaction, BN = Bulimia, BMI = Body Mass Index. *=*p*<.05.

Additional analyses were carried out to compare interference for sweet and savoury food images to ensure that these images are not processed differently (and henceforth justifying mixing such stimuli in a dot probe task). Interference scores for sweet and savoury trials met parametric assumptions. Paired t-tests revealed no significant differences between interference scores for sweet trials and savoury trials in the 2000ms condition ($t(56)=.490$, $p=.626$), or in the 200ms condition ($t(59)=-1.617$, $p=.111$). This adds further justification for the inclusion of both sweet and savoury stimuli in tasks assessing AB for food.

5.4. Discussion

Following on from the researchers' pilot study (Chapter Three) and study one (Chapter Four), it was hypothesised that once again slowed disengagement from food, as opposed to an automatic orientation bias, would be demonstrated using a modified Stroop task. However, contrary to predictions, the significant effect of word position found in the food condition did not reflect a consistently longer RT at word position 2 than all other word positions. Rather, RTs for position 2 were only significantly longer than RTs at position 7. There was also no evidence of an orientation bias (i.e. there was no evidence of delayed colour-naming for the food target words). Further contrary to predictions, RTs in the food condition were not significantly associated with any of the following eating behaviour variables: disinhibition; emotional eating; external eating; DFT; bulimic symptoms; and body dissatisfaction. This is consistent with a body of research whose findings suggest that such eating behaviour variables may not be related to biased attention processing of food (e.g. external eating: Johansson et al., 2004; DFT: Ben-Tovim & Walker, 1991; disinhibition: Veenstra et al., 2010), but these findings also stand in contrast to an equally large body of research suggesting these eating behaviours *are* associated with AB for food (e.g. external eating: Brignell et al., 2009; Nijs et al., 2009; DFT: Lattimore et al., 2000; disinhibition: Maalouf & Yeomans, 2010). Although restraint did not significantly correlate with RTs in the food condition, there was an approaching significant interaction between restraint and word position in the main analysis. However, follow-up analyses revealed no significant pattern of differences between restrained and unrestrained eaters. The lack of significant influence of restraint on task performance adds to the equivocal findings in the literature exploring AB amongst restrained eaters (e.g. Black et al., 1997; Long et al., 1994). It is of interest that a significant relationship between binge eating (according to scores on the BES) and RTs in the food condition emerged. Higher binge eating scores were associated with *quicker* responding at word positions 1 and 2 (representing orientation and slowed disengagement) suggesting that binge eaters may be displaying attentional *avoidance* of food. Although, given that there is difficulty in distinguishing between attention towards and avoidance from stimuli in the Stroop task (e.g. Williams et al., 1996) this is non-conclusive.

In the interpersonal threat condition, despite finding a significant word position effect, follow-up analyses revealed no evidence of an automatic orientation bias or slowed disengagement from threat. Again none of the following eating behaviours were significantly related to RTs: restraint; disinhibition; external eating; emotional eating; DFT, bulimic symptoms; and body dissatisfaction. This is surprising given the key role that interpersonal difficulties play in predicting overeating amongst restrained eaters (e.g. Tanofsky-Kraff et al., 2000) and the finding that dieters display an AB towards stimuli reflecting ego threat from others (Quinton, 1998). However, binge eating scores were found to be significantly related to RTs at word positions 1 and 2 in the interpersonal threat condition. As in the food condition, higher binge eating scores were associated with *quicker* RTs at word positions 1 and 2. This suggests that higher levels of binge eating are not associated with greater AB or slowed disengagement from interpersonal threat. Rather, it may be that binge eaters avoid interpersonally threatening stimuli as opposed to attending to it. However, again caution is expressed given the limitations of the Stroop task in distinguishing between AB and avoidance.

As in study one (Chapter Four) a significant word position effect was found in the neutral condition, despite improving the neutral condition through the replacement of animal words with household objects. RTs for word position 4 were significantly longer than positions 2, 3, 5 and 7, a pattern which is difficult to explain given that the word in position 4 was non-categorical and was never the same neutral word. However, this effect was not robust given that RTs for position 4 were not significantly longer than all other word positions. Surprisingly, binge eating was again significantly negatively correlated with word position 1 and 2 RTs in the neutral condition. This suggests that the speeded responding of binge eaters is not specific to the food and interpersonal threat conditions. Rather, there seems to have been a global speeding up of responding in the Stroop task amongst those with higher levels of binge eating. No other research to date has directly explored the influence of binge eating in non-clinical females on AB for food and interpersonal threat. Binge eating has been found to influence attention processing in a Stroop task in the present investigation, but further research is needed to explore this effect, for example through additionally accounting for the influence of impulsivity. Impulsivity is defined as acting without thinking/acting on the spur of the moment/difficulty in concentrating/'doing' as opposed to 'thinking' (Barratt, 1993). It has also been defined as a "predisposition toward rapid, unplanned reactions to internal or external stimuli" (Moeller, Barratt, Dougherty, Schmitz, & Swann, 2001 in Hou et al., 2011). Binge eating in females has been found to be strongly associated with impulsivity (e.g. Nasser, Gluck, & Geliebter, 2004; Racine, Culbert, Larson, & Klump, 2009) with a significant relation between BES scores and a measure of impulsivity (Barratt Impulsiveness Scale Version 11; Patton, Stanford, & Barratt, 1995) having been demonstrated (O'Neill, Tao, Miller, McHugh, Napolitano, Bullmore, & Nathan, 2010). It is possible that impulsivity (rather than binge eating) may have accounted for the quick responding, but as impulsivity was not controlled for in the current investigation this cannot be confirmed. Further research is required in order to clarify which of these traits is responsible for this effect. However, given that these concepts are so closely related one could expect them to lead to the same direction of correlation, i.e. if one was to predict that binge eating would lead to an AB towards food you would expect this to be the same of high levels of impulsivity. The relation between binge eating, impulsivity and AB for food requires further exploration to clarify how these variables interact. Given the inconsistencies across the literature on AB for food in non-clinical females the current findings require replication before any conclusions can be made on the predictive role of binge eating on attention processing of food.

An additional aim of the present investigation was to demonstrate slowed disengagement from food pictures in a dot probe task; however, contrary to predictions, neither early AB nor slowed disengagement was found. Rather, the only significant effect was that participants took significantly longer to respond in the 2000ms condition than in the 200ms condition. This seems logical given that the pace of the 2000ms condition is slower than the fast presentation of the images in the 200ms condition. Faster presentation of images would most likely lead to a faster pace of responding. Contrary to expectations, restrained eating, disinhibition, external eating, emotional eating, DFT, bulimic symptoms, body dissatisfaction and binge eating did not significantly influence performance on the task. These findings fit with the findings of Boon et al. (2000), for example, which revealed no evidence of AB towards or cognitive avoidance of food in restrained or unrestrained eaters. One possible reason for the lack of AB in the current dot probe task is that food pictures may not have been considered appealing to participants. If this were the case these foods would be unlikely to capture attention. Alternatively, it is possible that the objects chosen as neutral stimuli may not have been perceived as neutral to the participants, e.g. some may have evoked an emotional response and grabbed attention. Likewise, the same may have been true of the words used in the Stroop task. Given that word and image ratings were not taken from participants, this cannot be confirmed. Therefore, in future research, ratings of how appealing food items are perceived to be and how emotional matched stimuli are perceived to be should be obtained in order to validate the task.

One possible explanation for the lack of influence from the majority of eating variables on performance concerns the low questionnaire scores of participants. For example, scores on the BES range from 0 to 46 with scores above 27 identifying severe binge eating, and below 17 indicating mild or no binge eating (Greeno et al., 1995). The mean score in the current study was 10.08 indicating that the majority of participants experienced little or no binge eating. Likewise, the mean score on the TFEQ-D was 6.27, falling into the low disinhibition range (0-8; Stunkard & Messick, 1985). The restrained and external eating mean scores were comparable with previous studies and did not fall below the mid-point on the scale (restraint mean=2.5, external mean=3.2). Although, it is worth noting that some previous authors have used a cut-off point of 3 as an indication of the mid-point on the restraint subscale of the DEBQ (e.g. Tapper et al., 2008).

An additional methodological point to consider is that all participants were required to complete a Stroop task with three conditions and a dot probe task with two conditions in succession (although as stated earlier this order was counterbalanced). The tasks took approximately 20 minutes to complete and required constant concentration from participants. All participants were offered a break in between the Stroop and the dot probe tasks; however, no participants wished to have a break. It is possible that participants became bored and/or fatigued during the tasks, which may have impacted upon performance.

Given the methodological limitations of the current investigation, future researchers should carefully select food and neutral stimuli to include in Stroop and dot probe tasks. Such selection should be based on participants' ratings of how appealing foods are and how emotional matched stimuli are. Future research should also aim to place fewer demands on the participant's concentration by either incorporating fewer trials in each measure or only giving participants one measure of AB. Selecting samples on the basis of high versus low scores on variables of interest would also be preferable given that a large number of participants in the present investigation did not display the eating behaviours of interest, perhaps explaining the lack of predictive value of some of the questionnaire scores on task performance.

In conclusion, no evidence of AB towards or slowed disengagement from food or interpersonally threatening stimuli was found using modified Stroop and dot probe tasks with a non-clinical group of females. This research adds to an already existing body of ambiguous literature, further calling into question the robustness of biased attention processing in non-clinical females characterised by high levels of restraint, disinhibition, external eating, emotional eating, and non-clinical eating psychopathology. However, the present study does suggest that higher levels of (non-clinical) binge eating are associated with decreased AB. Further exploration of the optimum measurement of AB will allow researchers to understand the exact nature of biased attention processing of food in females characterised by eating-related concerns. This will then aid in the development of attention training (AT) programmes aimed at reducing biased processing of unhelpful stimuli, and correspondingly modifying potentially problematic eating behaviours. Such modification of AB may have a role to play in the prevention of disordered eating in potentially ‘at-risk’ individuals.

Chapter Six: Study Three
Attentional bias and slowed disengagement from food using pictorial dot probe tasks

6.1. Introduction

The two main sub-components of attentional bias (AB: orientation and disengagement) can be assessed through varying presentation times of food/neutral picture pairs in a dot probe task, and assessing the time taken to respond to the identity of a probe following these pictures. For example, presentation times of 200ms can be considered a measure of initial orientation (early attention processing), and 2000ms a measure of slowed disengagement (e.g. Field et al., 2004). A number of studies have found that clinical eating disorder (ED) patients display an orientation bias towards (e.g. Giel et al., 2011a; Shafran et al., 2007) and are slow to disengage from high-calorie foods (e.g. Smeets et al., 2008). Research with non-clinical females has, however, been mixed. One dot probe study failed to find any evidence of AB towards food in restrained eaters (Boon et al., 2000) whilst others have found an AB towards food in both restrained *and* unrestrained eaters (e.g. Ahern et al., 2010; Maalouf & Yeomans, 2010). On the other hand, some investigations have shown that only highly restrained eaters have an orientation bias towards food (e.g. Papies et al., 2008). Contradicting these findings further, Veenstra, deJong, Koster and Roefs (2010) found that both restrained and unrestrained eaters cognitively *avoid* food. Both the pilot and study one of the present thesis (see Chapters Three and Four) revealed that restrained eaters are slow to disengage from high-calorie food words in a Stroop task but do not display an initial orientation bias towards food. Directly contrasting with this finding, Hollitt et al. (2010) found that restrained eaters had an initial orientation bias towards food, but found no evidence of slowed disengagement. Clearly further research is needed to clarify if biased attention processing of food is present in restrained eaters, and which sub-component of AB is the most prominent in such individuals.

In addition to dietary restraint, other eating traits in non-clinical samples have also been found to predict AB for food: disinhibition (e.g. Maalouf & Yeomans, 2010; Tapper et al., 2008); external eating (e.g. Brignell et al., 2009; Hepworth et al., 2010; Hou et al., 2011); and non-clinical eating psychopathology (e.g. Lattimore et al., 2000; Rofey et al., 2004). However, a corresponding body of literature appear to contradict such findings (e.g. Johansson et al., 2004; Veenstra et al., 2010).

Study two of the present thesis (see Chapter Five) required non-clinical females to complete a pictorial dot probe task with food/neutral picture pairs presented for 200ms and 2000ms. These females were scored on various measures of eating behaviour with the aim of investigating which eating behaviours most predict biased attention processing of food stimuli. Contrary to predictions, no evidence of early orientation bias or slowed disengagement was found, and interference scores (incongruent trial response times minus congruent trial response times) were not significantly correlated with eating behaviour scores (restraint, disinhibition, external eating, emotional eating, binge eating, drive for thinness, bulimia, and body dissatisfaction). Following these non-significant findings, ratings were taken from a separate sample of females on how appealing they found the food images in the task, and how emotional they found the neutral stimuli (as discussed in subsection 6.2.2.5). These ratings where then used to inform development of the present dot probe task. In study two participants were also required to complete a Stroop task in addition to the two conditions of a dot probe task. Given the length of time participants were required to concentrate (approximately 20 minutes) they may have become bored or fatigued. Therefore, the present study aimed to employ a further modified version of the dot probe task only (based on ratings of images), whilst again exploring the influence of various eating behaviours previously found to influence AB (restraint, external eating, emotional eating and non-clinical eating psychopathology).

It was hypothesised that restrained eaters (compared to unrestrained eaters) would be quicker to detect probes appearing in the same location as food pictures (congruent trials) than neutral pictures (incongruent trials). This effect was expected to be greater when pictures were presented for a longer duration (2000ms) compared to a shorter duration (200ms), demonstrating slowed disengagement from food (following on from the findings in the pilot and study one). Response times (RTs) were converted into interference scores (incongruent trial minus congruent trial: positive values indicating AB and negative values indicating avoidance), and it was hypothesised that restrained eaters would have significantly more positive interference scores than unrestrained eaters. Once again, this was expected to be more pronounced in the 2000ms condition. The extent to which the following eating behaviour variables predicted biased processing in these tasks was also explored: emotional eating; external eating; drive for thinness (DFT); bulimic symptoms; and body dissatisfaction. In addition, the influence of possible confounding variables (i.e. other potential explanatory variables in addition to hypothesised predictors:

depression, anxiety, age, hunger and body mass index) on task performance was explored.

6.2. Method

6.2.1. Participants

Sixty female participants were recruited by email and word-of-mouth to participate in a study on attention processing. The study was approved by the Loughborough University Ethical Advisory Committee. The inclusion criteria were that participants should be female, aged between 18 and 45 and not currently diagnosed with an ED. Two participants' data were excluded because overall RT data were not normally distributed and on inspection (via box-plots and z-scores) these two outliers were located and removed. The remaining 58 participants were divided into high and low restraint groups based on a median-split of scores on the restraint subscale of the Dutch Eating Behaviour Questionnaire (DEBQ; Van Strien, Fijters, Bergers, & Defares, 1986). The high restraint group consisted of 27 females and the low restraint group consisted of 31 females (median=2.5), with those scoring on the median being categorised into the low group. Due to some of the demographic and questionnaire data not meeting parametric assumptions, Mann Whitney *U* tests were carried out in order to compare restraint groups on these measures. The high restraint group had significantly higher body mass indexes (BMIs), significantly higher scores on measures of restrained, emotional and external eating, DFT and body dissatisfaction, and were significantly more anxious than the low restraint group (see Table 6.1). Participants had a mean age of 21.02 (*SD*=1.36) and a mean BMI of 21.85 (*SD*=3.36).

Table 6.1: Participant characteristics of high and low restraint groups

Measure	Low Restraint *M*(SD)	High Restraint *M*(SD)	*U*	*z*	*p*
Age (years)	20.71 (1.16)	21.37 (1.5)	327.5	-1.46	.144
BMI	20.68 (2.14)	23.2 (4)	247	-2.67	.007*
Hunger (VAS)	37.1 (29.38)	35.89 (25.8)	409.5	-.14	.888
Restrained eating (DEBQ)	1.95 (.37)	3.31 (.54)	.000	-6.53	.000*
Emotional eating (DEBQ)	2.36 (.75)	2.97 (.76)	224	-3.04	.002*
External eating (DEBQ)	3.04 (.75)	3.39 (.53)	267	-2.37	.018*
Eating psychopathology (EDI-2)	6.07 (5.91)	20.44 (9.81)	86	-5.19	.000*
DFT (EDI-2)	.68 (1.4)	7.37 (.88)	41.5	-6.03	.000*
Bulimia (EDI-2)	.52 (.93)	1.67 (2.63)	330	-1.61	.108
Body Dissatisfaction (EDI-2)	4.87 (5.1)	11.41 (6.68)	167	-3.93	.000*
Depression (HADS)	2.32 (1.64)	3.19 (2.53)	345.5	-1.16	.248
Anxiety (HADS)	6.29 (3.3)	9.07 (4.5)	254	-2.58	.01*

Note: BMI = body mass index = weight in kg/height in m²; DEBQ = Dutch Eating Behaviour Questionnaire; EDI-2 = Eating Disorder Inventory-2; DFT = Drive For Thinness Subscale; HADS = Hospital Anxiety and Depression Scale; * $p<0.05$.

6.2.2. Measures

6.2.2.1. Dutch Eating Behaviour Questionnaire (DEBQ: Van Strien, Frijters, Bergers, & Defares, 1986)

Participants completed all three subscales of the DEBQ. The restrained eating subscale measures the tendency for an individual to restrict their food intake in order to control their body weight (Herman & Mack, 1975); the emotional eating subscale assesses sensitivity to overeating in response to negative arousal states (Van Strien et al., 1986); and the external eating subscale measures an individual's sensitivity to overeating in response to external food cues, regardless of hunger. All three subscales have high internal consistency and factorial validity (Braet & Van Strien, 1997; Van Strien et al., 1986). See Chapter Two Subsection 2.8.1 for further information on this measure. For the current sample Cronbach's α was .93 for the restraint subscale, .94 for the emotional eating subscale and .88 for the external eating subscale, comparable with the alpha coefficients reported by Van Strien et al. (1986): restraint=.95, emotional eating=.94 and external eating=.80.

6.2.2.2. Eating Disorder Inventory 2 (EDI-2: Garner, 1991)

The EDI-2 measures common psychological and behavioural traits found in AN and BN. The following three eating-related subscales were administered in the present experiment: the DFT subscale; the Bulimia subscale; and the Body Dissatisfaction subscale. This measure has high test-retest reliability in both clinical and non-clinical groups (e.g. Thiel & Paul, 2006; Wear & Pratz, 2006): see Chapter Two Subsection 2.8.2 for full details. For the current sample Cronbach's α was .89 for the three eating-related subscales combined. For the separate subscales Cronbach's α was .86 for the DFT subscale, .64 for the Bulimia subscale and .89 for the Body Dissatisfaction subscale. These α coefficients were comparable with those reported by Garner (1994) for the DFT (.81-.93), bulimia (.63-.93) and body dissatisfaction subscales (.88-.93). Participants' mean score on the DFT subscale was 3.80 (*SD*=4.67), with a range of 16 (min=0; max=16). This is comparable with normative data published in the EDI-2 manual (Garner, 1991): *M*=5.5 (*SD*=5.5). Participants' mean score on the Bulimia subscale was 1.05 (*SD*=1.99), with a range of 10 (min=0; max=10). This is again comparable with normative data published in the manual: *M*=1.2 (*SD*=1.9). Participants' mean score on the Body Dissatisfaction subscale was 7.91 (*SD*=6.69), with a range of 24 (min=0; max=24). This is again comparable with normative data reported in the EDI-2 manual: *M*=12.2 (*SD*=8.3).

6.2.2.3. Hospital Anxiety and Depression Scale (HADS: Zigmond & Snaith, 1983)

The HADS provides a reliable, valid, and practical tool for identifying and quantifying anxiety and depression (excluding severe psychopathological symptoms and physical symptoms of psychological distress). The scale contains 14 items, which makes it easy to administer and well accepted (Hermann, 1997). Seven items assess anxiety and seven items assess depression. This scale has acceptable internal consistency, factorial validity and test retest reliability in both clinical groups and in the general population (e.g. Bjelland, Dahl, Haug, & Neckelmann, 2002; Hermann, 1997): see Chapter Two Subsection 2.9.4. For the depression subscale Cronbach's α was .59 and for the anxiety subscale Cronbach's α was .85. The α coefficient obtained for the anxiety subscale is comparable with other reports (ranging from .80 to .90; Hermann, 1997), however the coefficient obtained for the depression subscale is lower than as reported in other investigations (ranging from .81 to .90; Hermann, 1997).

6.2.2.4. Visual Analogue Scales (VAS) and Likert Scales

Pre-task hunger and desire to eat were measured using 100mm VAS with two extreme end points labelled '*not at all*' to '*extremely*'. Ratings of food images used in the task were also assessed using 100mm VAS ranging from '*not at all appealing*' to '*extremely appealing*'. VAS have been found to be reliable and valid for appetite research (e.g. Flint, Raben, Blundell, & Astrup, 2000; Stubbs et al., 2000). Neutral objects were rated using five-point Likert scales: 1) negative, 2) slightly negative, 3) neutral, 4) slightly positive, 5) positive. The images were presented to participants using PowerPoint 2007. Likert scale ratings have been found to be reliable and valid for use in psychological research, for example Matell and Jacoby (1971) reported internal consistency reliabilities averaging at .66, and test-retest reliabilities averaging at .82 for a range of Likert scales. Despite some arguing that reliability increases with the number of scale points (e.g. Ferguson, 1941; Jahoda, Deutsch & Cook, 1951), Matell and Jacoby (1971) found reliability and internal consistency to be independent of the number of scale points. Therefore a five-point Likert scale is likely to be reliable and valid for the present research.

6.2.2.5. Dot probe task

Prior to the present investigation, 44 female students rated the 20 food images used in the dot probe task in study two (see Appendix 11 for these ratings). Four food images were rated on average below 50: spaghetti bolognaise; popcorn; a bagel with cream cheese; and onion rings. The same female students also rated the objects that were paired with the food images in the dot probe task (see Appendix 11 for these ratings). These were rated on a Likert scale: 1) negative, 2) slightly negative, 3) neutral, 4) slightly positive, 5) positive. One image (a small toy camel) was rated >1 away from 3 (a criteria of <1 away from a completely neutral rating of 3 was deemed an appropriate criteria for being neutral). Following these ratings, additional photos were taken in order to find appealing replacements for the four poorly rated food images, and a replacement neutral image for the toy camel. Additional ratings of these images were then obtained from 11 female staff members at Loughborough University (see Appendix 12 for ratings). A total of 32 food images (and their matched neutral objects) were rated and the most appealing food images (and most neutral matched objects) were selected for the present dot probe task.

The present dot probe task included 20 picture pairs of food and matched neutral stimuli, presented using SuperLab® software (see Figure 6.1 and Appendix 13 for example picture pairs). As in study two, neutral objects were placed on the same background item as the food image it was matched with to maintain consistency across picture categories. Pictures were presented on a 19 inch screen with the picture edges 4cm apart from each other. Pictures were on average 9cm in height x 10cm in width; however some taller objects (e.g. chocolate milkshake and hot chocolate) were 10cm in height and 8.5cm in width. The same two conditions of the dot probe as used in study two were presented to participants: stimuli presented for 200ms and 2000ms. As in study two each condition began with 24 practice trials (neutral/neutral picture pairs), and each food/neutral picture pair was presented eight times in each condition (appearing four times on the left, four times on the right, four times in congruent trials, and four times in incongruent trials). There were 368 trials (48 practice and 320 experimental). For a full description of the task procedure see Chapter Five Subsection 5.2.2.9. Errors were removed; a mean of 6.49% of responses in the 200ms condition were errors and a mean of 4.89% of responses in the 2000ms condition were errors. RTs below 200ms and above 2000ms were excluded, followed by removing outliers above or below two standard deviations (SDs) from the mean score (following procedures of Bradley, Mogg, White, Groom, & deBono, 1999 and Shafran et al., 2007).

Figure 6.1: Example picture pair from the dot probe task

6.2.3. Procedure

Participants were tested individually in an experimental cubicle to minimise distraction. Firstly participants were given an information sheet explaining that the study involved a computer task assessing attention to images, followed by completion of questionnaires on mood and appetite variables and ratings of food and non-food objects. After informed consent was gained, participants completed a health screen questionnaire and hunger/desire to eat VAS. Following this, the experimenter provided standardised verbal instructions on the dot probe task, and then participants followed on-screen instructions and carried out the task. The order in which the 200ms and 2000ms dot probe conditions were seen was counterbalanced. Following the task, participants filled in the questionnaire pack (DEBQ, EDI-2, and HADS). Then verbal instructions were given on the food and non-food object ratings and instructions were also provided on screen. Participants were presented with each image individually on screen and then rated how appealing they found the food images and how emotional they perceived the non-food objects to be on rating sheets provided. On completion and with permission, height and weight measurements were taken. Each participant was thanked for participation and debriefed as to the purpose of the study. The procedure took approximately 50 minutes.

6.2.4. Data Analysis

Errors in the task and RTs below 200ms and above 2000ms were removed followed by removing outliers more than two SDs away from the mean for each individual. The dependent variable was RT, and the independent variables were restraint group, congruence and task condition. A 2 (group: high/low restraint) x 2 (congruence: congruent/incongruent trial) x 2 (task condition: 200/2000ms) mixed ANOVA was conducted. Hypotheses were tested using the RT data, with quicker mean RTs for probes in the same location as food pictures (congruent trials) than mean RTs for probes in the same location as neutral pictures (incongruent trials) indicating an AB for food stimuli. An interference score was also calculated for each participant (incongruent trial minus congruent trial: positive value indicating AB and negative value indicating avoidance) and analysis was repeated with these interference scores in a 2 (group: high/low restraint) x 2 (task condition: 200ms/2000ms) ANOVA. Correlations were conducted between eating behaviours measured (restrained eating, emotional eating, external eating, DFT, bulimic symptoms and body dissatisfaction) and the participant's interference scores for each condition. Due to some questionnaire measures and 2000ms interference scores not meeting parametric assumptions, Spearman's rho correlations were conducted. These were conducted with a view to carrying out multiple regression analyses to assess relative contribution of significant factors. Additional Spearman's rho correlations between possible confounds (age, BMI, hunger, depression, anxiety) and interference scores were also conducted.

6.3. Results

6.3.1. Food-Related AB

A 2 (group: high/low restraint) x 2 (congruence: congruent/incongruent trial) x 2 (task condition: 200ms/2000ms) ANOVA revealed a non-significant main effect of congruence: $F(1,56)=1.157$, $p=.287$, $\eta p^2=.020$, indicating that participants showed neither an AB or attentional avoidance of food stimuli. There was also a non-significant restraint x congruence interaction: $F(1,56)=.021$, $p=.885$, $\eta p^2=.000$ and a non-significant congruence x task condition interaction: $F(1,56)=.780$, $p=.381$, $\eta p^2=.014$. There was, however, a significant main effect of task condition: $F(1,56)=47.79$, $p<.001$, $\eta p^2=.460$, with participants taking significantly longer to respond in the 2000ms condition (mean=605.828ms) than in the 200ms condition (mean=554.07ms). There was also a non-significant task condition x restraint interaction: $F(1,56)=.324$, $p=.572$, $\eta p^2=.006$ and a non-significant main effect of restraint: $F(1,56)=.842$, $p=.363$, $\eta p^2=.015$. There was also a non-significant three-way interaction: $F(1,56)=.032$, $p=.859$, $\eta p^2=.001$ (see Figure 6.2).

Data were also analysed with interference scores as the dependent variable in a 2 (group: high/low restraint) x 2 (task condition: 200ms/2000ms) ANOVA. This revealed no significant main effects or interactions (all $F<1$; see Figure 6.3). As can be seen in Figure 6.3 neither of the participant groups avoided the food stimuli (as all mean interference scores were positive), but neither were the interference scores high (i.e. they were close to 0).

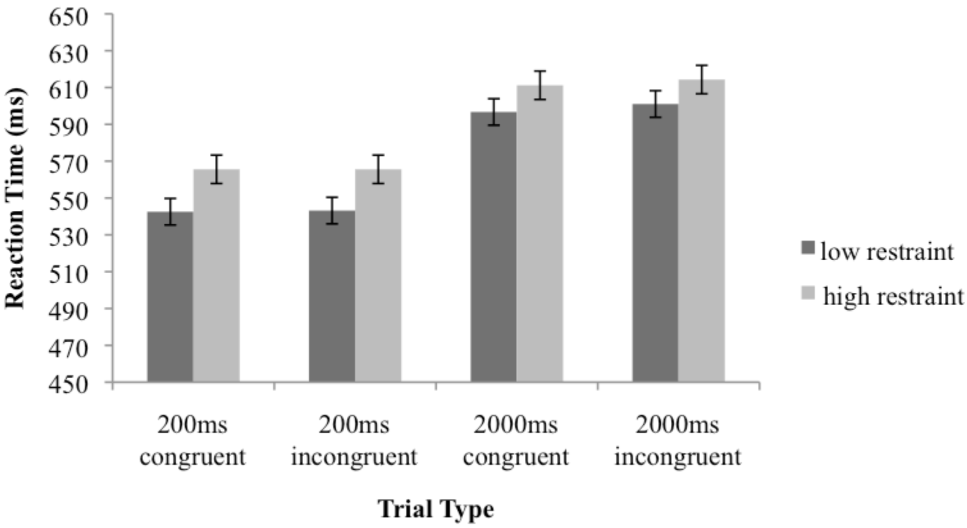

Figure 6.2: Mean (±SEM) response times for high and low restraint groups in each trial type

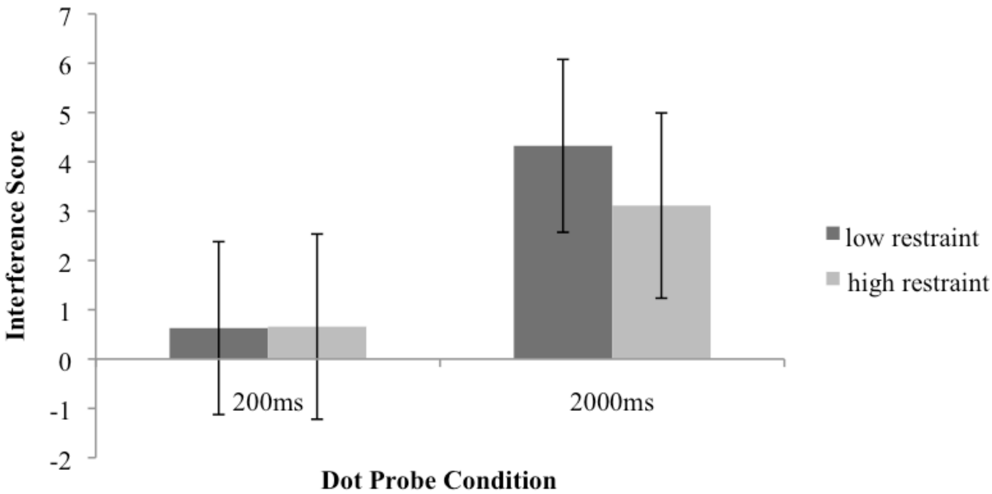

Figure 6.3: Mean (±SEM) interference scores for high and low restraint groups in each condition

6.3.2. Additional Trait Eating Behaviours

A series of Spearman's rho correlations were conducted between 200ms condition interference scores and restrained eating, emotional eating, external eating, overall eating psychopathology, DFT, bulimia, and body dissatisfaction; none of which were significant (see Table 6.2a). A series of correlations were also conducted between 2000ms condition interference scores and restrained eating, emotional eating, external eating, overall eating psychopathology, DFT, bulimia, and body dissatisfaction (see Table 6.2b). 2000ms interference was significantly negatively correlated with total scores on the eating-related subscales of the EDI-2; however, this was a weak correlation with EDI-2 scores only accounting for 6.9% of the variance in interference (R^2=.069).

Table 6.2a: Correlations between 200ms interference scores and eating behaviour variables.

	Restraint	Emotional eating	External eating	EDI-2 total	Drive for Thinness	Bulimia	Body Dissatisfact-ion
Spearmans Correlation	.046	-.099	-.025	-.064	.039	-.056	-.102
Sig. (2 tailed)	.729	.460	.853	.632	.771	.679	.447

Table 6.2b: Correlations between 2000ms interference scores and eating behaviour variables.

	Restraint	Emotional eating	External eating	EDI-2	Drive for Thinness	Bulimia	Body Dissatisfact-ion
Spearmans Correlation	-.119	-.166	-.049	-.278*	-.218	-.157	-.219
Sig. (2 tailed)	.373	.214	.714	.035*	.101	.238	.098

*p<.05

6.3.3. Possible Confounds and AB

Spearman's rho correlations were also conducted between 200ms interference scores and age, BMI, depression, anxiety and hunger in order to check if any of these potentially confounding variables were influencing performance. None were significantly correlated (see Table 6.3a for correlations). A series of correlations were also conducted between 2000ms condition interference scores and age, BMI, depression, anxiety and hunger (see Table 6.3b). 2000ms interference was significantly negatively correlated with age; however, age accounted for only 8.1% of the variance in interference (R^2=.081).

Table 6.3a: Correlations between 200ms interference scores and potential confounds

	Depression	Anxiety	Age	BMI	Hunger
Spearman's Correlation	.047	.073	.19	.015	-.018
Sig. (2 tailed)	.726	.585	.154	.910	.895

Table 6.3b: Correlations between 2000ms interference scores and potential confounds

	Depression	Anxiety	Age	BMI	Hunger
Spearman's Correlation	-.174	-.134	-.262*	-.072	-.074
Sig. (2 tailed)	.191	.315	.047*	.593	.582

*p<.05

6.3.4. Image Ratings

In order to validate the use of images in the task, ratings were obtained from those who completed the task. Ratings from all 60 participants were assessed. Food images were rated to be appealing overall (mean=53.43, *SD*=13.43), however seven food images were rated below 50: burger (mean=47.95, *SD*=24.48), cheese on toast (mean=47.95, *SD*=27.87), cooked breakfast (mean=44.38, *SD*=30.53), sweets (mean=49.38, *SD*=30.71), chips (mean=49.77, *SD*=27.54), doughnut (mean=44.43, *SD*=28.29), and scotch pancakes (mean=47.32, *SD*=27.18). However, there was large variation in the ratings, and it can be seen that these images were on average rated as only slightly unappealing. The matched objects were rated to be neutral overall (mean=2.97, *SD*=.24), with none of the neutral images being rated >1 away from 3 (see Appendix 15 for a full list of image ratings).

6.4. Discussion

The aim of the present experiment was to investigate whether a pictorial dot probe task can be used to demonstrate slowed disengagement from food in restrained eaters (compared to unrestrained eaters). Additionally, this research aimed to clarify previous ambiguous findings regarding food-related AB amongst such individuals. It was predicted that highly restrained eaters would be quicker to identify probes appearing in the same spatial location as food than neutral stimuli, and this effect was expected to be more pronounced in a 2000ms condition than a 200ms condition (hence demonstrating slowed disengagement to be the most robust sub-component of AB). Contrary to predictions, there was no evidence of AB or avoidance in either restrained or unrestrained eaters (replicating the findings of Boon et al. 2000 and study two of the present thesis). When the analysis was repeated with interference scores, no significant effects were found. In addition, restrained eating scores were not significantly correlated with interference scores in either condition of the task.

These findings stand in contrast to the findings of a body of literature that suggest that AB found in clinical ED patients is also present in non-clinically restrained eaters (e.g. Green & Rogers, 1993; Papies et al., 2008).

The second eating behaviour explored in its effect on attention processing of food was emotional eating. Contrary to predictions, emotional eating scores were not significantly correlated with interference scores in either condition of the dot probe. One possible explanation for this is that mood was not taken into account in the present study. By definition, emotional eaters eat excessively in response to states of emotional arousal such as anger, fear or anxiety (e.g. Van Strien et al., 1986). Therefore, it is possible that emotional eaters will only display an AB for food when experiencing such states of emotional arousal, i.e. when food becomes desirable to them.

In the present investigation, a non-significant correlation between external eating and interference was found. This finding stands in contrast with other studies which have explored the effect of external eating on biased attention processing of food using a dot probe task. Johansson et al. (2004) found that external eaters directed their attention away from high-calorie food, and Brignell et al. (2009) found that external eaters (and not non-external eaters) had an AB for food. It is evident that there is little consistency across food AB studies in non-clinical females. However, eating psychopathology (assessed by total scores on the eating-related subscales of the EDI-2) *was* found to influence performance. A significant negative correlation between eating psychopathology and 2000ms interference emerged. This could suggest that females characterised by high levels of general eating psychopathology attentionally *avoid* food stimuli. However, none of the individual subscales (DFT, bulimia, body dissatisfaction) were significantly correlated with interference in the 2000ms condition. Rather it appears that a combination of high scores on all of these subscales leads to this effect. To date, all located studies exploring the effect of non-clinical eating psychopathology on AB have either employed only Stroop tasks (which have not been modified to measure separate sub-components of AB), or only looked at biases for body stimuli as opposed to food stimuli (e.g. Ben-Tovim & Walker, 1991; Jansen et al., 2005). Given that the majority of studies have employed such Stroop tasks, they cannot comment on whether individuals characterised by various forms of non-clinical eating psychopathology *avoid* food stimuli (as longer RTs in these Stroop tasks can reflect either AB *or* avoidance e.g. Jansen et al., 2005). Avoidance of food stimuli has, however, been reported in other groups: AN patients (Giel et al, 2011;

Veenstra & deJong, 2012) and restrained and unrestrained eaters (Veenstra et al., 2010). In the literature, there is a larger body of evidence supporting the presence of AB towards than avoidance of food in eating disordered and restrained eaters, but as this hasn't been explored amongst those with non-clinical levels of eating psychopathology (aside from in the present investigation) we do not know if AB is more prominent than avoidance in non-clinical females with high levels of eating psychopathology. As Werthmann, Roefs, Nederkoorn, Mogg, Bradley and Jansen (2011) point out, biases in attention maintenance can be susceptible to controlled avoidance strategies. It is possible that those without clinical levels of eating psychopathology are able to more effectively use avoidance of food as a defence mechanism, perhaps aiding in preventing the development of clinical EDs, whereas clinical ED patients may not be capable of doing so.

