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# The Role of Cognitive Processes in Eating Pathology

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**Abstract**

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Researchers have recently combined clinical and cognitive areas of research in order to investigate the role of cognitive factors in explaining how emotional disorders are developed and maintained. It is believed that biased cognitive processing of emotionally relevant information can greatly affect emotional responses and behaviour where insights into such cognitive processes can have invaluable clinical implications.

The present thesis investigates the role of cognitive biases for information related to food and body appearance in individuals with eating disorders (ED) and those with non-clinically eating disorder-related concerns (NED). Are ED characterised by cognitive biases toward such information related to their specific concerns? Are such cognitive biases specific to clinical ED or present also in NED samples? Are cognitive biases operating at both conscious and unconscious levels of cognitive processing?

The tasks used to pursue these questions were: the emotional Stroop task, an Internet version of the emotional Stroop, Jacoby's white noise paradigm and a recognition task. The influence of priming on the emotional Stroop task was also investigated in order to test whether the use of this task could be extended to more complex investigations than selective attention.

Results provide support for that cognitive processing of information related to eating and body appearance is biased in individuals with ED. It is, however, unclear whether such biased processing is specific to clinical ED. Findings further suggest that cognitive biases occur primarily at unconscious levels of cognitive processing. Support was also obtained for that the emotional Stroop task is sensitive to priming where initial body perception may be one factor influencing cognitive responses toward negative self referent words following exposure to thin ideal images. Results further suggest that the emotional Stroop task successfully can be administered via the Internet where manipulating task delivery and response mode may increase the sensitivity of this task. Some of the advantages of administering the emotional Stroop task via Internet over traditional methods are access to more heterogeneous samples, more ecologically valid situations, reduced costs and minimisation of demand characteristics.

*Keywords:* eating disorders, anorexia nervosa, bulimia nervosa, emotional Stroop task, implicit memory, explicit memory, Jacoby's white noise task

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## List of papers

The present doctoral thesis is based on the following studies, which will be referred to in the text by their Roman numerals:

I. Johansson, L., Lundh, L-G., & Andersson, G. (2005). Attentional bias for negative self-words in young women. The role of thin ideal priming and body shape dissatisfaction. *Personality and Individual Differences*, 38, 723-733.

II. Johansson, L., Ghaderi, A., & Andersson, G. (2005). Stroop interference for food- and body-related words: a meta-analysis. *Eating Behaviors*, 6, 271-281.

III. Johansson, L., Carlbring, P., Ghaderi, A., & Andersson, G. (2005) Emotional Stroop via Internet among individuals with eating disorders. Submitted for publication.

IV. Johansson, L., Ghaderi, A., Hällgren, M., & Andersson, G. (2005). Implicit memory bias for eating- and body appearance-related sentences in eating disorders. Submitted for publication.



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# Abbreviations

**AN:** Anorexia Nervosa

**BDI:** The Beck Depression Inventory

**BMI:** Body Mass Index

**BN:** Bulimia Nervosa

**BSQ:** Body Shape Questionnaire

**CBT:** Cognitive Behaviour Therapy

**DSM-IV:** Diagnostic and Statistical Manual of Mental Disorders (4<sup>th</sup> edition)

**EAT-26:** The Eating Attitudes Test

**ED:** Eating Disorders

**EDNOS:** Eating Disorders Not Otherwise Specified

**NC:** Normal control

**NED:** Participants with non-clinical concerns about eating and body weight

**RSE:** The Rosenberg Self-Esteem Scale

**SEDs:** Survey for Eating Disorders. A self-report questionnaire for diagnosing eating disorders

**STAI:** The trait and state versions of the State-Trait Anxiety Inventory



# Introduction

## Eating disorders: an overview

Eating disorders (ED) include three main categories, according to DSM-IV (American Psychiatric Association, APA, 1994): Anorexia Nervosa (AN), Bulimia Nervosa (BN) and Eating Disorder Not Otherwise Specified (ED-NOS). Eating disorders are characterised by serious disturbances in eating behaviour and overvalued attitudes about body weight and shape for self-evaluation (APA, 1994). Eating disorders occur primarily in female adolescents and young women with only approximately 10 percent of cases occurring in males (APA, 1994). Researchers propose that during the past 50 years, ED have been on the increase (Hsu, 1996; Hartley, 1998). Until recently, ED were mainly found in Western societies. However, accumulative research suggests that ED are becoming more widespread globally, especially in Japan and Hong Kong (e.g., Lee, 1993). Eating disorders are complex, serious and potentially life threatening conditions. There can be a number of health consequences involving both emotional and physical health. Eating disorders, especially AN, commonly have their onset in adolescence which is a time of rapid growth and development (APA, 1994). Eating disorders can thus seriously interfere with normal physical development. Everyday living can also be dramatically impaired affecting ability to continue school or work and socialise with family and friends.

Reports of disordered eating date back to the end of the 17<sup>th</sup> century where a description of a disorder apparently like AN was documented by Richard Morton (Vandereycken, 1995). However, the disorder was not recognised as a clinical condition until approximately two centuries later when explicit accounts of AN were given almost simultaneously in 1873 by a clinician named Ernest-Charles Lasègue in Paris and in 1874 by a physician named William Withey Gull in London (Bemporad, 1996). Bulimia nervosa was first distinguished from AN by a British psychiatrist named Gerald Russel in 1979 (Ziolko, 1996). These early historical accounts of ED have led some researchers to question whether ED are solely phenomenon of contemporary societies (Bemporad, 1996). Self-starvation throughout history has served as expressions of religious devotion, detachment from the material world and rejection of bodily needs, in different cultures and at different time epochs (Bemporad, 1996). However, research findings of an increase in the incidence of ED over the last 50 years (Hsu, 1996; Hartley, 1998) parallel the trend of progressively slimmer female body ideals in Western socie-

ties (Stice, 1994). This, in combination with ED being highly gender and age specific suggests contribution of socio-cultural factors. However, it is important to note that multiple factors contribute to the development of ED where different factors can play a role, in varying degrees, for different individuals.

### Anorexia nervosa

Anorexia nervosa is characterised by extreme pursuits of slenderness leading to intentional self-starvation (APA, 1994). Individuals with AN associate their self-worth with how much they weigh leading to obsessive preoccupation with thoughts about food and body weight. Despite being severely underweight, they tend to view themselves as overweight and are terrified of gaining weight. Individuals with AN will avoid eating, adopting strategies that are inconsistent with previous behaviours, such as deceiving and manipulating their family and friends. The denial of the seriousness of their excessively low body weight makes treatment of AN very difficult. This is unfortunate considering that AN is a very serious illness which is associated with a substantial risk of death and suicide. The self-imposed starvation forces the body to slow down its processes in order to conserve energy which can lead to kidney and liver damage and abnormally low blood pressure increasing the risk of heart failure (APA, 1994). Other examples of medical complications that can arise are amenorrhea, osteoporosis and infertility. Apart from the central features of concern with body weight and food, AN is also associated with other psychological symptoms, such as, depression, social withdrawal, and cognitive impairments (Beumont, 1995). The prevalence of AN among females is approximately 0.5 % and the age of onset is typically between 14-18 years (APA, 1994, pp 587). Diagnostic criteria for AN according to DSM-IV (APA, 1994, pp 544-545) are listed below:

- A. Refusal to maintain body weight at or above a minimally normal weight for age and height (e.g., weight loss leading to maintenance of body weight less than 85% of that expected; or failure to make expected weight gain during period of growth, leading to body weight less than 85% of that expected).
- B. Intense fear of gaining weight or becoming fat, even though underweight.
- C. Disturbance in the way in which one's body weight or shape is experienced, undue influence of body weight or shape on self-evaluation, or denial of the seriousness of current low body weight.
- D. In postmenarcheal females, amenorrhea, i.e., the absence of at least three consecutive menstrual cycles. (A woman is considered to have amenorrhea if her periods occur only following hormone, e.g., estrogen administration).

There are two types:

**Restricting Type:** during the current episode of Anorexia Nervosa, the person has not regularly engaged in binge-eating or purging behaviour (i.e., self-induced vomiting or the misuse of laxatives, diuretics, or enemas)

**Binge-Eating/Purging Type:** during the current episode of Anorexia Nervosa, the person has regularly engaged in binge-eating or purging behaviour (i.e., self-induced vomiting or the misuse of laxatives, diuretics, or enemas)

### Bulimia nervosa

Bulimia nervosa is characterised by episodes of binge-eating, where large amounts of food are consumed at one time, followed by compensatory behaviour such as, for example, vomiting or laxative abuse (APA, 1994). During the binge episode the individual has a sense of lack of control over eating and the food of choice tends to be high calorie foods that are not normally allowed as part of the diet. The binge results in fear of weight gain which motivates the individual to try and rid the body of the excess calories eaten. Similar to individuals with AN, individuals with BN are extremely preoccupied with thoughts about food and body weight and have an intense desire to be slim. Excessive emphasis is placed on body weight and shape, which almost exclusively define self-worth. In line with AN, the development of BN typically originates from excessive dieting. Eventually the individuals developing BN lose control around food and the extreme dieting rules are temporarily interrupted by binge-eating. Individuals with BN are often of normal weight which makes the disorder less visible compared to AN. Furthermore, individuals with BN often feel ashamed and disgusted by their behaviour which motivates them to be secretive about their bingeing and purging behaviour. The recurrent cycle of bingeing and purging can lead to electrolyte and chemical imbalances that, in turn, can disturb the functioning of the heart and other major organs (APA, 1994). Other examples of health consequences of BN are erosion of teeth enamel and gastric dilation and rupture (APA, 1994). Psychological symptoms that are often associated with BN, apart from the central features of exaggerated concerns with body weight and food, are depression, and feelings of helplessness and failure (Beumont, 1995). Bulimia nervosa is more common than AN with an estimated prevalence of 1% - 3 % in adolescent girls and young women (APA, 1994, Ghaderi & Scott, 2001). Bulimia nervosa typically starts slightly later than AN, usually in late adolescence or early adulthood (APA, 1994). Presented below are diagnostic criteria for BN according to DSM-IV (APA, 1994, pp 549 – 550).

- A. Recurrent episodes of binge-eating. An episode of binge-eating is characterised by both of the following:
  - 1. eating, in a discrete period of time (e.g., within any 2-hour period), an amount of food that is definitely larger than what most people would eat during a similar period of time and under similar circumstances
  - 2. a sense of lack of control overeating during the episode (e.g., a feeling that one cannot stop eating or control what or how much one is eating)
- B. Recurrent inappropriate compensatory behaviour in order to prevent weight gain, such as self-induced vomiting; misuse of laxatives, diuretics, enemas, or other medications; fasting; or excessive exercise.
- C. The binge-eating and inappropriate compensatory behaviours must occur, on the average, at least twice a week for 3 months.
- D. Self-evaluation is unduly influenced by body shape and weight.
- E. The disturbance does not occur exclusively during episodes of Anorexia Nervosa.

There are two types:

**Purging Type:** during the current episode of Bulimia Nervosa, the person has regularly engaged in self-induced vomiting or the misuse of laxatives, diuretics, or enemas

**Non-purging Type:** during the current episode of Bulimia Nervosa, the person has used other inappropriate compensatory behaviours, such as fasting or excessive exercise, but has not regularly engaged in self-induced vomiting or the misuse of laxatives, diuretics, or enemas

### Eating disorder not otherwise specified

Eating disorder not otherwise specified refers to clinical disorders of eating that do not meet criteria for either AN or BN (APA, 1994). This is a very broad category encompassing varying degrees of disordered eating. Many individuals with ED fit into this category. Despite not meeting formal diagnostic criteria for either AN or BN many patients demonstrate a mixture of both anorexic and bulimic behaviours. Eating disorders not otherwise specified are not less serious than AN or BN as individuals with this diagnosis can be as much in danger and suffer as much as individuals with AN or BN. Examples specified by the APA (1994, pp. 550) include:

1. For females, all of the criteria for Anorexia Nervosa are met except that the individual has regular menses.
2. All of the criteria for Anorexia Nervosa are met except that, despite significant weight loss, the individual's current weight is in the normal range.
3. All of the criteria for Bulimia Nervosa are met except that the binge-eating and inappropriate compensatory mechanisms occur at a frequency of less than twice a week or for a duration of less than 3 months.
4. The regular use of inappropriate compensatory behaviour by an individual of normal body weight after eating small amounts of food (e.g., self-induced vomiting after the consumption of two cookies).
5. Repeatedly chewing and spitting out, but not swallowing, large amounts of food.
6. Binge-eating disorder: recurrent episodes of binge-eating in the absence of the regular use of inappropriate compensatory behaviours characteristic of Bulimia Nervosa.

### Non-clinical concerns with body weight, shape and eating

Non-clinical concerns about eating and body appearance refer to milder forms of disordered eating that do not fulfil all diagnostic criteria for a clinical ED (Garfinkel et al., 1995). These types of non-clinical concerns are estimated to be more common than clinical ED (Garfinkel et al., 1995). In a study by Nevoenen and Broberg (2001), using a representative sample of girls, 21% were found to report that they previously had, or currently, experienced disordered eating such as dieting or binge-eating. Furthermore, research reveals that the majority of women living in contemporary Western societies are dissatisfied with their body appearance (Grogan, 1999). Body dissatisfaction may increase the likelihood of trying to alter body shape, by for example dieting (Stice & Agras, 1998). Dieting, in turn, has been found to increase the risk of developing eating pathology (Field, Camargo, Taylor, Berkey & Colditz, 1999; Santonastaso, Friederici, & Favaro, 1999; Stice & Agras, 1998). In line with clinical ED, non-clinical concerns about eating and body appearance show gender differences with most cases occurring in females (Lewinsohn, Seeley, Moerk & Striegel-Moore, 2002). However, some research suggests that overeating occurs fairly equally in males and females, although women more commonly associate such eating behaviour with negative feelings and loss of control (e.g., Lewinsohn et al., 2002).

## Causes of eating disorders relevant for the present thesis

Many people find it difficult to understand the function of many of the behaviours involved in AN and BN. For example, how can individuals with AN not realise that their bodies are in an emaciated state and that they are actually starving themselves to death? And how can individuals with BN feel compelled to overeat until they are painfully satiated? As mentioned previously, there is no known specific cause for the development of ED. Eating disorders are complex conditions that can arise from a variety of potential causes with several factors acting in combination. Several theories have been advanced to understand the causes of ED. However, in the studies involved in the present thesis only socio-cultural factors, body dissatisfaction and cognitive factors will be discussed as causes of ED. Therefore, in order to limit the scope of the present thesis, only these factors will be discussed below.

### Socio-cultural factors

Socio-cultural factors have been proposed to play a role in the development of ED by stressing standards of female attractiveness that are unhealthily thin, leading to increased dissatisfaction with body appearance and disordered eating in many females (Grogan, 1999; Stice, 1994). In Western societies the standard beauty for women is characterised by an ultra slender body shape which, apart from beauty, represents success, power, happiness and self-control. However, this idealised thin body shape is for most women impossible to achieve due to inherited and biological factors. This, in turn, leads to a discrepancy between the idealised body shape and the body shape of most women which can lead to body dissatisfaction. The trend of perceiving slenderness as attractive and fashionable in women is fairly recent, dating back to the 1920's (Gordon, 1990). In the 1930's until the 1950's the trend changed and the more voluptuous figure, such as that of Marilyn Monroe's, set a new standard for women (Grogan, 1999). However, the trend started to change back to a preference of slenderness in the 1950's, with film icons such as Grace Kelly and Audrey Hepburn as standards of female beauty (Grogan, 1999). The trend of slimness continued in the 1960's with Twiggy as a pioneer of the waif like supermodels of today. With her shapeless figure and boyish looks she became the idol for millions of teenage girls (Grogan, 1999). Slenderness as inestimably valued and a very important indicator of female physical attractiveness continued to prevail over time and was reflected by, for example, that winners of Miss American contests and models used in the photo shoots of magazines such as Playboy and Vogue became progressively slimmer between the 1960's and 1980's (Grogan, 1999). The 1990's was characterised by even more emphasis on female slenderness with for example supermodels such as Kate Moss (Grogan,

1999). An even more unattainable body ideal that was characteristic of the 1990's was the combination of a very slim but large breasted body shape, such as that of Pamela Anderson's.

The specificity of ED in terms of sex, age and also to a large degree culture provides support for a strong contribution of socio-cultural factors to aetiology. The cultural body ideal for women in Western societies is focused on a slim, trim and young body. This may thus explain why especially young females in Western societies are at particular risk of developing an ED. Young females may identify with the ideal more than women who are a bit older. For example, the female body ideal is often used in marketing as a means of selling products to young females. The Swedish clothes retailer Hennes & Mauritz, for example, often feature very slim, young female models in their marketing. The body ideal for men tends to be a lean and muscular body, rather than an ultra slim body shape. This may explain why men are not as susceptible to developing ED since conforming to a muscular body ideal presumably does not require dieting to the same degree as conforming to an ultra slender body ideal. Moreover, females tend to be evaluated more according to their appearance than men which may result in greater cultural pressure on women to conform to an idealised body shape (Grogan, 1999). Women are also exposed more frequently to images of idealised female body shapes since the female body is more visible in the popular media (Grogan, 1999). Research has demonstrated that magazines directed at females contain at least ten times more information related to dieting and body shape than magazines directed at males (Anderson & Di-Domenico, 1992). In non-Western societies, the emphasis on a slim, young female body ideal seem to occur only when the population is influenced by Western values (Grogan, 1999). However, it is important to mention that ED generally can be traced to causes related to the individual, although socio-cultural factors seem to play an important role in the aetiology of ED. Disordered eating is in some cases used as a means to somehow deal with personal issues or problems that may not actually be related to eating and body weight. For example, an individual who feels that she has no control over her life may view weight loss as a way of gaining some control and agency based on cultural values indicating that a slim body for females is a reflection of self-control, success and happiness. Emotional issues in a man may instead be masked by other behaviours such as, for example, aggression which in some cultures may be more associated with masculine behaviour.