Surprisingly, age was significantly negatively correlated with interference scores in the 2000ms condition, with younger participants being less able to disengage from food stimuli. The effect of age on AB hasn't been explored in great detail. To date, three studies have explored the influence of age on AB for food. The first of these (Green & McKenna, 1993) found that 9-11 year olds did not display an AB towards food in a Stroop task, but 14 year olds did display an AB for food. Lattimore et al. (2000) additionally explored the influence of age on AB for food. It was found that restrained eaters aged 14 and 15 showed an AB towards food, but 12-13 year old unrestrained eaters also showed an AB towards food. Finally, Seddon and Waller (2000) found that a younger group of women with non-clinical bulimic psychopathology (aged 18-21) showed attentional avoidance of negative stimuli, whereas an older group (aged 22-40) displayed an AB towards negative stimuli. Therefore, initial research seems to suggest age may influence AB, but this requires further exploration.

As in study two (Chapter Five), all participants took longer to respond in the 2000ms condition than the 200ms condition, which is likely to be due to the slower pace of this condition. Contrary to predictions, no evidence of AB towards or slowed disengagement from food was found, despite using an improved version of the dot probe task with carefully selected images. Despite gaining ratings from a separate group of females prior to the study in order to inform development of the task, the participants who took part in the study did not rate all of the food images as appealing. Seven food images were rated as slightly unappealing, and are therefore not likely to have grabbed participants' attention. There is clearly much variation in what foods women find to be appealing. Therefore, in order to find food images that are appealing to a large proportion of women, ratings from the separate groups of women (i.e. those who rated the stimuli prior to this study and those who took part in the present study) need to be combined in order to locate the most appealing images across a larger sample of women. Following combination of these ratings, only two images were rated as slightly unappealing; cheese on toast and cooked breakfast, which should be removed in future studies using this task.

Another possible limitation of the present study concerns the length of time spent carrying out the dot probe tasks. In study two (Chapter Five), participants were required to complete the Stroop task as well as two conditions of the dot probe task and this was acknowledged as a possible influence on performance. Although only two conditions of the dot probe task were included in the present study, these tasks still consisted of a large number of trials taking approximately 15 minutes to complete. It is possible that participants still became bored or fatigued throughout the task. Therefore, in future studies fewer trials should be used in order to prevent this.

As stated previously, research has not consistently demonstrated the presence of AB towards or slowed disengagement from food in non-clinical females. It could be argued that such biased attention processing only occurs in clinically eating disordered females given the greater significance of food to them. The fact that no evidence of biased attention processing of food was found in restrained eaters, external eaters, emotional eaters or those with high levels of eating psychopathology, provides some support to this claim. However, the lack of influence of these variables may have been due to the participant sample having relatively low scores on these measures. For example, restraint groups were divided according to a median split of 2.5 whereas some researchers have claimed that a score of 3 represents the true mid-point on this scale (e.g. Tapper et al., 2008). However, even when examining the influence of restraint continuously, no significant relation between restraint and task performance emerged in the present investigation.

In conclusion, two studies have failed to demonstrate the presence of AB towards and slowed disengagement from food using a dot probe task, in non-clinically restrained eaters. External eating, emotional eating and general eating psychopathology were not significantly related to AB towards, or slowed disengagement from food. Rather, in the present investigation, those with high levels of non-clinical eating psychopathology displayed attentional *avoidance* of food, whereas those with low levels of eating psychopathology showed greater AB for food. It is possible that biases in attention are restricted to clinical ED patients, as previous research with such samples has more consistently demonstrated biased attention processing of food (e.g. Ben-Tovim & Walker, 1991; Channon et al., 1988; Perpina et al., 1998; Shafran et al., 2007). Alternatively, some limitations of the dot probe task used in the present study (large number of trials, two poorly rated food images in terms of appeal) may account for the lack of significant findings. Furthermore, other factors not yet considered may predict biased processing of food in non-clinical females. For example, the combined effect of negative mood and restrained and/or disinhibited eating style has recently been found to predict AB towards food (Hepworth et al., 2010), and as stated previously emotional eaters may only display an AB for food when experiencing states of emotional arousal. Therefore, further research should employ a dot probe task that includes only food images widely rated to be appealing and a smaller number of trials, whilst also assessing the effect of negative mood on performance. The continued exploration of biased attention processing amongst non-clinical females characterised by eating-related concerns is important given the current equivocal findings. Further clarification of how food is processed by such individuals may aid in developing an attention training (AT) programme which could be used as a method of preventing ‘at-risk’ females developing clinical EDs. This is important given that AB towards, and slowed disengagement from food, is thought to maintain and exacerbate ED symptoms. By targeting biased attention at an early stage in ‘at-risk’ individuals this may help prevent development of EDs amongst such individuals. However, given the current inconsistencies in results, further research is needed to demonstrate the usefulness of such training.

Chapter Seven: Study Four Part One
Does negative mood interact with trait eating behaviour to predict biased attention processing of food stimuli?

7.1. Introduction

The aim of the present chapter was to explore the combined effect of negative mood and restrained/emotional eating on attentional bias (AB) for food measured using further modified Stroop and dot probe tasks. In studies two and three of the present thesis pictorial dot probe tasks have failed to demonstrate any significant cognitive avoidance, orientation bias towards, or slowed disengagement from food in restrained or unrestrained eaters. In study three emotional eating and external eating scores also did not significantly relate to AB. However, in study three those with lower levels of general eating psychopathology had greater AB than those with higher levels, indicated by a significant negative correlation between scores on the Eating Disorder Inventory-2 (EDI-2: Garner, 1991) and interference scores in the 2000ms condition. Surprisingly, in study three, age was also significantly negatively correlated with interference scores in the 2000ms condition, with younger participants showing more interference (i.e. they were less able to disengage from food stimuli). However, given the limited age range of the sample (18-25) it remains to be seen whether such an effect would be found in a sample consisting of a wider range of ages.

In the present thesis, two studies (the initial pilot study and study one) found that all participant groups (restrained/unrestrained eaters) were slow to disengage from food in a modified Stroop task. In study one, restrained eaters took longer than unrestrained eaters to disengage from food. However, in study two, no evidence of an orientation bias towards or slowed disengagement from food was found using a modified Stroop task. In addition, there was no significant pattern of differences between restrained and unrestrained eaters (although an interaction between restraint group and food word position response times (RTs) approached significance). The influence of various other eating behaviours on task performance has been explored in the present thesis, but only binge eating was found to significantly negatively correlate with RTs in the Stroop task in study two.

Some limitations of studies one to three have been acknowledged; for example, two of the food images in the dot probe tasks were rated to be unappealing across a large number of females (see Chapter Two Subsection 2.4.4). In addition, the dot probe tasks employed have consisted of a large number of trials (368) meaning that participants may have become bored or fatigued. This may have impacted upon performance and led to reduced concentration possibly preventing AB from being observed. This group of females also rated some food words in the Stroop task as unappealing, and some matched neutral stimuli as positive or negative (see Chapter Two Subsection 2.4.2).

The lack of significant AB towards or slowed disengagement from food in the dot probe tasks in studies two and three (and in the Stroop task in study two), may also have been due to not accounting for the influence of negative mood on biased attention processing of food. Indeed, there is reason to believe that negative mood will causally influence biased processing of food cues. For example, both females with clinical diagnoses of EDs, and those with non-clinical levels of eating concerns, increase eating in response to stress/negative mood (women are more prone to this response than men, e.g. Grunberg & Straub, 1992). A large body of naturalistic research has shown that negative mood precedes binge eating episodes in bulimic patients (e.g. Davis, Freeman, & Garner, 1988; Davis, Freeman & Solymon, 1985; Johnson & Larson, 1982). Naturalistic studies have also shown that restrained eaters overeat in response to stress caused by high workload (Wardle, Steptoe, Oliver, & Lipsey, 2000). Restrained eaters are also found to report significant weight gain after the onset of depression (Polivy & Herman, 1976) in addition to increasing intake in response to negative emotion or stress induced in the lab (e.g. Cools, Schotte, & McNally, 1992; Epel, Lapidus, McEwen, & Brownell, 2001; Mitchell & Epstein; 1996; Polivy & Herman, 1999; Polivy, Herman, & McFarlane, 1994; Rutledge & Linden, 1998; Wallis & Hetherington, 2004). Furthermore, emotional eaters, by definition, overeat in response to negative mood states (e.g. Van Strien et al., 1986).

Across the mood induction literature, a variety of mood induction techniques have been employed. Autobiographical recall is considered one of the most effective (Baker & Gutterfreud, 1993, cited in Jallais & Gilet, 2010). Using music to induce negative mood has also been found to be extremely effective (e.g. Sutherland, Newman & Rachman, 1982), with a combination of both recall and music increasing this effect (e.g. Heene et al., 2007; Hepworth et al., 2010; Hernandez et al., 2003; Marzillier & Davey, 2005; Van Der Does, 2002). Three studies have explored the effects of negative mood on AB. First, Grant, Stewart and Birch (2007) found that an anxious mood induction (music) predicted AB towards alcohol in a Stroop task in coping-motivated drinkers. Additionally, Rofey et al. (2004) found that naturally occurring negative mood states and bulimic symptoms interacted to predict AB towards food words in a Stroop task. Of further interest, Hepworth et al. (2010) found that induced negative mood (music and autobiographical recall) increased AB towards, and slowed the ability to disengage from food in a dot probe task (with 500ms and 2000ms presentation durations). Furthermore, AB correlated with emotional, external and restrained eating scores on the Dutch Eating Behaviour Questionnaire (DEBQ; Van Strien, Fijters, Bergers, & Defares, 1986). The authors concluded that a negative mood state increases the reward value of food cues and therefore activates the food reward system. In turn, this is thought to increase motivation to eat, shown through the capture of attention by food cues.

In summary, two potentially influential limitations of the studies in the present thesis have been acknowledged. Firstly, unappealing food stimuli were included in the AB tasks, which would not have been likely to 'grab' attention. Furthermore, negative mood has been found to increase food intake in restrained and emotional eaters (and increase AB in other participant groups), which has so far not been accounted for in the present thesis. Following on from these findings, novel hypotheses were formed. The aim of the present experiment was to explore the effect of restrained and emotional eating and negative mood, on AB for appealing food (based on previous participant ratings).

Firstly, it was hypothesised that highly restrained eaters in a negative mood would display a significantly greater food AB than those in a neutral mood (and with lower restraint scores). In other words, it was predicted that restrained eating scores and mood status would interact to predict food AB. AB towards food in the Stroop task would be reflected by significantly longer RTs for word position 1 (the food word) than later words in the sequence (positions 3-7). Likewise, slowed disengagement from food in this task would be reflected by significantly longer RTs for word position 2 than later words in the sequence (positions 3-7). Restrained eating scores were also expected to significantly positively correlate with RTs at word positions 1 and 2 amongst participants in a negative mood only. Additionally, AB towards food in the dot probe task would be reflected by significantly longer RTs in congruent trials than incongruent trials in the 200ms condition. Slowed disengagment from food in the dot probe task would be reflected by significantly longer RTs in congruent trials than incongruent trials in the 2000ms condition. Restrained eating scores were also expected to significantly positively correlate with interference scores (congruent trials minus incongruent trials: positive scores indicating AB, and negative scores indicating attentional avoidance) amongst participants in a negative mood only.

The second hypothesis was that highly emotional eaters in a negative mood would display a significantly greater food AB than those in a neutral mood (and with lower emotional eating scores). Emotional eating scores were also expected to significantly positively correlate with RTs at Stroop word positions 1 and 2 amongst participants in a negative mood only. Likewise, emotional eating scores were also expected to significantly positively correlate with dot probe interference scores amongst participants in a negative mood only.

The third hypothesis was that there would be significant associations between indicators of AB (RTs for Stroop word positions 1 and 2, and interference scores in 200/2000ms dot probe conditions) and other eating behaviours (external eating, drive for thinness, bulimic symptoms and body dissatisfaction). Expected associations were non-directional given previous ambiguous findings.

7.2. Method

7.2.1. Participants

Seventy-seven female participants were recruited by posters, department email lists, word-of-mouth, a research participation scheme at Loughborough University, and through the Loughborough University Community Newsletter. The study was approved by the Loughborough University Ethical Advisory Committee. The inclusion criteria included being female, aged between 18 and 45, not currently receiving treatment for an ED or a mood disorder, not colour blind, having English as their first language (or were highly proficient in the English language), and reporting no allergy for the study foods. Participants had a mean age of 21.06 (*SD*=5.11; range=18–41) and a mean BMI of 22.68 (*SD*=3.42). Thirty-eight participants were allocated to a negative mood condition, and 39 were allocated to a neutral mood condition[4] (see Table 7.1 for group characteristics). The data did not meet parametric assumptions

[4] Participant allocation was semi-randomised. Initially participants were grouped according to restrained and emotional eating scores (into one of four groups: Low Restraint/Low Emotional Eating; High Restraint/Low Emotional Eating; Low Restraint/High Emotional Eating; High Restraint/High Emotional Eating). Participants were classed as a high scorer if they scored >3 on the relevant subscale of the DEBQ. An equal number of participants from each group were allocated to the negative and neutral mood conditions. However, due to small numbers in some of these participant groups the analysis was changed to include restrained and emotional eating as covariates, as it was not feasible to compare groups.

(i.e. were non-normally distributed) therefore Mann Whitney *U* tests were carried out to compare mood groups. As expected, groups did not differ significantly in age, BMI, any measured eating behaviour, depression, or baseline hunger and sadness. However, the negative group had a greater (but non-significant) sadness rating at baseline (p=.064). This may have been due to expectations of sadness given that these participants had previously been asked to have a negative memory in mind to write about in the lab session (see Figure 7.1. for an overview of the procedure). As intended, those in the negative condition increased in sadness significantly more than those in the neutral condition showing that mood induction was successful.

Table 7.1: Characteristics of participants in each mood condition (n=77)

Measure	Negative Condition (n=38) M(SD)	Neutral Condition (n=39) M(SD)	U	z	p
Age (years)	20.87 (5.34)	21.26 (5.01)	621.5	-1.255	.209
BMI	22.18 (2.78)	23.09 (3.96)	641	-1.019	.308
Restraint (DEBQ)	2.67 (.95)	2.66 (.95)	727	-.143	.886
Emotional eating (DEBQ)	2.67 (.77)	2.68 (.99)	732	-.092	.927
External eating (DEBQ)	3.06 (.6)	3.22 (.59)	620	-1.235	.217
Total EDI-2 eating subscales	18.66 (14.52)	15.53 (12.75)	649	-.938	.348
DFT (EDI-2)	5.49 (6.41)	4.13 (5.18)	683.5	-.597	.551
Bulimia (EDI-2)	2.22 (3.16)	1.64 (2.39)	677	-.683	.495
Body Dissatisfaction (EDI-2)	10.5 (7.07)	9.56 (7.38)	672	-.515	.606
Depression (BDI-II)	6.34 (5.19)	6.39 (5.94)	687	-.365	.715
Baseline sadness (VAS)	16.43 (21.07)	8.7 (11.28)	559.5	-1.854	.064
Sadness change	-32.18 (27.39)	-.96 (11.42)	190.5	-5.613*	.000*
Baseline hunger (VAS)	35.51 (21.51)	34.97 (23)	736	-.051	.959

Note: BMI = body mass index = weight in kg/height in m²; DEBQ = Dutch Eating Behaviour Questionnaire; EDI-2 = Eating Disorder Inventory-2; DFT = Drive For Thinness Subscale; BDI-II = Beck's Depression Inventory 2; VAS = visual analogue scale; sadness change = pre mood manipulation VAS minus post mood manipulation VAS; * p<0.05.

7.2.2. Measures

7.2.2.1. Trait Measures of Mood and Appetite

7.2.2.1.1. Dutch Eating Behaviour Questionnaire (DEBQ: Van Strien, Frijters, Bergers, & Defares, 1986)

All three subscales of the DEBQ were administered: restrained eating; emotional eating; and external eating subscales. Higher scores on these scales indicate greater prevalence of these eating traits. All three subscales of the DEBQ have high internal consistency and factorial validity (e.g. Braet & van Strien, 1997; Van Strien et al., 1986): see Chapter Two Subsection 2.8.1 for full details. For the current sample Cronbach's alpha was .93 for the restraint subscale, .94 for the emotional eating subscale and .83 for the external eating subscale (comparable with the alpha coefficients reported by Van Strien et al., 1986: restraint=.95, emotional eating=.94 and external eating=.80).

7.2.2.1.2. Eating Disorder Inventory-2 (EDI-2: Garner, 1991)

The EDI-2 measures psychological and behavioural traits common to anorexia nervosa (AN) and bulimia nervosa (BN). The following three eating-related subscales were administered in the present experiment: the Drive for Thinness (DFT) subscale; the Bulimia subscale; and the Body Dissatisfaction (BD) subscale. Higher scores indicate greater prevalence of these traits. This measure has high test-retest reliability (e.g. Wear & Pratz, 2006) and strong reliability and stability (e.g. McCarthy, Simmons, Smith, Tomlinson, & Hill, 2002): see Chapter Two Subsection 2.8.2 for full details. For the current sample Cronbach's alpha was .92 for the three eating-related subscales combined. For the separate subscales Cronbach's alpha was .91 for the DFT subscale, .73 for the Bulimia subscale and .89 for the BD subscale. These alpha coefficients are comparable with those reported by Espelage, Mazzeo, Aggen, Quittner, Sherman, and Thompson (2003) for these subscales (ranging between .82 and .93). Participants' mean score on the DFT subscale was 4.95 (SD=5.94), with a range of 21 (min=0; max=21). This is comparable with normative data reported in the EDI-2 manual: M=5.5 (SD=5.5). Participants' mean score on the Bulimia subscale was 1.9 (SD=2.78), with a range of 13 (min=0; max=13). This is again comparable with normative data in the manual: M=1.2 (SD=1.9). Finally, participants' mean score on the BD subscale was 10 (SD=7.2), with a range of 27 (min=0; max=27). This is again comparable with the normative data published in the manual: *M*=12.2 (*SD*=8.3).

7.2.2.1.3. Beck Depression Inventory II (BDI-II: Beck, Steer, & Brown, 1996)

The BDI-II is a widely used 21-item self-report measure of affective, cognitive and somatic symptoms of depression. Higher scores indicate greater levels of depression. The BDI-II has robust psychometric properties with strong construct validity, high test-retest reliability and internal consistency (e.g. Beck, Steer, Ball, & Ranieri, 1996; Beck, Steer, & Brown, 1996; Dozois, Dobson & Ahnberg, 1998): see Chapter Two Subsection 2.9.3 for full details. Cronbach's alpha for the current sample was .82, comparable with the alpha reliability statistic reported by Beck, Steer and Brown (1996) for the BDI-II (.91). Participants' had a mean score of 6.37 (*SD*=5.54), with a range of 20 (min=0; max=20). This is comparable with normative data reported in the BDI-II manual: *M*=12.56 (*SD*=9.93).

7.2.2.2. State Measures of Mood and Appetite

7.2.2.2.1. The Positive and Negative Affect Scale (PANAS: Watson, Clark, & Tellegen, 1988)

The PANAS is a 20-item measure consisting of two distinct negative and positive affect scales. Positive affect refers to the extent to which a person feels enthusiastic, active and alert (with higher scores indicating greater positive affect), and negative affect refers to a state of distress which covers a range of negative mood states such as anger (with higher scores indicating greater negative affect: Watson et al., 1988). The PANAS requires participants to indicate the extent to which they have experienced specified mood states in a specified time frame. In the present study the time frame selected was how they were feeling at that precise moment, given that this questionnaire was used as a measure of change in state mood throughout the experiment. The PANAS has high internal consistency and reliability (e.g. Crawford & Henry, 2004; Watson et al., 1988). See Chapter Two Subsection 2.9.2 for further details on this measure. Cronbach's alpha for the current sample was .84 at baseline measurement for the positive affect scale (comparable with reliability statistics obtained by Watson et al. 1988; .86-.90), and .63 for the negative affect scale (slightly lower than reported by Watson et al., 1988; .84-.97).

7.2.2.2.2. Visual Analogue Scales (VAS)

Mood was measured using sad, happy and anxious 100mm VAS with participants required to indicate how they were feeling on each mood state right now, ranging from '*not at all*' to '*extremely*'. Mood VAS were given at various points throughout the study in order to assess the impact of the mood induction procedure, the tasks, and eating, on mood. Mood VAS have been used to assess the impact of mood induction, AB tasks and eating, on mood in a number of other research studies (e.g. Hepworth et al., 2010; Marzillier & Davey, 2005; Wallis & Hetherington, 2004). Hunger, fullness and desire to eat were also assessed using 100m VAS at three time points in the experiment (baseline, post mood induction and tasks, and post eating), as used for similar reasons in a number of other research studies (e.g. Hepworth et al., 2010; Wallis & Hetherington, 2004; Wallis & Hetherington, 2009). VAS measures of liking (subjective feelings of pleasure) and wanting (subjective feelings of intent or desire) for the study foods (chocolate and crisps) were also administered following the mood induction (as described in Chapter Eight). During the 'taste test', described in Chapter Eight, participants were also provided with VAS measures of the pleasantness, sweetness/saltiness of each of the study foods.

7.2.2.2.3. Food Recall Diary

Participants were instructed to have a normal meal (either breakfast or lunch depending on the time of the lab session between 12 and 5) two to three hours prior to attending the lab and drink only water following this. To assess adherence to this instruction participants completed a food recall diary at the start of the lab session. This required participants to record all food and drink that they had consumed that day, the time it was consumed and how much they had consumed. Such recall has been found to compare well with weighed records of intake (e.g. Bingham, Gill, Welch, Day, Cassidy, Khaw et al., 1994).

7.2.2.3. Stroop Task

7.2.2.3.1. Identification of Stroop Stimuli

Prior to the current study, 44 female students completed VAS ratings of the 12 food words from the Stroop task used in study two. The mean rating of the food words was 57.15 (*SD*=12.67) indicating that the words were rated as moderately appealing.

However, four words were rated below 50: ‘sugar’ (mean=48.89, *SD*=26.05), ‘pie’ (mean=41.55, *SD*=29.03), ‘cream’ (mean=32.77, *SD*=28.83) and ‘butter’ (mean=27.86, *SD*=25.02: see Appendix 6 for a full list of ratings). Therefore, these words (and their matched neutral words) were excluded from the current Stroop task. Ninety-seven females rated the neutral words from the task used in study two using Likert scales: 1) negative, 2) slightly negative, 3) neutral, 4) slightly positive, 5) positive (see Appendices VII and VIII for these ratings). Three of the matched neutral words in the food condition were rated as slightly positive and were therefore replaced: ‘companion’ was replaced by ‘container’; ‘bargain’ was replaced with ‘bracket’; and ‘premier’ was replaced with ‘parcels’. All household objects were rated as neutral, and only one of the matched neutral words (in the household object condition) was rated as positive (‘weekends’) and so this was replaced with the word ‘wrapping’. In order to have an equal number of stimuli in the two conditions, four household objects were excluded. Three household objects rated the furthest away from 3 (i.e. a completely neutral rating) were excluded (pillow, bath, photo) in addition to the word ‘sink’ given that this has multiple meanings and could therefore be considered negative. For a full list of words included in the present Stroop task see Appendix 5.

7.2.2.3.2. Stroop Procedure

Participants completed ‘Food’ and ‘Neutral’ (household object) conditions of the Stroop task, with the order counterbalanced across participants. The task began with 16 practice trials consisting of rows of ‘XXXXX’ in each of the four colours (red, blue, green and yellow). There were eight target and 48 neutral words in each of the conditions and each word was seen twice (224 trials in total). The pattern of words followed sequences of seven throughout, with the first in the sequence being the target word, followed by six neutral words. The words were presented individually in the centre of the screen. They were presented in a pseudo-randomised order; first the target words were randomised and then the individually matched neutral words for each target word were randomised. Participants responded via a response box with four colour buttons, as opposed to responding via keyboard as in studies one and two. Responding via a response box is recommended as the most accurate measure of reaction time in a Stroop task (e.g. Davidson & Wright, 2002).

In the previously employed Stroop tasks (studies one and two), no response stimulus interval (RSI) was used, i.e. each word was presented directly following the previous response. This is in line with a number of previous food Stroop studies (e.g. Green, Corr & deSilva, 1999; Green, Elliman, Rogers & Welch, 1997: for a full description of the use of RSIs see Chapter Two Subsection 2.4.1). Sharma and McKenna (2001) compared the effect of different RSI durations on emotional Stroop performance, finding that emotional interference only occurred in a 32ms condition. The Stroop tasks in the present PhD are largely based on the original task developed by McKenna and Sharma (2004), which included an RSI of 32ms. Therefore, in the current Stroop task an RSI of 32ms was included, given that this is a brief RSI and will therefore allow lingering effects to be observed, but still allows participants a brief pause between words.

As in studies one and two of the present thesis, errors were removed in addition to response latencies above or below two standard deviations (SDs) away from the mean for each individual. A mean of 2.91% of responses were errors and were therefore removed (1.48% in the Food condition; 1.43% in the Neutral condition). A mean of 4.52% of responses were outliers and were therefore removed (2.5% in the Food condition; 2.02% in the Neutral condition).

7.2.2.4. Dot Probe Tasks

After study three, all food image ratings collected up to this point were combined to produce an overall rating of the 20 images used in the dot probe task in study three (see Appendix 15 for these ratings). Only two images were rated as unappealing overall: cheese on toast and cooked breakfast. However, the burger (mean=50.24) and the pancakes (mean=50.77) were rated as neither appealing nor unappealing. It was felt that in the previous use of the dot probe task (studies two and three) the task was too long and participants may have become bored or fatigued throughout. There were a large number of trials, as every image pair was seen eight times in each of the two conditions meaning that each participant completed 320 experimental trials (and 48 practice trials) taking approximately 15 minutes. Therefore, the following five images (rated the least appealing by a large sample of women) were excluded in the present task: burger, pancakes, cheese on toast, cooked breakfast and the doughnut.

As in studies two and three, two conditions of the dot probe task were presented to participants: one condition where all food/neutral picture pairs were presented for 200ms and another where all food/neutral picture pairs were presented for 2000ms.

In this task, 15 images were repeated eight times in each condition, with each picture appearing four times on the left and four times on the right, and four times in a congruent trial (the probe appearing in the same location as the food picture), and four times in an incongruent trial (the probe appearing in the same location as the neutral picture). Therefore, there were 120 experimental trials in each condition, with a total of 288 trials including practice trials. For a full description of the task procedure see Chapter Five Subsection 5.2.2.9. As in studies two and three, errors were removed in addition to responses below 200ms or above 2000ms. Additionally, response latencies above or below two SDs away from the mean for each individual were removed. In the 200ms condition a mean of 4.60% of responses were errors and were therefore removed (2.37% in congruent trials; 2.23% in incongruent trials). In the 200ms condition a mean of 4.01% of responses were outliers and were therefore removed (1.90% in congruent trials; 2.11% in incongruent trials). In the 2000ms condition a mean of 4.46% of responses were errors and were therefore removed (2.00% in congruent trials; 2.46% in incongruent trials), and a mean of 4.22% of responses were outliers and were therefore removed (2.08% in congruent trials; 2.14% in incongruent trials).

7.2.2.5. Mood Induction Procedure

Those allocated to the negative mood condition were informed prior to taking part that during the lab session they would be asked to write about a negative memory of a recent personal event in their life in which they felt sad. They were told it may help for them to have an idea of what they would write about beforehand, following similar procedures by other researchers (e.g. Hernandez et al., 2003; Liotti, Mayberg, Brannan, McGinnis, Jerabek, & Fox, 2000; Liotti, Mayberg, McGinnis, Brannan, & Jerabek, 2002; Mayberg, Liotti, Brannan, McGinnis, Mahurin, Jerabek et al., 1999). Those allocated to the neutral mood condition were told they would be asked to write about a neutral memory (i.e. a memory in which they were in a non-emotional mood) such as making a routine journey or carrying out a daily routine. They too were asked to have an idea of something they could write about beforehand.

During the mood induction participants in the negative mood condition were provided with a booklet and pen and were given the following instructions: “Please think about one or more recent unhappy memories of a personal event in your life in which you felt sad. Please describe the event in detail and your reactions to it in the box below. Try to concentrate on your feelings at the time associated with the event/s. If you can't write for five minutes about one memory then please think of and write about another memory which has the same emotional significance." Participants in the neutral condition were given the following instructions: "Please think about one or more memories of ordinary recent events in which you were in a neutral non-emotional mood e.g. taking a routine journey or carrying out a daily routine. Please describe the event/s in detail in the box below. If you can't write for five minutes about one memory then please think of and write about another emotionally neutral memory."

Whilst writing down their memories, participants in the negative condition were played five minutes of Barber's Adagio for Strings via headphones. This piece of music has been found to be successful at inducing a sad mood in a number of previous studies (e.g. Eich & Metcalfe, 1989; Fox, Knight, & Zelinski 1998; Heene et al., 2007; Hernandez et al., 2003; Morrow & Nolen-Hoeksema, 1990). Participants in the neutral condition were alternatively played five minutes of music consisting of Chopin's Waltzes numbers 11 and 12 played consecutively via headphones. These pieces of music have been used successfully in neutral mood conditions in a number of mood induction studies (e.g. Heene et al., 2007; Marzillier & Davey, 2005; Startup & Davey, 2001; Wood, Saltzberg, & Goldsamt 1990). Before and after the mood induction procedure, mood VAS and the PANAS were administered. This was to ensure mood induction was successful. Martin (1990) commented that the majority of studies employing a mood induction have taken a change of 10mm or more on a 100mm sadness VAS as indicative of successful mood change. Teasdale and Fogarty (1979) and Lenton and Martin (1991), however, used a 20 point difference as an indication of successful mood change. In the present study an increase in VAS rating of "sad" by 15mm or more and/or a decrease in VAS rating of "happy" was taken as a successful mood induction, based on the procedure followed by Richell and Anderson (2004). Eleven participants did not meet these criteria; therefore analyses were conducted with and without these participants.

In between each AB computer task, a booster mood induction was administered in which participants continued to listen to the same piece of music for three minutes. Music was also played for three minutes following the final task (a total time of 14 minutes of music). If participants in the negative mood condition were still in a sad mood in the final mood rating at the end of the lab session, they were played Delibe's Mazurka from Coppelia (used as a positive mood inducer in a number of studies e.g. Bouhuys et al., 1994; Clark, Iversen, & Goodwin, 2001; Goldstein & Willner, 2002;

Parrott, 1991) whilst being asked to recall a recent happy memory. A final mood VAS was then administered to ensure mood had returned to baseline.

7.2.3. Procedure

Prior to the study, participants were emailed an information sheet and consent form, a health screen questionnaire (in order to check their eligibility to participate), the DEBQ and the BDI-II. Participants were allocated to either the negative mood induction or the neutral mood induction condition, and were allocated a time between 12pm and 5pm to take part in the lab session. Participants were asked to eat a normal meal (breakfast or lunch) 2-3 hours prior to the session and drink only water following this. At the start of the lab session, participants were asked to complete a food recall diary, baseline appetite and mood VAS and the PANAS. Following this, they carried out the mood induction procedure. After the mood induction further mood VAS and the PANAS were administered. After these mood ratings, participants completed the Stroop and dot probe tasks, the order of which was counterbalanced across participants. In between each task (and after the final task), a booster mood induction was also administered. Following this, mood VAS, PANAS, hunger, desire to eat and fullness ratings were taken. This was followed by measures of liking and wanting of crisps and chocolate and a ‘taste test’, as described in Chapter Eight. Finally, the experimenter administered mood and hunger ratings, followed by the EDI-2. Those in the negative mood condition who were still in a sad mood in the final mood rating underwent a positive mood induction. A final mood VAS was then administered to ensure mood had returned to baseline.

Height and weight measurements were taken (upon obtaining permission) and participants were provided with a written and verbal debrief. All participants in the negative mood condition were informed in the written debrief of the contact details of the University Counselling Service in the event of any significant distress following the negative memory recall. See Figure 7.1 for an outline of the procedure (intake-related data are presented in Chapter Eight as indicated in Figure 7.1).

7.2.4. Data Analysis

In order to check whether the data met parametric assumptions histograms, skewness and kurtosis statistics and Kolmogorov-Smirnov statistics were obtained and assessed. Some of the data were not normally distributed therefore, where available, non-parametric equivalents of statistical tests were employed. In the Stroop and dot probe tasks, errors and outliers more than two SDs away from the mean RT for each individual were removed.

In order to test hypotheses one and two (that those with high restrained/emotional eating scores in a negative mood would display a significantly greater food AB than those in a neutral mood and with lower scores), separate analyses were conducted with the Stroop and dot probe data. A 2 (mood condition: negative/neutral) x 7 (word position) mixed measures ANOVA with restrained and emotional eating scores as covariates was conducted for each Stroop condition (food and neutral). Hypotheses were tested using the RT data, with a delayed colour-naming time for the target food word demonstrating an AB towards the word, and a delayed colour-naming time for the neutral word following the food word showing slowed disengagement from food (this is compared to RTs for later neutral words in the sequence). An α level of 0.05 was taken to be significant. The Stroop data were also analysed by conducting Spearman's rho correlations for each group (negative/neutral), between RTs at word positions 1 and 2 in the Stroop task (representing orientation and disengagement) and restrained and emotional eating scores. This analysis on the Stroop data was repeated with 11 participants removed who were either not successfully induced into a negative mood following negative mood induction (*n*=7) or who were not maintained at a neutral mood following the neutral mood induction (*n*=4).[5]

Hypotheses one and two were also assessed using the dot probe data by conducting a 2 (mood condition: negative/neutral) x 2 (task condition: 200/2000ms) x 2 (congruence: incongruent/congruent trial) mixed measures ANOVA with restrained and emotional eating as covariates. Hypotheses were tested using the RT data, with quicker mean RTs for probes in the same location as food pictures (congruent trials) than mean RTs for probes in the same location as neutral pictures (incongruent trials) indicating an AB for food stimuli. An interference score was also calculated for each participant (incongruent trial minus congruent trial; positive value indicating AB towards the food stimuli and a negative value indicating attentional avoidance). The interference scores were analysed in a 2 (mood condition: negative/neutral) x 2 (task condition: 200/2000ms) ANOVA with restrained and emotional eating as covariates.

[5] These participants were not removed at the start because of significantly reducing the sample size. Due to the complex analysis there was concern about losing power. However, it was also necessary to check whether these participants skewed the data at all.

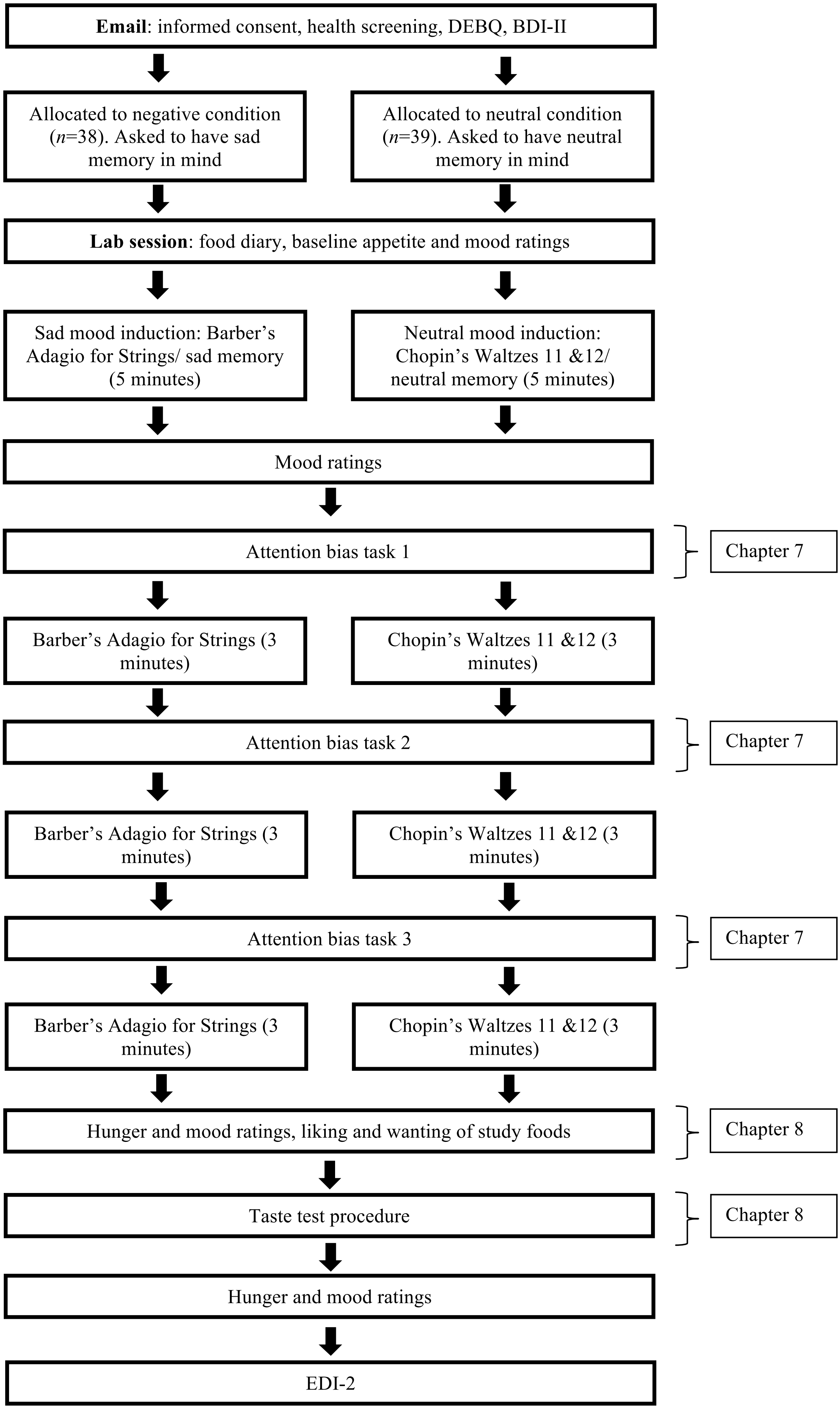

Figure 7.1: Overview of experimental procedure

For each group (negative/neutral) Spearman's rho correlations were conducted between restrained/emotional eating scores and the participant's interference scores for each task condition (200/2000ms). This analysis on the dot probe task was again repeated with 11 participants removed who were either not successfully induced into a negative mood following negative mood induction (*n*=7) or who were not maintained at a neutral mood following the neutral mood induction (*n*=4).