As mentioned previously, some researchers propose that the trend of ED on the increase has paralleled the progressively thinner female body ideals in Western societies, as emphasised in the mass media (e.g., Stice, 1994). In a meta-analysis carried out by Groesz, Levine and Murnen (2002) of experimental studies investigating the impact on females of viewing pictures of stereotypically slim female models it was found that such exposure to the thin ideal lead to increased body dissatisfaction. Women have also been

found to report changes in mood and well being, such as elevated levels of depression and lowered self-esteem, following exposure to the thin ideal (Irvin, 1990; Pinhas, Toner, Ali, Garfinkel & Stuckless, 1999; Stice & Shaw, 1994). These studies thus suggest, in support for the socio-cultural perspective, that media's propagation of ultra slenderness as the ideal standard of female attractiveness impacts negatively on women's body image and well being.

### Body dissatisfaction

Since all women of Western societies are exposed to the thin female body ideal but only a proportion goes on to develop disordered eating, it may be plausible to assume that there are some vulnerability characteristics involved that make some women more susceptible to negative impact following thin ideal exposure than others (Durkin & Paxton, 2002). Previous research suggests that one such factor is pre-existing body dissatisfaction (e.g., Groesz et al., 2002; Heinberg & Thompson, 1995; Posavac, Posavac & Posavac, 1998). For example, Posavac et al. (1998) found that, while body dissatisfied women reported increased concerns with body weight following exposure to thin idealised images, women low in body dissatisfaction actually showed a trend of reduced concerns with weight following thin ideal exposure. Body dissatisfaction has also been found to be related to increased negative affect following exposure to slender female models (Heinberg & Thompson, 1995; Stice, Spangler & Agras, 2001). These studies thus suggest that females who are dissatisfied with their bodies are particularly susceptible to adverse effects of thin ideal exposure, whereas women satisfied with their bodies may even respond positively to such images.

Many researchers (e.g., Posavac et al., 1998; Heinberg & Thompson, 1995) have proposed that women engage in a process of social comparison when exposed to thin ideal images. Women dissatisfied with their bodies are thus expected to be especially vulnerable to the negative impact of such comparison due to perceived, or actual, discrepancy between the thin ideal and their own bodies (e.g., Posavac et al., 1998). In contrast, women satisfied with their bodies may be immune against such negative impact, for example, because they do not view their own body appearance as very different from the thin ideal or because they do not feel pressure to be as thin as the ideal because they do not relate their self-worth to body weight and appearance (Posavac et al., 1998). Thin ideal media images may thus be more personally salient to women dissatisfied with their bodies where perceived, or actual, body discrepancy activates negative self-evaluation which, in turn, may increase the risk of engaging in behaviours aimed at altering body shape and weight.

Research has found that body dissatisfaction is strongly related to ED, although there are many women who are dissatisfied with their body appear-

ance who do not have symptoms of an ED (Gardner, Stark, Friedman & Jackson, 2000; Ghaderi & Scott, 2001; Leon, Fulkerson, Perry & Early-Zald, 1995). In fact some authors propose that body dissatisfaction is normative in women of Western societies (e.g., Grogan, 1999). Furthermore, women tend to be more dissatisfied with their bodies than men (Lokken, Ferraro, Kirchner & Bowling, 2003). As mentioned previously, body dissatisfaction may lead to attempts to alter body shape and weight by, for example, dieting where dieting, in turn, increases the risk of disordered eating, such as excessive dieting or binge-eating (Polivy, 1996; Stice & Agras, 1998). The initial weight loss may provide the dieter with a surge of feelings of self-control and efficacy. Often family and friends compliment on the new body shape. In individuals with low self-esteem such approval from others may be very powerful and sought after. They may start to believe that losing weight is the key to happiness and approval from others where they start relying on body appearance for proof of worthiness. Such beliefs are further reinforced by the messages from magazines and television that thinness is the way to happiness, success and acceptance. The result may be an iron determination to become thinner and thinner where no matter how much weight is lost it is never enough and the dieter becomes caught in a web of obsessional and rigid dieting rules, perhaps resulting in AN. In some individuals, the severe caloric restriction as characterised by strict dieting may result in binge-eating. The constant hunger pangs lead to occasional losses of control around food where the individual consumes amounts of food that would be considered excessive in normal circumstances. The fear of weight gain may lead to attempts to compensate for overeating and this behaviour may thus lead to BN.

### Cognitive factors

Individuals with ED commonly display obsessive thoughts and rigid thinking patterns (Gleaves, Lowe, Snow, Green & Murphy-Eberenz, 2000). One personality trait that is intimately related to obsession and rigid thinking is perfectionism. Many researchers have proposed that perfectionism is one of many factors that can predispose an individual to eating pathology (e.g., Joiner, Heatherton, Rudd, & Schmidt, 1997). Perfectionism can easily influence eating behaviour by a strong need for a perfect self-presentation where anything less than perfection is perceived as failure. Individuals with ED commonly have an all-or-nothing mindset which is often called black and white thinking. They categorise thoughts and behaviours into either positive or negative with no middle ground, where they perceive themselves as either good or bad, a success or a complete failure, as worthwhile or worthless (Garner & Bemis, 1982). Individuals with such tendencies of rigid thinking in terms of perfection who live in Western societies may be inclined to perceive their bodies as imperfect when comparing themselves to the socio-

cultural expectations of the thin ideal. The driving force behind the motivation to conform to the thin ideal may be attributed to the belief that a flawless image is required in order to be accepted by others. As mentioned previously, ED are complex multi-factorial disorders that involve many interacting factors. For example, excessive motivation to be accepted by others is, in turn, commonly linked to low self-esteem (Harter, 1999). Hence, individuals with low self-esteem may be particularly vulnerable to adopting dysfunctional behaviours to attempt to live up to the perceived standards of others in order to be accepted. A woman high in perfectionism and low in self-esteem living in a Western society stressing the value of slimness for female attractiveness may thus be especially susceptible to body dissatisfaction and to adopting the external messages from media that achievement of a culturally idealised body appearance is the key to higher self-esteem and acceptance from others. However, as mentioned previously, achieving the thin ideal appearance is impossible for most women and often involves strict dieting rules and excessive exercise which could lead to eating pathology. As is evident in the above discussion of potential causes of ED, a variety of factors can play a part in varying degrees for different individuals.

## Cognition and emotion

### Emotion

Psychologists have disagreed about the definition of emotion where the most favoured solution has been to treat emotion as a multi-faceted phenomenon (Williams, Watts, MacLeod, and Mathews, 1997). For example, Lang (1985) proposed that emotions include behavioural (e.g., approaching), physiological (e.g., pounding heart), and cognitive (e.g., appraisal) components. Furthermore, researchers have distinguished between basic emotions and complex emotions. Basic emotions are proposed to be innately determined and to occur universally in all human beings (e.g., Oatley & Johnson-Laird, 1987, Levenson, Ekman & Friesen, 1990). Opinions vary as to how many emotions can be regarded as basic and which emotions these are. For example, Oatley and Johnson-Laird (1987) proposed that there are five basic emotions; happiness, sadness, anxiety (or fear), anger, and disgust. Complex emotions are proposed to derive from basic emotions and tend to vary from culture to culture and from person to person (Oatley & Johnson-Laird, 1987). An example of a complex emotion is remorse which is based on the basic emotion sadness (Oatley & Johnson-Laird, 1987). Complex emotions are proposed to involve more extensive cognitive elaboration than basic emotions, for example encompassing reference to the self, which causes these two types of emotions to exert different effects on information processing (Williams et al., 1997). Emotions that involve extensive cognitive elabo-

ration are, for example, more likely to be characterised by a ruminative information processing style that can serve to maintain the emotion (Williams et al., 1997).

## Cognition

The term “cognition” refers to a huge variety of activities and mental processes involved in the human mind such as, for example, sensation, perception, vision, audition, olfaction, language, thinking, reasoning, problem solving, motor control, speech, memory, consciousness and attention (Eysenck & Keane, 1995). Researchers within the domain of cognitive psychology stress the role of such mental processes in understanding behaviour. In recent years this approach has also been generalised to other areas of psychology, such as clinical psychology. Accumulative research has combined the two disciplines of cognitive and clinical psychology where the role of information processing in emotional disorders has been investigated (Williams et al., 1997). It is believed that emotional disorders are associated with biased information processing of emotionally provoking material (Williams et al., 1997). Investigating how patients with emotional disorders process information is thus predicted to provide valuable information about the mechanisms behind the development and maintenance of emotional disorders.