The third hypothesis, that there would be significant associations between indicators of AB and other trait eating behaviours (external eating, DFT, bulimic symptoms, and BD), was analysed by conducting Spearman's rho correlations between indicators of AB (Stroop word position 1 and 2 RTs; dot probe 200/2000ms interference scores) and eating behaviour questionnaire scores. Finally, Spearman's rho correlations were also conducted between these indicators of AB and possible confounds (depression, age, BMI, and baseline hunger). As a priori hypotheses were not made for these analyses, α was adjusted for multiple comparisons: significant α set at .0125 to account for correlations for two groups at two Stroop word positions/two dot probe conditions.

Finally, multiple regression analyses were conducted with those eating behaviours/confounds (predictors) that were significantly correlated with indicators of AB (outcome). These were carried out in order to assess relative contribution of significant factors. Assumptions for stepwise regression were met: there was no multicollinearity as indicated by VIF (<10) and Tolerance (>.2) statistics, there was normality of errors as indicated by normal distribution in a histogram and through points falling close to the line in a normal probability plot, and there was homogeneity of variance of error terms (scatterplot of standardised residuals against standardised values were not skewed or curved: see Appendix 27).

7.3. Results

7.3.1. Restrained and Emotional Eating

7.3.1.1. Food Stroop Task

In order to assess hypotheses one and two using the Stroop task data, a 2 (mood condition: negative/neutral) x 7 (word position) ANOVA with restrained and emotional eating as covariates was conducted. Mauchly's sphericity was violated and so

Greenhouse-Geisser correction was employed (although uncorrected degrees of freedom are reported in the text). A non-significant main effect of word position emerged: $F(6,438)=.346$, $p=.885$, $\eta p^2=.005$, however, given a priori hypotheses that there would be a difference between word position RTs Bonferroni comparisons were carried out. These revealed that RTs were significantly longer at word position 1 than all other word positions (all $p<.001$: see Figure 7.2). There was a non-significant main effect of mood condition: $F(1,73)=.038$, $p=.846$, $\eta p^2=.001$, and a non-significant interaction between word position and mood condition: $F(6,438)=.694$, $p=.628$, $\eta p^2=.009$. There was a non-significant main effect of restrained eating: $F(1,73)=.096$, $p=.758$, $\eta p^2=.001$ and emotional eating: $F(1,73)=.038$, $p=.846$, $\eta p^2=.030$, and non-significant interactions between word position and restrained eating: $F(6,438)=.835$, $p=.526$, $\eta p^2=.011$, and word position and emotional eating: $F(6,438)=.345$, $p=.885$, $\eta p^2=.005$. This analysis was then repeated with 11 participants removed (for whom mood induction was not successful) which revealed a significant main effect of emotional eating: $F(1,62)=5.607$, $p=.021$, $\eta p^2=.083$ which signifies that higher scorers on the emotional eating subscale were slower to respond in this task.

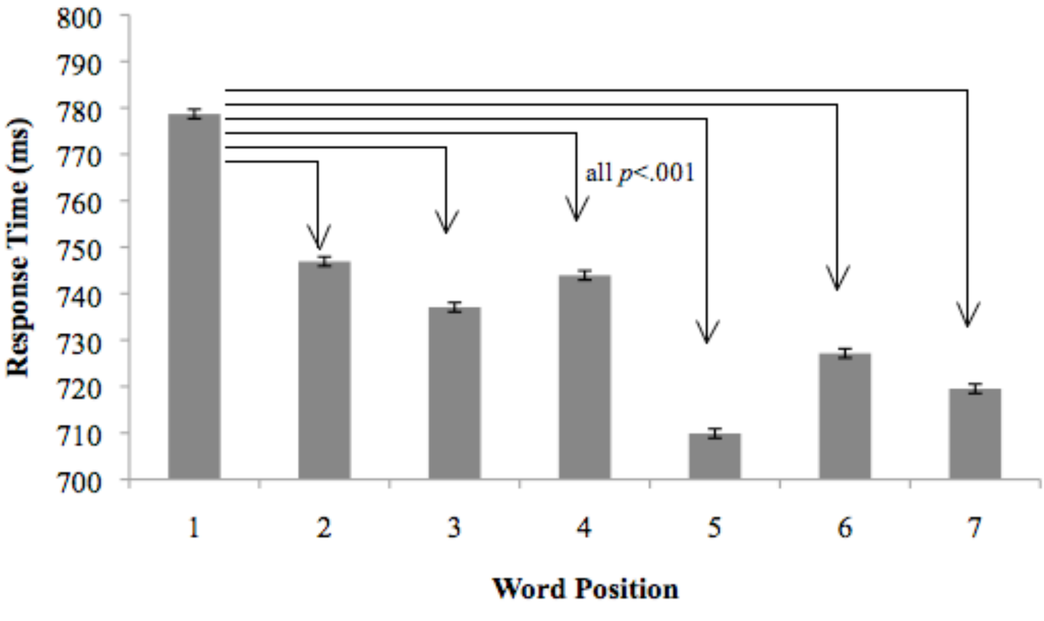

Figure 7.2: Mean (±SEM) response times at each word position in the food condition (*n*=77)

Spearman's correlations between emotional eating and word position 1 and 2 RTs (representing orientation and disengagement) were conducted separately for those in the negative ($n=38$) and neutral ($n=39$) mood groups. The correlation between emotional eating and word position 1 RT was significant amongst those in the negative condition ($r_s=.464$, $p=.003$), but the correlation between emotional eating and position 1 RT was non-significant amongst those in the neutral condition (r_s=.115, p=.487). Restrained eating was non-significantly correlated with word position 1 RTs amongst participants in the negative (r_s=.284, p=.085) and neutral groups (r_s=-.223, p=.173). Emotional eating and restrained eating scores were significantly correlated with word position 2 RTs amongst those in the negative group only (see Table 7.2a). With 11 participants removed (for whom mood induction was not successful) emotional eating remained significantly positively correlated with word position 1 RTs amongst those in a negative mood, although emotional eating was also significantly positively correlated with word position 2 RTs amongst those in a neutral mood (see Table 7.2b).

Table 7.2a: Correlations for negative and neutral groups between food word position 1 and 2 response times and restrained and emotional eating (n=77)

		Restrained Eating		Emotional Eating	
	Word Position	Spearman's Correlation	Sig. (2-tailed)	Spearman's Correlation	Sig. (2-tailed)
Negative Mood	1	.284	.085	.464*	.003*
	2	.369*	.022*	.379*	.019*
Neutral Mood	1	-.223	.173	.115	.487
	2	-.248	.128	.167	.310

*p<.05

Table 7.2b: Correlations for negative and neutral groups between food word position 1 and 2 response times and restrained and emotional eating (n=66)

		Restrained Eating		Emotional Eating	
	Word Position	Spearman's Correlation	Sig. (2-tailed)	Pearson Correlation	Sig. (2-tailed)
Negative Mood	1	.202	.277	.448*	.012*
	2	.295	.107	.354	.051
Neutral Mood	1	-.226	.191	.303	.077
	2	-.265	.124	.369*	.029*

*p<.05

7.3.1.2. Neutral Stroop Task

In a 2 (mood condition: negative/neutral) x 7 (word position) ANOVA with restrained and emotional eating as covariates, Mauchly's sphericity was violated so Greenhouse-Geisser correction was employed. There were no significant effects: all $F<1$ except the main effect of word position: $F(6,438)=2.075$, $p=.069$, $\eta p^2=.028$ (see Figure 7.3) and the interaction between word position and restraint: $F(6,438)=1.337$, $p=.249$, $\eta p^2=.018$. This remained the same with 11 participants removed. Restrained and emotional eating scores were also non-significantly correlated with RTs at word positions 1 and 2 (both with and without participants removed: see Appendix 29 Tables 2a and 2b).

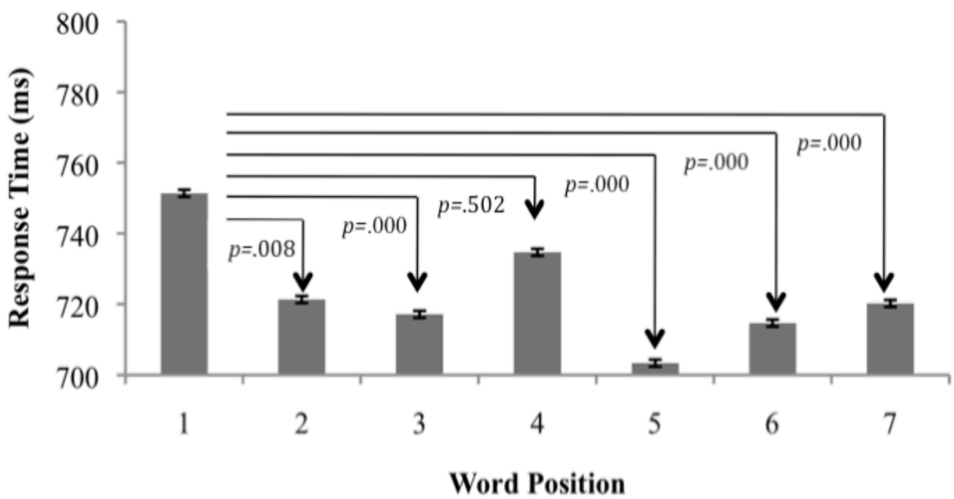

Figure 7.3: Mean (±SEM) response times at each word position in the neutral condition (*n*=77)

As can be seen by comparing Figures 7.2 and 7.3, RTs were quicker in the neutral condition than in the food condition. In order to assess whether this difference was significant an additional 2 (task condition: food/neutral) x 7 (word position) ANOVA was conducted. This revealed a significant main effect of task condition: $F(1,76)=8.901$, $p=.004$, $\eta p^2=.105$, with significantly longer RTs found in the food condition (mean=737.64ms) than in the neutral condition (mean=723.2ms). There was also a significant task condition x word position interaction: $F(6,456)=2.484$, $p=.029$, $\eta p^2=.032$, revealing that RT at word position 1 was longer than all other word positions in the food condition than in the neutral condition.

7.3.1.3 Dot Probe Task

A 2 (mood condition: negative/neutral) x 2 (task condition: 200/2000ms) x 2 (congruence: congruent/incongruent) ANOVA with restrained and emotional eating as covariates (and RT as the DV) revealed no significant main effects or interactions. When the analysis was repeated with 11 participants removed a significant main effect of emotional eating emerged: $F(1,62)=4.922$, $p=.030$, $\eta p^2=.074$ with higher emotional eating scores significantly associated with slower responding in the tasks.

The analysis was repeated with interference scores as the dependent variable in a 2 (mood condition: negative/neutral) x 2 (task condition: 200/2000ms) ANOVA with restrained and emotional eating as covariates. This revealed no significant main effects or interactions. With 11 participants removed, the main effect of mood condition marginally approached significance: $F(1,62)=2.93$, $p=.092$, $\eta p^2=.045$. Those in the neutral condition (mean=4.821) had (non-significantly) more positive interference scores than those in the negative condition (mean=-2.207).

A series of Spearman's correlations were also conducted between 200/2000ms interference scores and restrained/emotional eating scores for negative and neutral groups, none of which were significant with α adjusted to .0125 (see Appendix 29 Tables 5a and 5b).

7.3.2. Additional Trait Eating Behaviours

7.3.2.1. Food Stroop

In order to test the third hypothesis (i.e. that there would be a significant association between other eating behaviours and AB), Spearman's correlations between word position 1 and 2 RTs and external eating, EDI-2 eating-related subscale total scores, DFT, bulimia and BD were carried out for participants in the negative and neutral groups (α adjusted to .0125 due to comparisons for two groups of participants at two word positions). This revealed that external eating scores were significantly positively correlated with word position 1 RTs only amongst participants in a neutral mood. On the other hand, DFT scores were only significantly positively correlated with word position 1 RTs amongst participants in a negative mood (see Table 7.3a). With 11 participants removed, external eating scores were significantly positively correlated with word position 1 and 2 RTs amongst those in a neutral mood, and the correlations between DFT scores and word position RTs approached significance amongst those in a negative mood (see Table 7.3b).

Table 7.3a: Correlations for negative and neutral groups between food word position 1 and 2 response times and eating behaviours (*n*=77)

		External Eating		EDI-2 Total		DFT		Bulimia		BD	
	Word Position	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)
Negative Mood	1	.057	.732	.334	.041	.438*	.006*	.305	.062	.179	.290
	2	.090	.589	.219	.186	.351	.031	.242	.143	.075	.658
Neutral Mood	1	.437*	.005*	.012	.940	-.011	.948	.062	.705	.035	.832
	2	.392	.014	-.049	.768	-.052	.754	.135	.413	-.050	.763

*$p<.0125$

Table 7.3b: Correlations for negative and neutral groups between food word position 1 and 2 response times and eating behaviours (*n*=66)

		External Eating		EDI-2 Total		DFT		Bulimia		BD	
	Word Position	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)
Negative Mood	1	.003	.989	.268	.145	.376	.037	.357	.049	.159	.393
	2	-.051	.786	.199	.284	.377	.037	.266	.148	.064	.732
Neutral Mood	1	.596*	.000*	.057	.745	.008	.964	.166	.340	.056	.750
	2	.575*	.000*	-.018	.918	-.059	.736	.251	.146	-.033	.852

*$p<.0125$

7.3.2.2. Neutral Stroop

A series of Spearman's correlations between neutral word position 1 and 2 RTs and eating behaviour variables, were conducted for each of the mood groups. With all 77 participants included in the analysis there were no significant correlations (see Appendix 29 Table 3). With the 11 participants removed a significant correlation between external eating scores and word position 1 RTs amongst participants in the neutral group emerged, in addition to a significant correlation between word position 1 RTs and DFT scores amongst participants in a negative mood (see Table 7.4).

Table 7.4: Correlations between neutral word position 1 and 2 response times and eating behaviours in the negative and neutral groups (*n*=66)

		External Eating		EDI-2 Total		DFT		Bulimia		BD	
	Word Position	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)
Negative Mood	1	-.149	.422	.322	.077	.454*	.01*	.239	.196	.203	.274
	2	-.110	.556	.174	.349	.261	.157	.190	.306	.084	.652
Neutral Mood	1	.422*	.012*	.112	.520	.025	.887	.178	.306	.133	.446
	2	.380	.024	.109	.534	-.003	.984	.136	.436	.155	.375

$^*p<.0125$

7.3.2.3. Dot Probe Task

A series of Spearman's correlations were also conducted between 200/2000ms interference scores and measured eating behaviour variables for negative and neutral groups, none of which were significant with α adjusted to .0125 (see Appendix 29 Tables 5a and 5b).

7.3.3. Possible Confounds and AB

Spearman's correlations between age, depression, BMI, baseline hunger and food Stroop word position 1 and 2 mean RTs for those in negative and neutral groups, revealed no significant correlations (see Tables 1a and 1b in Appendix 29). Additionally, none of the possible confounds were significantly correlated with neutral Stroop word position 1 and 2 RTs amongst participants in either mood group when *n*=77 (see Appendix 29 Table 4). However, with 11 participants removed baseline hunger was significantly negatively correlated with word position 1 RTs amongst participants in a negative mood (see Table 7.5).

Table 7.5: Correlations between neutral word position 1 and 2 response times and possible confounds in the negative and neutral conditions (*n*=66)

		Depression		Age		BMI		Baseline Hunger	
	Word Position	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)
Negative Mood	1	-.098	.601	-.052	.781	-.025	.896	-.455*	.01*
	2	-.002	.990	-.114	.541	-.064	.732	-.139	.455
Neutral Mood	1	.287	.099	-.204	.240	-.195	.261	-.004	.980
	2	.270	.123	-.211	.224	-.187	.283	-.003	.989

*p<.0125

A series of Spearman's correlations were also conducted between 200/2000ms interference scores and possible confounds (see Tables 7.6a and 7.6b). There was a significant positive correlation between age and 200ms interference amongst participants in a neutral mood (both with and without 11 participants excluded).

Table 7.6a: Correlations between interference scores and possible confounds for those in negative and neutral conditions (*n*=77)

		Depression		Age		BMI		Baseline Hunger	
	Task	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)
Negative Mood	200ms	-.074	.658	-.150	.369	.203	.222	.227	.170
	2000ms	-.052	.758	-.267	.105	.111	.508	.065	.699
Neutral Mood	200ms	-.296	.071	.492*	.001*	-.078	.636	-.272	.094
	2000ms	.182	.275	-.116	.482	-.161	.326	.238	.144

*p<.0125

Table 7.6b: Correlations between interference scores and possible confounds for those in negative and neutral conditions (*n*=66)

		Depression		Age		BMI		Baseline Hunger	
	Task	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)
Negative Mood	200ms	-.028	.882	-.152	.415	.290	.114	.212	.252
	2000ms	-.087	.643	-.216	.242	-.042	.824	.156	.402
Neutral Mood	200ms	-.392	.022	.460*	.005*	-.057	.746	-.220	.204
	2000ms	.191	.279	-.069	.692	-.129	.462	.230	.183

*p<.0125

7.3.4. Significant Predictors of AB

The variables which significantly correlated with (or approached significant correlations with) Stroop food word position 1 RTs amongst participants in the negative group (emotional eating and DFT) were then entered into a regression model (with position 1 RTs from participants in the negative group as the outcome). Stepwise regression (forward method) was deemed appropriate in order to find out the individual contribution of each predictor (DFT and emotional eating) and because there was no reason to expect one predictor would be greater than the other. In the first model DFT was included, and R^2 was .259 indicating that DFT accounted for 25.9% of the variance in RT. This model was highly significant: $F(1,36)=12.581$, $p=.001$. A second model emerged and this added the predictor emotional eating. In this model R^2 increased to .338 which indicates that emotional eating accounted for an additional 7.9% of the variance in RT. This model was highly significant: $F(2,35)=8.92$, $p=.001$ (see Table 7.7). With 11 participants removed only DFT was included in the model and R^2 was .245 indicating that DFT accounted for 24.5% of the variance in RT. This model was highly significant: $F(1,30)=9.42$, $p=.005$ (see Appendix 27).

Table 7.7: Multiple regression analysis with word position 1 response times in the negative group as the outcome (*n*=77)

		B	*SE B*	*β*
Step 1	Constant	722.51	23.76	
	Drive for thinness	9.68	2.73	.509*
Step 2	Constant	604.16	62.36	
	Drive for Thinness	8.86	2.65	.466*
	Emotional Eating	46.2	22.66	.284*

Note: $R^2=.259$ for Step 1; $\Delta R^2=.338$ for Step 2 ($p=.001$). $^*p<.05$

As only external eating scores were significantly correlated with food Stroop word position 1 RTs amongst participants in the neutral mood group, a simple linear regression was conducted with RT as the outcome and external eating as the predictor (see Appendix 28 for testing of assumptions). This model was significant: $F(1,38)=8.718$, $p=.005$ with external eating accounting for 19.1% of the variance in RT ($R^2=.191$: see Table 7.8).

Table 7.8: Simple linear regression analysis with word position 1 response times in the neutral group as the outcome

	B	*SE B*	*β*
Constant	397.67	131.16	
External eating	118.44	40.12	.437*

Note: R^2=.191 (p=.005). *p<.01

7.4. Discussion

The aim of the present investigation was to explore the effect of restrained and emotional eating and negative mood on food AB. Firstly, it was hypothesised that highly restrained eaters in a negative mood would display a significantly greater AB towards and/or slowed disengagement from food, than those in a neutral mood (and with lower restraint scores). Restrained eating was not significantly related to AB towards food in the Stroop task, corresponding with studies one and two and adding to a growing body of literature regarding the relation between restraint and AB where findings are ambiguous (e.g. Ahern et al., 2010; Black et al., 1997; Sackville et al., 1998; Veenstra et al., 2010). However, restrained eating scores were significantly correlated with the time taken to disengage from food in the Stroop task, amongst participants in a negative mood only. This indicates that there is some combined effect of negative mood and restrained eating style on the processing of food stimuli. However, restrained eating scores were not significantly related to food AB in the dot probe tasks (corresponding with studies two and three). These null effects correspond with a number of investigations using a dot probe task which call into question the relation between dietary restraint and AB for food (e.g. Ahern et al., 2010; Boon et al., 2000).

The second hypothesis was that highly emotional eaters in a negative mood would display a significantly greater food AB than those in a neutral mood, and with lower emotional eating scores. As expected, emotional eating significantly influenced responding in the food Stroop, with higher scores associated with slower responding throughout the task. Furthermore, emotional eating was significantly positively correlated with AB towards the food words, but only amongst participants in the negative mood group. Therefore, it seems that emotional eaters display an AB for food only when in a negative mood (potentially explaining why emotional eating was not found to be related to AB in study two). Emotional eating was also found to significantly influence responding in the dot probe task, with higher scores associated with slower responding (i.e. increased global distraction). However, highly emotional eaters were delayed in responding in the dot probe task regardless of mood state.

Regardless of restrained and emotional eating scores, participants were found to have a significant AB towards food words in the Stroop task (and this was significantly greater than in the neutral Stroop therefore eliminating the previously observed categorical effect). However, they displayed no difficulty in disengaging from food words. These findings directly contrast with study one (and the initial pilot study) where all participants were slow to disengage from food words but did not have a significant AB towards them. This finding also differs from study two where no evidence of AB towards or slowed disengagement from food words was found. These differences may be due to the present experiment employing a further modified version of the Stroop task based on participant ratings from a large sample of females. In addition, given that accuracy of RT measurement was increased due to the use of a response box, compared to keyboard response in earlier studies, one can be more confident in the accuracy of the present results.

Contrasting with the significant AB for food found across all participants with the Stroop task, the dot probe task showed no evidence of AB towards, slowed disengagement from or attentional avoidance of food. Contrary to the prediction that those in a negative mood would display a greater food AB than those in a neutral mood (as found by Hepworth et al., 2010), the opposite pattern was observed (although non-significant). This is perhaps surprising given the number of methodological similarities between Hepworth and colleagues' and the present study: samples were comparable in size and inclusion criteria; the assessment of the success of the mood induction was the same; and a combination of music and autobiographical recall was used to induce negative mood in both experiments. However, contrasting findings could be due to a few, potentially influential, methodological differences. Firstly, Hepworth et al. (2010) included both healthy (e.g. salad) and unhealthy (e.g. chocolate cake) food images in their dot probe task. As stated previously (see Chapter Two, Subsection 2.4.1) individuals attentionally process healthy and unhealthy foods differently (e.g. Shafran et al., 2007; 2008). Given that emotional and restrained eaters tend to over-consume high-calorie foods, it would be expected that only such stimuli will consistently 'grab' attention. Therefore, the present task is likely to be more reliable than that employed by Hepworth et al. (2010). The dot probe tasks also differed in the presentation times of picture pairs (200ms/2000ms versus 500ms/2000ms), and given that the presentation time of 500ms is thought to represent either orientation or slowed disengagement, a presentation time of 200ms is often preferred as a measure of early attention processing (e.g. Field et al., 2004).

The third hypothesis was that other trait eating behaviours (external eating, DFT, bulimic symptoms and BD) would be significantly associated with food AB. This was partially supported. Firstly, higher DFT scores were significantly associated with greater AB for food in the Stroop task, but only amongst those in the negative mood condition. DFT was the greatest predictor of AB towards food amongst those in the negative condition, explaining 25.9% of the variance. These results extend the findings of Perpina et al. (1993) who found that higher DFT scores were related to slower colour-naming in a food Stroop. The present study has provided evidence that such an effect is more pronounced amongst high scorers in a negative mood. As stated previously, non-clinical females characterised by various eating traits (e.g. restrained eating) are found to increase intake of food when in a negative mood (e.g. Epel et al., 2001; Heatherton et al., 1991) and it was posited by the present researchers that negative mood would also lead to an AB for food in such individuals. It is possible that food cues become more salient to those with a high DFT when in a negative mood, leading to greater AB. Negative mood has been found to increase body-size perception in eating disorder (ED) patients (e.g. Polivy & Herman, 2002), which may also be the case for non-clinical females with a high DFT: negative mood may elevate concerns about body size and therefore food cues may become more meaningful and be processed preferentially. However, this slowed colour-naming by those with a high DFT in the negative mood condition was not specific to the food words as the same was found for household object colour-naming in such individuals. Therefore perhaps those with a high DFT in a negative mood were globally slowed down in their responding in the present experiment.

Further in support of the third hypothesis, higher external eating scores were significantly associated with greater AB towards and slower disengagement from food in the Stroop task. It is of interest that this occurred only amongst participants in the neutral mood group. In addition, external eating was the only significant predictor of food colour-naming times amongst participants in the neutral condition, explaining 19.1% of the variance in RT. This is perhaps surprising given that it has previously been posited that stress reduces internal cues to hunger and draws attention to external cues (e.g. Heatherton & Baumeister, 1991), which may lead to increased intake in external eaters under periods of stress (e.g. Conner, Fitter, & Fletcher, 1999; Newman et al., 2008). Indeed, it has been found that high external eaters (compared to low external eaters) increase snack intake during periods of stress (e.g. Conner et al., 1999), but on the other hand Fay and Finlayson (2011) failed to find a significant correlation between external eating scores and negative mood-induced intake. Furthermore, Newman et al. (2008) found that stress did not increase AB for food in external eaters. In addition, Van Strien, Schippers and Cox (1995) found that only emotional eating was significantly related to emotional problems, whilst no relationship between external eating and emotional problems emerged. There is clearly some discrepancy concerning whether negative mood will influence intake amongst external eaters. There is little research exploring whether external eaters increase intake during negative mood states (and no other published research has explored whether negative mood enhances AB for food in external eaters), therefore further investigation is needed before clear conclusions can be made. The present research does suggest, however, that external eaters are more likely to display an AB for food when in a neutral mood. However, a general slowing down of responding may have occurred in external eaters in a neutral mood (as there was also some evidence of slowed colour-naming of household object words). In addition, external eating scores were not significantly related to bias scores in the dot probe task.

In addition to exploring the relations between eating behaviours and food AB, it was considered important to check if any possible confounds were related to AB. Given that age was found to significantly negatively correlate with interference in the 2000ms dot probe task in study three, it was thought that age could also influence responding when including a sample with a larger age range. Indeed, there was a significant positive correlation between age and interference in the 200ms dot probe task amongst participants in a neutral mood. In addition, a further confounding variable that emerged was that of baseline hunger. Hunger has previously been found to be significantly related with AB for food (e.g. Mogg et al., 1998) and so was acknowledged as a potential confound in the current study. However, in the present experiment, baseline hunger was significantly negatively correlated with colour-naming of household object words amongst participants in the negative mood group. This suggests that the less hungry an individual in the negative mood group was, the slower their colour-naming of household object words. This appears to be an arbitrary finding, although a possible explanation (which must be approached with caution) is that those who had lower levels of hunger may have been less likely to attend to food stimuli and more likely to attend to neutral stimuli given their lack of drive for food. However, given that there was no evidence of increased attention towards food amongst those who reported greater levels of baseline hunger, it is perhaps not likely that this was the case.

A few limitations of the present research should be acknowledged. Firstly, the effects of the menstrual cycle on mood were not accounted for and this is something that has been controlled for in previous mood induction studies (e.g. Hernandez et al., 2003). In addition, despite having a greater range of ages (18-41) than in study three (18-25), the spread of ages was uneven with 60 out of 77 participants aged 18-21 (therefore the age data were largely skewed). Despite these limitations, the present study has made a number of methodological improvements to earlier studies, not only within the present thesis but also across the AB and mood induction literature.

In summary, regardless of restrained and emotional eating, a strong AB towards food words, but no evidence of slowed disengagement, was demonstrated using a modified version of the Stroop task. A modified Stroop task was more sensitive at detecting AB for food than a modified dot probe task (even with improvements to the dot probe task e.g. based on ratings). Contrary to hypotheses, highly restrained eaters did not display increased AB towards food, even when in a negative mood. However, higher restraint scores were significantly associated with slower disengagement amongst those in a negative mood. In further support of the hypotheses, highly emotional eaters in a negative mood displayed increased AB towards and slowed disengagement from food. Furthermore, those with a high DFT in a negative mood displayed an AB towards food words. This suggests that a negative mood state increases the salience of food to individuals characterised by high levels of restraint, emotional eating and DFT, resulting in biased attention processing of food. On the other hand, those with high levels of external eating were biased towards food words when in a neutral mood and not when in a negative mood. These findings demonstrate that ABs for food can be found in women characterised by non-clinical eating traits, when manipulating mood state. The inconsistent results in earlier research studies may have been due to not accounting for the influence of negative mood on AB.

The present findings could have important implications for developing programmes to prevent EDs amongst ‘at-risk’ females. As discussed throughout the present thesis, AB for disorder-relevant stimuli is believed to maintain and exacerbate problematic eating behaviours (e.g. Vitousek & Hollon, 1990). However, as of yet, there is no published research demonstrating a direct link between AB and actual eating behaviour amongst non-clinical females characterised by eating-related concerns. In addition, findings from research exploring whether such females even display this AB are largely ambiguous. One of the overarching themes of the present thesis is to explore the usefulness of an AT programme for females 'at-risk' of developing EDs (e.g. restrained and emotional eaters). The first step in assessing this is to demonstrate that these females actually display this bias. The present research study has shown that highly emotional eaters, highly restrained eaters, and those with a high DFT do indeed display an AB for food, but only when in a negative mood. Therefore, according to cognitive theories, AT for highly emotional eaters (where AB for food is replaced with attentional avoidance of food) would lead to a reduction in overeating in response to negative mood. However, this will only be confirmed (or contested) in part two, where the association between AB and actual eating behaviour will be explored. In addition, through emphasising the importance of negative mood in increasing AB amongst restrained eaters, emotional eaters, and those with a high DFT, potential prevention techniques could incorporate ways to train 'at-risk' females how to effectively cope with negative mood when attention is drawn to food stimuli (and theoretically resulting in increased eating). However, before this can be concluded, the widely hypothesised causal relationship between AB for food and eating behaviour needs to be explored.

Chapter Eight: Study Four Part Two
Does biased attention processing of food mediate the negative mood-eating relationship?

8.1. Introduction

The aim of the second part of study four was to extend the findings of part one by exploring the effect of trait eating behaviours, negative mood and attentional bias (AB) for food, on subjective appetite and actual consumption of high-fat snacks. Study four (part one) of the present thesis failed to demonstrate any significant cognitive avoidance, AB towards, or slowed disengagement from food in restrained or unrestrained eaters using a pictorial dot probe task. In study four (part one), however, higher levels of emotional eating were significantly associated with slower responding in the dot probe task (regardless of current mood state). External eating and eating psychopathology (drive for thinness, bulimia, body dissatisfaction), however, were not significantly related to performance on the dot probe task in this study. Using a modified Stroop task, in study four (part one) all participants displayed an AB towards food words but did not struggle to disengage attention (and restraint was not related to performance). Furthermore in study four (part one) higher emotional eating scores were significantly associated with slower responding in the food Stroop. In addition, there was a significant correlation between emotional eating and food word colour-naming times (representing both orientation bias and slowed disengagement) amongst participants in a negative mood.

In study four (part one) external eating scores were significantly positively correlated with food Stroop colour-naming times, but only amongst participants in a neutral mood. In fact, external eating scores were found to be the greatest predictor of food response times (RTs) amongst participants in the neutral mood condition. Additionally, in this study drive for thinness (DFT) was significantly positively correlated with food colour-naming times amongst those in a negative mood. DFT was also the greatest predictor of food colour-naming times amongst participants in the negative mood group.

In addition to the relationship between mood state and biased attentional processing of food (as suggested by the findings reported in study four part one), there is extensive evidence that mood influences food intake. Both females with a clinical diagnosis of an eating disorder (ED) and non-clinical females characterised by eating-related concerns increase eating in response to stress/negative mood. For example, naturalistic research demonstrates that negative mood precedes binge eating episodes in bulimic patients (e.g. Davis et al., 1988; Davis et al., 1985; Johnson & Larson, 1982) particularly in the consumption of snacks and desserts (Davis et al., 1988); restrained eaters overeat in response to stress caused by high workload (Wardle, Steptoe, Oliver, & Lipsey, 2000); and during periods of stress/negative mood females increase intake of snack foods such as chocolate and ice cream (e.g. Oliver & Wardle, 1999; Wansink, Cheney, & Chan, 2003). Restrained eaters also report significant weight gain after the onset of depression (Polivy & Herman, 1976) and increase intake in response to negative emotion or stress induced in the lab (e.g. Baucom & Aiken, 1981; Cools et al., 1992; Epel et al., 2001; Frost et al., 1982; Heatherton et al., 1991; Mitchell & Epstein; 1996; Polivy et al., 1994; Ruderman, 1985; Rutledge & Linden, 1998; Schotte et al., 1990; Polivy & Herman, 1999; Wallis & Hetherington, 2004).

As discussed in Chapter Seven, Hepworth et al. (2010) found that induced negative mood increased AB towards, and slowed the ability to disengage from food in a dot probe task. Furthermore, AB correlated with emotional, external and restrained eating scores on the Dutch Eating Behaviour Questionnaire (DEBQ; Van Strien, Fijters, Bergers, & Defares, 1986), and negative mood increased subjective appetite. The authors concluded that a negative mood state increases the reward value of food cues. In turn, this is thought to increase motivation to eat, shown through an increase in subjective appetite and the capture of attention by food cues. This finding suggests that AB may act as a mediating factor in the negative mood-eating relationship. However, the influence of negative mood (and biased attention) on actual food intake was not assessed in Hepworth and colleagues' investigation.

In recent years, a body of literature has dissociated between two specific aspects of subjective appetite: 'liking' and 'wanting'. 'Liking' refers to feelings of subjective pleasure/palatability (i.e. an hedonic/affective component of appetite: e.g. Berridge, Robinson & Aldridge, 2009; Finlayson, King & Blundell, 2007; Havermans, Janssen, Giesen, Roefs & Jansen, 2009) and 'wanting' refers to incentive motivation that promotes approach towards and consumption of rewards (i.e. a drive process/directed impulse towards a targeted food stimulus: e.g. Berridge et al., 2009; Finlayson et al., 2007; Havermans et al., 2009). As Berridge et al. (2009) point out, a brain 'likes' the rewards that it 'wants', but sometimes it may just 'want' them. Indeed, research has firmly established that 'liking' and 'wanting' are two distinct components (e.g. Berridge, 1996; Berridge, 2004; Berridge & Robinson, 2003; Finlayson et al., 2007) and that they can be objectively measured and dissociated (e.g. Finlayson et al., 2007). Berridge (1996, 2007) argues that when assessing eating behaviour one must differentiate between food liking and wanting. One such study that has assessed the influence of induced negative mood (through autobiographical memory retrieval) on food wanting (in addition to actual food consumption) found that participants had both a greater explicit wanting of, and ate significantly more popcorn after negative mood induction than after a neutral mood induction (Fay & Finlayson, 2011). In addition, there were significant correlations between intake in the negative mood condition and restrained and emotional eating, but not external eating. Intake in the negative mood group was the greatest in a high restraint/high disinhibition sub-group of participants who also had a stronger explicit wanting of the test food. The high restraint/high disinhibition group also consumed significantly more calories than the low restraint/low disinhibition group. This evidence, therefore, also suggests that AB towards and slowed disengagement from food could mediate the negative-mood eating relationship.

The aim of the second part of study four was to explore the effect of trait eating behaviours, negative mood and biased attention processing of food, on subjective appetite and consumption of sweet and savoury high-fat snacks. As already described, there is evidence that negative mood leads to a greater desire to eat amongst highly restrained and emotional eaters, and that those high in restraint, emotional eating and DFT display biased processing of food when in a negative mood. Therefore it was hypothesised that participants in the negative mood group (particularly those high in restraint, emotional eating and DFT) would have a significantly greater desire to eat following mood induction than those in the neutral mood group. It was also hypothesised that those in the negative mood group (particularly those high in restraint, emotional eating and DFT) would report significantly greater liking and wanting of chocolate and crisps than those in the neutral mood group (at a post-mood induction assessment). In addition, it was hypothesised that greater orientation bias/slowed disengagement would be significantly associated with greater wanting of chocolate and crisps. Based on evidence that restrained and emotional eaters in a negative mood increase intake of snack foods, it was also hypothesised that participants in a negative mood (particularly those high in restraint, emotional eating and DFT) would consume significantly more snack foods than those in the neutral mood group. It was additionally hypothesised that greater orientation bias/slowed disengagement (in both Stroop and dot probe tasks) would be significantly associated with greater food intake amongst participants in the negative condition. It was hypothesised that negative mood would predict AB towards and slowed disengagement from food in those high on restraint, emotional eating and DFT (as explored in part one) which, in turn, would predict greater consumption of high-fat snacks. Therefore, it was hypothesised that AB would mediate the negative mood-eating relationship.