## Bower’s network theory

One of the most influential cognitive theories of emotion was proposed by Bower (1981). He proposed a network theory where long-term memory can be regarded as an associative semantic network where emotions, like words and concepts, are represented as nodes. Each emotion corresponds to a specific node that is linked to physical and mental experiences associated with that emotion (Williams et al., 1997). Nodes can be activated by both internal and external events where activation of a node results in a spread of activation to other associatively related nodes. Activation thus spreads throughout the network via words, concepts and themes that have been associated with the emotion in question. Activation of nodes, in turn, increases their availability. For example, when an individual is in an anxious state, the node corresponding to anxiety is activated and this activation spreads to nodes within the network that are associated with this emotion. The assumptions of Bower’s network theory lead to a number of hypotheses. It was, for example, predicted that emotional information should be learned best when there is correspondence between the affective value of the information and the current mood state of the learner. There has been some mixed experimental evidence for this theory (see Power & Dalglish, 1997). For example, it is predicted in Bower’s theory that mood states overall should be associated with cognitive biases at a variety of mental activities. However, research

suggests that different mood states may be associated with different types of cognitive biases (Williams et al., 1997).

## Cognition and emotional disorders

### Beck's schema theory

In contrast to Bower's network theory of emotion which was based on normal emotions, cognitive theories of emotional disorders take disordered emotions as their starting point. Beck (1976) proposed a schema theory of emotional disorders based mainly on clinical observations. He proposed that emotional disorders, specifically anxiety and depression, are characterised by maladaptive schemata. Researchers have not reached perfect unanimity in the definition of schemata, but they have been described as functional knowledge structures which are based on previous experiences and have accumulated during the course of life experience (Power & Dalgleish, 1997). Schemata can thus be described as belief systems around which an individual organises and process incoming information which subsequently serves to guide behaviour. These schemata bias information processing toward schemata-congruent information automatically by guiding processing resources toward information consistent with the schemata. Such facilitation of information processing can obviously be positive and functional but it can also be negative and dysfunctional. Positive schemata can provide support and foster healthy self-esteem where automatic thoughts may, for example, be that "I am a good person and I can achieve many things". Negative schemata can instead serve to reduce self-esteem, where automatic thoughts instead may be that "I am useless and I can never do anything right". When schemata contain such dysfunctional beliefs and attitudes, biased information processing serving to preserve the negative schemata is maladaptive. Individuals with emotional disorders are believed to differ from normal individuals in how they process information central to their concerns due to such dysfunctional schemata. For example, Beck and Emery (1985) proposed that the central schemata involved in anxiety disorders is that of vulnerability and danger predisposing automatic biased information processing of threat-relevant information. Anxious individuals may thus selectively focus on threatening information and interpret their environments as threatening due to threatening experiences in the past. Hence, they expect danger even though there is no impending threat. The key schemata involved in depression instead involve negative attitudes predisposing the individual to selectively interpret, perceive and remember events, themselves and other people in a negative way (Beck, 1987).

## Integrative model by Williams and colleagues

Williams et al. (1988, 1997) proposed an integrative model of cognition and emotional disorders, primarily anxiety and depression, based on empirical research evidence. These authors proposed that the evidence does not support Bower's and Beck's arguments that emotional disorders overall are characterised by global cognitive biases. Instead Williams et al. (1988, 1997) suggested a finer grained cognitive model of emotional disorders where a distinction was made between two levels of cognitive processing related to the depth of processing: priming and elaboration. Priming refers to an automatic process where the processing of a stimulus leads to activation of associated components involved in the representation of that stimulus. Prior exposure of a stimulus thus makes it more cognitively accessible at an initial automatic stage in information processing. Elaboration refers to a more controlled, strategic process where activation of a representation results in activation of old and new links between that representation and other similar representations. Activation of associated representations results in increased retrieval of the representation at a later more controlled and strategic stage in information processing. In line with research evidence, Williams et al. (1988, 1997) proposed that anxiety is associated with cognitive bias at initial automatic stages, priming, whereas depression instead is associated with cognitive bias at later stages in information processing, elaboration. These findings were interpreted as reflections of the different natures of these two emotional disorders. Individuals with anxiety disorders are hypervigilant towards the detection of threatening situations. This causes them to automatically interpret information in the periphery as impending threat and, in turn, demonstrate cognitive bias at automatic stages in cognitive processing. Individuals with depression are ruminating on negative thoughts leading instead to selective retrieval of negative situations, in turn, resulting in cognitive bias at later more elaborate stages in cognitive processing. Williams et al. (1988, 1997) thus proposed that different emotional disorders are associated with cognitive bias at different levels of cognitive processing. However, the authors themselves acknowledge that there are research findings that do not fit into their model where bias at elaborative stages has been found in anxiety and bias at priming stages has been found in depression.

## Cognition and eating disorders

Based on clinical observations and Beck's model of emotional disorders, particularly depression (Beck, 1976; Beck, Rush, Shaw & Emery, 1979), Garner and Bemis (1982) proposed a cognitive theory of AN. These authors proposed that AN is characterised by distorted, biased cognitive processing of information related to eating and body appearance. Such dysfunctional

processing can take the form of distorted interpretations of events and obsessive and rigid thinking patterns, such as dichotomous thinking, overgeneralization and errors of attribution (Garner & Bemis, 1982). For example, as mentioned previously, individuals with AN hold rigid beliefs about the value of thinness which controls their behaviour where they tend to perceive themselves as either a success or a complete failure (Garner & Bemis, 1982). An example of such thinking is that individuals with AN commonly categorise food into non-fattening and fattening food. They may ban food perceived as fattening from their diets because they would feel that they lost control if they ate such food and that eating such food would result in weight gain. This is thus an example of how eating only low caloric food can be perceived as being in complete control, and thus a success, whereas eating only a small amount of high caloric food can be perceived as having lost all control, and thus a total failure. Such cognitive distortions are believed to play a role in the development and maintenance of AN (Garner & Bemis, 1982).

Based on the cognitive theory of AN put forward by Garner and Bemis (1982), Fairburn, Cooper and Cooper (1986) proposed a cognitive theory of BN. In line with the cognitive theory of AN, individuals with BN are proposed to be characterised by dysfunctional cognitive processing of eating and body appearance relevant material which serves to play a role in the development and the maintenance of this ED. Individuals with BN are similarly believed to hold rigid and extreme attitudes and beliefs about food, eating, body weight and shape that serves to guide behaviour. Similar to individuals with AN they equate self-worth in terms of body appearance and adopt rigid dieting rules. The strict diet eventually becomes impossible to follow. The slightest deviation from dieting rules is often perceived as total loss of control and the individual with BN engages in binge-eating. Since minor departure from the rules of dieting is equated with total failure the individual feels he or she might as well keep eating. Such thinking is a reflection of dichotomous thinking.

Based on cognitive theories of ED, such as the ones described above, Vitousek and Hollon (1990) developed a model of schematicity in order to explain the role played by the maladaptive cognitive processes involved in ED. These authors proposed that individuals with ED develop elaborate cognitive schemata about issues related to eating and body appearance. As mentioned previously, such schemata serve to bias processing toward information that is consistent with the schemata and thus confirms the schemata. The maladaptive schemata thus remain unchallenged. Specifically, ED are believed to be characterised by three types of dysfunctional schemata: self-schemata, weight related schemata and weight related self-schemata (Vitousek & Hollon, 1990). Self-schemata refer to organised cognitive structures describing the self. Individuals with ED typically have negative self-schemata where they perceive themselves as inadequate, unattractive and not loveable. This is associated with the low self-esteem commonly observed in

individuals with ED (Fairburn, Cooper, Doll & Welch, 1999; Fairburn, Welch, Doll, Davies & O'Connor, 1997). Weight related schemata refer to organised cognitive structures about what it means to be thin versus fat. Individuals with ED associate being thin with positive characteristics, such as being attractive, in control and successful. Being fat is conversely associated with negative characteristics, such as being unattractive, undisciplined and unintelligent. However, such associations to thinness and fatness are not specific to individuals with ED, but shared by many individuals living in Western societies, where thinness is highly valued (Grogan, 1999). Weight related self-schemata on the other hand is believed to represent the core psychopathology of ED and refer to what implications the dysfunctional attitudes about eating and body appearance has for the evaluation of the self. An example of this is the DSM criteria of both AN and BN that self-evaluation is unduly influenced by body appearance. Subjective evaluation of body appearance thus impacts on how individuals with ED value themselves. For example, if the individual perceives his or her bodily physique as too large this will additionally lead to negative self judgement. If body physique is instead perceived as slim this will lead to positive self-evaluation. An example of the workings of such a weight related self-schemata may be that an individual who perceives him- or herself as too heavy would selectively focus on information that confirms the pre-existing schemata stating that this makes him or her worthless. The person may for example selectively attend to the behaviour of people treating him or her with disrespect and attribute this behaviour to his or her own body appearance rather than to the possibility that the person being disrespectful could just be having a bad day.

The clinical observations converging on that both AN and BN are characterised by cognitive distortions has had clinical implications and thus served to guide treatment for ED. Cognitive Behavioural Therapy (CBT) was pioneered by Beck (1976) and combines the individual goals of cognitive therapy and behavioural therapy. This therapy form concentrates on the here and now instead of looking for causes of patients concerns in the past. It is assumed that maladaptive thinking patterns cause maladaptive behaviour and negative emotions (Wilson, Fairburn & Agras, 1997). Instead of responding to the reality of a situation, an individual with an emotional disorder responds to the disturbed viewpoint he or she has of the situation. For example, an individual with BN may reach the conclusion that she is worthless because she has gained one kilogram. In CBT, the therapist tries to make the patient aware of such cognitive distortions and challenge them in order to subsequently be able to change them. The patient may, for example, be asked to test the validity of the belief that weight gain makes her worthless by asking her to produce evidence for and against this belief. Hopefully, the patient realises after such an examination that her friends and family do not base their love and evaluation of her on how much she weighs. Readjusting cognitive distortions would in turn serve to replace maladaptive behaviours

with more healthy behaviours since thinking patterns are believed to guide behaviour. For example, realisation that the approval from family and friends does not depend on body appearance may serve to decrease concern with body weight and thus reduce dieting behaviour.

Behavioural methods are also important in changing cognitive distortions where patients are gradually exposed to anxiety provoking situations in order to realise that such encounters are not necessarily as aversive as they thought. For example, some patients may feel extremely anxious at the thought of eating high calorie foods because they think that eating such foods will result in excessive weight gain and therefore they ban such food from their diets. However, some individuals with ED may allow themselves to binge on such high calorie food if they compensate somehow afterwards, for example by vomiting, in order to get rid of the food. But they would never allow themselves such food on days they are not bingeing. These patients may be asked by their therapist to write a list of such “forbidden foods” where they rate each food item according to how much anxiety it provokes. They may then be asked to start by introducing into their normal diets the food item on the list that is least anxiety provoking and then gradually introduce more and more such food items, according to how anxiety provoking they are, in their diets until they are able to eat the most anxiety provoking food item on their list, without compensating. The aim of this behavioural experiment is for the patients to accept for themselves that introducing a wider variety of foods in their diets where they eat high calorie foods occasionally and in moderation does not lead to excessive weight gain, as feared. Such recognition by personal experience serves to reduce their automatic anxiety reactions when introduced to such food. Cognitive methods for challenging dysfunctional attitudes about eating and body appearance on a conscious level are thus complemented by behavioural techniques in order to target maladaptive concerns at a more non-conscious level. It is however difficult to disentangle precisely which methods in CBT that serve to alter disordered reactions at which levels in cognitive processing (Williams et al., 1997). It is, therefore, important to increase the understanding of these cognitive processes involved in ED in order to advance the development of efficient treatment strategies.

Research reveals that CBT tends to be associated with a remission rate of 57% in BN which is an impressive figure in comparison to most other treatment approaches (Wilson et al., 1997). Therefore, CBT tends to be the treatment of choice for BN. This provides indirect support for the importance of cognitive factors in BN. However, since CBT contains both a cognitive and a behavioural component it is difficult to disentangle which of these components are responsible for the efficacy of the treatment. It could simply be the behavioural component that produces the treatment results. However, in a study by Fairburn et al. (1991), assessment of distorted cognitions around issues of body appearance was included where results indicated

beneficial effects that were independent of behavioural modification techniques, thus providing support for the importance of altering cognitive distortions. Unfortunately there has been very few controlled trials comparing different types of treatments for AN which means that the efficacy of CBT in this group of patients is largely unknown (Garner, Vitousek & Pike, 1997). Other ways to investigate the validity of cognitive theories of ED has for example been to employ experimental paradigms studying the cognitive processes involved in ED. Some of these paradigms, the ones relevant for the present thesis, will be discussed below.

## Methods

### The emotional Stroop task

According to cognitive theories of ED, individuals with these disorders are predicted to selectively focus their attention toward information related to eating and body appearance (Vitousek & Hollon, 1990). The use of self-report measures as a means of gaining information about dysfunctional cognitive processes are prone to contamination by demand characteristics, denial and distortion and are only informative of conscious processes (Hermans, Pieters, & Eelen, 1998). Therefore, measures adopted from cognitive experimental psychology relying on observable responses to controlled laboratory stimuli have been used as the main dependent variables in the studies presented in this thesis. The most frequently used task to test the assumption of selective attention has been the emotional Stroop task (Williams, Mathews & MacLeod, 1996). This task is a modification of what is called the classical Stroop task (Stroop, 1935). In the classical Stroop task participants are presented with colour words printed in different colours. There are two trials: congruent trials and incongruent trials. In the congruent trials the meaning of the word presented is congruent with the colour the word is printed in. For example, the word RED printed in the colour red. In the incongruent trials the meaning of the word presented is incongruent with the colour the word is printed in. For example the word GREEN printed in the colour red. What was consistently found in these types of studies was that it took longer for participants to colour name on incongruent trials than on congruent trials (see MacLeod, 1991, for review). This effect was attributed to automatic word reading. Hence, attention is automatically directed toward the meaning of the words and this thus interferes with the primary task of colour naming on incongruent trials. This effect was referred to as the standard Stroop interference effect.

The finding that the classical Stroop task was very much affected by the meaning of stimuli lead researchers to modify it in order to investigate the cognitive processing involved in emotional disorders (for a review, see Williams et al., 1996). This modification led to the introduction of two novel types of trials: emotional trials and control trials. In the emotional trials the meaning of the words presented was related to the specific concerns of participants with an emotional disorder. For example, words related to anxiety, such as danger, when investigating the cognitive processing in anxiety disorder.

ders. In the control trials the meaning of the words presented was neutral in valence, for comparison. For example, words related to furniture. Further developments of the Stroop task since 1935 are replacements of card format by computerised versions. In card formats a number of words are written on a card and colour naming latencies are summarised manually for each card and type of trial (congruent vs. incongruent; emotional vs. control). In computerised versions each word is instead presented individually where participants typically either press a button to indicate their colour naming response or verbally say each colour out loud using a microphone. Colour naming latency is recorded for each word separately. Participants are required to ignore the meaning of the words and to simply indicate their colour naming response as quickly as possible. Accumulative research suggests that for many emotional disorders, emotional Stroop interference is demonstrated for words related to emotional concerns (for a review, see Williams et al., 1996). Hence, participants with emotional disorders take longer to colour name words related to their emotional concerns than neutral words, whereas no such difference between trials is observed in normal control participants. This effect is referred to as emotional Stroop interference.

Research using the modified Stroop colour naming task has repeatedly demonstrated that individuals with ED demonstrate greater Stroop interference for words related to body weight, shape, eating and food compared to control participants (e.g., Ben-Tovim, & Walker, 1991; Ben-Tovim, Walker, Fok & Yap, 1989; Channon, Hemsley & De Silva, 1988). In line with cognitive theories, individuals with ED have thus been found to demonstrate selective attention toward information related to food and body appearance and hence biased distorted information processing of information related to such concerns. Furthermore, more specifically, some researchers that have separated food- and body-related words (Ben-Tovim et al., 1989; Channon et al., 1988; Perpiñá, Hemsley, Treasure, & De Silva, 1993) have found that individuals with AN are slower than control participants to colour name food-related words but not body-related words. In contrast, individuals with BN have been found to be slower, in comparison to controls, when weight- and body shape-related words are presented but not food-related words (Lovell, Williams & Hill, 1997; Perpiñá et al., 1993). These results are in accordance with findings obtained by Cooper and Fairburn (1992a), suggesting that patients with BN were primarily concerned with body weight and appearance whereas patients with AN were more concerned with eating.