8.2. Method

8.2.1. Participants

Seventy-seven female participants were recruited by posters, email, word-of-mouth, a research participation scheme at Loughborough University, and through the Loughborough University Community Newsletter. The study was approved by the Loughborough University Ethical Advisory Committee. The inclusion criteria were that participants were female, aged between 18 and 45, not currently receiving treatment for an ED or a mood disorder, not colour blind, spoke English as their first language (or they were highly proficient in the English language), and had no allergy for the study foods. Participants had a mean age of 21.06 (*SD*=5.11) and a mean BMI of 22.68 (*SD*=3.42). 38 participants were allocated to the negative condition, and 39 were allocated to the neutral condition (see Chapter Seven Subsection 7.2.1 Table 7.1 for group characteristics). As expected, groups did not differ significantly in age, BMI, any measured eating behaviour, depression, or baseline hunger and sadness. Mood induction was found to be highly successful, as those in the negative condition increased in sadness significantly more than those in the neutral condition (p<.001).

8.2.2. Measures

8.2.2.1. Trait Measures of Mood and Appetite

8.2.2.1.1. Dutch Eating Behaviour Questionnaire (DEBQ: Van Strien, Frijters, Bergers, & Defares, 1986)

The restrained eating subscale measures the tendency for an individual to restrict their food intake in order to control their body weight (Herman & Mack, 1975), the emotional eating subscale assesses sensitivity to eating in response to negative mood states, and the external eating subscale assesses the tendency to overeat in response to external cues. Higher scores on these subscales reflect higher levels of each trait. All three subscales have high internal consistency and factorial validity (e.g. Braet & van Strien, 1997; Van Strien et al., 1986). See Chapter Two Subsection 2.8.1 for further information.

8.2.2.1.2. Eating Disorder Inventory-2 (EDI-2: Garner, 1991)

The DFT subscale; Bulimia Subscale; and Body Dissatisfaction (BD) subscale were administered. Higher scores on these subscales reflect greater incidence of these traits. These subscales have high test-retest reliability (e.g. Wear & Pratz, 2006) and strong reliability and stability (e.g. McCarthy et al., 2002). See Chapter Two Subsection 2.8.2 for further information.

8.2.2.1.3. Beck Depression Inventory II (BDI-II: Beck, Steer, & Brown, 1996)

The BDI-II measures affective, cognitive and somatic symptoms of depression and is found to have robust psychometric properties with strong construct validity, high test-retest reliability and internal consistency (e.g. Beck, Steer, Ball, & Ranieri, 1996; Beck, Steer & Brown, 1996: see Chapter Two Subsection 2.9.3 for further information).

8.2.2.2. State Measures of Mood and Appetite

8.2.2.2.1. The Positive and Negative Affect Scale (PANAS: Watson, Clark, & Tellegen, 1988)

The PANAS requires participants to indicate the extent to which they have experienced specified mood states (concerning either positive or negative affect) in a specified time frame. The PANAS has high internal consistency and reliability (e.g. Crawford & Henry, 2004; Watson et al., 1988: see Chapter Two Subsection 2.9.2 for further details).

8.2.2.2.2. Visual Analogue Scales (VAS)

Mood was measured using sad, happy and anxious 100mm VAS with participants required to indicate how they were feeling on each mood state right now, ranging from '*not at all*' to '*extremely*'. Mood VAS were given at baseline, post-mood induction, post-computer tasks, and post-taste test. Hunger, fullness and desire to eat were also assessed using 100m VAS at three time points (baseline, post mood induction and tasks, and post eating). VAS measures of liking (subjective feelings of pleasure) and wanting (subjective feelings of intent or desire) for the study foods (chocolate and crisps) were also administered following the mood induction. These were based on Finlayson, King and Blundell's (2008) VAS in which participants rate from '*not at all*' to '*extremely*' the following statements for each study food: "how pleasant would it be to experience a mouthful of chocolate/crisps right now?" (a measure of liking) and "how much do you want some chocolate/crisps right now?" (a measure of wanting). During the 'taste test', described in the procedure, participants were also provided with VAS measures of the pleasantness, sweetness/saltiness of each of the study foods.

8.2.2.2.3. Food Recall Diary

Participants were instructed to have a normal meal (either breakfast or lunch depending on the time of the lab session between 12 and 5) two to three hours prior to attending the lab and drink only water following this. To assess adherence to this, participants completed a food recall diary at the start of the lab session. Participants recorded all food and drink that they had consumed that day, the time it was consumed and how much they had consumed. Such recall has been found to compare well with weighed records of intake (e.g. Bingham et al., 1994).

8.2.2.3. Measures of AB

8.2.2.3.1. Stroop Task

For a full list of words included in the present Stroop task see Appendix 5. Participants completed 'Food' and 'Neutral' (household object) conditions of the Stroop task, with the order counterbalanced across participants. The pattern of words followed sequences of seven throughout, with the first in the sequence being the target word, followed by six neutral words (for a full description of the task see Chapter Seven Subsection 7.2.2.7). Errors were removed in addition to response latencies above or below two standard deviations (SDs) away from the mean for each individual.

8.2.2.3.2. Dot Probe Tasks

Two conditions of the dot probe task were presented to participants: one condition where all food/neutral pictures pairs were presented for 200ms and another where all picture pairs were presented for 2000ms. Fifteen images were repeated eight times in each condition, with each picture appearing four times on the left and four times on the right, and four times in a congruent trial (the probe appearing in the same location as the food picture), and four times in an incongruent trial (the probe appearing in the same location as the neutral picture). For a full description of the task see Chapter Five Subsection 5.2.2.9 and Chapter Seven Subsection 7.2.2.8. Errors were removed in addition to responses below 200ms or above 2000ms. Additionally, response latencies above or below two SDs away from the mean for each individual were removed.

8.2.2.4. Mood Induction Procedure

In the lab session participants in the negative mood condition were given the following instructions: “Please think about one or more recent unhappy memories of a personal event in your life in which you felt sad. Please describe the event in detail and your reactions to it in the box below. Try to concentrate on your feelings at the time associated with the event/s. If you can’t write for five minutes about one memory then please think of and write about another memory which has the same emotional significance.” Participants in the neutral condition were given the following instructions: “Please think about one or more memories of ordinary recent events in which you were in a neutral non-emotional mood e.g. taking a routine journey or carrying out a daily routine. Please describe the event/s in detail in the box below. If you can’t write for five minutes about one memory then please think of and write about another emotionally neutral memory.” Whilst writing down their memories participants in the negative condition were played five minutes of Barber’s Adagio for Strings via headphones. Participants in the neutral condition were alternatively played five minutes of music consisting of Chopin’s Waltzes numbers 11 and 12 played consecutively via headphones. Before and after the mood induction mood VAS and the PANAS were administered. This was to ensure mood induction was successful. In the present study an increase in VAS rating of “sad” by 15mm or more and/or a decrease in VAS rating of “happy” was taken as a successful mood induction, following e.g. Richell and Anderson (2004). Eleven participants did not meet these criteria; therefore analyses were conducted with and without these participants.[6] For a full description of the mood induction procedure see Chapter Seven Subsection 7.2.2.9.

8.2.3. Procedure

For a detailed description of the procedure see Chapter Seven Subsection 7.2.3. Participants were initially emailed an information sheet/consent form, a health screen questionnaire, the DEBQ and the BDI-II. Participants were allocated to either a negative or a neutral mood induction condition. At the start of the lab session participants completed a food diary, baseline appetite and mood VAS and the PANAS. Following this, participants completed the mood induction and then further mood VAS and the PANAS were administered. Participants then completed the Stroop and dot probe tasks, the order of which was counterbalanced across participants. Following each task, a booster mood induction was administered. After this, mood VAS, PANAS, hunger, desire to eat and fullness ratings were taken, followed by measures of liking and wanting of crisps and chocolate.

The next part of the lab session was disguised as a 'taste test' where participants were asked to rate (in terms of pleasantness and sweetness/saltiness) two high-fat sweet snacks (Cadbury's chocolate finger biscuits, Cadbury's chocolate buttons) and two high-fat savoury snacks (McCoy's flame-grilled BBQ steak crisps, Original Pringles). 100g of chocolate buttons (525 kcal), 14 chocolate finger biscuits (approximately 75g: 420 kcal), 50g of McCoy's crisps (258.5 kcal) and 50g of Pringles (262 kcal) were presented to participants. Foods were presented in bowls on a tray with a glass of water. Participants were told that once they had completed their ratings they may eat as much as they like as the food can't be used with other participants due to sanitary concerns (following Shapiro & Anderson, 2005). The experimenter told participants they were leaving the lab for this part of the experiment and would return in 10 minutes (length of time following e.g. Fay & Finlayson, 2011; Herman & Mack, 1975; Shapiro & Anderson, 2005). On returning to the lab the experimenter administered mood and hunger ratings, followed by the EDI-2. If participants in the negative mood condition were still in a sad mood in the final mood rating they were played Delibe's Mazurka from Coppelia whilst being asked to recall a recent happy memory. A final mood VAS was then administered to ensure

[6] These participants were not removed at the start because of significantly reducing the sample size. Due to the complex analysis there was concern about losing power. However, it was also necessary to check whether these participants skewed the data at all.

mood had returned to baseline. Height and weight measurements were taken (upon obtaining permission) and participants were provided with a written and verbal debrief. Participants were informed of the contact details of the University Counselling Service in the event of any significant distress following the negative memory recall. Following departure of the participant, the experimenter weighed the bowls of food and calculated the amount eaten (in grams and kcal). See Figure 8.1 for an overview of the experimental procedure.

8.2.4. Data Analysis

RT and questionnaire data were non-normally distributed, therefore where available non-parametric tests were employed. The following describes how each hypothesis was tested:

1) In order to test the hypothesis that participants in the negative mood group (particularly those high in restraint, emotional eating and DFT) would have a significantly greater desire to eat following mood induction than those in a neutral mood, a 2 (mood condition: negative/neutral) x 3 (time point) mixed measure ANOVA was conducted with desire to eat VAS as the DV and restrained eating, emotional eating and DFT scores as covariates.

2) In order to test the hypothesis that participants in the negative mood group with higher scores on restraint, emotional eating and DFT would report significantly greater liking and wanting of chocolate and crisps than those with lower scores (with no such pattern expected in the neutral group), Spearman's correlations were conducted for negative and neutral groups between eating behaviours (restraint, emotional eating and DFT) and liking/wanting of chocolate/crisps: significant α set at .0167 to account for three correlations (three eating behaviours) in each mood group for each measure of subjective appetite.

3) In order to test the hypothesis that greater orientation bias/slowed disengagement would be significantly associated with greater wanting of chocolate/crisps, Spearman's correlations were conducted between measures of AB (Food Stroop word position 1 RT, Food Stroop word position 2 RT, dot probe 200ms interference score, dot probe 2000ms interference score) and wanting of chocolate and crisps. Significant α was set at .0125 to account for correlations at four measures of AB.

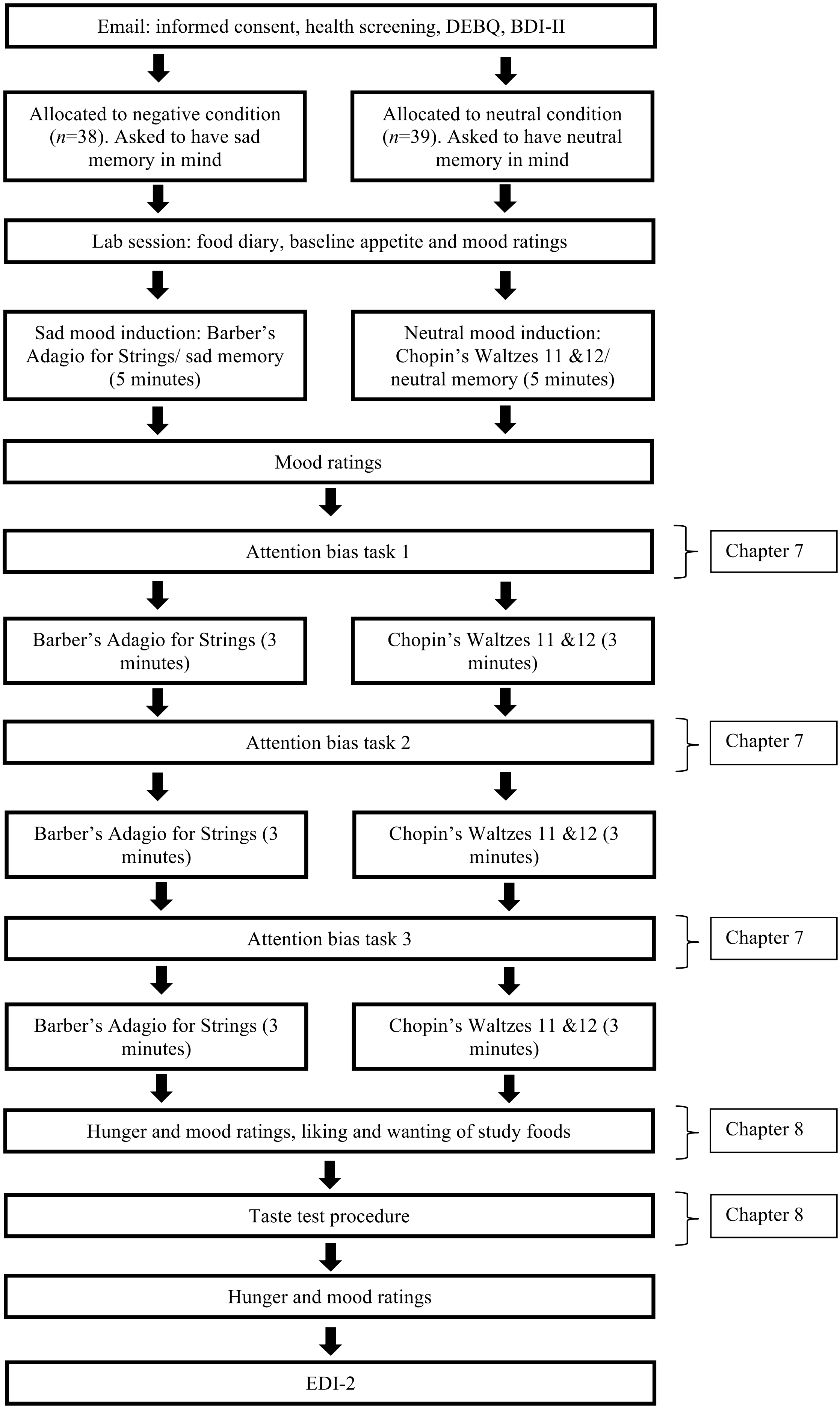

Figure 8.1: Overview of experimental procedure

4) In order to analyse the food intake data, a repeated measures one-way ANOVA with intake (kcal) as the DV and food type as the IV (chocolate buttons, chocolate fingers, Pringles, BBQ crisps) was conducted. This then informed whether intake data were analysed as a whole, or according to separate food items. Firstly, Mann Whitney *U* tests were used to compare mood groups in intake. Then, in order to test the hypothesis that participants in the negative mood group with higher scores on restraint, emotional eating and DFT would have greater food consumption than those with lower scores (with no such pattern expected in the neutral group), Spearman's correlations for negative and neutral groups between eating behaviours (restraint, emotional eating and DFT) and food intake were carried out.

5) In order to test the hypothesis that greater orientation bias/slowed disengagement would be significantly associated with greater food intake, Spearman's correlations were conducted between measures of AB (Food Stroop word position 1 RT, Food Stroop word position 2 RT, dot probe 200ms interference, dot probe 2000ms interference) and intake.

6) In order to test the hypothesis that AB would mediate the negative-mood eating relationship the following would need to be significant: 1) the correlation between the predictor (negative mood) and the outcome (food intake) as explored in the present chapter; 2) the correlation between the predictor (negative mood) and the mediator (AB) as explored in Chapter Seven; and 3) the correlation between the mediator (AB) and the outcome (food intake) as explored in the present chapter. If these associations are all significant then one assesses whether the predictor-outcome effect is less after controlling for the mediator (e.g. Baron & Kenny, 1986; Holmbeck, 2002).

All analyses were repeated with 11 participants removed who were either not successfully induced into a negative mood following negative mood induction (n=7) or who were not maintained at a neutral mood following the neutral mood induction (n=4).

8.3. Results

8.3.1. Negative Memories

The negative memories that were recalled by the 38 females in the negative condition in the present study were coded into one of seven categories: 1) isolation/loneliness (n=8); 2) a family member being ill (n=11); 3) relationship break-up (n=6); 4) trauma (n=1); 5) someone close divorcing (n=3); 6) death of someone close (n=6); and 7) other (n=3). Due to the small numbers in each of these categories it was not possible to carry out statistical analysis in order to compare these participant groups in terms of their food intake. However, through eyeballing the mean intake for participants in each of these categories, those who recalled the death of someone close to them consumed the most (533.36 kcal) and those who recalled the divorce of someone close to them consumed the least (321.04 kcal).

8.3.2. Subjective Appetite

In order to test the hypothesis that participants in the negative mood group (particularly those high in restraint, emotional eating and DFT) would have a significantly greater desire to eat following mood induction than those in the neutral group, a 2 (mood condition: negative/neutral) x 3 (time point) mixed measures ANOVA was conducted with desire to eat VAS as the DV and restrained eating, emotional eating and DFT scores as covariates. Mauchly's sphericity was violated so Greenhouse-Geisser correction was employed (although uncorrected degrees of freedom are reported). All main effects and interactions were non-significant except the main effect of emotional eating: $F(1,72)=5.282$, $p=.024$, $\eta p^2=.068$. In order to clarify this effect, Spearman's rho correlations between emotional eating scores and desire to eat ratings (at three time points) were carried out for each mood group. These revealed that emotional eating was significantly positively correlated with baseline desire to eat ($r_s=.362$, $p=.025$) and post-mood induction desire to eat ($r_s=.400$, $p=.013$) only amongst participants in the negative mood group. This indicates that emotional eaters in the negative mood group had an increased desire to eat post-mood induction (as expected), but additionally at baseline. It is worth noting back to the finding that those in the negative mood group had a (non-significantly) higher sadness rating at baseline than the neutral group (most likely due to expectations of sadness based on instructions to have a negative memory in mind prior to the mood induction: see Chapter Seven Subsection 7.2.1). This increased level of sadness may explain why desire to eat was also elevated at baseline for emotional eaters in this group.

When this analysis was repeated with 11 participants removed, an additional significant interaction between time and emotional eating emerged: $F(2,122)=4.411$, $p=.020$, $\eta p^2=.067$, and again, emotional eating was significantly positively correlated with baseline desire to eat ($r_{s=}.409$, $p=.022$) and post-mood induction desire to eat ($r_s=.486$, $p=.006$) in the negative group only.

In order to test the hypothesis that those in the negative mood group (particularly those high in restraint, emotional eating and DFT) would report significantly greater liking and wanting of chocolate and crisps than those in the neutral mood group, Spearman's correlations were conducted for negative and neutral groups between eating behaviours (restraint, emotional eating and DFT) and liking/wanting of chocolate/crisps: significant α set at .0167 to account for three correlations (three eating behaviours) in each mood group for each measure of subjective appetite. These revealed no significant correlations, although when 11 participants were removed from the analysis there was an approaching significant positive correlation between emotional eating and wanting of chocolate ($r_s=.375$, $p=.026$: see Appendix 30 Tables 1a and 1b).

In order to test the hypothesis that greater orientation bias towards/slowed disengagement from food would be associated with greater wanting of chocolate/crisps, Spearman's correlations were conducted between measures of AB (Food Stroop word position 1 RT, Food Stroop word position 2 RT, dot probe 200ms interference, dot probe 2000ms interference) and VAS measures of wanting of chocolate and crisps. These revealed no significant correlations with significant α set at .0125 to account for correlations at four measures of AB (see Appendix 30 Tables 2a and 2b).

8.3.3. Food Intake

Prior to the main food intake analysis a repeated measures one-way ANOVA with intake (kcal) as the DV and food type as the IV (chocolate buttons, chocolate fingers, Pringles, BBQ crisps) was conducted. Sphericity was violated so Greenhouse-Geisser correction was employed (although uncorrected degrees of freedom are reported). There was a significant main effect of food type: $F(3,228)=17.741$, $p<.001$,

ηp^2=.189. Bonferroni corrected pairwise comparisons revealed that intake of the chocolate buttons and the chocolate fingers did not significantly differ (p=.104). In addition, intake of the Pringles and the BBQ crisps did not significantly differ (p=1.00). However, intake of chocolate buttons and chocolate fingers was significantly greater than intake of both Pringles and BBQ crisps (all p<.01). Therefore, in the following analyses food types were grouped into sweet (chocolate buttons and chocolate fingers) and savoury (Pringles and BBQ crisps) items. Mann Whitney *U* tests were firstly conducted to assess if participants in the negative and neutral mood groups differed significantly in their intake of sweet and savoury foods. These revealed no significant differences with alpha set at .05 (see Appendix 30 Tables 3a and 3b).

In order to test the hypothesis that participants in the negative mood group with higher scores on restraint, emotional eating and DFT would have significantly greater food consumption than those with lower scores (with no such pattern expected in the neutral group), Spearman's correlations for negative and neutral groups between eating behaviours (restraint, emotional eating and DFT) and food intake (sweet and savoury foods) were carried out. None of these correlations were significant (see Tables 8.1a and 8.1b) with alpha adjusted to .025 (to account for two correlations: sweet and savoury foods).

Table 8.1a: Correlations between food intake and eating behaviours for each mood group (n=77)

		Restraint		Emotional Eating		DFT	
	Food Type	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)
Negative Mood	Sweet Intake	-.099	.553	.148	.374	.142	.397
	Savoury Intake	.145	.385	.025	.883	.067	.668
Neutral Mood	Sweet Intake	-.113	.492	.081	.625	-.166	.312
	Savoury Intake	-.092	.576	.191	.245	.1	.545

*p<.025

Table 8.1b: Correlations between food intake and eating behaviours for each mood group (*n*=66)

		Restraint		Emotional Eating		DFT	
	Food Type	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)
Negative Mood	Sweet Intake	-.001	.994	.220	.234	.247	.181
	Savoury Intake	.233	.203	.077	.68	.105	.573
Neutral Mood	Sweet Intake	-.102	.561	.162	.352	-.213	.22
	Savoury Intake	-.096	.585	.266	.123	.122	.484

**p*<.025

In order to test the hypothesis that greater orientation bias/slowed disengagement would be associated with greater food intake, Spearman's correlations were conducted between measures of AB (Food Stroop word position 1 RT, Food Stroop word position 2 RT, dot probe 200ms interference, dot probe 2000ms interference) and food intake (sweet and savoury foods). These were conducted separately for negative and neutral mood groups. None were significantly correlated with alpha adjusted to .025 (to account for correlations for two food types: see Tables 8.2a and 8.2b).

Table 8.2a: Correlations for negative and neutral mood groups between food intake and measures of AB (*n*=77)

		Food Stroop Word Position 1		Food Stroop Word Position 2		Dot Probe 200ms Interference		Dot Probe 2000ms Interference	
	Food Type	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Spearman Correlation	Sig. (2-tailed)	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)
Negative Mood	Sweet Intake	-.05	.768	.039	.815	.035	.833	.128	.445
	Savoury Intake	-.18	.28	-.127	.448	-.052	.756	-.086	.609
Neutral Mood	Sweet Intake	.037	.821	.077	.64	.044	.789	.19	.246
	Savoury Intake	.061	.711	-.013	.939	-.035	.83	.189	.25

**p*<.025

Table 8.2b: Correlations for negative and neutral mood groups between food intake and measures of AB (*n*=66)

		Food Stroop Word Position 1		Food Stroop Word Position 2		Dot Probe 200ms Interference		Dot Probe 2000ms Interference	
	Food Type	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Spearman Correlation	Sig. (2-tailed)	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)
Negative Mood	Sweet Intake	-.009	.962	-.024	.899	.03	.873	.179	.334
	Savoury Intake	-.201	.279	-.153	.411	-.018	.923	-.035	.85
Neutral Mood	Sweet Intake	.04	.819	.087	.618	-.014	.938	.139	.425
	Savoury Intake	.075	.669	.013	.94	-.106	.545	.124	.48

*p<.025

8.3.4. Mediation Analysis

It was hypothesised that AB would mediate the negative mood-eating relationship. A mediator is defined as a variable that serves to explain the process by which a predictor significantly affects an outcome. To test for mediation the following must be significant: 1) the association between the predictor (negative mood) and the outcome (food intake); 2) the association between the predictor (negative mood) and the mediator (AB); and 3) the association between the mediator (AB) and the outcome (food intake): see Figure 8.2. If these associations are all significant then one assesses whether the predictor-outcome effect is less after controlling for the mediator (e.g. Baron & Kenny, 1986; Holmbeck, 2002). However, the conditions for mediation were not met.

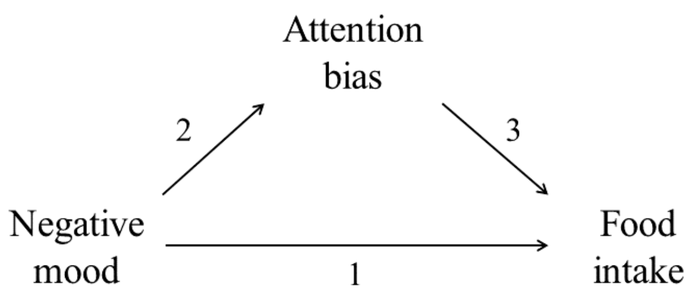

Figure 8.2: The mediation process

8.4. Discussion

The aim of the second part of study four was to explore the effect of trait eating behaviour, negative mood and AB for food on subjective appetite and consumption of sweet and savoury high-fat snacks. It was firstly hypothesised that participants characterised by high levels of emotional eating, restrained eating and DFT who had received a negative mood induction would have a significantly greater desire to eat than participants who had received a neutral mood induction. This was partially supported, as higher emotional eating scores in the negative mood group were significantly associated with greater desire to eat post-mood induction. This indicates that, as predicted, when emotional eaters are in a negative mood they have an increased desire to eat (supporting the findings of e.g. Fay & Finalyson, 2011; Hepworth et al., 2010). It was additionally hypothesised that amongst participants in the negative mood group higher scores on restraint, emotional eating and DFT would be significantly positively correlated with liking and wanting of chocolate and crisps (with no such pattern expected in the neutral group). However, this was not supported. Therefore, despite finding an increase in general desire to eat amongst highly emotional eaters in a negative mood, these individuals did not have an increased wanting of the chosen study foods (chocolate and crisps). This differs from Fay and Finlayson's (2011) finding that participants who had received a negative mood induction reported significantly greater wanting of food compared to those who had received a neutral mood induction (with the greatest food wanting found in highly restrained and emotional eaters). These discrepancies may be due to methodological differences between these investigations, for example Fay and Finlayson's (2011) sample consisted of 30 females (compared with 77 in the present experiment) who were not obese and who were not currently dieting. However, in the present sample there were three obese people (i.e. with a BMI >30) and 12 females who described themselves as currently dieting. Additionally, Fay and Finlayson (2011) only used one method of mood induction (three minutes of autobiographical memory retrieval) whereas a preferred method of combining mood induction techniques was used in the present study (i.e. autobiographical memory retrieval and music). Furthermore, different foods were used in these investigations: Fay and Finlayson (2011) used sweet popcorn only (as opposed to sweet and savoury snacks in the present investigation).

Given that DFT was significantly associated with increased AB towards food stimuli in the Stroop task (as reported in Chapter Seven) it was also hypothesised that those with a high DFT in a negative mood would show an increased wanting of the study foods (and an increased desire to eat). However, there was no evidence that high DFT scorers in a negative mood had increased liking/wanting of the study foods or an increased desire to eat. The same was also found with highly restrained eaters (contrasting with the findings of e.g. Fay & Finlayson, 2011). It was also hypothesised that amongst participants in the negative mood group higher scores on restraint, emotional eating and DFT would be significantly positively correlated with food consumption (with no such pattern expected in the neutral group). However, restraint, emotional eating and DFT scores (and mood state) were not significantly related to food intake. These findings contrast to Fay and Finlayson's (2011) investigation in which negative mood induction led to greater wanting of and consumption of a snack food (popcorn), particularly in a high restraint/high emotional eating subgroup of participants. This also differs to previous findings that restrained eaters overeat in response to negative mood induced in the lab (e.g. Epel et al., 2001; Polivy & Herman, 1999; Wallis & Hetherington, 2004).

The main hypothesis tested in this experiment was that biased attention processing of food would mediate the negative mood-eating relationship. However, this was not supported. Firstly, there was no significant relationship between the mediator (AB) and the outcome (food intake). It was hypothesised that greater orientation bias towards/slowed disengagement from food stimuli (in modified Stroop and dot probe tasks) would be associated with greater wanting of, and intake of the study foods (sweet and savoury high fat snacks). However, there were no significant associations between performance in the Stroop and dot probe tasks and wanting of/intake of sweet and savoury high fat snacks. Furthermore, despite finding there was a significant association between the predictor (negative mood) and the mediator (AB) amongst participants with a high DFT (as discussed in depth in Chapter Seven), there was no evidence of increased food intake amongst those with higher scores on DFT in a negative mood (hence indicating there was no significant relation between the predictor; negative mood, and the outcome; food intake). Surprisingly, despite demonstrating a significant relationship between the predictor (negative mood) and the mediator (AB for food) amongst highly emotional eaters (as discussed in Chapter Seven), there was no evidence of increased intake amongst higher scorers on emotional eating (hence failing to demonstrate a significant relationship between the predictor and the outcome). This was even in spite of higher scorers on emotional eating reporting an increased desire to eat following the negative mood induction. One possible reason for this finding concerns the measure of emotional eating used.

High scorers on the emotional eating subscale of the DEBQ may also be high scorers on the restrained eating subscale of the same measure. Given that the emotional eating subscale asks questions concerning desire to eat (as opposed to actual eating behaviour) when experiencing negative mood states, high scorers on this questionnaire may be successful restrainers even when experiencing an urge to overeat. Therefore, high scores on the emotional eating subscale may not correspond with actual eating behaviour, but merely a desire to overeat when in a negative mood (as found in the present experiment).

Some possible methodological limitations of the present investigation should be acknowledged. For example, it is possible that the foods selected for the 'taste test' were not appealing to participants (as indicated by a lack of increase in study food liking/wanting amongst participants in a negative mood, even when a general desire to eat increased). However, on assessment of 100mm VAS pleasantness ratings in the 'taste test', it can be seen that participants did rate the foods as appealing: chocolate buttons mean rating=81.34 (*SD*=14.75); chocolate fingers mean rating=75.97 (*SD*=15.93); BBQ crisps mean rating=62.6 (*SD*=25.58); Original Pringles mean rating=63.31 (*SD*=22.24). Although, when looking at individual participant ratings, four participants rated the chocolate buttons <50, two participants rated the chocolate fingers <50, 22 participants rated the BBQ crisps <50, and 21 participants rated the Pringles <50. Therefore, despite an overall liking of the study foods, some participants did not enjoy eating them and this would have likely reduced intake in such individuals. However, the food choices in the present investigation were based upon research evidence that females tend to overeat snack foods, in particular chocolate (e.g. Wansink et al., 2003; Oliver & Wardle, 1999), in response to negative mood. Similar choices of foods (i.e. chocolate and crisps) have also been used in a number of comparable investigations (e.g. Epel et al., 2001; Levine et al., 1997; Wallis & Hetherington, 2004; Zellner et al., 2006) therefore it seems unlikely that choice of foods is completely responsible for these null results. One further issue arising from the present investigation concerns the type of negative memories recalled by participants. It is possible that some memories (e.g. traumatic memories) may lead to a decrease in appetite, whereas other negative memories (e.g. relationship break-ups) may lead to an increase in appetite. Those who recalled the death of someone close to them consumed the most whereas those who recalled the divorce of someone close to them consumed the least (however, due to the small numbers in each of the categories of negative memory statistical analysis was not possible and so it is not possible to comment on whether types of memories recalled significantly influence food intake). Future research is needed with a larger sample of females in order to assess whether the type of negative memory recall will differentially influence food intake.

In summary, emotional eaters in a negative mood have been found to show a greater desire to eat than those in a neutral mood; however high scorers on emotional eating in a negative mood have not been found to consume more snacks than those with lower scores. Furthermore, despite an earlier finding (in study four part one) that those with a high DFT in a negative mood display an AB for food, in the present study there was no evidence of increased desire to eat or food intake in such individuals. In addition, AB for food has not been found to significantly relate to desire to eat or food intake. Therefore, the present findings indicate that AB does not mediate the negative mood-eating relationship amongst highly emotional or restrained eaters, or those with a high DFT. Despite many cognitive psychologists postulating that AB for food maintains and perhaps even exacerbates non-clinical eating behaviours and clinical eating disorder (ED) symptoms (e.g. Hollitt et al., 2010; Vitousek & Hollon, 1990; Williamson et al., 1999), the present findings challenge the idea that AB for food is associated with actual eating behaviours. These findings also challenge the usefulness of an AT programme in order to modify actual eating attitudes or behaviour. However, this is the first investigation to explore the relationship between AB for food and actual food intake and further research is needed in order to replicate these findings before the usefulness of AT can be ruled out. In addition, it is possible that AB for food may mediate a negative mood-eating relationship amongst clinical ED patients, which is yet to be explored.

Chapter Nine: Discussion

9.1. Introduction

The following chapter leads with a summary of the aims and hypotheses of the thesis, followed by a discussion of the key findings that emerged. These findings are discussed in relation to theory and previous research. The chapter ends with a discussion of the limitations and future research implications emerging from this research, followed by final conclusions.

9.2. Aims of the Thesis

The present thesis aimed to identify the optimum assessment of attentional bias (AB) for food through employing novel modifications of Stroop and dot probe tasks. Through employing carefully developed assessments of AB, the studies outlined within this thesis aimed to identify which trait eating behaviours in non-clinical females are associated with AB for food and interpersonal threat. In addition, the separate sub-components of AB (orientation towards and slowed disengagement from food), in addition to attentional avoidance, were assessed with the aim of teasing out which component is most prominent amongst these females. The influence of negative mood state on AB for food, and actual eating behaviour, was also explored. The overarching aim was to conduct a systematic experimental investigation of attention processing of food cues, in order to assess the need for an attention training (AT) program as a means of preventing the development of eating disorder (ED) symptoms amongst 'at-risk' females. This is an important area to explore given that AB for disorder-relevant stimuli is believed to maintain and exacerbate problematic eating behaviours (e.g. Vitousek & Hollon, 1990).

9.3. Findings of the Thesis

The findings from the present thesis will now be discussed in relation to the key psychological constructs that were explored.

9.3.1. Orientation Biases

In three studies there was consistently no evidence of orientation biases towards food and interpersonally threatening stimuli in modified Stroop tasks. However, one study revealed a significant orientation bias towards food (and this was not due to a categorical effect as this was not found in the neutral Stroop). All three experiments that employed a dot probe task with 200ms presentation to assess orientation consistently failed to find any evidence of an orientation bias towards food pictures.

It has previously been theorised that individuals characterised by eating-related concerns will display orientation biases for stimuli that are threatening to them, and that this maintains and exacerbates these concerns (e.g. Hollitt et al., 2010; Vitousek & Hollon, 1990). However, this was not found in the present thesis. Even when an orientation bias towards food stimuli was found in study four (part one) this was found across all participants. Furthermore, this orientation bias was only found in follow-up analyses (Bonferroni comparisons) and the word position main effect was actually non-significant with a small effect size (ηp^2=.005). The failure to find any evidence of an orientation bias in three studies stands in contrast to a body of findings that have found that individuals high in eating-related concerns have orientation biases towards food using both Stroop (e.g. EDs: Ben-Tovim et al., 1989; Perpina et al., 1993; High Restraint: Franics et al., 1997; Tapper et al., 2008) and dot probe tasks (e.g. EDs: Shafran et al., 2007; High Restraint: Papies et al., 2008). However, as in three studies in the present thesis, a number of studies have also failed to find evidence of a significant orientation bias towards food using both Stroop (e.g. EDs: Davidson & Wright, 2002; Sackville et al., 1998; High Restraint: Jansen et al., 1998; Mahamedi & Heatherton, 1993) and dot probe tasks (e.g. High Restraint: Boon et al., 2000).

Where orientation and disengagement biases have been differentiated in previous research, evidence of an orientation bias towards food and no evidence of slowed disengagement have been found (e.g. anorexia nervosa (AN) patients: Giel et al., 2011a; High Restraint: Hollitt et al., 2010; Obese adults: Nijs et al., 2010; Werthmann et al., 2010), as was the case in study four. However, the opposite pattern has also been found (e.g. ED patients: Smeets et al., 2008), supporting the findings of the pilot and study one (as dicussed in the following subsection). Furthermore, evidence of both orientation and disengagement biases has also been found (e.g. Castellanos et al., 2009; Hepworth et al., 2010). Therefore, this widely hypothesised orientation bias for food is not as robust and consistent as has previously been theorised.

9.3.2. Slowed Disengagement

In two experiments a robust slowed disengagement effect from food and negative emotion/interpersonal threat was found amongst all participant groups using modified Stroop tasks. Effect sizes were large for the food and interpersonal threat word position main effects in these two experiments (ηp^2 ranging between 0.40 and 0.53: partial eta squared >0.14 = large effect size: Cohen, 1988; Gray & Kinnear, 2012). However, another two experiments that employed a Stroop task failed to find any evidence of slowed disengagement from food. It is also important to note that even though a slowed disengagement effect was found in two experiments this might have been due to the mere inclusion of a category as the same pattern was found in the neutral conditions. All three experiments which employed dot probe tasks with 2000ms presentation of images to assess disengagement effects, consistently failed to find any evidence of slowed disengagement from food pictures.

Finding that participants displayed a robust slowed disengagment effect from food, supports previous findings that have found evidence for slowed disengagement from food and no orientation bias (e.g. Smeets et al., 2008). However, a conflicting finding where only an orientation bias was observed (as discussed in Subsection 9.5.1.1) is also supported by a number of other previous studies (e.g. Giel et al., 2011a; Hollitt et al., 2010). These findings both within the present thesis and in the wider literature demonstrate the inconsistencies in AB research in the eating behaviour field. Therefore, at present no firm conclusions can be made as to whether individuals with eating-related concerns (e.g. restrained eaters) consistently display one specific sub-component of AB.

9.3.3. Attentional Avoidance

Contrary to expectations, there was some evidence of attentional avoidance of food/threat stimuli in the present thesis. In study two those with higher binge eating scores were faster to colour-name food and interpersonal threat words than those with lower binge eating scores. This could suggest that binge eaters attentionally avoid such threatening stimuli; however, this same pattern was also found in colour-naming of household object words. Therefore, this is not likely to have reflected attentional avoidance of threatening stimuli specifically. Binge eating was only measured in study two; therefore, this pattern of findings was not followed up in subsequent studies. This was in order to keep to the main aims of the thesis which were to assess orientation and disengagement biases in order to assess the usefulness of AT. If certain participants groups already avoid threatening stimuli, then AT (which trains individuals to avoid threat) would not be useful to them.

As previously explained, interference scores in the dot probe task (incongruent trial minus congruent trial) reveal whether participants have an AB (indicated by a positive value) or whether they attentionally avoid stimuli (indicated by a negative value). No significant avoidance of food stimuli was found in any of the three experiments employing dot probe tasks; however, in study two both restrained and unrestrained eaters had negative mean interference scores in both 200ms and 2000ms conditions. This indicates a slight (but non-significant) avoidance effect.

In study three, 2000ms bias scores were significantly negatively correlated with general eating psychopathology (total scores on the three eating related subscales of the Eating Disorder Inventory-2; EDI-2: Garner et al., 1991) providing suggestive evidence that those with high levels of general non-clinical eating psychopathology attentionally avoid food stimuli. Again, this suggests that AT would not be useful amongst such individuals, as they already display what AT aims to achieve. There is clearly no need to train someone to avoid threat if they manage this alone.

Given that previous researchers have theorised that individuals characterised by eating-related concerns have biased attention processing of high-calorie foods (e.g. Vitousek & Hollon, 1990), and that a large body of findings have demonstrated this to be the case, attentional avoidance of food in such individuals was not expected. However, despite a larger body of evidence suggesting these individuals have an AB for food (see Chapter One), a few studies have also found that certain participant groups avoid food stimuli (e.g. AN patients: Veenstra & de Jong, 2012; Restrained Eating: Veenstra et al., 2010; External Eating: Johansson et al., 2004). In fact, one third of the AB studies reviewed in Chapter One that allowed for assessment of avoidance demonstrated that individuals characterised by eating-related concerns avoid food (four out of 12 studies). This is problematic when considering the usefulness of AT. However, the need for AT cannot be ruled out at the present stage because there is still a much larger support basis for AB than attentional avoidance of food stimuli amongst individuals with eating-related concerns. What these findings do point towards, however, is the need to pre-assess individuals in terms of their attention processing and then only train those already displaying biased attention processing of food.

9.3.4. Restrained Eating

Throughout the present thesis there was fairly consistent evidence that levels of restrained eating are *not* related to AB for food. In two experiments restrained eating was not significantly related to performance in modified Stroop tasks. In three experiments restrained eating was also not significantly related to performance in dot probe tasks (in either negative or neutral mood groups in study four). However, in study one there were differences between restrained and unrestrained eaters in their patterns of response in a Food Stroop. Unrestrained eaters were significantly slower to colour-name neutral words in position 2 (i.e. directly following a food word) whereas restrained eaters were only significantly faster to colour-name words in position 5 (i.e. the neutral word furthest away from the food word). As discussed in Chapter Four, this could be due to restrained eaters taking longer to disengage from food stimuli than unrestrained eaters, hence only speeding up in responding by the word furthest from the food word. However, as there were no further neutral words in the sequence, it was not possible to assess whether colour-naming would have continued to speed up after word five. Although, when further neutral words were added to the sequence in a Stroop task in study two, there were no significant differences between restrained and unrestrained eaters in responding. Rather, neither participant group displayed any evidence of biased attention processing of food. Another possible explanation for the pattern of responding by restrained eaters in study one (i.e. speeding up of responding at word position 5) concerns practice effects. These participants may have become faster at colour-naming each word after the food word due to practice during each sequence.

When in a negative mood highly restrained eaters took longer to disengage from food words than those in a neutral mood and with lower restraint scores. This indicates that there is some relation between highly restrained eating and biased attention processing of food. However, as noted in Chapter Eight (see Subsections 8.3.2 and 8.3.3), this did not relate to subjective appetite or eating behaviour.

It has been posited by a number of cognitive psychologists that restrained eaters have biased attention processing of high-calorie foods (e.g. Hollitt et al., 2010). Throughout the present thesis, however, there has been very limited support for restrained eating being significantly related to AB for food. The majority of the present findings therefore support the body of literature that has found no effect of restraint on biased attention processing of food measured by both Stroop (e.g. Black et al., 1997; Jansen et al., 1998; Mahamedi & Heatherton, 1993; Sackville et al., 1998) and dot probe tasks (e.g. Ahern et al., 2010; Boon et al., 2000). However, these results also stand in contrast with an equally robust body of findings that suggest restrained eating *does* significantly influence AB for food measured by both Stroop (e.g. Francis et al., 1997; Huon & Brown, 1996; Perpina et al., 1993; Stewart & Samoluk, 1997; Tapper et al., 2008) and dot probe tasks (e.g. Papies et al., 2008).

Despite consistently finding no evidence of a significant relation between restraint and AB in the first four experiments of the thesis, when additionally accounting for negative mood in the final study a relation between these variables emerged. Therefore, it is possible that restrained eaters will only display biased attention processing of food when in a negative mood, fitting with the body of research that has found restrained eaters overeat when in a negative mood (e.g. Cools et al., 1992; Wallis & Hetherington, 2004). However, there was no relation between restrained eating scores and food wanting or intake. This questions the utility of the concept of restraint in the field. If 'restraint' does not significantly relate to attention processing of food or actual eating behaviour, what does this concept encompass? Perhaps assessing a more practical variable (i.e. a variable that is consistently related to actual eating behaviour) such as dieting behaviour would be more informative in future research (as discussed further in Subsection 9.7).

9.3.5. Emotional Eating

Emotional eating was not significantly related to food AB when mood was not accounted for. However, when in a negative mood higher levels of emotional eating was significantly associated with greater orientation bias towards and slowed disengagement from food. Therefore, evidence suggests that emotional eaters in a current negative mood (and not in a neutral mood) display biased attention processing of food. Furthermore, higher emotional eating scorers (in a negative mood) displayed greater desire to eat post-mood induction compared to lower scorers (and those in a neutral mood).

The only published study to date that has explored the relationship between emotional eating and AB for food is that of Hepworth et al. (2010). In their study they found that emotional eating scores were significantly correlated with orientation bias towards and slowed disengagement from food in a dot probe task. This supports the present findings obtained when assessing AB using a modified Stroop task.

However, Hepworth et al. (2010) detected significant relations between emotional eating scores and AB measured using their dot probe task, whereas this was not the case in the present thesis. However there were methodological limitations of the task used by Hepworth et al. (2010), which were discussed in Chapter Seven Subsection 7.4. Therefore, these differences in findings may be attributed to methodological differences (with the presently used dot probe task providing a more methodologically sound assessment of AB).

9.3.6. External Eating

Two studies explored whether there was a relationship between external eating and AB for food using a Stroop task. The first of these found no significant relationship between external eating and food AB. However the latter (which additionally accounted for mood state) found that external eaters displayed a food AB when in a neutral mood. However, this effect was not specific to food AB, but was also found for colour-naming of household object words. Furthermore, external eating scores were consistently not significantly related to performance on the dot probe task.

The majority of the findings in the present thesis have consistently demonstrated a non-significant relationship between external eating and AB for food, supporting a few studies employing Stroop tasks (Johansson et al., 2004; Newman et al., 2008). However, they differ from three dot probe studies that have found differences between external and non-external eaters in their attention processing of food (Brignell et al., 2009; Hepworth et al., 2010; Johansson et al., 2004). Finding that those with high external eating scores in a neutral mood only, were slower to colour-name food words than lower scorers (and those in a negative mood), conflicts with previous theory and research. For example, it stands in contrast to the idea that *negative* mood states reduce internal cues to hunger and draw attention to external cues (e.g. Heatherton & Baumeister, 1991), leading to increased intake in external eaters (e.g. Conner et al., 1999; Newman et al., 2008). However, there is also research that supports the present findings, such as the study by Fay and Finlayson (2011) that failed to find a significant correlation between external eating scores and negative mood-induced intake. Furthermore, Newman et al. (2008) found that stress did not increase AB for food in external eaters and Van Strien et al. (1995) found no relationship between external eating and emotional problems (such as negative mood). There is clearly discrepancy concerning whether negative mood will influence intake amongst external eaters. No other research at the time of writing has explored whether negative mood enhances AB for food in external eaters, therefore further investigation is needed before clear conclusions can be made. The present research does suggest, however, that external eaters do not display greater AB for food when in a negative mood, but rather are more likely to display an AB for food when in a neutral mood.

9.3.7. Eating Psychopathology

General eating psychopathology (total scores on the eating-related subscales of the EDI-2) was significantly negatively correlated with 2000ms interferences scores in one of the dot probe tasks. As discussed in Subsection 9.5.3 this could suggest that those characterised by high levels of non-clinical eating psychopathology attentionally avoid food stimuli, calling into question the usefulness of AT for such individuals. However, aside from this finding, there was consistently no significant effects regarding general eating psychopathology.

The effect of drive for thinness (DFT) on performance in Stroop tasks was explored in three experiments. When mood state was not accounted for, DFT had no significant effects on food AB. However, those with a high DFT did display a significant food AB when in a negative mood. As with emotional eating, it therefore appears that those with a high DFT display biased processing of food when in a current negative mood. However, DFT was consistently *not* significantly related to performance in the dot probe task.

Bulimic symptoms (as assessed using the Bulimia subscale of the EDI-2) consistently had no significant effects in any experiment of the present thesis. This was particularly surprising in study four when participants were induced into a negative mood. As with bulimic symptoms, body dissatisfaction consistently had no significant effects in any experiment of the present thesis.

As already discussed, individuals characterised by eating-related concerns are thought to have ABs for food (e.g. Vitousek & Hollon, 1990). Therefore, it was surprising to find that those with higher levels of non-clinical eating psychopathology would have less of an AB for food than lower scorers. Only one study reviewed in Chapter One explored the effect of general eating psychopathology on AB and this study only explored biased attention processing of body stimuli (Jansen et al., 2005). The studies in the present thesis, therefore, offer initial insight into the relation between general non-clinical eating psychopathology and attention processing of food.

In the present thesis performance in two Stroop tasks and all three dot probe tasks was consistently not significantly related to DFT. This corresponds with the findings of four previous Stroop studies (Ben-Tovim & Walker, 1991; Green et al., 1997; Perpina et al., 1993; Sackville et al., 1998) but contrasts with the findings of others who have found a significant relation between AB for food and DFT (Lattimore et al., 2000). It is worthy of note that none of these previous investigations accounted for the effects of negative mood. Although the majority of findings regarding DFT were non-significant in the present thesis, when induced into a negative mood those with higher DFT scores had greater orientation bias towards food words in a Stroop task than those with lower scores (and in a neutral mood). This suggests that negative mood predisposes those with an already high DFT to process food stimuli preferentially. However, given that this pattern was also found for colour-naming of household object words this preferential processing may not be specific to food stimuli.

The consistent finding through the present thesis that non-clinical bulimic symptoms are not significantly related to performance in both Stroop and dot probe tasks, stands in contrast with previous research which has found that high bulimia scorers (compared to low scorers) have a significantly greater AB for food in a Stroop task (Formea & Burns, 1996). It is also particularly surprising that no evidence of AB for food was found amongst high bulimia scorers in a negative mood, given that negative mood is found to precede binge eating episodes in bulimic patients (e.g. Davis, Freeman, & Garner, 1988; Davis, Freeman & Solymon, 1985; Johnson & Larson, 1982). This could suggest that such individuals would therefore preferentially process food stimuli when in a negative mood, given their need to obtain food in order to escape from awareness of negative affect (e.g. Heatherton et al., 1991; Heatherton & Baumeister, 1991). However, it may be that only clinically diagnosed BN patients (as opposed to non-clinical females displaying bulimic symptoms) will display an AB for food when in a negative mood, which is yet to be explored.

As with bulimic symptoms, body dissatisfaction was also not significantly related to AB for food. The studies reviewed in Chapter One that explored the relation between body dissatisfaction and AB only measured attention processing of body stimuli. Therefore the studies in the present thesis provide the first experimental assessments of the relation between body dissatisfaction and attention processing of food stimuli. It is possible that those characterised by high levels of body dissatisfaction only display an AB for body stimuli (given more direct relevance to their primary concerns); however, previous findings both support (e.g. Gao et al., 2011a; Gao et al., 2011b; Glauert et al., 2010 Study Two) and contradict the idea that body dissatisfied women even have an AB for body stimuli (e.g. Glauert et al., 2010 Study One; Smith & Rieger, 2010).

9.3.8. The Influence of Potential Confounds

A number of potential confounds were analysed in the present thesis in order to assess whether they accounted for any variation in AB. Age had no effect on performance in the Stroop tasks employed in two experiments or performance in the dot probe task in one experiment. However, in one experiment age was significantly negatively correlated with 2000ms interference scores in the dot probe task (but not the 200ms scores) indicating that younger females in the sample were slower to disengage from food. However, this was found with a very limited age range (18-25). When the age range was extended in study four (18-41: although the spread of ages was still largely skewed), in contrast there was a significant positive correlation between age and 200ms interference scores in the dot probe task amongst participants in a neutral mood only.

Baseline hunger had no significant effect on task performance (as expected due to giving identical eating instructions to be followed prior to participation), except for the Stroop task in one experiment. In this case, hunger was significantly correlated with household object response times (RTs) amongst participants in a negative mood only, which appears to be an arbitrary finding. The potential effects of depression and anxiety were also explored in the present thesis, but were consistently not significantly related to task performance. Likewise, body mass index (BMI) was also not found to significantly effect task performance in any experiment.

Initial research does suggest that age may influence AB for food, both in the present thesis and in the wider literature. Green and McKenna (1993) have previously concluded that the developmental onset of AB for food is 14, whereas Lattimore et al. (2000) found that 12-13 year old unrestrained eaters (and 14-15 year old restrained eaters) display an AB for food. These findings, along with the findings from two studies in the present thesis, suggest that age does influence AB for food. However, again these findings are conflicting with one another and require further investigation.

Hunger was assessed in terms of its impact on AB for food, due to a number of previous investigations finding that hunger can predict AB for food (e.g. Channon & Hayward, 1990; Mogg et al., 1998; Nijs et al., 2010; Placanica et al., 2002). As a result of these findings, all participants were instructed to have a normal meal two to three hours prior to participation and then refrain from eating after this. Hunger did not significantly relate to performance in Stroop and dot probe tasks except for in the Stroop task in study four (and this was likely to be an arbitrary finding). Likewise, given that BMI/weight status has previously been found to predict AB for food (e.g. Braet & Crombez, 2003; Castellanos et al., 2009; Nijs et al., 2010; Werthmann et al., 2011) the potential relation between BMI and AB for food was explored in the present thesis. However, BMI had no significant effects on AB in any study. Both depression and anxiety also did not have a significant effect on performance in any of the AB tasks. This corresponds with previous findings, for example Formea and Burns (1996) included a depressed control group in their experiment and found no differences between depressed and non-depressed participants in their attention processing of food. Depression and anxiety are particularly important to control for when assessing AB for threat (as assessed in studies one and two of the present thesis), as these mood variables are often associated with threat biases (e.g. Martin et al., 1991; Mathews & MacLeod, 1985). Depression and anxiety, however, had no significant relation to attention processing of interpersonal threat in the present thesis.

9.3.9. Negative Mood

The influence of negative mood on AB for food, subjective appetite and food intake was explored in the final experiment of the thesis. The findings regarding the effect of negative mood on AB will firstly be discussed. Only amongst those in a negative mood was highly restrained eating significantly associated with slower disengagement from food. Likewise, only when in a negative mood was highly emotional eating significantly associated with greater orientation bias towards and slower disengagement from food. Higher levels of DFT were also significantly associated with greater AB towards food amongst those in a negative mood. Finally, contrary to expectations, those in the neutral mood condition had a slighter greater (but non-significant) AB towards and slowed disengagement from food in the dot probe task than those in the negative condition.

Regarding the influence of negative mood on subjective appetite and food intake, it was found that highly emotional eaters in a negative mood had a greater desire to eat than lower scorers and those in a neutral mood. However, there was no evidence that high emotional eating, DFT or restrained eating scorers in a negative mood had increased liking/wanting of the study foods, increased desire to eat or increased food intake. Therefore it was not possible to carry out mediation analysis to assess whether AB mediates the negative mood-eating relationship (as conditions were not met).

These findings conflict with many previous research studies. For example, Hepworth et al. (2010) found that those in a negative mood induction condition had significantly greater AB for food than those in a neutral condition (with a trend towards the opposite pattern found in the present thesis). This is perhaps surprising given the number of methodological similarities between this and the present study: samples were comparable in size and inclusion criteria; the assessment of the success of the mood induction was the same; and a combination of music and autobiographical recall was used to induce negative mood in both experiments. However, as previously discussed (see Chapters Seven and Eight) there were a few methodological differences that may have accounted for these discrepancies (with an improved methodological design, particularly in relation to mood induction technique and AB tasks, in the present thesis).

Finding that higher DFT scores (amongst those in a negative mood) were associated with greater AB for food could suggest that food cues become more salient to those with a high DFT when in a negative mood, leading to greater AB. Negative mood has been found to increase body-size perception in ED patients (e.g. Polivy & Herman, 2002), which may also be the case for non-clinical females with a high DFT: negative mood may elevate concerns about body size and therefore food cues may become more meaningful and be processed preferentially. The finding that emotional eaters in a negative mood had an increased desire to eat is supported by a number of findings (e.g. Fay & Finlayson, 2011; Hepworth et al., 2010). However, the fact that highly emotional eaters in a negative mood did not have increased food wanting or food intake, differs from previous findings. For example, Fay and Finlayson (2011) found that high restrained/emotional eating scores and negative mood, led to increased wanting of and consumption of a snack food (popcorn). The present results also differ from previous findings that restrained eaters overeat in response to negative mood induced in the lab (e.g. Epel et al., 2001; Polivy & Herman, 1999; Wallis & Hetherington, 2004).

9.4. How Does the Thesis Differ From Previous Research?

The present series of studies make a number of methodological improvements to earlier research. For example, a novel Stroop task methodology that allows a distinction between orientation bias and slowed disengagement was modified to include food and interpersonally threatening stimuli for the first time. This is an important addition to the Stroop literature given that earlier Stroop research in the eating behaviour field has not been able to distinguish between these sub-components of attention (perhaps explaining why their findings have been equivocal). The modified Stroop tasks employed in the present thesis are therefore more informative than the original version of the task.

The dot probe tasks employed have been rigorously developed in the following ways: by taking original photographs of high-calorie food stimuli and carefully matched neutral objects; by gathering ratings of images from a large sample of females in order to tease out the most appealing food images and the most neutral object images; and through reviewing the dot probe literature in order to establish the optimal presentation time of images (for distinguishing between sub-components of attention). Furthermore, the present thesis contains the first experiment that explores whether AB for food mediates the negative-mood eating relationship often found amongst restrained and emotional eaters. It is surprising that this is the first experiment to explore this, given that many researchers take the viewpoint that AB for food has a maintaining and exacerbating role for problematic eating behaviours. Therefore, this thesis offers an experimental testing of the widely agreed upon hypothesis that AB for food is associated with actual eating behaviour. This is very important to establish in order to assess whether AT will be beneficial to individuals experiencing problematic eating behaviours. If AB for food does not influence actual eating behaviour, then the usefulness of retraining AB for food in order to modify these behaviours is called into question.

9.5. How are the Findings Consistent with the Field?

As in the present thesis, the AB field in general also demonstrates inconsistencies in whether orientation bias towards food, slowed disengagement from food, or avoidance of food is evident in those with eating-related concerns. Even when evidence for one of these constructs has been gained, there are further inconsistencies in which is most prominent.

In the AB field, it has been posited by a number of cognitive psychologists that restrained eaters are characterised by biased attention processing of high-calorie foods. However, in the present thesis, as with a significant proportion of the research evidence in the field, when mood is not accounted for restrained eaters do not display consistent food ABs. However, when in a negative mood restrained eaters do display biased processing of food, fitting in with the eating behaviour field (which demonstrates that restrained eaters overeat in a negative mood).

There is limited research evidence concerning the relationship between emotional eating and food AB in the AB field; however, the limited evidence available aligns with the present findings that when in a negative mood emotional eaters display food AB (although there is some discrepancy in which AB tasks are sensitive enough to demonstrate this). The present finding that emotional eaters in a negative mood increase in desire to eat also aligns with the AB field. However, the fact that these individuals did not increase in food intake or wanting does not extend these findings.

In the AB field, the effect of external eating on food AB has been inconsistent. The present thesis, however, sides with the null findings in the field. But of great interest, the influence of a neutral mood state has led to a significant relation between external eating and food AB. This finding, however, contrasts with the eating behaviour field which suggests that negative mood leads to increased salience of food in external eaters (although not all findings in this area are consistent with one another).

In the present thesis, as with the majority of the research evidence in the area, when mood is not accounted for, those with a high DFT do not display consistent food ABs. However, a novel investigation in the present thesis revealed that when in a negative mood those with a high DFT do display food AB (although this was not related to increased food intake).

9.6. Limitations

The present thesis made a number of methodological improvements to the existing literature on AB for food, as already discussed. However, a few limitations of the present research must be addressed (for a full description of the limitations of each study see each study chapter's discussion). In the pilot study (median=2.2), study one (median=2.6), study two (median=2.5) and study three (median=2.5) median-splits were carried out on the restraint subscale of the Dutch Eating Behaviour Questionnaire (DEBQ; Van Strien et al., 1986) in order to establish low and high restraint groups. However, given that the median for each of these studies fell below the true mid-point on the scale (3: e.g. Tapper et al., 2008), it is possible that unrestrained eaters were placed in the high restraint groups, reducing the likelihood of observing group differences. It has been argued that using a median-split may result in diminished power (e.g. Cohen, 1988) and although converting continuous variables into categories is not an error it is often considered 'bad practice' (e.g. Altman & Royston, 2006; Bell et al., 2012; Harris et al., 2011). However, this is a valid technique and often used in AB research (e.g. Ahern et al., 2010; Lattimore, et al., 2000). Furthermore, given that eating measures of interest were also used as continuous variables to supplement such analysis, the potential low median score grouping cannot explain null results also produced by this continuous analysis.

Another limitation concerns the frequent use of correlations (particularly in Study Four Parts 1 and 2). Correlation coefficients give no indication of the direction of causality, i.e. they do not provide any evidence as to whether one variable *causes* the other (e.g. Field, 2005). Another potential limitation of the research concerns statistical power. Sample sizes were mostly comparable with previous studies reviewed in Chapter One; the mean sample size of AB studies with non-clinical samples reviewed in Chapter One was 55 (although there was a large variation of sample sizes which ranged from 20 up to 224: see summary tables in Chapter One for further details regarding previous sample sizes). The sample size in study four (n=77) was larger than the average sample size from earlier studies with non-clinical samples, and comparable to Hepworth and colleagues' (2010) study of which study four was an extension (n=80). However, the present researcher initially aimed to recruit 20 females characterised by high restraint/high emotional eating (HR/HE; according to scores >3 on relevant subscales of the DEBQ); 20 females characterised by high restraint/low emotional eating (HR/LE); 20 females characterised by low restraint/high emotional eating (LR/HE); and 20 females characterised by low restraint/low emotional eating (LR/LE). In each of these groups, it was intended that 10 would be allocated to each of the mood induction conditions. However, final recruitment figures were as follows: LR/LE n=30 (15 neutral; 15 negative); HR/LE n=19 (10 neutral; 9 negative); LR/HE n=14 (7 neutral; 7 negative) and HR/HE n=16 (7 neutral; 9 negative). Due to uneven groups and low numbers in the high emotional eating groups, comparison between participant groups was not feasible. It is possible that this study was underpowered based on under-recruitment of highly emotional eaters.

An additional constraint of the present thesis is that only non-clinical females were recruited to take part in the experiments. This clearly limits any conclusions being made for clinical ED patients (although to have also assessed AB for food amongst clinical patients would have fallen outside the scope of the present PhD). It is possible that some of the null results that were found in these experiments were due to the mere inclusion of a non-clinical group with eating concerns, as studies reviewed (see Chapter One) have struggled to find consistent results with such samples. It could be argued that such biased attention processing only occurs in clinically eating disordered females given the greater significance of food to them. In support of this, previous research with clinical ED samples has more consistently demonstrated biased attention processing of food (see Chapter One).

A further issue arising in the present thesis is the use of tightly controlled laboratory experiments as opposed to naturalistic research. There are obvious pros and cons of each approach. For example naturalistic research is more ecologically valid; however, is also prone to an increased number of confounding variables that may not be easily identified. On the other hand some claim that laboratory studies lack ecological validity, as for example someone's intake in a 'taste test' in a laboratory may differ from how much they may eat at home or whilst with friends or family. However, one major advantage of conducting laboratory experiments is that the influence of individual variables can be controlled. For example in a taste test in a laboratory the researcher can remove distraction, and can personally weigh the foods eaten as opposed to relying on accurate self-report from the individual. Tightly controlled experiments have multiple advantages; however, in drawing conclusions from such research one must bear in mind limitations of generalising findings to real-world situations.

One final limitation concerning generalisability of the findings from the present thesis concerns the nature of the study samples. Participants were predominantly students (although participants were also recruited from the local community) and therefore the samples were skewed in terms of participant age (as the majority of participants were aged 18-22 with a total mean age of 20.96 years). This must be taken into account when drawing conclusions from the findings.

9.7. Implications and Future Directions

There are a number of implications from this research. In particular, further research is needed into the robustness of AB for eating-related stimuli and the relationship between such ABs and actual eating behaviour. This is required before heading down the route of AT as there is yet adequate justification for carrying out such training (i.e. researchers have yet to establish an evidence-base for a real-world need for AT). Whilst many cognitive psychologists have theorised the causal and maintaining role of AB for disorder symptoms and other non-clinical problematic behaviours and attitudes, there is not yet sufficient evidence that this is actually the case. The null results in the present thesis highlight that the role of (and indeed the nature of) AB for food and threatening stimuli is not yet clear. There will be no justification for AT for individuals with eating-related concerns, until we can understand fully what AB is, how it is manifested, who is characerised by it, and how it affects the real world. However, some researchers in the field have recently (paper in press at the time of writing) carried out Food-related AT (Hardman, Rogers, Etchells, Houstoun & Munafo, *in press*). These researchers have not evidenced a causal role of AB on food intake (i.e. they found that AT did not have a significant effect on actual eating behaviour).

Additionally, the mostly consistent null results in the present thesis regarding the relationship between restraint and AB for food, question the utility of the concept of restraint in this area of research. In a number of rigorously and systemically developed studies, no significant differences were found between restraint groups in their attention processing of food (and restraint was not significantly related to actual eating behaviour during a ‘taste test’). Actual dieting behaviour may be more informative in the field than the concept of restraint (there were not sufficient numbers of dieters to allow for statistical analysis in each study of the present thesis but this could be an interesting avenue for future research). There is some debate as to what the concept of restraint encompasses and how well it relates to actual behaviour. For example, it has been found that four measures of restraint (including the DEBQ-R) do not measure the same theoretical construct, do not predict changes in energy balance and are not informative of a current state of negative energy balance (Williamson, Martin, York-Crowe, Anton, Redman, Han & Ravussin, 2007). Rather, frequently used measures of restraint (including the DEBQ-R) are found only to measure *intent* to diet (e.g. Williamson et al., 2007).

A few suggestions for future research have emerged. Firstly, as already discussed, some of the null and inconsistent results across this thesis may indicate that the tasks may not be sensitive measures of AB in non-clinical samples, as argued by Schmukle (2005) in relation to the dot probe task. In order to assess whether the null/inconsistent results in the present thesis (found particularly with regard to the dot probe task) are due to methodological limitations (e.g. task insensitivity) rather than a lack of AB in these 'at-risk' females, future research should compare task performance in these females (e.g. those high in restraint) with a clinical ED group. If AB for food was not found in a clinical sample then this would raise concerns with the sensitivity and reliability of the dot probe task, as opposed to a lack of AB in non-clinical females. Therefore, future research should investigate differences between clinically restrictive, non-clinically restrictive and non-restrictive controls on performance on the modified Stroop and dot probe tasks that have been refined throughout this thesis.

The problems arising from the heavily skewed age data in the present thesis have already been touched upon. However, it is worth noting here that two of the studies in the present thesis have found a significant relation between age and AB for food. Therefore, it is worthwhile for future researchers to explore the effect of age on food-related AB by including a sample with more varied ages.

As discussed in Chapter Seven, there is little research exploring whether external eaters increase intake during negative mood states (and no other research at the time of writing has explored whether negative mood enhances AB for food in external eaters). The findings of study four part one suggest that external eaters do not display greater AB for food when in a negative mood, but rather are more likely to display an AB for food when in a neutral mood. However, given that a general slowing down of responding may have occurred in external eaters in a neutral mood (as opposed to this being specific to colour-naming of food stimuli), further research is needed in order to validate this finding.

The questionnaires often employed in order to measure eating behaviours also require some attention. As noted in Chapter Eight, the emotional eating subscale of the DEBQ only asks questions concerning a desire to eat in response to emotional states. The restraint and external eating subscales, on the other hand, ask questions about actual eating behaviour (although this is in addition to some questions on desire to eat/restrict intake, and as noted earlier in this subsection the DEBQ-R has been found to only measure *intent* to diet). In study four part two, highly emotional eaters (according to scores on the DEBQ) increased in desire to eat following a negative mood induction but did not increase in actual intake. However, this would make sense given that high scorers on this measure are only identifying themselves as those who have an increased desire to eat in response to negative emotion. A significant relation between emotional eating, negative mood, AB for food and food intake may emerge if an alternative measure of emotional eating, which asks the individual about their actual eating behaviour, is used (e.g. the Weight-Related Eating Questionnaire-Emotional Eating subscale: Schembre, Greene & Melanson, 2009; the Emotional Appetite Questionnaire-Negative affect subscale: Geliebter & Aversa, 2003; Nolan, Halperin & Geliebter, 2013; the Emotional Overeating Questionnaire; Masheb & Grilo, 2006).

One further area of exploration that could provide further insight into the relation between negative mood and eating concerns the type of negative memories recalled by participants. It is possible that some memories (e.g. traumatic memories) may lead to a decrease in appetite, whereas other negative memories (e.g. of loneliness) may lead to an increase in appetite. Future research is needed with a larger sample of females in order to assess whether the type of negative memory recalled will differentially influence food intake.

9.8. Conclusions

The purpose of the studies in this thesis was to explore whether females characterised by eating-related concerns (such as restrained eating) display orientation biases towards and slowed disengagement from food stimuli in modified Stroop and dot probe tasks (and whether AB for food influences actual eating behaviour). For example, it was expected that highly restrained eaters, compared to unrestrained eaters, would display an AB for food. Despite some inconsistencies in this thesis in terms of the presence of AB in non-clinical females, negative mood has proven to be a key component in identifying AB for food amongst highly restrained eaters, emotional eaters and those with a high DFT. It is possible that previous ambiguous findings (in the present thesis and in previous research) could be explained by not accounting for negative mood, or not assessing both orientation bias and slowed disengagement (in previous research).

In the present thesis the Stroop task has been shown to be more sensitive at detecting AB for food in a non-clinical sample than the dot probe task. This is perhaps surprising given that the dot probe task has previously been considered an improved measure of AB than the Stroop task. This is because it allows for the inclusion of images, which are more ecologically valid (e.g. Shafran et al., 2007), and is considered to be a more direct test of AB (e.g. Faunce, 2002; Placanica et al., 2000; MacLeod et al., 1986; Mogg & Bradley, 1998). Despite these arguments, the Stroop task is still the most frequently employed measure of AB in the eating literature (see Chapter One) and has produced significant effects in the present research. The presently employed Stroop tasks also address some previous concerns with the use of the task, as it allowed separate assessments of orientation and slowed disengagement (although it does not allow assessment of avoidance).

Despite finding some evidence of both orientation biases towards, and slowed disengagement from food and interpersonally threatening stimuli in the present thesis, this was most often regardless of eating-related concerns. Some eating behaviours were even associated with reduced AB in some studies. However, when inducing participants into a negative mood, restraint, emotional eating and DFT scores were significantly positively correlated with AB for food. However, despite many cognitive psychologists postulating that AB for food maintains and even exacerbates non-clinical eating behaviours and clinical ED symptoms (e.g. Hollitt et al., 2010; Vitousek & Hollon, 1990; Williamson et al., 1999), the present thesis challenges the idea that AB for food influences actual eating behaviour in non-clinical females. These findings also challenge the usefulness of an AT program in order to help reduce overeating in response to negative mood in those characterised by high levels of restraint, emotional eating and DFT. However, this is only the first investigation to explore the effect of AB for food on actual food intake and further research is needed in order to replicate these findings before the usefulness of AT can be ruled out. In addition, it is possible that AB for food may mediate a negative mood-eating relationship amongst clinical ED patients, which is yet to be explored. Given the increased relevance of food to ED patients, AT may serve well as a clinical treatment as opposed to a preventative measure (as it has shown success with other clinical groups: see Chapter One Subsection 1.8).

Further investigation into how best to measure AB for food (both orientation and slowed disengagement) in females who experience problematic eating behaviours is essential to informing how best to retrain attention in such individuals in order to help prevent development of clinical EDs (or for informing whether such training is necessary at all). The present thesis provides important suggestions for modifications of Stroop and dot probe tasks designed to target both orientation bias and disengagement and provides an important contribution to the AB literature.

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Appendices

Loughborough University

Health Screen Questionnaire for Study Volunteers

As a volunteer participating in a research study, it is important that you are currently in good health and have had no significant medical problems in the past. This is (i) to ensure your own continuing well-being and (ii) to avoid the possibility of individual health issues confounding study outcomes.

Please complete this brief questionnaire to confirm your fitness and eligibility to participate:

Participant Code: (code to be completed by researcher)	**Date:**
Date of birth:	**Sex:**
Height:	**Weight**

1. **At present,** do you have any health problem for which you are:

(a)	on medication, prescribed or otherwise	Yes	☐	No	☐
(b)	attending your general practitioner	Yes	☐	No	☐
(c)	on a hospital waiting list	Yes	☐	No	☐

2. **Have you ever** had any of the following:

(a)	Convulsions/epilepsy	Yes	☐	No	☐
(b)	Head injury	Yes	☐	No	☐
(c)	Disturbance of vision or hearing………………..	Yes	☐	No	☐
(d)	Diabetes	Yes	☐	No	☐
(e)	Food allergy or intolerance	Yes	☐	No	☐
(f)	Eating disorder…………………………………….	Yes	☐	No	☐
(g)	Mood disorder (e.g. depression or anxiety)…….	Yes	☐	No	☐

If YES to any question, please describe briefly if you wish(eg to confirm problem was/is short-lived, insignificant or well controlled.) If you suffer from a food allergy or intolerance please state which food/s this involves

....

....