Stroop interference for ED relevant words has also been observed in women with non-clinical concerns with dieting and restrained eating (e.g., Green & Rogers, 1993; Perpiñá et al., 1993). This suggests that delayed colour naming of food- and body-related stimuli on the Stroop task does not reflect cognitive disturbance specific to individuals with clinical ED but extends to non-clinical concerns with eating and body appearance. However, the results from women with non-clinical concerns have been equivocal with

a number of studies failing to show delayed colour naming for ED relevant words (e.g., Ben-Tovim & Walker, 1991; Jansen, Huygens, & Tenney, 1998; Sackville, Schotte, Touyz, Griffiths & Beumont, 1998). Previous research has shown that activation of eating and body shape concerns, such as giving a caloric preload or presenting a slide of fattening food, increases interference for body-related words in individuals with non-clinical concerns about eating and body appearance (e.g., Mahamedi & Heatherton, 1993; Green, Elliman, Rogers & Welch, 1997). It is thus possible that activation of relevant concerns is necessary in order to observe a Stroop interference effect in non-clinical individuals. Furthermore, researchers have used different means of classifying participants into high or low groups with regard to over concerns about eating and body appearance which may explain the mixed Stroop findings. It is possible that non-clinical concerns about food and body weight and shape have to be genuinely sub-clinical in order to observe a Stroop interference effect for food and body relevant words. For example, Cooper and Fairburn (1992b) found that participants who were currently on a diet and had a history of ED relevant symptoms showed Stroop interference for food- and body-related words whereas no such interference was found in current dieters without a history of ED relevant symptoms.

Although there has been some debate regarding the mechanisms underlying the emotional Stroop interference effect, it is most commonly suggested that attention is being automatically directed toward information of emotional concern due to activation of concern relevant schemata which interferes with the primary task of colour naming. This interpretation is based on Beck's (1976) schema theory and Bower's (1981) network theory. Recently, a parallel distributed processing model, put forward by Cohen, Dunbar and McClelland (1990), has been proposed to be the best account for the available Stroop research (MacLeod, 1991; Williams et al., 1997). According to this model, there are separate pathways for processing words and colours that work in parallel. Attention modulates task-appropriate processing and when both pathways are active simultaneously interference of colour naming occurs because of relative greater strength of the processing pathway for emotionally salient material (Williams et al., 1997). Williams et al. (1997) propose that emotional Stroop interference is a reflection of cognitive bias in the early stages of information processing: priming.

There is also some debate with regard to the meaning of emotional Stroop interference. A comprehensive discussion of the issues surrounding this debate are beyond the scope of the present thesis but some of the issues raised are, for example, that Stroop interference for food- and body-related words in individuals with ED could simply be due to greater practice with words related to food and body concerns and that Stroop interference for food words could be due to greater levels of hunger relative to control participants (e.g., Faunce, 2002, for a review). However, some research reveals that Stroop interference for ED relevant words is decreased with treatment (Coo-

per & Fairburn, 1994; Green, Wakeling, Elliman & Rogers, 1998). If Stroop interference for food- and body-related material was simply a practice effect one would not expect treatment to decrease the effect. However, results with regard to treatment have been equivocal with some studies finding no change in Stroop interference (Black, Wilson, Labouive & Heffernan, 1997; Carter, Bulik, McIntosh & Joyce, 2000). Research has shown that hunger is related to Stroop interference for food words (Channon & Hayward, 1990; Lavy & van den Hout, 1993). Furthermore, in a study using a dot probe task, both participants high and low in non-clinical ED relevant concerns showed attentional bias toward words related to high calorie foods when fasting (Placanica, Faunce & Job, 2002). Hunger may thus explain why individuals with AN seem to be more sensitive on the Stroop task to food-related words than to body-related words. However, when non-fasting only the participants high in non-clinical concerns demonstrated attentional bias toward words related to low calorie foods which suggests that attentional bias toward food words can not simply be explained as a result of hunger. Furthermore, in a study by Stewart and Samoluk (1997) dieting due to concerns about body appearance was found to be related to Stroop interference for high calorie food-related words, whereas food deprivation per se did not produce Stroop interference for such food words.

## Explicit memory

Cognitive theories of ED also predict that individuals with ED should demonstrate selective memory for information related to eating and body appearance (Vitousek & Hollon, 1990). Researchers distinguish between explicit and implicit memory. Explicit memory is characterised by conscious recollection or recognition of a previous event or experience that took place at a specific time and place (e.g., Schacter, 1987). Explicit memory tasks thus require conscious recollection. Examples of such tasks are recognition, recall and cued recall. Williams et al. (1997) propose that explicit memory bias is a reflection of cognitive bias at controlled, strategic stages in information processing: elaboration. A number of studies have found support for an explicit memory bias in individuals with ED for ED relevant words (Hermans et al., 1998; Hunt & Cooper, 2001, King, Polivy, & Herman, 1991; Sebastian, Williamson, & Blouin, 1996). The explicit memory tasks used in these studies were cued recall or recall memory. Furthermore, all studies except King et al. (1991) involved single words related to food and body appearance where participants were required to imagine a scene involving themselves and each word. The study by King et al. (1991) instead involved recalling a story about a woman with ED related concerns. Findings from research using samples with non-clinical concerns about eating and body appearance have been equivocal with some studies demonstrating explicit

memory bias in such samples, (Baker, Williamson & Sylve, 1995; King et al., 1991; Watkins, Martin, Muller & Day, 1995) whereas others have only found partial support for such effects (Israeli & Stewart, 2001) and some no such support (Sebastian et al., 1996).

## Implicit memory

Implicit memory is exhibited when prior experience facilitates, or primes, performance on a task without conscious recollection of the experience that influenced performance (e.g., Mathews, Mogg, May & Eysenck, 1989). Hence, implicit memory tasks do not require conscious recollection. Implicit memory bias is also an example of cognitive bias in early, automatic stages of information processing (Williams et al., 1997). There is only one published study, to our knowledge, that has investigated implicit memory bias for ED relevant material in individuals with ED. This study was carried out by Hermans et al. (1998) using a sample of individuals with AN and a sample of normal controls. This study used word stem completion to test implicit memory. Participants were presented with neutral words, ED related words as well as negative and positive words. They were required to imagine a personal scene involving themselves and each word. They were subsequently presented with word stems of the words previously presented intermixed with new words. They were instructed to complete the stems with the first word that came to mind. Results provided no support for implicit memory bias in individuals with ED.

## Jacoby's white noise judgement task

A number of investigators (e.g., Roediger, 1990; Roediger & McDermott, 1992; Schacter, 1992) have proposed that word stem completion is a mainly perceptually driven test. Perceptually driven tests are characterised by being affected by manipulating perceptual processing. Participants are typically required to identify or complete stimuli in degraded form, as in the stem completion test. For example, Roediger and Blaxton (1987) found that priming diminished if stimuli were first presented in upper-case letters and later in lower-case letters. Such perceptual tasks would thus not be appropriate as measures of meaning based emotional memories (Amir, McNally & Wiegartz, 1996b). Furthermore, it is possible that responses are contaminated by explicit memory of the stimuli (Amir et al., 1996b). Conceptually driven tasks are instead affected by manipulating meaning. These tasks thus require processing of meaning. Jacoby, Allan, Collins and Larwill (1988) developed such a conceptually driven test of implicit memory. In this task participants are required to listen to sentences and to repeat them out loud. Subsequently,

these sentences are presented again intermixed with new sentences not previously heard against a background noise varying in intensity. Participants are required to subjectively judge the intensity of this background noise. Jacoby et al. (1988) found that participants rated the noise as less loud when sentences previously heard were presented compared to when new sentences were presented. These results were interpreted to indicate that participants had implicit memory of the old sentences.

Jacoby's white noise judgement task has been used to examine the role of implicit memory in emotional disorders where sentences related to participants emotional concerns as well as neutral sentences have been presented. The hypothesis in these studies have been that the background noise accompanying sentences of emotional valence that have been presented previously should be rated as lower than the background noise accompanying sentences of neutral valence previously presented. Support for this hypothesis has been provided in at least three studies. Participants with generalised social phobia (Amir, Foa & Coles, 2000), participants with panic disorder (Amir, McNally, Riemann & Clements, 1996a) and participants with post traumatic stress disorder (Amir et al, 1996b) have been found to rate the background noise as relatively lower when previously presented sentences central to their particular concerns are presented. This suggests that Jacoby's white noise judgement task is sensitive to meaning of the material presented. Further support for that this paradigm is conceptually driven rather than perceptually driven comes from the observation that the priming effect of previously presented sentences does not seem to be influenced by changing the voice of the person verbally presenting the sentences (Amir et al., 2000). Additionally, the implicit memory effect does not seem to be influenced by either the knowledge of how the paradigm works or by instructions to try to resist the effect (Jacoby, Toth, Lindsay & Debner, 1992). This suggests that the effect seen in Jacoby's white noise judgement task is sensitive to automatic processes rendering it particularly suitable for the study of implicit memory. Furthermore, the usage of sentences in this task probably provides a fuller context than single words which would seem important for testing hypotheses of differences in memory for material differing in emotional meaning.