3. Do you smoke? Yes ☐ No ☐ **If yes, how many per day?**: …………

4. Are you currently dieting? Yes ☐ No ☐

5. How often do you diet? Never ☐ Once ☐ More than ☐
Always ☐

per year once per year

6. Have you been diagnosed with any of the following:

dyslexia Yes ☐ No ☐ **dyscalculia** Yes ☐ No ☐**dyspraxia** Yes ☐ No ☐

7. Are you colour blind? Yes ☐ No ☐

8. Additional questions for female participants

(a)	are your periods normal/regular?	Yes	☐	No	☐
(b)	are you on “the pill”?	Yes	☐	No	☐
(c)	could you be pregnant?	Yes	☐	No	☐
(d)	are you taking hormone replacement therapy?	Yes	☐	No	☐

Full list of words in the Stroop task in the pilot study

Food condition					
Food words	**Frequency**	**Word Length**	**Neutral words**	**Frequency**	**Word Length**
CHIPS	36	5	CONFORM	13	7
BISCUIT	16	7	CONSIST	64	7
CREAM	33	5	GLANCE	41	6
SWEET	36	5	TOWER	42	5
Mean (SD)	30.25	5.5	Mean (SD)	40	6.25
Mood Condition					
Negative mood words	**Frequency**	**Word length**	**Neutral words**	**Frequency**	**Word length**
CRYING	14	6	LABEL	29	5
ISOLATE	18	7	FOSSIL	14	6
GUILTY	42	6	DETECT	34	6
UPSET	17	5	KNIGHT	12	6
Mean (SD)	22.75	6	Mean (SD)	22.25	5.75
Neutral Condition					
Neutral Words	**Frequency**	**Word length**	**Neutral words**	**Frequency**	**Word length**
MONITOR	35	7	PRINT	35	5
NOTABLE	16	7	INVEST	37	6
BISHOP	40	6	SWING	34	5
INVOLVE	42	7	TENTH	11	5
Mean (SD)	33.25	6.75	Mean (SD)	29.25	5.25

Full list of words in the Stroop task in Study One

Food word	Frequency	Word Length	Matched Neutral	Frequency	Word Length
CAKE	38	4	CROP	31	4
			COAT	42	4
			CORE	36	4
			CREW	40	4
CHIPS	36	5	CHEEK	35	5
			CLOUD	37	5
			COACH	37	5
			CLOCK	33	5
CREAM	33	5	CHART	26	5
			CEASE	30	5
			CURVE	34	5
			CLERK	26	5
BUTTER	21	6	BASKET	18	6
			BREEZE	15	6
			BRONZE	17	6
			BUTTON	26	6
CHOCOLATE	24	9	COMPANION	25	9
			CONSTABLE	22	9
			COVERAGE	22	9
			CONTINENT	21	9
BISCUIT	16	7	BLANKET	17	7
			BRIGADE	13	7
			BUILDER	19	7
			BARGAIN	12	7
PIE	16	3	PAD	11	3
			PIN	14	3
			PET	19	3
			PAN	15	3

SUGAR	38	5	SOLVE	38	5
			SCOPE	34	5
			SHIFT	34	5
			SHARP	44	5
SANDWICH	19	8	SANCTION	16	8
			SPECTRUM	20	8
			SYMBOLIC	14	8
			STIMULUS	23	8
PUDDING	11	7	PARKING	15	7
			PREMIER	17	7
			PURSUIT	16	7
			PROVING	11	7
SWEET	36	5	STEEL	38	5
			SOLID	35	5
			SHIRT	36	5
			SLEEP	39	5
TOAST	10	5	TENTH	11	5
			TRUNK	12	5
			TUTOR	18	5
			TYRES	8	5

Ego-threat word	**Frequency**	**Word length**	**Matched Neutral**	**Frequency**	**Word length**
CRITICISED	13	10	COMMENTARY	10	10
			COMPLIANCE	13	10
			COMPATIBLE	12	10
			COMPENSATE	14	10
REJECTED	39	8	REACHING	29	8
			RESIDENT	44	8
			REALISED	49	8
			RECOVERY	39	8
HATED	17	5	HEDGE	16	5
			HOLLY	10	5

			HURRY	25	5
			HERBS	9	5
UNDERMINED	7	10	UNDERGOING	6	10
			UNDERLINED	5	10
			UNDERNEATH	10	10
			UTTERANCES	5	10
IGNORED	32	7	INSTALL	32	7
			INVITED	42	7
			ISLANDS	36	7
			INSPIRE	23	7
CONDEMNED	14	9	CIRCULATE	14	9
			COMMODITY	15	9
			COPYRIGHT	11	9
			COLOURFUL	11	9
JUDGED	17	6	JEWISH	22	6
			JOINTS	9	6
			JUMPED	24	6
			JUNGLE	11	6
ATTACKED	29	8	ACCURATE	29	8
			ADDITION	28	8
			ADVANCED	33	8
			ABSOLUTE	35	8
EMBARRASSED	13	11	ELECTRONICS	15	11
			EVOLUTIONARY	11	11
			ENFORCEMENT	13	11
			ENCOUNTERED	17	11
EXPLOITED	9	9	ELABORATE	13	9
			EMPIRICAL	15	9
			EVIDENTLY	15	9
			ECONOMIST	16	9
DISMISSED	30	9	DEPARTURE	27	9

			DETECTIVE	27	9
			DISCOURSE	27	9
			DISCOVERY		9
BLAMED	14	6	BALLET	15	6
			BARREL	14	6
			BUCKET	14	6
			BANKER	15	6

Animal word	**Frequency**	**Word length**	**Matched Neutral**	**Frequency**	**Word length**
ELEPHANT	15	8	ENVELOPE	19	8
			ENABLING	21	8
			ELIGIBLE	13	8
			ENVISAGE	18	8
DOLPHIN	16	7	DESKTOP	15	7
			DIAMOND	17	7
			DOORWAY	19	7
			DIAGRAM	18	7
PONY	11	4	PACT	12	4
			PIER	11	4
			PUMP	15	4
			PLEA	15	4
SHEEP	30	5	SHELF	26	5
			SHELL	30	5
			STEAM	29	5
			SWEEP	31	5
TIGER	13	5	THUMB	14	5
			TORCH	12	5
			TOWEL	13	5
			TRIBE	14	5
RABBIT	25	6	RHYTHM	21	6
			REMARK	24	6
			REMEDY	24	6

			RESORT	23	6
EAGLE	18	5	EQUIP	19	5
			EXACT	22	5
			EAGER	14	5
			ELBOW	16	5
LION	21	4	LAMP	22	4
			LEAP	21	4
			LOUD	23	4
			LUNG	18	4
MONKEY	11	6	MARKER	12	6
			MOSAIC	12	6
			MORALE	12	6
			MOBILE	14	6
WHALE	13	5	WEAVE	11	5
			WIDEN	14	5
			WRIST	15	5
			WHEAT	10	5
BULL	12	4	BOIL	12	4
			BOLT	12	4
			BULB	10	4
			BEAM	17	4
INSECT	21	6	INDUCE	22	6
			INSERT	18	6
			INVENT	19	6
			INFANT	26	6

Full list of words from the Stroop task in Study Two

Food word	Frequency	Word Length	Matched Neutral	Frequency	Word Length
CAKE	38	4	COAT	42	4
			CORE	36	4
			CREW	40	4
			CROP	31	4
			COOL	40	4
			CAST	37	4
TOAST	10	5	TYRES	8	5
			TRUNK	12	5
			TORCH	12	5
			TRAIL	11	5
			TOWEL	13	5
			TENTH	11	5
CHIPS	36	5	CRAFT	25	5
			COACH	37	5
			CHEEK	35	5
			CHIEF	38	5
			COAST	49	5
			CLOUD	37	5
BUTTER	21	6	BUCKET	14	6
			BASKET	18	6
			BANKER	15	6
			BRONZE	17	6
			BREEZE	15	6
			BUTTON	26	6
SWEET	36	5	STEEL	38	5
			SOLID	35	5
			SLEEP	39	5
			SHIRT	36	5

			SMELL	31	5
			SWING	34	5
SUGAR	38	5	SHARP	44	5
			SCOPE	34	5
			SHELL	30	5
			SHIFT	34	5
			SCORE	45	5
			SOLVE	48	5
CREAM	33	5	CEASE	30	5
			COUNT	32	5
			CHART	26	5
			CURVE	34	5
			CLERK	26	5
			CANAL	26	5
PUDDING	11	7	PROVING	11	7
			PURSUIT	16	7
			POCKETS	16	7
			PARKING	15	7
			PAINTER	20	7
			PREMIER	17	7
CHOCOLATE	24	9	CONTINENT	21	9
			CATALOGUE	30	9
			COVERAGE	22	9
			CONSTABLE	22	9
			COLLECTOR	28	9
			COMPANION	25	9
PIE	16	3	PAT	18	3
			PAD	11	3
			PET	19	3
			PIN	14	3
			PAN	15	3

			POP	20	3
BISCUIT	16	7	BRIGADE	17	7
			BOOKLET	13	7
			BALCONY	19	7
			BARGAIN	12	7
			BUILDER	11	7
			BLANKET	12	7
SANDWICH	19	8	STIMULUS	23	8
			SANCTION	16	8
			SELECTED	14	8
			SQUADRON	15	8
			SYMBOLIC	14	8
			SPECTRUM	20	8
Ego-threat word	**Frequency**	**Word length**	**Matched Neutral**	**Frequency**	**Word length**
EXPLOITED	9	9	EXEMPTION	10	9
			EVIDENTLY	15	9
			EMPIRICAL	15	9
			ENVELOPES	4	9
			ECONOMIST	16	9
			ELABORATE	13	9
DISMISSED	30	9	DEPARTURE	27	9
			DISCOURSE	27	9
			DESCRIBES	26	9
			DISCOVERY	35	9
			DETECTIVE	27	9
			DELIVERED	37	9
BLAMED	14	6	BEHALF	14	6
			BUCKET	14	6
			BANKER	15	6
			BALLET	15	6
			BARREL	14	6

			BOUNCE	13	6
IGNORED	32	7	INVITED	42	7
			INSTALL	32	7
			ISLANDS	36	7
			IMPLIES	20	7
			INQUIRY	44	7
			INSIGHT	22	7
JUDGED	17	6	JUNIOR	28	6
			JUMPED	24	6
			JEWISH	22	6
			JOINTS	9	6
			JUNGLE	11	6
			JOKING	7	6
UNDERMINED	7	10	UTTERANCES	5	10
			UNDERNEATH	10	10
			UTILITIES	5	9
			UNCHANGED	11	9
			UNDERGOING	6	10
			UNDERLINED	5	10
REJECTED	39	8	RELATIVE	39	8
			REACHING	29	8
			RESIDENT	44	8
			REGISTER	35	8
			REALISED	49	8
			RECOVERY	39	8
CRITICISED	13	10	CONSCIENCE	15	10
			COORDINATE	10	10
			COMPLIANCE	13	10
			COMPENSATE	14	10
			COMPATIBLE	12	10
			COMMENTARY	10	10

CONDEMNED	14	9	CRITERION	13	9
			COMMODITY	15	9
			COLOURFUL	11	9
			CIRCULATE	14	9
			CONSENSUS	18	9
			COPYRIGHT	11	9
ATTACKED	29	8	ASSESSED	23	8
			ABSOLUTE	35	8
			ACCURATE	29	8
			ADVANCED	33	8
			ADDITION	28	8
			AMBITION	23	8
EMBARRASSED	13	11	EXHIBITIONS	13	11
			ELECTRONICS	15	11
			ESTABLISHED	20	11
			ENCOUNTERED	17	11
			EVOLUTIONARY	11	11
			EXPLORATION	17	11
HATED	17	5	HEELS	12	5
			HOLLY	10	5
			HIRED	10	5
			HEDGE	16	5
			HURRY	25	5
			HERBS	9	5

Household word	**Frequency**	**Word length**	**Matched Neutral**	**Frequency**	**Word length**
BATH	33	4	BELL	28	4
			BEND	35	4
			BOOT	41	4
			BARE	23	4
			BOSS	40	4
			BOWL	30	4

CARPET	34	6	CAUSES	26	6
			CHEQUE	29	6
			CATTLE	26	6
			CLAIMS	37	6
			CAMERA	39	6
			CUSTOM	37	6
CABINET	69	7	CONSIST	64	7
			CONTRAST	66	7
			COMMENT	75	7
			CONCEPT	64	7
			COMBINE	59	7
			CAPTAIN	56	7
CLOCK	33	5	CLUBS	38	5
			CABLE	25	5
			CLOTH	22	5
			CARDS	39	5
			CALLS	31	5
			CHECK	27	5
PHOTO	21	5	PLAIN	16	5
			PROOF	29	5
			PAINT	26	5
			PENNY	15	5
			PULSE	15	5
			PATCH	25	5
CURTAINS	20	8	CHECKING	16	8
			COLLEGES	25	8
			CHAPTERS	20	8
			CONSISTS	26	8
			CEREMONY	22	8
			COLONIAL	15	8
CUPBOARD	19	8	CHOOSING	17	8

			COINCIDE	16	8
			CARRIAGE	24	8
			COMPOSED	20	8
			COMPOUND	20	8
			CONCRETE	18	8
SINK	13	4	SPUR	12	4
			SCAN	12	4
			STEM	14	4
			SOLO	12	4
			SPIN	18	4
			SEAL	15	4
SOFA	12	4	SOLE	22	4
			SAIL	12	4
			SUMS	15	4
			SITS	12	4
			SOCK	12	4
			SACK	12	4
LAMP	22	4	LOCK	24	4
			LUNG	18	4
			LEND	29	4
			LIFT	28	4
			LAWN	14	4
			LEAP	21	4
PILLOW	11	6	PENCIL	14	6
			PARCEL	12	6
			PROVES	8	6
			PRICED	11	6
			PATENT	13	6
			PILLAR	10	6
WARDROBE	11	8	WORKINGS	7	8
			WANDERED	10	8

	WOODLAND	13	8
	WILDLIFE	20	8
	WEEKENDS	10	8
	WRITINGS	11	8

Full list of words in the Stroop task in Study Four

Food word	Frequency	Word Length	Matched Neutral	Frequency	Word Length
CAKE	38	4	COAT	42	4
			CORE	36	4
			CREW	40	4
			CROP	31	4
			COOL	40	4
			CAST	37	4
TOAST	10	5	TYRES	8	5
			TRUNK	12	5
			TORCH	12	5
			TRAIL	11	5
			TOWEL	13	5
			TENTH	11	5
CHIPS	36	5	CRAFT	25	5
			COACH	37	5
			CHEEK	35	5
			CHIEF	38	5
			COAST	49	5
			CLOUD	37	5
SWEET	21	6	STEEL	38	6
			SOLID	35	6
			SLEEP	39	6
			SHIRT	36	6
			SMELL	31	6
			SWING	34	6
PUDDING	11	7	PROVING	11	7
			PURSUIT	16	7
			POCKETS	16	7
			PARKING	15	7
			PAINTER	20	7
			PARCELS	5	7

CHOCOLATE	24	9	CONTINENT	21	9
			CATALOGUE	30	9
			COVERAGE	22	8
			CONSTABLE	22	9
			COLLECTOR	19	9
			CONTAINER	16	9
BISCUIT	16	7	BRIGADE	13	7
			BOOKLET	12	7
			BALCONY	11	7
			BRACKET	10	7
			BUILDER	19	7
			BLANKET	17	7
SANDWICH	19	8	STIMULUS	23	8
			SANCTION	16	8
			SELECTED	14	8
			SQUADRON	15	8
			SYMBOLIC	14	8
			SPECTRUM	20	8
CHIPS	36	5	CHIEF	38	5
			CRAFT	25	5
			COAST	46	5
			COACH	37	5
			CLOUD	37	5
			CHEEK	35	5
SANDWICH	19	8	STIMULUS	23	8
			SPECTRUM	20	8
			SYMBOLIC	14	8
			SELECTED	29	8
			SQUADRON	15	8
			SANCTION	16	8
TOAST	5		TORCH	12	5
			TYRES	8	5
			TOWEL	13	5

		TENTH	11	5
		TRUNK	12	5
		TRAIL	11	5
PUDDING	7	POCKETS	16	7
		PARKING	15	7
		PARCELS	5	7
		PURSUIT	16	7
		PAINTER	20	7
		PROVING	11	7
CHOCOLATE	9	COLLECTOR	19	9
		CATALOGUE	30	9
		CONTINENT	21	9
		CONSTABLE	22	9
		CONTAINER	16	9
		COVERAGE	22	9
CAKE	4	CAST	37	4
		CREW	40	4
		COOL	40	4
		CORE	36	4
		CROP	31	4
		COAT	42	4
SWEET	5	SOLID	35	5
		SMELL	31	5
		STEEL	38	5
		SHIRT	36	5
		SWING	34	5
		SLEEP	39	5
BISCUIT	7	BOOKLET	12	7
		BRACKET	10	7
		BRIGADE	13	7
		BLANKET	17	7
		BALCONY	11	7
		BUILDER	19	7

Household word	Frequency	Word length	Matched Neutral	Frequency	Word length
CARPET	34	6	CAUSES	26	6
			CHEQUE	29	6
			CATTLE	26	6
			CLAIMS	37	6
			CAMERA	39	6
			CUSTOM	37	6
CABINET	69	7	CONSIST	64	7
			CONTRAST	66	7
			COMMENT	75	7
			CONCEPT	64	7
			COMBINE	59	7
			CAPTAIN	56	7
CLOCK	33	5	CLUBS	38	5
			CABLE	25	5
			CLOTH	22	5
			CARDS	39	5
			CALLS	31	5
			CHECK	27	5
CURTAINS	20	8	CHECKING	16	8
			COLLEGES	25	8
			CHAPTERS	20	8
			CONSISTS	26	8
			CEREMONY	22	8
			COLONIAL	15	8
CUPBOARD	19	8	CHOOSING	17	8
			COINCIDE	16	8
			CARRIAGE	24	8
			COMPOSED	20	8
			COMPOUND	20	8
			CONCRETE	18	8
SOFA	12	4	SOLE	22	4
			SAIL	12	4

			SUMS	15	4
			SITS	12	4
			SOCK	12	4
			SACK	12	4
LAMP	22	4	LOCK	24	4
			LUNG	18	4
			LEND	29	4
			LIFT	28	4
			LAWN	14	4
			LEAP	21	4
WARDROBE	11	8	WORKINGS	7	8
			WANDERED	10	8
			WOODLAND	13	8
			WILDLIFE	20	8
			WRAPPING	2	8
			WRITINGS	11	8
CARPET	34	6	CHEQUE	29	6
			CATTLE	26	6
			CLAIMS	37	6
			CAMERA	39	6
			CAUSES	26	6
			CUSTOM	37	6
CUPBOARD	19	7	CHOOSING	17	8
			COINCIDE	16	8
			CARRIAGE	24	8
			COMPOSED	20	8
			COMPOUND	20	8
			CONCRETE	18	8
LAMP	33	5	LEND	29	5
			LEAP	21	5
			LIFT	28	5
			LUNG	18	5
			LAWN	14	5

			LOCK	24	5
CURTAINS	20	8	COLLEGES	25	8
			CHAPTERS	20	8
			COLONIAL	15	8
			CHECKING	16	8
			CEREMONY	22	8
			CONSISTS	26	8
WARDROBE	19	8	WRAPPING	2	8
			WOODLAND	13	8
			WANDERED	10	8
			WILDLIFE	20	8
			WRITINGS	11	8
			WORKINGS	7	8
CLOCK	33	4	CARDS	39	4
			CLUBS	38	4
			CHECK	27	4
			CLOTH	22	4
			CALLS	31	4
			CABLE	25	4
SOFA	22	4	SOLE	22	4
			SAIL	12	4
			SUMS	15	4
			SOCK	12	4
			SITS	12	4
			SACK	12	4
CABINET	69	8	CONSIST	64	8
			CONTRAST	66	8
			COMMENT	75	8
			CONCEPT	64	8
			COMBINE	59	8
			CAPTAIN	56	8

Study Two Food Word Ratings (*n*=44)

Food Word	*Mean*	*SD*
Cake	70.3	22.6
Chips	63.34	24.77
Cream*	32.77*	28.83
Butter*	27.86*	25.02
Chocolate	81.82	19.2
Biscuit	68.34	24.29
Pie*	41.55*	29.03
Sugar*	48.89*	26.05
Toast	59.59	26.22
Sandwich	57.93	27.48
Pudding	63.82	25.53
Sweet	69.57	25.49
Overall Mean	57.15	12.67

* = *rating below 50*

Study Two Interpersonal Ego Threat Word Ratings (*n*=97)

Ego Threat Word	*Mean*	*SD*
Judged	1.55	.63
Embarrassed	1.45	.6
Exploited	1.27	.59
Dismissed	1.63	.59
Blamed	1.34	.56
Undermined	1.49	.68
Ignored	1.5	.72
Condemned	1.41	.73
Criticised	1.6	.73
Rejected	1.3	.77
Attacked	1.3	.58
Hated	1.19	.71
Overall mean	1.45	.56

Study Two Household Object Word Ratings (*n*=97)

Household Object	*Mean*	*SD*
Cabinet	2.92	.33
Sofa	3.39	.73
Curtains	3.01	.21
Wardrobe	3.17	.45
Carpet	3.06	.29
Clock	3	.38
Sink	2.76	.52
Cupboard	3	.42
Bath	3.8	.88
Photo	3.49	.76
Lamp	3.09	.41
Pillow	3.6	.86
Overall mean	3.2	.43

Study Two Non-Categorical Neutral Word Ratings (*n*=53)

Non-Target Neutral Word	*Mean*	*SD*	*Non-Target Neutral Word*	*Mean*	*SD*
Undergoing	2.35	.8	Choosing	3.23	.71
Underlined	2.77	.65	Coincide	3.08	.63
Underneath	2.58	.64	Compound	2.73	.6
Utterances	2.69	.55	Composed	3.46	.76
Utilities	3.04	.6	Concrete	2.5	.71
Unchanged	2.73	.78	Circulate	3	.63
Basket	3	.49	Commodity	3.31	.62
Breeze	3.23	.86	Copyright	2.5	.76
Bronze	3.42	.76	Colourful	4.27*	.92
Button	3.04	.66	Consensus	3.15	.61
Banker	2.69	.79	Criterion	2.96	.54
Bucket	2.92	.48	Blanket	3.58	.76
Cable	2.92	.39	Brigade	2.92	.48
Check	3.27	.72	Builder	2.88	.52
Clubs	3.35	.85	Bargain	4*	.94
Calls	3.35	.85	Balcony	3.42	.9
Cloth	2.92	.48	Booklet	3	.49
Cards	3.31	.79	Bare	2.69	.74
Install	3.08	.8	Bell	3.04	.6
Invited	4.35*	.49	Boot	3.08	.84
Islands	3.5	.91	Bend	2.73	.6
Insight	3.96	.54	Boss	2.5	1.03
Inquiry	3.12	.65	Bowl	2.96	.53
Implies	2.89	.71	Commentary	2.88	.65
Companion	4.69*	.55	Compliance	3.19	.85
Constable	2.88	.52	Compatible	4.27*	.6
Coverage	3	.49	Compensate	3.38	.8
Continent	3.12	.59	Conscience	3.38	.64
Catalogue	3.19	.63	Coordinate	3.38	.75
Collector	2.9	.63	Crop	2.62	.64
Carriage	3.31	.74	Coat	3.12	.86
Cool	3.65	.98	Curve	3.19	.63
Patch	2.88	.43	Clerk	2.77	.65
Paint	3.07	.69	Canal	3.08	.63
Plain	2.27	.67	Count	2.96	.45
Pulse	3.5	.91	Patent	2.88	.52

Proof	3.31	.68	Pencil	3	.75
Penny	3.27	.72	Pillar	2.88	.59
Reaching	3.31	.47	Parcel	3.65	.89
Resident	2.96	.53	Priced	2.62	.64
Realised	3.78	.51	Proves	3.42	.58
Recovery	4.35*	.85	Elaborate	3.44	.7
Register	3	.57	Empirical	3.07	.62
Relative	4.08*	.8	Evidently	3.15	.36
Cheek	3	.75	Economist	3.04	.59
Cloud	2.78	.82	Envelopes	3.04	.34
Coach	2.96	.53	Exemption	2.85	.99
Coast	3.58	.81	Parking	2.81	.57
Chief	2.88	.71	Premier	4.08*	.69
Craft	3.08	.8	Pursuit	3.48	.85
Leap	3.34	.75	Proving	3.63	.79
Lock	2.65	.63	Painter	3.11	.32
Lift	3.27	.67	Pockets	3.07	.27
Lung	3.04	.53	Ceremony	3.59	.89
Lawn	3.19	.63	Colleges	3.33	.62
Lend	3.52	.59	Colonial	2.85	.66
Hedge	2.85	.54	Checking	2.96	.52
Holly	3.31	.74	Chapters	3.11	.58
Hurry	2.27	.53	Consists	3.07	.27
Herbs	2.96	.66	Departure	2.22	.85
Hired	3.65	1.13	Detective	2.81	.74
Heels	3.5	.99	Discourse	2.7	.54
Chart	2.88	.43	Discovery	4.15*	.6
Cease	2.5	.76	Describes	3.26	.53
Steel	2.89	.32	Jumped	3.19	.62
Solid	3.11	.42	Jungle	3.24	.6
Shirt	3.11	.32	Junior	3	.63
Sleep	3.93	.83	Joking	3.9	.89
Swing	3.11	.32	Pad	2.96	.19
Smell	2.41	.97	Pin	2.63	.49
Wandered	3.04	.65	Pet	3.7	.67
Wildlife	3.63	.79	Pan	3	.28
Woodland	3.3	.72	Pat	3	.48
Writings	3.19	.4	Pop	3.22	.58
Weekends	4.3*	.72	Scan	2.63	.63
Workings	2.59	.69	Seal	3.11	.75

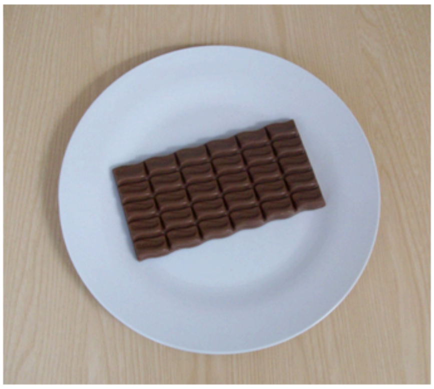
Ballet	3.31	.84	Solo	2.56	.75
Barrel	2.89	.7	Stem	3	.39
Bucket	2.96	.34	Spin	3.07	.47
Banker	2.59	.57	Spur	2.93	.68
Bounce	3.41	.64	Accurate	4.04*	.76
Behalf	3.07	.38	Addition	3.3	.78
Tenth	2.81	.62	Advanced	4.11*	.85
Trunk	2.93	.27	Absolute	3.59	.84
Towel	3.11	.32	Assessed	2.38	.8
Tyres	2.96	.34	Ambition	4.41*	.69
Trail	3.11	.42	Solve	3.96	.81
Torch	3.07	.47	Scope	3.3	.61
Camera	3.44	.75	Shift	2.93	.27
Custom	3.11	.51	Sharp	2.41	.89
Causes	2.74	.53	Shell	2.93	.73
Cheque	3.52	.75	Score	3.63	.79
Cattle	3	.39	Comment	2.96	.44
Claims	2.56	.75	Consist	3	.28
Jewish	2.89	.32	Concept	3.26	.45
Joints	2.85	.46	Combine	3.41	.57
Electronics	2.85	.66			
Evolutionary	3.7	.72			
Exhibitions	3.3	.72			
Encountered	3.04	.65			
Exploration	3.74	1.06			
Established	3.63	.74			
Sanction	2.48	.89			
Spectrum	2.93	.47			
Symbolic	3.3	.47			
Stimulus	3.26	.66			
Selected	3.37	.88			
Squadron	2.85	.66			
Sock	3.07	.38			
Sack	2.89	.51			
Sole	2.96	.34			
Sums	2.81	.69			
Sail	3.19	.49			
Sits	3.07	.38			
Overall Mean	3.15	.27			

** = words >1 away from 3*

Example food/neutral picture pairs from dot probe task in Study Two








Appendix 10: Example food/neutral picture pairs from dot probe task in Study Two

Appendix X: Study Two Dot Probe Image Ratings (*n*=44)

Food Image	*Mean (SD)*	*Matched Neutral Image*	*Mean (SD)*
Bagel*	42.48 (27.2)*	CD	3.17 (.5)
Biscuits	55.8 (26.16)	Toy cars	3.19 (.63)
Burger	53.98 (25.81)	Sponge	3.19 (.76)
Cake	59.66 (28.39)	Wooden blocks	3.12 (.76)
Cheese	55 (31.51)	Washing up sponge	2.37 (.85)
Chocolate	78.32 (22.75)	Calculator	2.4 (.98)
Cooked breakfast	57.34 (29.92)	Stationary	2.7 (.94)
Chocolate Milkshake	59.39 (36.36)	Toothbrush in glass	3.42 (.66)
Nachos	61.25 (30.71)	Pencil shavings	2.44 (.83)
Popcorn*	48.43 (31.14)*	Marbles	3.81 (.66)
Spaghetti Bolognaise*	48.84 (28.99)*	Wool	2.65 (.92)
Sweets	55.95 (31.94)	Pot pouirri	2.95 (1.13)
Chips	61.43 (27.61)	Pencils	3 (.65)
Cupcake	68.91 (21.94)	Tennis ball	3.79 (.8)
Onion Rings*	39.84 (32.3)*	Bracelets	3.79 (.77)
Hot chocolate	72.05 (27.21)	Paint	3.58 (.85)
Pizza	68.75 (29.14)	Protractor	2.19 (.76)
Doughnut	58.89 (32.86)	Hair scrunchie	2.58 (.7)
Cheesecake	62.68 (31.81)	Shuttlecock	3.58 (.7)
Toffee Pudding	57.95 (35.9)	Cuddly Toy*	4.19 (.82)*
Overall Mean	58.34 (14.95)	Overall mean	3.11 (.27)

** = images rated below 50   * = images rated >1 away from 3*

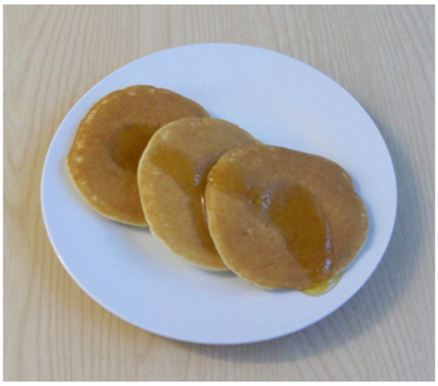
Appendix XI: Further image ratings (*n*=11)

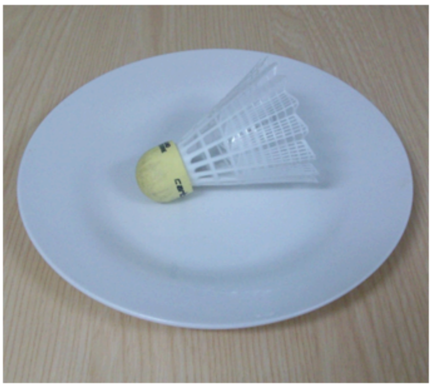
Food Image	*Mean (SD)*	*Matched Neutral Image*	*Mean (SD)*
Bagel 1	48.73* (23.17)	CD	3 (.45)
Bagel 2	43.73* (16.24)	Cellotape	3.36 (.5)
Biscuits	49* (20.95)	Toy cars	3.18 (.87)
Burger	47.82* (22.49)	Sponge	3 (.77)
Cake	53.36 (27.64)	Wooden blocks	3.55 (.69)
Cheese on toast	25.36* (17.56)	Washing up sponge	2.64 (.5)
Chocolate	55 (25.48)	Calculator	3.09 (1.04)
Cooked breakfast	47.14* (26.32)	Stationary	3.18 (.75)
Milkshake	57.91 (26.06)	Toothbrush in a glass	3 (.45)
Nachos	46.86* (30.25)	Pencil shavings	3 (.77)
Popcorn	36.59* (30.62)	Marbles	3.73 (.79)
Spaghetti bolognaise	29.14* (22.69)	Wool	2.91 (.3)
Pasta with tomato sauce	51.09 (28.2)		
Pasta with pesto	48.5* (22.48)		
Sweets	50.09 (33.4)	Pot pouirri	3.27 (.47)
Chips	43.64* (21.12)	Pencils	3.27 (.47)
Cupcake	53.05 (31.91)	Tennis ball	3.45 (.69)
Onion rings	31.82* (22.16)	Bracelets	3.27 (.65)
Hot chocolate	60.55 (23.23)	Paint	3 (.77)
Pizza	38.95* (18.72)	Protractor	3.18 (.4)
Doughnut	60.18 (28.6)	Hair scrunchie	2.91 (.83)
Cheesecake	56.82 (25.16)	Shuttlecock	3.36 (.67)
Toffee pudding	48.09* (30.51)	Toy	3.63 (.67)
		Scrunched up paper	2.73 (.47)
Pancakes 1	58.45 (19.3)	Cotton pads 1	3 (.45)
Pancakes 2	69.64 (16.58)	Cotton pads 2	3.09 (.3)
Cookies	54.64 (25.71)	Leaves	3 (.63)
Éclair	46.73* (26.88)	Glasses case	2.9 (.3)
Ice cream	63.59 (29.69)	Cotton wool	3.18 (.6)
Muffin	55.27 (26.38)	Ball of wool	3 (0)
Nuggets	26.55* (21.88)	Pebbles	3.27 (.47)
Pie	19.18* (20.13)	Pot	3.36 (.81)
Pringles	38.09* (23.4)	Post it notes	3.36 (.81)
Overall Mean	47.36 (15.75)	Overall Mean	3.15 (.19)

** = image ratings below 50*

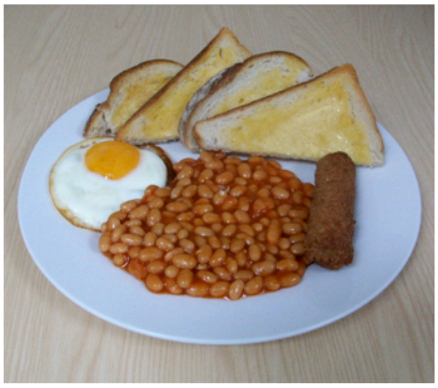
<u>Example food/neutral pictures pairs from dot probe task in study three</u>





Appendix 13: Example food/neutral picture pairs from dot probe task in study three



Study Three Dot Probe Image Ratings (*n*=60)

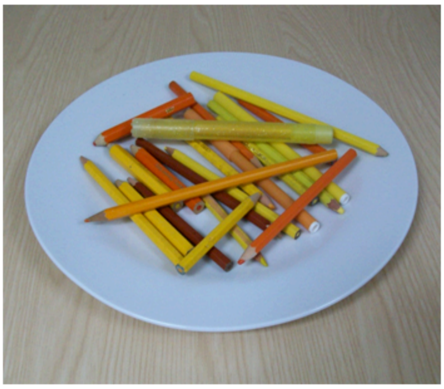
Food Image	*Mean (SD)*	*Matched Neutral Image*	*Mean (SD)*
Biscuits	53.73 (25.73)	Toy cars	3.07 (.66)
Burger*	47.95 (24.48)*	Sponge	3.38 (.72)
Cake	62.15 (24.98)	Wooden blocks	3 (.66)
Cheese on toast*	47.95 (27.87)*	Washing up sponge	2.53 (.83)
Chocolate	65.65 (25.26)	Calculator	2.45 (.91)
Cooked breakfast*	44.38 (30.53)*	Stationary	2.85 (.95)
Milkshake	56.97 (32.81)	Toothbrush	3.33 (.75)
Nachos	59.97 (29.18)	Pencil shavings	2.4 (.91)
Pasta	51.83 (29.03)	Wool	2.6 (.83)
Sweets*	49.38 (30.71)*	Pot pouirri	3.53 (.83)
Chips*	49.77 (27.54)*	Pencils	3.2 (.68)
Cupcake	56.63 (25.4)	Tennis ball	3.62 (.98)
Hot chocolate	54.17 (31.08)	Paint	3.2 (.78)
Pizza	56.8 (25.38)	Protractor	2.43 (.93)
Doughnut*	44.43 (28.29)*	Hair scrunchie	2.93 (.9)
Cheesecake	54.38 (28.62)	Shuttlecock	3.45 (.81)
Toffee pudding	52.1 (29.35)	Scrunched up paper	2.33 (.75)
Scotch pancakes*	47.32 (27.18)*	Cotton pads	3.13 (.72)
Ice cream sundae	57.02 (28.11)	Cotton wool	3.02 (.85)
Muffin	56.07 (28.11)	Ball of wool	2.85 (.63)
Overall mean	53.43 (13.43)	Overall mean	2.97 (.24)

** = image ratings under 50*

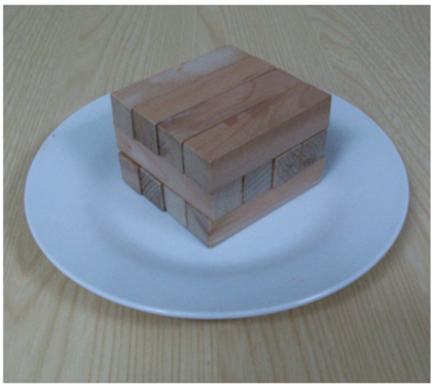
Combined ratings

Food Image	*Mean (SD) n=115*
Biscuits	54.1 (25.35)
Burger	50.24 (24.79)
Cake	60.36 (26.47)
Cheese on toast	48.49 (29.52)
Chocolate	69.48 (25.31)
Cooked breakfast	49.53 (30.29)
Chocolate milkshake	57.98 (33.41)
Nachos	59.2 (28.89)
Sweets	52 (31.32)
Chips	53.64 (27.57)
Cupcake	61 (25.4)
Hot chocolate	61.62 (30)
Pizza	59.67 (27.61)
Doughnut	51.47 (30.79)
Cheesecake	57.79 (29.61)
Toffee pudding	53.96 (32.01)
Food Image	*Mean (SD) n=71*
Pasta with tomato sauce	51.72 (28.7)
Pancakes	50.77 (26.98)
Ice cream	58.04 (28.82)
Muffin	55.94 (27.67)

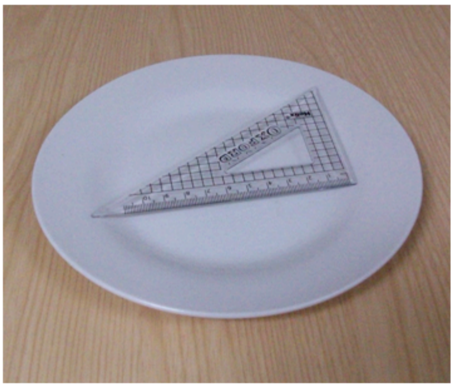
Example food/neutral picture pairs from dot probe task in study four





Appendix 16: Example food/neutral picture pairs from dot probe task in study four



Dutch Eating Behaviour Questionnaire

DEBQ

Please indicate the answer that applies to you by placing a bold mark through the appropriate response box from the 5 options. There are 33 questions - please answer all questions.

	Never	Seldom	Sometimes	Often	Very often
1. When you have put on weight do you eat less than you usually do?	☐	☐	☐	☐	☐
2. Do you try to eat less at mealtimes than you would like to eat?	☐	☐	☐	☐	☐
3. How often do you refuse food or drink offered because you are concerned about your weight?	☐	☐	☐	☐	☐
4. Do you watch exactly what you eat?	☐	☐	☐	☐	☐
5. Do you deliberately eat foods that are slimming?	☐	☐	☐	☐	☐
6. When you have eaten too much, do you eat less than usual the following day?	☐	☐	☐	☐	☐
7. Do you deliberately eat less in order not to become heavier?	☐	☐	☐	☐	☐
8. How often do you try not to eat between meals because you are watching your weight?	☐	☐	☐	☐	☐
9. How often in the evenings do you try not to eat because you are watching your weight?	☐	☐	☐	☐	☐
10. Do you take your weight into account with what you eat?	☐	☐	☐	☐	☐
11. Do you have a desire to eat when you are irritated?	☐	☐	☐	☐	☐
12. Do you have a desire to eat when you have nothing to do?	☐	☐	☐	☐	☐
13. Do you have a desire to eat when you are depressed or discouraged?	☐	☐	☐	☐	☐
14. Do you have a desire to eat when you are feeling lonely?	☐	☐	☐	☐	☐
15. Do you have a desire to eat when somebody lets you down?	☐	☐	☐	☐	☐

	Never	Seldom	Sometimes	Often	Very often
16. Do you have a desire to eat when you are cross?	☐	☐	☐	☐	☐
17. Do you have a desire to eat when something unpleasant is about to happen?	☐	☐	☐	☐	☐
18. Do you get the desire to eat when you are anxious, worried or teased?	☐	☐	☐	☐	☐
19. Do you have a desire to eat when things are going against you or have gone wrong?	☐	☐	☐	☐	☐
20. Do you have a desire to eat when you are frightened?	☐	☐	☐	☐	☐
21. Do you have a desire to eat when you are disappointed?	☐	☐	☐	☐	☐
22. Do you have a desire to eat when you are emotionally upset?	☐	☐	☐	☐	☐
23. Do you have a desire to eat when you are bored or restless?	☐	☐	☐	☐	☐
24. If food tastes good to you, do you eat more than usual?	☐	☐	☐	☐	☐
25. If food smells and looks good, do you eat more than usual?	☐	☐	☐	☐	☐
26. If you see or smell something delicious, do you have a desire to eat it?	☐	☐	☐	☐	☐
27. If you see or smell something delicious, do you eat it straight away?	☐	☐	☐	☐	☐
28. If you see others eating, do you also want to eat?	☐	☐	☐	☐	☐
29. Do you eat more than usual when you see others eating?	☐	☐	☐	☐	☐
30. When preparing a meal are you inclined to eat something?	☐	☐	☐	☐	☐
31. If you walk past the bakery do you have the desire to buy something delicious?	☐	☐	☐	☐	☐
32. If you walk past a snack bar or a café, do you have the desire to buy something delicious?	☐	☐	☐	☐	☐
33. Can you resist eating delicious food?	☐	☐	☐	☐	☐

Eating Disorder Inventory-II

EDI-2: Eating subscales

The following items ask about your own attitudes, feelings and behaviour. The items relate to food or eating.

For each item, decide if the item is true about you **ALWAYS** (A), **USUALLY** (U), **OFTEN** (O), **SOMETIMES** (S), **RARELY** (R), or **NEVER** (N). Circle the letter that corresponds to your rating. For example, if your rating for an item is OFTEN, you would circle the (O) for that item. Try to respond to all of the items, making sure that you circle the letter for the rating that is true about you.

1) I eat sweets and carbohydrates without feeling nervous	A U O S R N
2) I think that my stomach is too big	A U O S R N
3) I eat when I am upset	A U O S R N
4) I stuff myself with food	A U O S R N
5) I think about dieting	A U O S R N
6) I think that my thighs are too large	A U O S R N
7) I feel extremely guilty after overeating	A U O S R N
8) I think that my stomach is just the right size	A U O S R N
9) I am terrified of gaining weight	A U O S R N
10) I feel satisfied with the shape of my body	A U O S R N
11) I exaggerate or magnify the importance of weight	A U O S R N
12) I have gone on eating binges where I have felt that I could not stop	A U O S R N
13) I like the shape of my buttocks	A U O S R N
14) I am preoccupied with the desire to be thinner	A U O S R N
15) I think about bingeing (overeating)	A U O S R N
16) I think my hips are too big	A U O S R N
17) I eat moderately in front of others and stuff myself when they're gone	A U O S R N
18) If I gain a pound, I worry that I will keep gaining	A U O S R N
19) I have the thought of trying to vomit to lose weight	A U O S R N
20) I think that my thighs are just the right size	A U O S R N
21) I think my buttocks are too large	A U O S R N
22) I eat or drink in secrecy	A U O S R N
23) I think that my hips are just the right size	A U O S R N

Binge Eating Scale

Eating habits checklist (BES)

***Instructions**:* Below are groups of numbered statements. Read all of the statements in each group and circle the number that best describes the way you feel about the problems you have controlling your eating behaviour.

#l
1. I don't feel self-conscious about my weight or body size when I'm with others.
2. I feel concerned about how I look to others, but it normally does not make me feel disappointed with myself.
3. I do get self-conscious about my appearance and weight which makes me feel disappointed in myself.
4. I feel very self-conscious about my weight and frequently, I feel intense shame and disgust for myself. I try to avoid social contacts because of my self-consciousness.

#2
1. I don't have any difficulty eating slowly in the proper manner.
2. Although I seem to "gobble down" foods, I don't end up feeling stuffed because of eating too much.
3. At times, I tend to eat quickly and then, I feel uncomfortably full afterwards.
4. I have the habit of bolting down my food, without really chewing it. When this happens I usually feel uncomfortably stuffed because I've eaten too much.

#3
1. I feel capable to control my eating urges when I want to.
2. I feel like I have failed to control my eating more than the average person.
3. I feel utterly helpless when it comes to feeling in control of my eating urges.
4. Because I feel so helpless about controlling my eating I have become very desperate about trying to get in control.

#4
1. I don't have the habit of eating when I'm bored.
2. I sometimes eat when I'm bored, but often I'm able to "get busy" and get my mind off food.
3. I have a regular habit of eating when I'm bored, but occasionally, I can use some other activity to get my mind off eating.
4. I have a strong habit of eating when I'm bored. Nothing seems to help me break the habit.

#5
1. I'm usually physically hungry when I eat something.
2. Occasionally, I eat something on impulse even though I really am not hungry.
3. I have the regular habit of eating foods that I might not really enjoy, to satisfy a hungry feeling even though physically I don't need the food.
4. Even though I'm not physically hungry, I get a hungry feeling in my mouth that only seems to be satisfied when I eat a food, like a sandwich, that fills my mouth. Sometimes, when I eat the food to satisfy my mouth hunger, I then spit the food out so I won't gain weight.

#6
1. I don't feel any guilt or self-hate after I overeat.
2. After I overeat, occasionally I feel guilt or self-hate.
3. Almost all the time I experience strong guilt or self-hate after I overeat.

#7
1. I don't lose total control of my eating when dieting even after periods when I overeat.
2. Sometimes when I eat a "forbidden food" on a diet, I feel like I "blew it" and eat even more.
3. Frequently, I have the habit of saying to myself, "I've blown it now, why not go all the way" when I overeat on a diet. When that happens I eat even more.
4. I have a regular habit of starting strict diets for myself, but I break the diets by going on an eating binge. My life seems to be either a "feast" or "famine."

#8
1. I rarely eat so much food that I feel uncomfortably stuffed afterwards.
2. Usually about once a month, I eat such a quantity of food, I end up feeling very stuffed.

3. I have regular periods during the month when I eat large amounts of food, either at mealtime or at snacks.
4. I eat so much food that I regularly feel quite uncomfortable after eating and sometimes a bit nauseous.

#9
1. My level of calorie intake does not go up very high or go down very low on a regular basis.
2. Sometimes after I overeat, I will try to reduce my caloric intake to almost nothing to compensate for the excess calories I've eaten.
3. I have a regular habit of overeating during the night. It seems that my routine is not to be hungry in the morning but overeat in the evening.
4. In my adult years, I have had week-long periods where I practically starve myself. This follows periods when I overeat. It seems I live a life of either "feast or famine."

#10
1. I usually am able to stop eating when I want to. I know when "enough is enough."
2. Every so often, I experience a compulsion to eat which I can't seem to control.
3. Frequently, I experience strong urges to eat which I seem unable to control, but at other times I can control my eating urges.
4. I feel incapable of controlling urges to eat. I have a fear of not being able to stop eating voluntarily.

#11
1. I don't have any problem stopping eating when I feel full.
2. I usually can stop eating when I feel full but occasionally overeat leaving me feeling uncomfortably stuffed.
3. I have a problem stopping eating once I start and usually I feel uncomfortably stuffed after I eat a meal.
4. Because I have a problem not being able to stop eating when I want, I sometimes have to induce vomiting to relieve my stuffed feeling.

#12
1. I seem to eat just as much when I'm with others (family, social gatherings) as when I'm by myself.
2. Sometimes, when I'm with other persons, I don't eat as much as I want to eat because I'm self-conscious about my eating.
3. Frequently, I eat only a small amount of food when others are present, because I'm very embarrassed about my eating.
4. I feel so ashamed about overeating that I pick times to overeat when I know no one will see me. I feel like a "closet eater."

#13
1. I eat three meals a day with only an occasional between meal snack.
2. I eat 3 meals a day, but I also normally snack between meals.
3. When I am snacking heavily, I get in the habit of skipping regular meals.
4. There are regular periods when I seem to be continually eating, with no planned meals.

#14
1. I don't think much about trying to control unwanted eating urges.
2. At least some of the time, I feel my thoughts are pre-occupied with trying to control my eating urges.
3. I feel that frequently I spend much time thinking about how much I ate or about trying not to eat anymore.
4. It seems to me that most of my waking hours are pre-occupied by thoughts about eating or not eating. I feel like I'm constantly struggling not to eat.

#15
1. I don't think about food a great deal.
2. I have strong cravings for food but they last only for brief periods of time.
3. I have days when I can't seem to think about anything else but food.
4. Most of my days seem to be pre-occupied with thoughts about food. I feel like I live to eat.

#16
1. I usually know whether or not I'm physically hungry. I take the right portion of food to satisfy me.
2. Occasionally, I feel uncertain about knowing whether or not I'm physically hungry. At these times it's hard to know how much food I should take to satisfy me.
3. Even though I might know how many calories I should eat, I don't have any idea what is a "normal" amount of food for me.

Three Factor Eating Questionnaire

TFEQ-D

This questionnaire contains a number of statements. Each statement should be answered either TRUE or FALSE, in part I. Read each statement and decide how you feel about it. If you agree with the statement, circle the T next to the statement. If you disagree circle the F next to the statement.

Part I.

1. When I smell a sizzling steak or see a juicy piece of meat I find it very difficult to keep from eating, even if I have just finished a meal.	T	F
2. I usually eat too much at social occasions, like parties and picnics.	T	F
3. Sometimes things just taste so good that I keep on eating, even when I am no longer hungry.	T	F
4. When I feel anxious I find myself eating.	T	F
5. Since my weight goes up and down, I have gone on reducing diets more than once.	T	F
6. When I am with someone who is overeating, I usually overeat too.	T	F
7. Sometimes when I start eating, I just can't seem to stop.	T	F
8. It is not difficult for me to leave something on my plate.	T	F
9. When I feel blue I often overeat.	T	F
10. My weight has hardly changed at all in the last ten years.	T	F
11. When I feel lonely, I console myself by eating.	T	F
12. Without even thinking about it I take a long time to eat.	T	F
13. While on a diet, if I eat food that is not allowed, I often then splurge and eat other high calorie foods.	T	F

Part II.

Please answer the following questions by circling the number above the response that is appropriate for you.

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

1	2	3	4
never	rarely	often	always

15. Do you go on eating binges even though you are not hungry?

1	2	3	4
never	rarely	sometimes	at least once a week

16. To what extent does this statement describe your eating behaviour ?

'I start dieting in the morning, but because of any number of things that happen during the day, by evening I have given up and eat what I want, promising myself to start dieting again tomorrow.'

1	2	3	4
not like me	a little like me	pretty good description	describes me perfectly

Positive and Negative Affect Scale

Please read this carefully.
This scale consists of a number of words that describe different feelings and emotions. Read each word and indicate to what extent you feel this way at this precise moment by placing a bold mark under the appropriate response from the 5 options below, e.g. {ð}.

	Not at all	A little	Moderately	Quite a bit	Extremely
Interested	{}	{}	{}	{}	{}
Distressed	{}	{}	{}	{}	{}
Excited	{}	{}	{}	{}	{}
Upset	{}	{}	{}	{}	{}
Strong	{}	{}	{}	{}	{}
Guilty	{}	{}	{}	{}	{}
Scared	{}	{}	{}	{}	{}
Hostile	{}	{}	{}	{}	{}
Enthusiastic	{}	{}	{}	{}	{}
Proud	{}	{}	{}	{}	{}
Irritable	{}	{}	{}	{}	{}
Alert	{}	{}	{}	{}	{}
Ashamed	{}	{}	{}	{}	{}
Inspired	{}	{}	{}	{}	{}
Nervous	{}	{}	{}	{}	{}
Determined	{}	{}	{}	{}	{}
Attentive	{}	{}	{}	{}	{}
Jittery	{}	{}	{}	{}	{}
Active	{}	{}	{}	{}	{}
Afraid	{}	{}	{}	{}	{}

Beck's Depression Inventory-II

BDI-II

This questionnaire consists of 21 groups of statements. Please read each group of statements carefully and then pick out the **one statement** in each group that best describes the way you have been feeling during the **PAST TWO WEEKS (INCLUDING TODAY).** Circle the number beside the statement that you have picked. If several statements in the group seem to apply equally well circle the highest number for that group. Be sure that you do not choose more than one statement from each group, including item 16 (Changes in Sleeping Pattern) or item 18 (Changes in Appetite).

1. Sadness

0 I do not feel sad.
1 I feel sad much of the time.
2 I am sad all of the time.
3 I am so sad or unhappy that I can't stand it.

2. Pessimism

0 I am not discouraged about the future.
1 I feel more discouraged about my future than I used to be.
2 I do not expect things to work out for me.
3 I feel my future is hopeless and will only get worse.

3. Past Failure

0 I do not feel like a failure.
1 I have failed more than I should have.
2 As I look back, I see a lot of failures.
3 I feel I am a total failure as a person.

4. Loss of Pleasure

0 I get as much pleasure as I ever did from the things I enjoy.
1 I don't enjoy things as much as a I used to.
2 I get very little pleasure from the things I used to enjoy.
3 I can't get any pleasure from the things I used to enjoy.

5. Guilty Feelings

0 I don't feel particularly guilty.
1 I feel guilty over many of the things I have done or not done.
2 I feel quite guilty most of the time.
3 I feel guilty all the time.

6. Punishment feelings

0 I don't feel that I am being punished.
1 I feel I may be punished.
2 I expect to be punished.
3 I feel that I am being punished.

7. Self-dislike

0 I feel the same about myself as ever.
1 I have lost confidence in myself.
2 I am disappointed with myself.
3 I dislike myself.

8. Self-Criticalness

0 I don't criticise or blame myself more than usual.
1 I am more critical of myself than I used to be.
2 I criticise myself for all of my faults.
3 I blame myself for everything that happens to me.

9. Suicidal Thought or Wishes

0 I don't have any thoughts of killing myself.
1 I have thoughts of killing myself, but I would not carry them out.
2 I would like to kill myself.
3 I would kill myself if I had the chance.

10. Crying

0 I don't cry any more than I used to.
1 I cry more than I used to.
2 I cry over every little thing.
3 I feel like crying but I can't.

11.		**Agitation**	**17.**		**Irritability**
	0	I am no more restless or wound up than I used to be.		0	I am no more irritable than usual.
	1	I feel more restless or wound up than I used to.		1	I am more irritable than usual.
	2	I am so restless or agitated that it's hard to stay still.		2	I am much more irritable than usual.
	3	I am so restless or agitated that I have to keep moving or doing something.		3	I am irritable all the time.
12.		**Loss of interest**	**18.**		**Changes in Appetite**
	0	I have not lost interest in other people or activities.		0	I have not experienced any changes in my appetite.
	1	I am less interested in other people or things than before.		1a	My appetite is somewhat less than usual.
				1b	My appetite is somewhat greater than usual.
	2	I have lost most of my interest in other people or things.		2a	My appetite is much less than before.
				2b	My appetite is much greater than usual.
	3	It's hard to get interested in anything.		3a	I have no appetite at all.
				3b	I crave food all the time.
13.		**Indecisiveness**	**19.**		**Concentration Difficulty**
	0	I make decisions about as well as ever.		0	I can concentrate as well as ever.
	1	I find it more difficult to make decisions than usual.		1	I can't concentrate as well as usual.
	2	I have much greater difficulty in making decisions than I used to.		2	It's hard to keep my mind on anything for very long.
	3	I have trouble making decisions.		3	I find that I can't concentrate on anything.
14.		**Worthlessness**	**20.**		**Tiredness of Fatigue**
	0	I do not feel that I am worthless.		0	I am no more tired or fatigued than usual.
	1	I don't consider myself as worthwhile and useful as I used to.		1	I get more tired or fatigued more easily than usual.
	2	I feel more worthless as compared to other people.		2	I am too tired or fatigued to do a lot of the things I used to do.
	3	I feel utterly worthless.		3	I am too tired or fatigued to do most of the things I used to do.
15.		**Loss of Energy**	**21.**		**Loss of Interest in Sex**
	0	I have as much energy as ever.		0	I have not noticed any recent changes in my interest in sex.
	1	I have less energy than I used to have.		1	I am less interested in sex than I used to be.
	2	I don't have enough energy to do very much.		2	I am much less interested in sex now.
	3	I don't have energy to do anything.		3	I have lost interest in sex completely
16.		**Changes in Sleep Pattern**			
	0	I have not experienced any changes in my sleeping pattern.			
	1a	I sleep somewhat more than usual.			
	1b	I sleep somewhat less than usual.			
	2a	I sleep a lot more than usual.			
	2b	I sleep a lot less than usual.			
	3a	I sleep most of the day.			
	3b	I wake up 1-2 hours early and can't get back to sleep.			

Hospital Anxiety and Depression Scale

Read each item and place a firm tick in the box opposite the reply which comes closest to how you have been feeling in the past week. Don't take too long over your replies, your immediate reaction to each item will probably be more accurate than a long thought-out response.
Tick one box only in each section

1 I feel tense or 'wound up':
- Most of the time ☐
- A lot of the time ☐
- Time to time, Occasionally ☐
- Not at all ☐

2 I still enjoy the things I used to enjoy:
- Definitely as much ☐
- Not quite so much ☐
- Only a little ☐
- Hardly at all ☐

3 I get a sort of frightened feeling as if something awful is about to happen:
- Very definitely and quite badly ☐
- Yes, but not too badly ☐
- A little, but it doesn't worry me ☐
- Not at all ☐

4 I can laugh and see the funny side of things:
- As much as I always could ☐
- Not quite so much now ☐
- Definitely not so much now ☐
- Not at all ☐

5 Worrying thoughts go through my mind:
- A great deal of the time ☐
- A lot of the time ☐
- From time to time but not too often ☐
- Only occasionally ☐

8 I fell as if I am slowed down:
- Nearly all the time ☐
- Very often ☐
- Sometimes ☐
- Not at all ☐

9 I get a sort of frightened feeling like 'butterflies' in the stomach:
- Not at all ☐
- Occasionally ☐
- Quite often ☐
- Very often ☐

10 I have lost interest in my appearance:
- Definitely ☐
- I don't take so much care as I should ☐
- I may not take quite as much care ☐
- I take just as much care as ever ☐

11 I feel restless as if I have to be on the move:
- Very much indeed ☐
- Quite a lot ☐
- Not very much ☐
- Not at all ☐

12 I look forward with enjoyment to things:
- As much as I ever did ☐
- Rather less than I used to ☐
- Definitely less than I used to ☐
- Hardly at all

6 I feel cheerful:

- Not at all ☐
- Not often ☐
- Sometimes ☐
- Most of the time ☐

7 I can sit at ease and feel relaxed:

- Definitely ☐
- Usually ☐
- Not often ☐
- Not at all ☐

13 I get sudden feelings of panic:

- Very often indeed ☐
- Quite often ☐
- Not very often ☐
- Not at all ☐

14 I can enjoy a good book or radio or TV programme:

- Often ☐
- Sometimes ☐
- Not often ☐
- Very seldom ☐

Self-evaluation Questionnaire – STAI-T

A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you *generally* feel. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe how you *generally* feel.

		Almost never	Sometimes	Often	Always
1	I feel pleasant	1	2	3	4
2	I feel nervous and restless	1	2	3	4
3	I am satisfied with myself	1	2	3	4
4	I wish I could be as happy as others seem to be	1	2	3	4
5	I feel like a failure	1	2	3	4
6	I feel rested	1	2	3	4
7	I am "calm, cool and collected"	1	2	3	4
8	I feel that difficulties are piling up so that I cannot overcome them	1	2	3	4
9	I worry too much over something that doesn't really matter	1	2	3	4
10	I am happy	1	2	3	4
11	I have disturbing thoughts	1	2	3	4
12	I lack self-confidence	1	2	3	4
13	I feel secure	1	2	3	4
14	I make decisions easily	1	2	3	4
15	I feel inadequate	1	2	3	4
16	I am content	1	2	3	4
17	Some unimportant thought runs through my mind and bothers me	1	2	3	4
18	I take disappointments so keenly that I can't put them out of my mind	1	2	3	4
19	I am a steady person	1	2	3	4
20	I get in a state of tension or turmoil as I think over my recent concerns and interests	1	2	3	4

Published Paper in Cognitive Therapy and Research

Ceri Wilson and Deborah J. Wallis *

Attentional bias and slowed disengagement from food and threat stimuli in restrained eaters using a modified Stroop task

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Attentional Bias and Slowed Disengagement from Food and Threat Stimuli in Restrained Eaters Using a Modified Stroop Task

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Abstract: This experiment examined fast (orientation) and slow (disengagement) components of attention to food and interpersonal threat words in high and low restrained eaters using a modified Stroop task. Target words (food, interpersonal ego threat, neutral) were presented prior to a sequence of four matched neutral words. Participants were slow to disengage from food and ego threat words, and this pattern was particularly striking for the high restraint group. Findings show no evidence of an orientation bias but indicate that slowed disengagement from these stimuli can be demonstrated consistently using the Stroop task. However, restraint was not a significant predictor, and slowed disengagement was also found in the neutral condition, suggesting a categorical effect. This study provides important suggestions for modifications of Stroop tasks designed to target both attention bias and disengagement. Implications of slowed disengagement from disorder-relevant stimuli are discussed in relation to the development of disordered eating.
Keywords: Attentional bias; Slowed disengagement; Modified Stroop; Restrained eating

Introduction

Attention bias is defined as the propensity to look for, and be attentive to certain information in the environment (Posner and Peterson 1990). More specifically, it is the tendency to selectively attend to disorder-relevant stimuli (e.g. Mathews and MacLeod 2005). The Stroop task (Stroop 1935) has been used frequently to study such biases. The original Stroop colour-naming task measures the ability to inhibit the automatic tendency to report the name of a colour word rather than the colour in which it is printed. Modifications of this task permit the assessment of reaction times to disorder relevant and neutral words. In such tasks biased attention is inferred from greater response latencies for disorder-related than neutral words.

Much of the work on attentional biases in psychopathology has focused on anxiety and depression. Beck and Clark (1997) claim that attentional biases in anxiety occur in the initial registration of stimuli, also referred to in later research as orientation, automatic or fast biases. Such automatic orientation biases involve an initial orientation of attention towards stimuli. More recently, automatic orientation biases have also been demonstrated in restrained eaters and among the eating disorders. According to cognitive models, eating disordered individuals have elaborated dysfunctional schemata about eating and body appearance, leading to biased information processing which is thought to maintain the disorder (e.g. Vitousek and Hollon 1990). Food and Body Stroop tasks have been developed, with interference (i.e. slowed colour-naming) observed in both anorexia (AN) and bulimia nervosa (BN) patients for both word categories (e.g. Ben-Tovim and Walker 1991; Cooper and Fairburn 1992; Perpina et al. 1993; Sackville et al. 1998). This interference is found more consistently with food words (Lee and Shafran 2004). The extent to which this applies to non-clinical levels of disordered eating is less clear.

There is some debate as to whether orientation biases towards food and body stimuli are restricted to individuals with clinically diagnosed eating disorders (e.g. Dobson and Dozois 2004). Limited research has been carried out with non-clinical samples, and has tended to investigate biases among restrained eaters. This research has found some support for orientation biases towards food and body stimuli using the Dutch Eating Behaviour Questionnaire (DEBQ; Van Strien et al. 1986) to assess restraint (e.g. Green and Rogers 1993; Tapper et al. 2008). However, some studies using the Restraint Scale (RS; Herman et al. 1978) have not found such an effect (e.g. Jansen et al. 1998; Sackville et al. 1998). Many have argued that this is due to the problems with the construct validity of the RS as it confounds restraint with disinhibition (e.g. Placanica et al. 2002; Tapper et al. 2008), whereas the restraint scale of the DEBQ is a measure of restraint alone. Other investigations with non-clinical samples have found a positive association between drive for thinness (DFT) and bias for food words (Perpina et al. 1993), but others have failed to do so (e.g. Ben-Tovim and Walker 1991). However, Perpina et al. (1993) included both non-clinical and clinical participants in their high DFT group, limiting conclusions regarding non-clinical concerns. Cooper and Fairburn (1992) also failed to find a significant difference between dieting and control groups in performance on a food Stroop, which could suggest that significant food Stroop effects cannot be found in non-clinical groups. A Stroop interference effect has, however, been found in food deprived individuals (Channon and Hayward 1990) and dieters and non-dieters following a preload (Mahamedi and Heatherton 1993). Furthermore, Black et al. (1997) found a significant interference effect for food and body words in restrained and unrestrained eaters, as well as BN patients, demonstrating that findings from non-clinical Stroop research are equivocal.

Automatic orientation biases have more recently been differentiated from slowed disengagement, which concerns a difficulty withdrawing attention from a stimulus (later, more elaborate processing/attentional dwelling). An increasing number of researchers have found slowed disengagement to be the dominant bias, particularly with regard to anxiety (e.g. Fox et al. 2001; Van Damme et al. 2008). These studies have used alternative measures of attention bias (e.g. the exogenous cuing task), and some researchers argue that the Stroop task cannot be used as a measure of slowed disengagement (e.g. Fox et al. 2001; Cisler et al. 2007). However, McKenna and Sharma (2004) have demonstrated that the Stroop task can measure slowed disengagement (referred to as a slow effect). McKenna (1986) previously demonstrated a lingering effect in an emotional Stroop task using a blocked presentation, finding that when emotional words precede a session of neutral words, an interference effect (i.e. slowed colour-naming) was observed on the neutral words. They concluded that disruptive effects of emotional stimuli persist beyond their presentation in this task. McKenna and Sharma (2004) later explored the impact of mixing emotional and negative stimuli using a pseudorandom design. In a series of experiments they found consistent evidence for slowed disengagement from emotional stimuli as opposed to automatic orientation biases. Their findings indicated that the presentation of emotional stimuli in a Stroop task disrupts the processing of subsequent stimuli, which lasts for one following trial; however, this has been explored only with emotional words (as opposed to, for example, food words) and requires replication.

The distinction between orientation and disengagement biases has recently been addressed in eating disorder research. Using a visual search task, Smeets et al. (2008) found evidence for facilitated orientation towards body stimuli and slowed disengagement from high calorie food stimuli, suggesting that the exact nature of attentional biases also depends on the type of stimuli involved. Given that slowed disengagement was found to be the dominant bias in relation to food stimuli, pilot data from the present authors investigated whether slowed disengagement from food could be demonstrated using a modified version of McKenna and Sharma's (2004) Stroop task. The adapted task assessed orientation bias towards food and mood (negative emotion) stimuli through assessment of colour- naming times for food and mood 'target' words, and slowed disengagement through colour-naming times for neutral words which followed each 'target'. The task involved sequences of five words in which a 'target' word was followed by four neutral words. There were three conditions: a food, mood and neutral condition (consisting of all neutral words). Performance on the task did not differ significantly in any condition between high and low restrained eaters (according to median split scores on the DEBQ). For all participants the word immediately following the target food or mood word consistently produced the longest reaction time, indicating slowed disengagement from the target words lasting for one consecutive word. This was followed by a gradual speeding up of colour- naming until the next target word. No clear attentional bias towards the target words was demonstrated. Therefore, the slowed disengagement effect seemed to be far more robust. However, contrary to predictions, this pattern of responding was also found in the neutral condition, showing that this pattern may not have been due to the use of a specific word category. These inconclusive findings may have been due to a number of methodological limitations. For example hunger, frequently acknowledged as a confounding variable in food bias research (e.g. Mogg et al. 1998; Placanica et al. 2002; Lee and Shafran 2004), was not accounted for and may have predicted the overall bias. The absence of restraint group differences could also be partially explained by low restraint scores, which were dichotomized above or below the median of 2.2. Furthermore, the order of conditions was not counterbalanced, leaving performance open to fatigue, boredom or practice effects. As the neutral task was always last in the sequence, participants may have developed a pattern of response based on the previous conditions. Additionally, neutral and target words were not displayed an equal number of times, which may have impacted upon response time. There was also no inclusion of a neutral category in place of target words in the neutral condition, meaning that the occurrence of a general categorical effect in the task could not be ruled out. Such methodological limitations leave this study in need of modification and replication.

Attention biases towards stimuli other than food are also associated with forms of disordered eating. Previous research has identified a relationship between bulimic attitudes and ego-threat biases (e.g. Waller et al. 1996; Meyer et al. 2000). Waller et al. (1996) found that bulimic, but not restrictive tendencies were related to a bias for self-directed ego threat. Quinton (2004), however, observed biases for ego threats to self and ego threats from others in bulimic, anorexic and non-clinical individuals, which indicates that threat information is also relevant for non-clinical groups. Meyer et al. (2000) found that bulimia, according to scores on the Eating Disorder Inventory (EDI), was associated with an ego threat bias; however, they did not find this among women with restrictive tendencies. Johannson et al. (2005) also found that high scorers on the Body Shape Questionnaire (Cooper et al. 1987) had a larger delay in colour naming performance-related threat than interpersonal threat words (equivalent to ego threat from others), after being primed with a thin ideal image. However, they focused specifically on body dissatisfaction; therefore, a bias for interpersonal threat words cannot be ruled out from those with general bulimic and restrictive tendencies.

Findings regarding attention biases for different types of ego threat among women with bulimic and restrictive tendencies are inconsistent. Some researchers have found evidence for attention biases towards all types of ego threat in both bulimic and restrictive women; others have found evidence only among those with bulimic tendencies or for only certain types of ego threat. These biases seem to be found less consistently among those with restrictive tendencies; therefore, further investigation is required in order to develop firm conclusions regarding the degree to which such individuals are distracted by these stimuli. In particular, biases are expected in relation to ego threat from others (interpersonal threat) in restrictive individuals, as interpersonal difficulties are found to precede binge eating in such individuals (Tanofsky-Kraff et al. 2000). Furthermore, experimental studies show that presentation of ego threatening stimuli in a Stroop task leads to overeating in restrained eaters (e.g. Lattimore and Maxwell 2004; Wallis and Hetherington 2004), and interpersonal difficulties are given a key role in the aetiology and maintenance of AN. For example, interpersonal psychotherapy is found to be largely successful for treatment of AN (e.g. McIntosh et al. 2000). Given the relationship between interpersonal difficulties, restraint and overeating, it is expected that restrained eaters will be more distracted by stimuli signifying ego threat from others than by neutral stimuli.

The overall aim of the current study was to investigate, in restrained eaters, attention bias for food stimuli and stimuli signifying ego threat from others. This was carried out using a modification of the present authors' pilot Stroop task designed to address its limitations (controlling for hunger, counterbalancing order of conditions, matching neutral words according to each individual target word, and including a single neutral category of words in the neutral condition). It was hypothesised that compared with the low restraint group, those high in restraint would show slowed disengagement from food and interpersonal ego threat words indicated by a longer response time to a neutral word in position 2 (i.e. directly following a target word). This effect was not expected in the neutral (animal) condition. As slowed disengagement was found previously to be the more robust sub-component of attention bias, it was hypothesised that this, but not an orientation bias, would again be found in the food and ego threat conditions. This investigation is novel in its application of McKenna and Sharma's (2004) Stroop task design to food stimuli, and is important because the findings from food-related attention bias research have been equivocal using current methods of assessment. Given that disengagement is emerging as the key component in food biases, a modified Stroop task may be more informative than the original version of the task in exploring attention bias. By utilizing the Stroop as a measure of disengagement this study will help optimize the assessment of attention bias, a factor that is thought to maintain and exacerbate certain eating behaviours and which may be informative in the treatment of various clinical disorders. This is shown through the success of attention training programs for anxiety and depression in particular (for reviews of some of this literature see MacLeod et al. 2009; Bar-Haim 2010; Hakamata et al. 2010). Clarifying the mechanisms involved in attention bias concerning food stimuli may help to inform potential attention training programs for the alteration of certain problematic eating behaviours.

Method

Participants

A total of 48 female university students participated in a study on individual differences in attention to words. Participants were recruited by email, fliers around the University and word-of-mouth, and did not receive any incentive to take part. The study was approved by the Loughborough University Ethics Committee. The inclusion criteria were that participants should not be colour blind, not currently being treated for an eating disorder, and either English was their first language or they were highly proficient in the English language. Participants were categorised into low (n = 25) and high (n = 23) restraint groups based on median-split scores on the restraint scale of the DEBQ (median = 2.6, with those scoring on the median categorised as low restraint). All participants were aged between 18 and 32, with a mean age of 21.81 years (SD = 2.99) and a mean Body Mass Index of 22.43 (SD = 2.97). Due to demographic and questionnaire data not meeting parametric assumptions, Mann–Whitney U tests were carried out in order to compare restraint groups. There were no significant differences between groups in age, BMI, hunger, desire to eat, time since last meal, depression and trait anxiety (see Table 1). High and low restrained eaters differed significantly on restraint scores, indicating that they represented independent groups. Highly restrained eaters also had significantly higher scores on the DFT subscale of the EDI-2.

Materials

Dutch Eating Behaviour Questionnaire: Restraint Scale (DEBQ: Van Strien et al. 1986)

Restrained eating is the tendency for an individual to restrict their food intake in order to control their body weight (Herman and Mack 1975). This was measured using the 10-item restrained eating subscale of the DEBQ. Participants are required to answer each question (e.g. ‘when you have put on weight do you eat less than you usually do?’) with ‘never’ (scoring 1), ‘seldom’ (scoring 2), ‘sometimes’ (scoring 3), ‘often’ (scoring 4) or ‘very often’ (scoring 5). This subscale has high internal consistency and factorial validity (Van Strien et al. 1986; Braet and Van Strien 1997) and Cronbach’s a for various samples ranges between .92 and .95 (Van Strien et al. 1986). High internal consistency was also found in the present sample (Cron- bach’s a = .84). In this study, participants were categorised into high and low restrained eating groups according to median-split scores on this scale. Some have argued that using a median-split may result in diminished power (e.g. Cohen 1988) but this is a valid technique and often employed in attention bias research (e.g. Lattimore et al. 2000; Ahern et al. 2010).

STAI-Trait Scale (STAI-T: Spielberger et al. 1970)

The STAI-T is a 20 item self-report measure of trait anxiety symptoms and produces a range of scores between 20 and 80, with higher scores indicating greater anxiety. Trait anxiety refers to how anxiety manifests itself over time, and is thought to be relatively stable. Respondents are required to circle on a four point scale (1 = ‘almost never’, 2 = ‘sometimes’, 3 = ‘often’ and 4 = ‘always’, with half of the items reverse scored) how they generally feel in terms of each statement (e.g. ‘I feel pleasant’). According to Spielberger (1983) the trait anxiety scale possesses adequate psychometric characteristics. This scale is found to have high internal consistency (e.g. Barnes et al. 2002) with reported a reliabilities varying between .89 and .9, and test–retest reliabilities between .86 and .66, over 2 week and 3 month periods (Jacobs et al. 1988; Spielberger et al. 1970). High internal consistency was also found in the present sample (Cronbach’s a = .91).

Beck Depression Inventory II (BDI-II: Beck et al. 1996b)

The BDI is a widely used 21-item self-report measure of affective, cognitive and somatic symptoms of depression, producing scores between 0 and 63. The respondent is required to choose from four possible choices for each item (scored from 0 to 3) that best describes how they have been feeling during the last 2 weeks. The BDI-II is found to have high test–retest reliability and high internal consistency (Beck et al. 1996a). Beck et al. (1996a) reported an a coefficient of .91 for the BDI-II. High internal consistency was also found in the present sample (Cronbach's a = .86).

Eating Disorder Inventory 2 (EDI-2: Garner 1991)

The EDI-2 measures psychological and behavioural traits associated with AN and BN using three subscales: drive for thinness, which measures excessive concern with dieting, preoccupation with weight and an extreme drive for thin- ness (7 items); bulimia, which measures the tendency towards bingeing and purging (7 items); and the body dissatisfaction subscale, which measures dissatisfaction with body shape and weight (9 items). Respondents are required to indicate if each statement (e.g. 'I think that my stomach is too big') is true about them 'always', 'usually', 'often', 'sometimes', 'rarely' or 'never'. Respondents can score between 0 and 3 for each item and scores are totalled. Wear and Pratz (2006) found very high test–retest reliability of the EDI, with all subscales within the acceptable range for reliability. Crowther et al. (2006) found that the EDI was stable over a 7-year period, with Pearson correlations indicating considerable stability, and Espelage et al. (2003) found reliability of the scales of the EDI to range from .82 to .93. High internal consistency was also found in the present sample (Drive for thinness = .86; Bulimia = .78; Body Dissatisfaction = .88).

Visual Analogue Scales (VAS)

In order to ensure that the words in the task evoked the intended response, at the end of the experiment participants rated (on 100 mm VAS) how appealing they found each food word (ranging from 'not at all appealing' to 'extremely appealing'), and how emotional they found each interpersonal threat word (ranging from 'not at all negative' to 'extremely negative'). Comparisons of these ratings between groups were also carried out. Mean interpersonal ego threat word ratings did not differ between high (74.35 8.57) and low (73.06 9.18) restraint groups (U = 280.5, N1 = 23, N2 = 25, p=.0885, two-tailed). However, the difference between groups on ratings of food words approached significance (U = 194, N1 = 23, N2= 25, p=.054, two-tailed; unrestrained = 59.91 13.91; restrained = 53.24 10.91). Overall, interpersonal ego threat words were rated as highly negative (mean = 73.68) and food words as moderately appealing (mean = 56.72).