## Aim of the present thesis

The aim of the present thesis was to test cognitive theories of information processing biases in individuals with AN and BN, and in individuals with non-clinical concerns about eating and body appearance. Since ED relevant concerns are typically more prevalent in women than in men (APA, 1994) the samples used in the studies of the present thesis were exclusively females. Samples of females with non-clinical concerns about eating and body appearance were included in study II, III and IV in order to investigate whether cognitive bias for eating and body appearance related information is specific to clinical concerns about eating and body appearance and thus a hallmark of pathological ED related concerns or if such bias is also present in females with non-clinical concerns. Furthermore, in study I, a sample of non-clinically concerned women were included in order to investigate whether activating relevant concerns by priming would lead to Stroop interference for negative self referent words in this sample, and thus if use of the emotional Stroop task could be extended to more complex investigations. As mentioned previously, self-report measures are not ideal for gaining information about dysfunctional cognitive processes (Hermans et al., 1998). Therefore, measures adopted from cognitive experimental psychology were used in the studies presented in this thesis. More specifically, these experimental tasks were the emotional Stroop task, an explicit recognition test and Jacoby's white noise task. The types of biased, distorted cognitive processes which were under investigation were thus selective attention and selective memory.

As mentioned previously, cognitive therapy methods have been influenced by cognitive theories of ED (Wilson et al., 1997). In therapy, it is thus important to challenge, and alter dysfunctional cognitive schemata that serve to guide information processing toward information consistent with maladaptive beliefs and assumptions. Increasing the understanding of such selective processing in individuals with ED may thus have clinical implications for the development of treatment for ED. It is important to investigate such bias both at conscious and non-conscious levels. If bias operates both at conscious and at non-conscious levels it would not be sufficient for therapist and patient to discuss and challenge dysfunctional attitudes on a conscious level but methods that target such bias at a non-conscious level may also be required. The patient may on a conscious level be able to recognise that her attitudes towards eating and body appearance are dysfunctional and mal-

adaptive. However, on a non-conscious level her cognitive processing may still be biased towards information that confirms her dysfunctional attitudes. In order for therapy to be successful changes must take place at all levels of information processing at which reactions are dysfunctional (Williams et al., 1997).

In analogue, an example can be drawn of a person with dog phobia. The dog phobic may be able to acknowledge that the fear of dogs is excessive and irrational on a conscious level. However, when a dog approaches the person automatically experiences extreme anxiety. In order to target such initial, automatic and non-conscious fear reactions the patient is gradually exposed to the feared object and gradually learns for him or herself that such interaction with dogs does not result in the aversive experience expected. Hence, when exposed to dogs in the future the person does not experience automatic anxiety. Similarly, patients with ED are in CBT, as mentioned previously, gradually exposed to situations they find anxiety provoking and are uncomfortable with in order to target more unconscious reactions and also asked to challenge more conscious thoughts about eating and body appearance. Increasing the understanding of the cognitive processes involved at different stages in information processing in ED may have important implications for advancing the development of efficient treatment strategies targeting distorted cognitive processing at all levels where reactions are dysfunctional.

## Study I

### Introduction

Many women, especially in Western societies, have concerns about body weight, shape and eating but do not meet clinical diagnosis for an ED (Grogan, 1999). As mentioned previously, many investigators propose that the Western idealisation of thinness in females and constant exposure to such thin ideals can play a role in the development of body dissatisfaction and disordered eating (e.g., Levine, Smolak & Hayden, 1994; Stice, Schupak-Neuberg, Shaw & Stein, 1994). It is important to investigate what factors, in that case, play a role in such susceptibility to negative affect following exposure to thin ideals. Since all women living in Western societies are exposed to images of stereotypically slim body ideas on a daily basis one would expect most women to eventually develop body dissatisfaction and disturbed eating behaviours if such exposure to the thin ideal is crucial. As most women do not develop disordered eating it is important to investigate what characterise those women who are negatively affected by thin ideal exposure since such information could be valuable when developing interventions to reduce the negative impact of thin ideal exposure. Ideally, a prospective

design would be required in order to gain insight into such risk factors. However, based on previous research suggesting that one such vulnerability characteristic is body dissatisfaction, the effect on information processing of negative self referent words was in study I investigated in women dissatisfied with their bodies after exposure to stereotypically thin female body ideals. It was thus hypothesised that exposure to thin ideal images would activate negative self-schemata in women dissatisfied with their bodies which would in turn direct their attention toward information consistent with negative self referent information. Furthermore, body dissatisfied women were expected to self-report more reductions in self-esteem subsequent to viewing slim female models than women low in body dissatisfaction.

## Method

In order to pursue the first hypothesis of study I, the emotional Stroop task was employed using negative self referent words as well as neutral words, for comparison. Based on Beck's (1983) proposal that individuals tend to define their self-esteem either in terms of social relationships and approval from others ("sociotropy") or in terms of independence and achievement ("autonomy"), negative self referent words were divided into two types: performance-related and interpersonal threat words. If two concepts are related in the cognitive system one would expect presentation of one of the concepts to "prime"; i.e. increase accessibility of the other concept. Previous research suggests that priming can influence the emotional Stroop effect (e.g., Lundh & Czyzykow-Czarnocka, 2001). In study I, a thin ideal priming condition was thus introduced prior to the Stroop test. This priming condition, encompassing exposure to stereotypically slim female body ideals, was expected to lead to activation of negative self-schemata in women dissatisfied with their bodies. Activation of negative self-schemata, and thus increased accessibility of negative self referent information, was expected to be reflected through delayed colour naming of negative self referent information. The Stroop task used 24 negative self referent words (12 performance-related and 12 interpersonal threat words) and 12 neutral words. Stimuli in all categories were matched according to length (number of characters), and the word categories were in addition matched for frequency of usage based on Swedish language norms established by Allén (1971).

Women were divided into two different groups by performing a median split on their scores on a self-report measure called the Body Shape Questionnaire (BSQ) assessing concerns about body shape. This resulted in a group called high BSQ (high in body dissatisfaction) and a group called low BSQ (low in body dissatisfaction). These two groups were randomly allocated to two priming conditions prior to the emotional Stroop task: 1) viewing images of stereotypically slim female models wearing only underwear and 2) viewing neutral images of gender neutral shoes. In order to pursue the

second hypothesis of study I a self-report measure assessing self-esteem was administered at two occasions: 1) at the beginning of the session, before all other questionnaires and before the Stroop task and 2) after the questionnaires and the priming procedure, but before the Stroop task.

## Participants

The results of 87 female participants, aged between 18 and 31 years, were analysed. Participants in the thin ideal priming condition had a mean age of 22.8 (SD = 2.7) and participants in the neutral priming condition had a mean age of 22.6 (SD = 3.0). Two participants did not report their weight and were therefore excluded when analyses included BMI.

## Self-report measures

As previous research has shown that emotional Stroop interference is associated with anxiety (e.g. Mathews & MacLeod, 1985), eating and body image concerns (e.g., Green & Rogers, 1993) and perhaps also with depression (e.g. Gotlib & McCann, 1984), each woman was asked to complete the Swedish versions of six self-report measures: The Beck Depression Inventory (BDI; Beck, Ward, Mendelson, Mock, & Erbaugh, 1961). The Body Shape Questionnaire (BSQ; Cooper, Taylor, Cooper, & Fairburn, 1987). The Eating Attitudes Test (EAT-26; Garner, Olmsted, Bohr, & Garfinkel, 1982). The Rosenberg Self-Esteem Scale (RSE; Rosenberg, 1989) (Higher scores indicate lower self-esteem). The trait and state versions of the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983). Participants first completed the RSE in order to obtain a measure of global self-esteem at the start of the study prior to any manipulations. Participants subsequently received the remaining questionnaires in a random order. They were also asked to report their weight and height. The RSE was completed once again after priming.

## Results

Stroop interference indexes for performance-related threat words and interpersonal threat words were computed by subtracting the latencies for each category of threat words with those for the neutral words. Statistical analyses revealed a significant interaction between BSQ and priming on performance-related threat words,  $F(1,80) = 5.95, p = .017$ . Analysis of simple main effect of BSQ on thin ideal priming revealed that high BSQ participants were significantly more delayed in their colour naming of performance-related threat words than the low BSQ participants after thin ideal priming (an interference of 19.5 ms vs. a facilitation of -21.2 ms),  $F(1,40) = 6.16, p = .017$ . On the other hand, there was no significant effect of BSQ, after neutral priming  $F <$

1. Analysis of simple main effects of priming showed a significant effect in the low BSQ group,  $F(1,38) = 5.74, p = .022$ , in the sense that the thin ideal primed participants were relatively faster to colour name performance-related threat words than the neutrally primed participants (a facilitation of  $-21.2$  ms vs. an interference of  $10.7$  ms). On the other hand, there was no significant effect of thin ideal priming,  $F < 1$  in the high BSQ group. Furthermore, there was no significant change in self-reported self-esteem among the high BSQ participants ( $21.5$  before testing vs.  $21.9$  after testing,  $F(1,42) < 1$ ), but a significant change in the low BSQ group ( $18.0$  before testing vs.  $16.9$  after testing,  $F(1,41) = 5.68, p = .022$ ). That is, the low BSQ group showed an improvement in self-rated self-esteem after testing.