Modified Stroop Task

All participants completed 'Food', 'Ego-threat' and 'Neutral' conditions of the Stroop task, with the order counterbalanced across participants. The task was presented in a single session using EPrime stimulus presentation soft- ware. This was a computerised version of the task, in which the stimulus words were presented individually on the screen until the participant responded to the colour using a key press. The words were presented in red, blue, green or yellow (each colour used in equal frequency) and participants were required to press the corresponding colour key. Food words were high calorie such as 'cake' and 'chocolate'; ego-threat words were interpersonal such as 'rejected' and 'criticised'; and neutral words were animal words such as 'elephant' and 'tiger'. Each target word was individually matched according to length, initial letter, and written and spoken frequency in the English language (Leech et al. 2001), with four neutral words that followed. There were 12 target and 48 neutral words in each of the three conditions (180 words in total). Words were presented in a pseudo-random order, with no word or colour appearing consecutively. They appeared in a sequence of five, beginning with the target word (food, ego threat or animal) followed by four neutral words. See ''Appendix'' for examples of words used (the corresponding author can be contacted for a full list of words).

Procedure

Participants were tested individually in an experimental cubicle to minimise distraction, and given an information sheet explaining that the study involved a computer-based task assessing attention to words, followed by completion of questionnaires on mood and appetite variables. On arrival at the laboratory, participants completed appetite scales. Following this, the experimenter provided standardised verbal instructions on the computer task, then participants followed on-screen instructions and carried out the task, which began with a practice round of 16 rows of XXXXX. After completing the computer task they filled in the questionnaire pack (EDI-2, BDI-II, DEBQ, and STAI- T). On completion and with permission, height and weight measurements were taken. Each participant was thanked for participation and debriefed as to the purpose of the study. The procedure took approximately 30 min.

Data Analysis

For each of the food, interpersonal ego threat and neutral conditions of the Stroop tasks, errors were removed so that only trials in which the target colour were correctly identified were included for analysis. Response latencies above or below two standard deviations from the mean reaction time for each condition, for each individual participant, were also removed.
The dependent variable was reaction time, and the independent variables were restraint group, Stroop condition and word position. Each condition was analysed separately in 2 (group: high/low restraint) 9 5 (word position) mixed ANOVA. To account for significant group differences the analyses were repeated with DFT as a covariate. Significant interactions were explored further using separate one-way ANOVA with subsequent Bonferroni pairwise comparisons (within group differences) and independent t tests (a adjusted for multiple comparisons; significant a set at .01 to account for five comparisons within each condition). Where sphericity was violated Greenhouse Geisser correction was employed (although uncorrected degrees of freedom are reported in the text).

Results

Food Condition

The main effect of restraint was not significant, $F(1, 46) = .346$, $p = 0.559$, $p^2 = .007$. However, there was a significant main effect of position, $F(4, 184) = 35.380$, $p<0.001$, $p^2 = .435$, with Bonferroni corrected pairwise comparisons revealing that participants were significantly slower at colour-naming words in position 2 than all other word positions (all $p < 0.05$) and were significantly faster at colour-naming words in position 5 than all other word positions (all $p < 0.001$). There was no clear orientation bias towards the food words, as response times at word position 1 did not significantly differ from colour-naming times for positions 3 ($p = 0.675$) or 4 ($p = 0.094$).

There was also a significant restraint group x position interaction, $F(4, 184) = 3.098$, $p = 0.017$, $p^2 = .063$. The significant group differences in DFT were accounted for in a subsequent covariate analysis and the results remained unchanged. There was also no significant main effect of DFT or DFT x position interaction (both $p<0.05$), indicating that any observed differences were associated with restraint status, but not variations in DFT. The significant restraint group x position interaction was explored further using separate one way repeated measures ANOVA for each restraint group. There was a significant main effect of position for both low restraint, $F(4, 96) = 20.6$, $p < 0.001$, $p^2 = .46$, and high restraint groups, $F(4, 88) = 18.3$, $p < 0.001$, $p^2 = .36$ (see Fig. 1). Bonferroni corrected pairwise comparisons revealed that the high restraint group was significantly faster to colour-name words in position 5 than all other positions (all $p < 0.01$). However, those in the low restraint group were significantly slower to colour-name words in position 2 than all other word positions (all $p < 0.05$), and were also significantly faster to colour-name words in position 5 than all other word positions (all p < 0.05). To explore further the difference between low and high restraint groups in this position effect, independent t tests (two-tailed) were conducted for these separate groups at each position (see Fig. 1). These revealed no group differences at each position (all tests p < 0.05; significant alpha set at .01 for multiple comparisons).

Correlations were also conducted between restraint scores and colour-naming times for words in the food condition in position 1 (r = -.003, N = 48, p = 0.982) and position 2 (r = -.046, N = 48, p = 0.758), neither of which were significant.

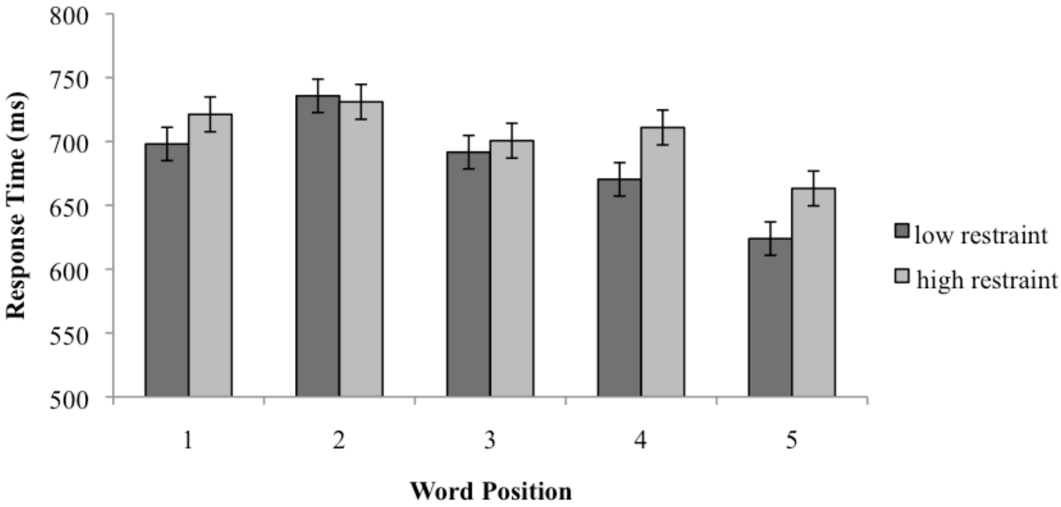

Fig 1: Mean (±SD) response times to words in the food condition for high and low restraint groups

Interpersonal Ego Threat Condition

Although the high restraint group was slower to respond overall than unrestrained eaters (restrained = 734.674 ms, unrestrained = 669.402 ms), this difference was not significant, $F(1, 46) = 2.648$, $p = 0.110$, $p^2 = .054$. As with the food condition, there was a significant main effect of position, $F(4, 184) = 36.389$, $p < 0.001$, $p^2 = .442$, with Bonferroni pairwise comparisons revealing the same pat- tern of significant differences from all other word positions for position 2 (all p < 0.001) and 5 (all p < 0.05). Again, there was no clear orientation bias towards the ego threat words, as colour-naming times for word position 1 did not differ significantly from position 3 (p = 1.000). A significant position x restraint group interaction, $F(4, 184) = 3.583$, $p = 0.008$, $p^2 = .072$, remained when the analysis was repeated with DFT as a covariate. There was also no significant effect of DFT or interaction between DFT and position (both p < 0.05). Separate one way repeated measures ANOVA revealed significant position effects for both low restraint, $F(4,96)$ = 25.6, $p < 0.001$, $p^2 = .52$, and high restraint groups, $F(4,88) = 12.6$, $p < 0.001$, $p^2 = .36$ (see Fig. 2). Bonferroni comparisons revealed, in the low restraint group, that the mean response time for the ego threat words (position 1) was significantly faster than the mean time for words in position 2 (p = 0.010) and was significantly slower than word positions 4 and 5 (p < 0.05). Colour-naming times for words in position 2 were again significantly slower than at all other word positions (p < 0.05), colour-naming of words in position 4 was significantly faster than position 3 (p = 0.041) and in position 5 was significantly faster than for positions 1, 2 and 3 (all p<0.0001). The high restraint group was significantly slower to colour-name words in position 2 than words in positions 3, 4 and 5 (all p<0.01) and colour- naming of words in position 5 was significantly faster than for words in positions 1 and 2 (p < 0.05).

Again, to further explore the difference between low and high restraint groups in the significant position effect, independent t tests (two-tailed) were conducted for these separate groups at each position. These revealed no group differences (all p<0.05). However, the high restraint group had a notably longer colour-naming time for words in position 4 (mean = 726.887 ± 157.427) than the low restraint group (mean = 640.490 ms ± 105.087; p = 0.029), and also at position 5 (high restraint mean = 703.763 ± 179.188; low restraint mean = 614.491 ± 129.886; p = 0.053).

Correlations were also conducted between restraint scores and response times for words in the interpersonal ego threat condition in position 1 (r = -.093, N = 48, p = 0.529) and position 2 (r = -.105, N = 48, p = 0.478), neither of which were significant.

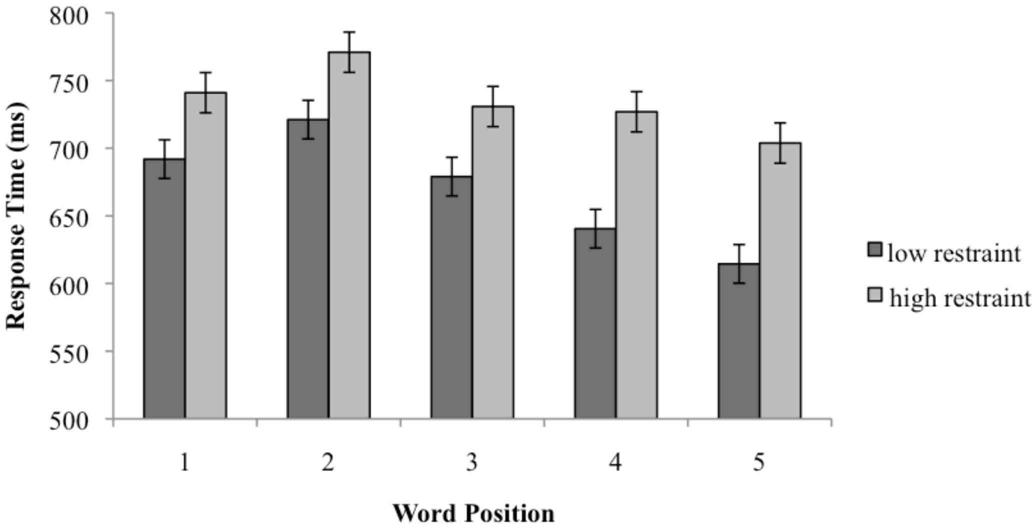

Fig 2: Mean (±SD) response times to words in the ego-threat condition for high and low restraint groups

Neutral Condition

Sphericity was violated (p < 0.001) so Greenhouse Geisser correction was used. The main effect of position was significant, $F(4, 184) = 21.48$, $p < 0.001$, $p^2 = .318$, with Bonferroni pairwise comparisons revealing the same pat- tern as found in the other conditions (Fig. 3). However, for this condition there was no significant main effect of restraint, $F(1, 46) = 1.33$, $p = 0.225$, $p^2 = .02$, and no significant interaction between position and restraint group, $F(4, 184) = .951$, $p = 0.417$, $p^2 = .020$. Again, these findings remained when the analysis was repeated with DFT as a covariate. There was also no significant effect of DFT or interaction between DFT and position (both p < 0.05).

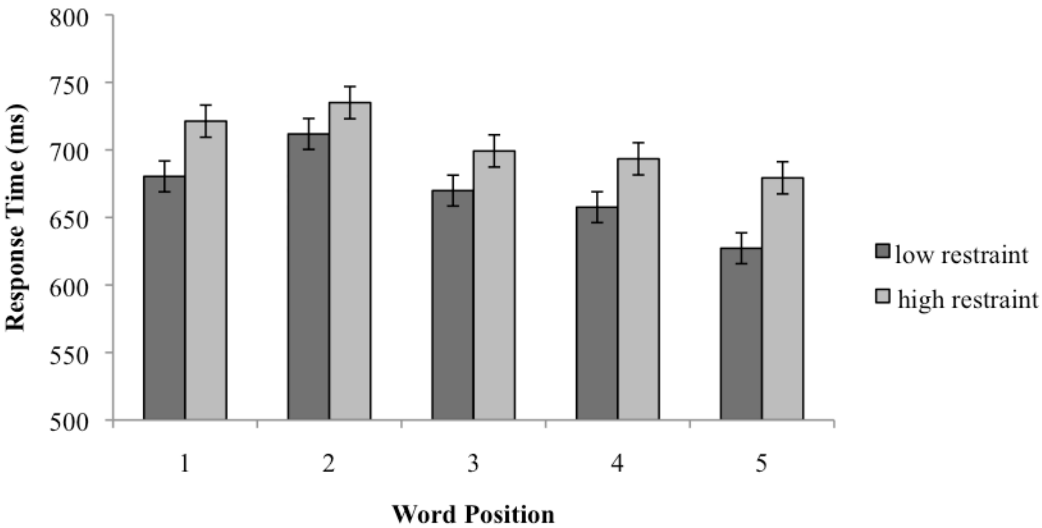

Fig 3: Mean (±SD) response times to words in the neutral condition for high and low restraint groups

Discussion

This study was conducted with the aim of exploring, using a modified Stroop task design, whether restrained eaters are slow to disengage from food words. It was hypothesised that restrained eaters would demonstrate slowed disengagement from food words, and that this would last for one consecutive trial. Contrary to our expectations (but consistent with our previous findings) a general disengagement effect occurred across all participants and conditions. However, this study provides further support for the claim that slowed disengagement is the dominant bias regarding food stimuli and that this component of attention can be demonstrated using the Stroop task. Consistent with previous findings there were no significant differences between restraint groups in their overall performance, even with a larger sample and higher restraint scores overall. Hunger was also controlled for and did not explain this effect. In contrast with the earlier investigation, there was a significant interaction between word position and restraint group in the food condition, but further exploration of this interaction did not find significant differences between groups at each word position. However, when the position effect was analysed for the low and high restraint groups separately, different patterns emerged. It could be postulated that the slowed disengagement effect was restricted to the low restraint group, as only they displayed the expected pattern: a significantly delayed reaction time for word position 2. On the other hand, given that for the high restraint group Bonferroni comparisons were significant only at position 5, one could very speculatively suggest that carry over effects from the food word lasted longer than a single trial. As sequences of only five words were included in this study, it would be interesting to see whether response times for highly restrained eaters would continue to speed up if further neutral words were included in the sequence. Therefore, there seems to be an indication of a differential pattern between restraint groups emerging in relation to food stimuli, although it must be noted that this difference was not statistically significant in the current investigation. Caution must be expressed with regard to these speculative conclusions, and further research is needed with a larger sample, and with further neutral words in the sequence, in order to confirm and clarify further the interaction between restraint and attentional disengagement from food.

In this study, as there were restraint group differences in DFT, this was accounted for in the analyses and was found not to influence response times in any condition, supporting the findings of Ben-Tovim and Walker (1991) as opposed to Perpina et al. (1993). This is, perhaps, not surprising given that the current sample was entirely non-clinical.

It was also hypothesised that restrained eaters would be slow to disengage from words denoting ego threat from others. However, again, this slowed disengagement was a general effect across all participants, but there was a significant interaction between restraint and word position. Separate analyses for the position effects for low and high restraint groups revealed that both groups struggled to disengage from interpersonal threat for one consecutive trial. Although not significant, mean response time data showed a trend for restrained eaters to display a longer response time at position 2, suggesting that biases regarding ego threatening stimuli may be found more predominantly in restrictive individuals. However, again, as this was not significant, it would be pertinent to recommend further research before any such conclusions can be made. Such research should be conducted with a larger sample and with individuals who have higher levels of restraint.

Contrary to hypotheses, there was again a significant position effect in the neutral (animal) condition. As the presentation of conditions was counterbalanced, this cannot be explained with reference to order effects. This shows that when using this modified Stroop design to assess slowed disengagement one needs to be wary of such a categorical effect taking place. This categorical effect is, however, contrary to the findings of McKenna and Sharma (2004) who, when using a categorical neutral condition, did not show any differences in word position. However, it is encouraging that no effect of restraint, and no interaction between restraint and word position response times, occurred in the neutral condition. Rather, these significant effects were unique to the other two conditions, showing some specific effect of restraint on attention to food and interpersonal stimuli.

Despite refinements to the design used in the earlier pilot investigation, further limitations need to be addressed. For example, although food words were found to be appealing and ego threat words were found to be highly negative, neutrality of animal words was not rated. Although efforts were made to include only animals that are not likely to induce fear, it is possible that some (e.g. 'tiger') may have elicited an emotional response and thus the category might not have been entirely neutral. How- ever, previous researchers have also included animal categories in their Stroop tasks (e.g. Rofey et al. 2004; Francis et al. 1997; Sackville et al. 1998; Flynn and McNally 1999). Other categories that may be considered more neutral include travel-related words (e.g. Tapper et al. 2008) and stationary (e.g. Jansen et al. 1998). Future research could assign words based on participant ratings of neutrality in order to ensure that no emotional response is being evoked. Another limitation is that although the order of conditions was counterbalanced, the order of words within each condition was not randomised. In order to rule out order effects as a potential explanation, it would be necessary to randomise the order of neutral words presented following target words. Although the sample size here (n = 48) was slightly larger than in the pilot investigation (n = 40), the effect sizes were fairly small in this study and further replication with a larger sample is warranted.

This study demonstrates that the emotional Stroop task design used by McKenna and Sharma (2004) can be utilised successfully with food and interpersonal threat stimuli, thus replicating and extending their findings. In contrast with some claims that the Stroop task cannot assess disengagement of attention (e.g. Fox et al. 2001; Cisler et al. 2007), this work provides evidence that the Stroop task can distinguish between separate sub-components of attention. This work also suggests that biases in attention (in particular slowed disengagement of attention from stimuli) can be demonstrated in non-clinical eating groups, although significant restraint group differences were not found. However, there is promise for studies with larger samples, and as a result greater statistical power, to find significant group differences in non-clinically restrictive individuals, given the significant interaction between restraint group and performance on the Stroop task.

These findings suggest an extended use of the Stroop task in attention research with those differing in eating behaviour-related characteristics. However, further study design modifications would be necessary in order to maximise its utility for the study of attentional biases and slowed disengagement in eating behaviour research. The findings imply that research should focus on slowed dis- engagement in addition to automatic orientation biases when investigating how attention differs for food stimuli. With this focus less ambiguous and inconsistent findings would be expected, given the more robust effect of slowed disengagement here, and in previous research. With regard to the current findings, it is acknowledged that there is progress to be made in establishing significant differences between restrained and unrestrained eaters in this slowed disengagement from food. It is unknown whether the lack of significant differences between these groups in this study is due to issues of statistical power, or whether group differences are less likely to be found in those with non- clinical eating concerns. Future research should investigate differences between clinically restrictive, non-clinically restrictive and non-restrictive controls on performance on this modified food Stroop task.

The current finding that individuals are slow to disengage from food stimuli is believed to reflect rumination on food in real-world settings. Cognitive rumination (often defined in relation to depression) can be defined as an individual uncontrollably spending an extensive amount of time thinking, worrying or obsessing about something, often a problem (i.e. being unable to turn thoughts to something else) which affects the individual's normal functioning (e.g. Troop and Treasure 1997; Troop et al. 1998). This concept clearly demonstrates an overlap with the definition of slowed disengagement offered in this paper: difficulty withdrawing attention from a stimulus (i.e. attentional dwelling). Both concepts involve cognitively dwelling on something for an extended period of time, which in turn is believed to be unhelpful to daily functioning. Cognitive rumination has been found to predict onset of AN and BN (e.g. Troop and Treasure 1997; Troop et al. 1998) and so such cognitive dwelling is found to predict dysfunctional eating behaviours. Rumination on food in real-world settings is believed to promote unhealthy and potentially harmful beliefs about food and lead to unhealthy eating. Such effects, as found in a non-clinical group here, may suggest a benefit of attention training in order to reduce such biases and correspondingly reduce the promotion of negative thoughts and unhelpful cognitions.

In conclusion, the use of a modified Stroop task to measure slowed disengagement from stimuli is still in its infancy, particularly with regard to food and interpersonally ego threatening stimuli. The current study design holds promise for informing the field of attention research in non-clinical and clinical groups of individuals with eating concerns. This is important, given the expected role of attention biases in the maintenance of eating disorder psychopathology. Further investigation is necessary to investigate how best to measure biases in attention in those with eating difficulties, and to establish which sub-component holds the dominant bias. This would hold implications for the design of attention retraining interventions for such individuals.

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Study Two: Neutral Stroop Correlations

Table: Correlations between neutral word position 1 and 2 response times and eating behaviours and confounds

	Restraint		Disinhibition		External Eating		Emotional Eating		EDI-2 Eating Subscales		DFT		BD	
Word Position	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Spearman Correlation	Spearman Correlation	Sig. (2-tailed)	Sig. (2-tailed)	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)
1	-.084	.522	-.249	.055	-.146	.267	-.082	.536	-.241	.063	-.224	.085	-.234	.072
2	-.107	.414	-.073	.579	-.208	.110	-.005	.970	-.195	.136	-.182	.164	-.188	.149

	BN		Binge Eating		Hunger		Age		BMI		Depression		Anxiety	
Word Position	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Spearman Correlation	Spearman Correlation	Sig. (2-tailed)	Sig. (2-tailed)	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)
1	-.045	.735	-.411*	.001*	.094	.475	-.058	.658	-.133	.312	-.246	.058	-.139	.288
2	.096	.464	-.262*	.043*	.067	.609	-.045	.734	-.055	.675	-.085	.520	.079	.551

Note: EDI-2 = Eating Disorder Inventory-2, DFT = Drive For Thinness, BD = Body Dissatisfaction, BN = Bulimia, BMI = Body Mass Index.

Study Four Part One Multiple Regression Analysis

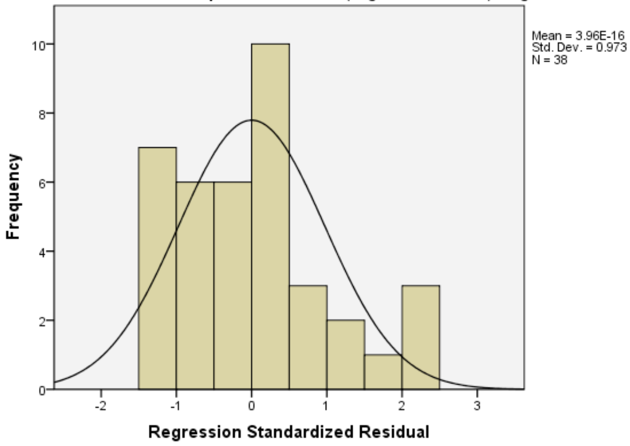
Assumption Testing

	Collinearity Statistics	
	Tolerance	VIF
Emotional eating	.977	1.024
DFT	.977	1.024

Histogram

Dependent Variable: Stroop mean reaction time for word in food condtion postion 1

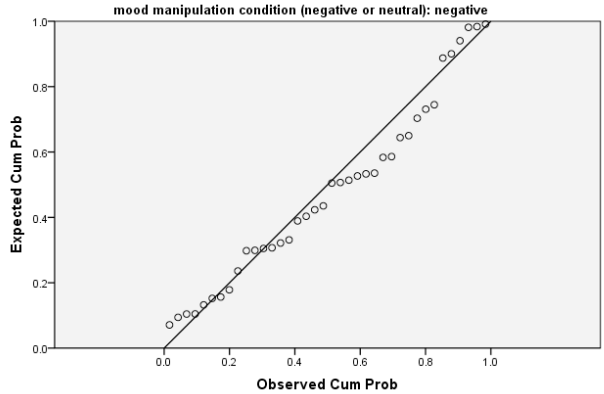
mood manipulation condition (negative or neutral): negative



Normal P-P Plot of Regression Standardized Residual

Dependent Variable: Stroop mean reaction time for word in food condtion postion 1

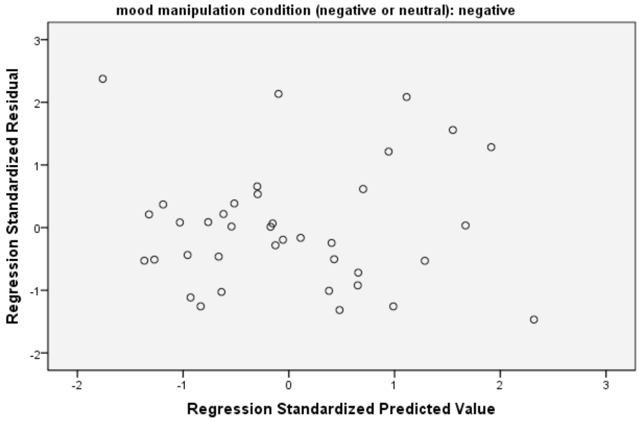
mood manipulation condition (negative or neutral): negative



Scatterplot

Dependent Variable: Stroop mean reaction time for word in food condtion postion 1

mood manipulation condition (negative or neutral): negative



Regression Table *n*=66 (Outcome: Food Stroop Word Position 1; Predictors: DFT, Emotional Eating)

Multiple regression analysis with word position 1 response times in the negative group as the outcome (*n*=66)

		B	*SE B*	*β*
Step 1	Constant	727.56	27.22	
	Drive for thinness	9.92	3.23	.495*

Note: R^2=.245 for Step 1; *p<.01

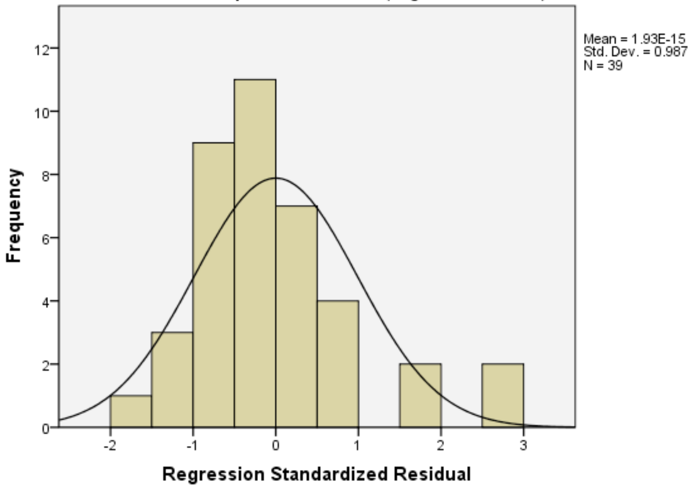
Study Four Part One Simple Linear Regression

Assumption Testing

Histogram

Dependent Variable: Stroop mean reaction time for word in food condtion postion 1

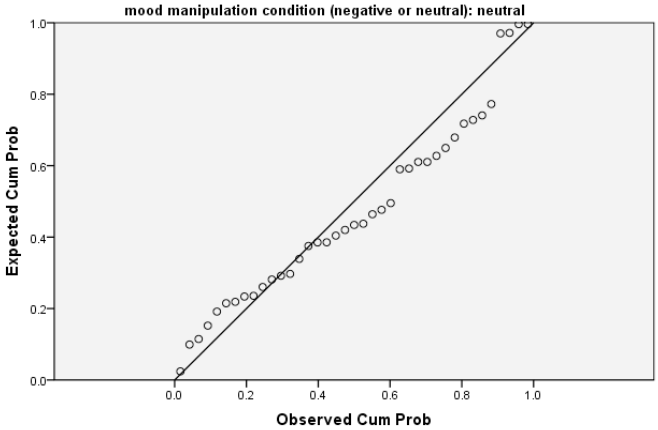
mood manipulation condition (negative or neutral): neutral

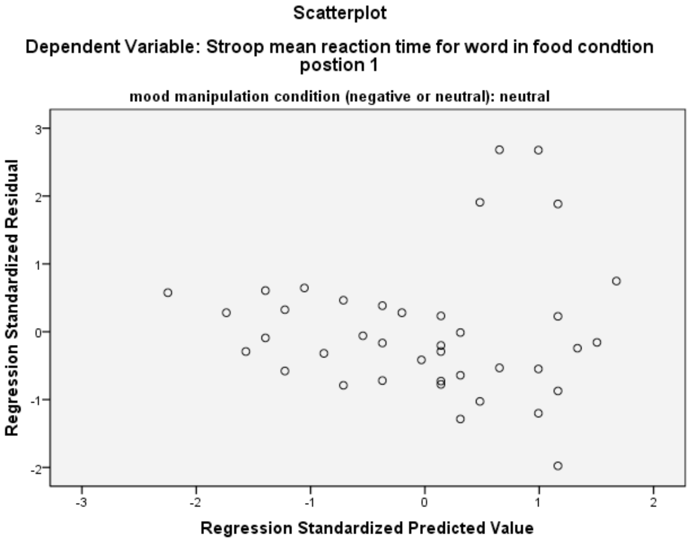


Normal P-P Plot of Regression Standardized Residual

Dependent Variable: Stroop mean reaction time for word in food condtion postion 1

mood manipulation condition (negative or neutral): neutral




Scatterplot
Dependent Variable: Stroop mean reaction time for word in food condtion postion 1
mood manipulation condition (negative or neutral): neutral
Regression Standardized Residual
Regression Standardized Predicted Value
3
2
1
0
-1
-2
-3
-2
-1
0
1
2

Study Four Part One Correlations

Table 1a: Correlations between food word position 1 and 2 response times and possible confounds in negative and neutral groups (*n*=77)

		Depression		Age		BMI		Baseline Hunger	
	Word Position	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)
Negative Mood	1	.131	.434	-.011	.949	-.102	.541	-.119	.478
	2	.098	.557	.007	.968	-.002	.990	.053	.750
Neutral Mood	1	.095	.572	-.215	.188	-.059	.723	-.021	.900
	2	.049	.771	-.111	.502	-.058	.724	-.103	.533

**p*<.0125

Table 1b: Correlations between food word position 1 and 2 response times and possible confounds in negative and neutral groups (*n*=66)

		Depression		Age		BMI		Baseline Hunger	
	Word Position	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)
Negative Mood	1	.034	.856	-.068	.717	.025	.896	-.130	.485
	2	-.020	.915	-.061	.743	.047	.801	-.014	.940
Neutral Mood	1	.246	.161	-.233	.179	-.163	.350	-.037	.834
	2	.196	.266	-.095	.589	-.163	.350	-.145	.407

**p*<.0125

Table 2a: Correlations for negative and neutral groups between neutral condition response times and restrained and emotional eating (*n*=77)

		Restrained Eating		Emotional Eating	
	Word Position	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)
Negative Mood	1	.133	.425	.166	.320
	2	.201	.226	.239	.148
Neutral Mood	1	-.212	.195	.045	.784
	2	-.203	.216	.035	.831

**p*<.05

Table 2b: Correlations for negative and neutral groups between neutral condition response times and restrained and emotional eating (*n*=66)

		Restrained Eating		Emotional Eating	
	Word Position	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)
Negative Mood	1	.116	.553	.112	.548
	2	.204	.270	.224	.226
Neutral Mood	1	-.191	.271	.213	.218
	2	-.186	.286	.177	.310

**p*<.05

Table 3: Correlations between neutral word position 1 and 2 response times and eating behaviours in the negative and neutral groups (*n*=77)

		External Eating		EDI-2 Total		Drive for Thinness		Bulimia		Body Dissatisfaction	
	Word Position	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)
Negative Mood	1	.044	.795	.264	.110	.382	.018	.135	.420	.118	.488
	2	.039	.818	.127	.448	.194	.242	.121	.471	.023	.891
Neutral Mood	1	.274	.092	.043	.793	.005	.975	.093	.572	.073	.658
	2	.247	.130	.056	.734	-.006	.969	.069	.675	.101	.542

**p*<.0125

Table 4: Correlations between neutral word position 1 and 2 response times and possible confounds in the negative and neutral conditions (*n*=77)

		Depression		Age		BMI		Baseline Hunger	
	Word Position	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)
Negative Mood	1	-.001	.995	.079	.639	-.199	.230	-.306	.061
	2	.037	.826	.047	.779	-.164	.324	.037	.826
Neutral Mood	1	-.201	.219	-.201	.219	-.111	.501	.040	.810
	2	-.212	.195	-.212	.195	-.117	.478	.040	.810

**p*<.0125

Table 5a: Correlations between interference scores and eating behaviours for negative and neutral groups (*n*=77)

		Restrained Eating		Emotional Eating		External Eating		EDI-2 Total		Drive for Thinness		Bulimia		Body Dissatisfaction	
	Task	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)
Negative Mood	200ms	-.115	.493	.114	.497	-.073	.663	.162	.331	.082	.624	.144	.387	.165	.328
	2000ms	.174	.295	-.024	.887	-.104	.536	.082	.626	.041	.807	.010	.95	.113	.506
Neutral Mood	200ms	.128	.438	.107	.518	.013	.938	.035	.831	.175	.286	.035	.831	-.026	.877
	2000ms	-.073	.658	-.006	.972	-.011	.949	-.016	.924	.049	.769	.059	.720	-.047	.776

Table 5b: Correlations between interference scores and eating behaviours for negative and neutral groups (*n*=66)

		Restrained Eating		Emotional Eating		External Eating		EDI-2 Total		Drive for Thinness		Bulimia		Body Dissatisfaction	
	Task	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)
Negative Mood	200ms	-.049	.795	.139	.455	-.039	.837	.231	.211	.115	.539	.198	.285	.242	.190
	2000ms	.208	.262	-.008	.967	-.080	.668	.020	.915	-.031	.869	-.037	.845	.055	.771
Neutral Mood	200ms	.097	.579	.076	.663	-.042	.812	.001	.995	.173	.320	-.010	.953	-.060	.734
	2000ms	.035	.843	.010	.955	-.003	.986	.039	.826	.098	.577	.038	.827	.009	.959

Study Four Part Two Correlations

Table 1a: Correlations between eating behaviours and liking/wanting of chocolate/crisps in each mood group (*n*=77)

		Liking Chocolate		Liking Crisps		Wanting Chocolate		Wanting Crisps	
	Eating Behaviour	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)
Negative Mood	Restraint	.07	.678	-.067	.689	-.045	.79	-.051	.763
	Emotional Eating	.163	.328	.067	.69	.119	.478	-.06	.719
	DFT	.191	.25	-.106	.526	.234	.157	-.03	.858
Neutral Mood	Restraint	-.115	.485	-.261	.109	-.167	.309	-.188	.252
	Emotional Eating	.062	.707	.092	.576	.249	.127	.225	.169
	DFT	.216	.187	.079	.634	.127	.441	.009	.957

**p*<.0167

Table 1b: Correlations between eating behaviours and liking/wanting of chocolate/crisps in each mood group (*n*=66)

		Liking Chocolate		Liking Crisps		Wanting Chocolate		Wanting Crisps	
	Eating Behaviour	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)
Negative Mood	Restraint	-.013	.943	-.015	.934	-.028	.88	.102	.585
	Emotional Eating	-.004	.982	.06	.748	.066	.723	-.006	.973
	DFT	.149	.423	-.201	.279	.204	.272	-.048	.798
Neutral Mood	Restraint	-.128	.464	-.261	.13	-.128	.465	-.134	.444
	Emotional Eating	.128	.464	.122	.484	.375	.026	.252	.145
	DFT	.232	.18	.099	.57	.172	.324	.067	.701

**p*<.0167

Table 2a: Correlations between measures of AB and wanting of chocolate/crisps for negative and neutral mood groups (*n*=77)

		Wanting Chocolate		Wanting Crisps	
	AB measure	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)
Negative Mood	Food Stroop 1 RT	.177	.287	-.155	.352
	Food Stroop 2 RT	.086	.608	-.306	.062
	Dot Probe 200ms Interference	.129	.439	.110	.51
	Dot Probe 2000ms Interference	.154	.356	-.037	.827
Neutral Mood	Food Stroop 1 RT	.16	.331	.201	.22
	Food Stroop 2 RT	.148	.367	.125	.449
	Dot Probe 200ms Interference	.099	.549	.127	.422
	Dot Probe 2000ms Interference	.162	.323	.031	.852

Table 2b: Correlations between measures of AB and wanting of chocolate/crisps for negative and neutral mood groups (*n*=66)

		Wanting Chocolate		Wanting Crisps	
	AB measure	Spearman Correlation	Sig. (2-tailed)	Spearman Correlation	Sig. (2-tailed)
Negative Mood	Food Stroop 1 RT	.098	.599	-.246	.182
	Food Stroop 2 RT	.098	.601	-.287	.118
	Dot Probe 200ms Interference	.154	.41	.08	.67
	Dot Probe 2000ms Interference	.159	.393	-.07	.709
Neutral Mood	Food Stroop 1 RT	.116	.507	.279	.105
	Food Stroop 2 RT	.101	.565	.195	.262
	Dot Probe 200ms Interference	.105	.548	.134	.445
	Dot Probe 2000ms Interference	.108	.535	-.061	.727

Table 3a: Food intake in negative and neutral conditions (*n*=77)

Food Type	Negative Condition *M*(SD)	Neutral Condition *M*(SD)	*U*	*p*
Intake of Sweet Foods (kcal)	267.06 (140.51)	281.76 (153.24)	699.5	.672
Intake of Savoury Foods (kcal)	169.75 (103.98)	143.98 (68.93)	667	.451

Table 3b: Food intake in negative and neutral conditions (*n*=66)

Food Type	Negative Condition *M*(SD)	Neutral Condition *M*(SD)	*U*	*p*
Intake of Sweet Foods (kcal)	282.37 (146.71)	274.27 (131.73)	534.5	.918
Intake of Savoury Foods (kcal)	181.65 (110.83)	143.16 (64.5)	445	.210

*p<.05