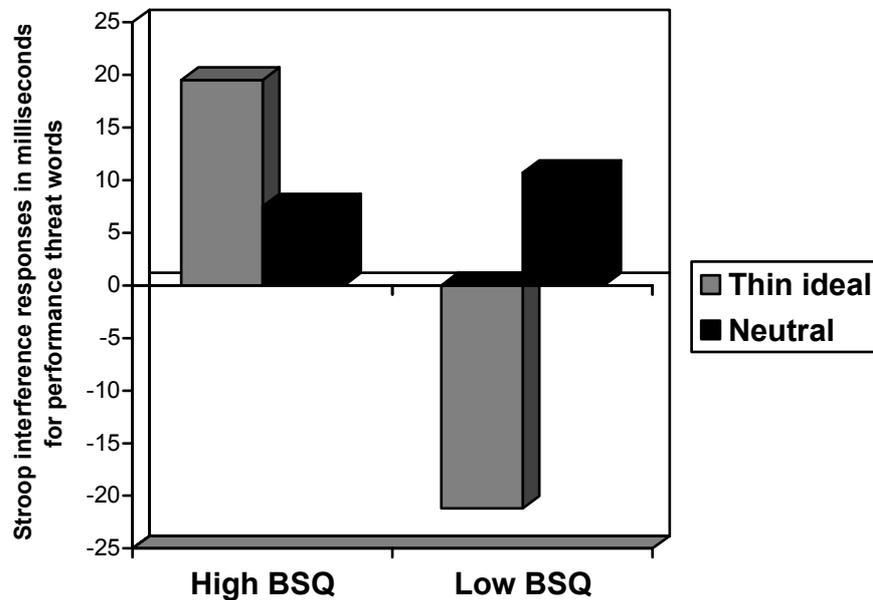


Figure 1. Interaction between groups high and low on BSQ and the two priming conditions for Stroop responses, in milliseconds, for performance-related threat words.

## Discussion

Because the Stroop effect on performance-related threat words did not differ significantly between high BSQ women in the thin ideal and the neutral priming conditions the data did not support the hypothesis that viewing ide-

alized images activate negative self-schemata in body dissatisfied women. However, there was a trend in the expected direction as high BSQ women in the thin ideal priming condition showed significantly greater Stroop interference than the low BSQ women in the thin ideal priming condition. The most robust Stroop effect of thin ideal priming was seen in the low BSQ women who were significantly faster to colour name the performance-related threat words both as compared to high BSQ women in the thin ideal priming condition, and as compared with low BSQ women in the neutral priming condition. What does this Stroop facilitation effect mean? One possibility is that Stroop facilitation is associated with positive affect, whereas Stroop interference is associated with negative affect. Kuhl and Kazén (1999) found that positive affect (as induced by an experimental manipulation) removed the classical Stroop interference effect (i.e., delayed colour naming of incongruent colour words). Lundh, Wikström and Westerlund (2001) also found that emotional Stroop interference was associated with less of positive affect (and Stroop facilitation, conversely, with more of positive affect). One possible interpretation of the present finding, therefore, is that low BSQ women, because of their more positive body image, responded to the thin ideal priming by an activation of positive affect, thereby causing a facilitation of their colour naming of performance-related threat words. This would be consistent with previous research indicating that women satisfied with their bodies showed a trend of reporting less concerns with weight subsequent to viewing thin ideal images (Posavac et al., 1998). Alternatively, the facilitation effect seen for performance-related threat words may reflect strategic avoidant processing, where women low in BSQ deliberately directed attentional resources away from performance-related threat words following media exposure. Stroop facilitation may thus represent a “reversed bias” that is associated with defensiveness (Eysenck, 1997). Such a style of information processing may serve to buffer women satisfied with their bodies from the negative effects of media exposure.

The finding that low BSQ women demonstrated an increase in self-reported self-esteem after testing was found to be unrelated to the priming condition and may, therefore, be assumed to be an effect of answering the questionnaires, which was done prior to the priming condition. For example, the low BSQ women may have felt a boost in self-esteem as a result of having had the occasion to express their positive body image on the BSQ. In combination with thin ideal priming this may also have produced Stroop facilitation. A partly similar effect was reported by Waller and Barnes (2002), who found that women with healthy eating attitudes showed an improvement in their body percept after having been subliminally exposed to the word “thin” ten times with 5-second inter-stimulus intervals.

In conclusion, results of the present study suggest, in line with previous research, that the effect of thin ideal exposure depends on initial body dissatisfaction. Further research is needed in order to clarify the mechanisms in-

volved in Stroop facilitation effects for negative words following thin ideal priming. This could provide valuable information about the cognitive responses of women satisfied with their bodies when viewing thin ideal media images. Such information could, in turn, be used when developing interventions to reduce the negative impact of media images on vulnerable women.

## Study II

### Introduction

As mentioned previously, research using the emotional Stroop colour naming test has repeatedly demonstrated that participants with ED are slower to colour name body weight-, shape- and food-related words compared to control participants (e.g., Ben-Tovim & Walker, 1991; Ben-Tovim et al., 1989; Channon et al., 1988). Study II was a quantitative meta-analytic review (Andersson, 2003) of some of these studies. A meta-analysis on Stroop performance for food-, body weight- and shape-related words was recently published by Dobson and Dozois (2004). The present meta-analysis was carried out without knowledge of this meta-analysis. Results from the study by Dobson and Dozois (2004) indicated that, in comparison to normal controls, BN individuals showed greater interference for food and body relevant words as well as neutral words, whereas AN individuals showed modest interference only for body-related words. Individuals with non-clinical concerns about eating and body appearance showed modest interference for food-related words. Within-group comparisons did, however, not reveal any interference effects between ED relevant and neutral words for AN, BN or non-clinical participants.

The present study was a quantitative meta-analytic review of Stroop studies investigating interference for food- and body-related words that had thus been conducted independently of the meta-analysis by Dobson and Dozois (2004). The present meta-analysis was conducted in a slightly different way; for example, using different inclusion criteria and calculation of effect sizes. The aim of the present study was to investigate whether Stroop interference for food- and body-related words, in comparison to neutral words, is specific to women with clinical ED or whether individuals with non-clinical concerns about body weight and eating (NED) would also show interference effects. The hypotheses were that individuals with ED would show greater interference on the Stroop task for food- and body-related words compared to individuals classified as NED and compared to individuals classified as normal controls (NC). However, since food- and body-related stimuli similarly match the concerns of individuals with NED it was also hypothesised that individuals with such non-clinical concerns would show greater Stroop interference for food and body words than NC. Furthermore, based on previous

research (for a review see Faunce, 2002) individuals with BN were expected to show greater colour naming retardation for body-related words compared to food-related words whereas individuals with AN were expected to show greater delays in colour naming food-related words compared to body-related words.

## Method

In order to locate Stroop studies using samples of participants with ED and participants with NED, the computerised databases PsychINFO and Medline were searched from 1978 through June 2003. Key words used were *eating disorders, anorexia, bulimia, restraint, dieting, eating, food, body weight, Stroop, Stroop interference, colour naming, color naming, information processing, selective processing* and *selective attention*. Reference sections from literature reviews on ED and Stroop interference (Faunce, 2002; Huon, 1995) and from Stroop studies of interest were also carefully scrutinised. Only published articles in English were included. Dissertations and book chapters were not considered. This search resulted in 58 articles that appeared to be of interest. Out of these studies, 27 met eight criteria for inclusion in the meta-analysis:

- 1) Because ED and NED are over represented among young girls and women (e.g., Pawluck & Gorey, 1998) only studies with samples containing exclusively females were included.
- 2) Participant groups had to be defined as ED, NED or NC participants. Participants categorised as NED were assessed by self-report measure of eating- and body appearance- related concerns or self-reports of dieting efforts. NC samples were excluded if no assessment had been made with regard to ED related symptoms. In some studies the mean value on measures of ED related concerns was provided for the group as a whole admittedly making it difficult to exclude the possibility that some of the samples characterised as NC contained individuals concerned with eating and body weight. However, samples characterised as NC were excluded if it was explicitly explained that they contained a mixture of individuals high and low in non-clinical ED related attitudes.
- 3) Samples defined as obese were not included since there were so few studies with participants explicitly defined as obese.
- 4) Studies were only included if they used words related to food/eating and/or body weight and/or body shape as well as neutral words for comparison with concern relevant words. However, categories of food and body words regarded as non-anxiety provoking or positive, such as words related to healthy foods and words related to areas of the body generally not associated with weight problems, such as fingers and nose, were excluded in order to try and restrict words to those specifically associated

with ED related concerns. It should, however, be mentioned that some of the categories of food and body words used did include occasional words that did not have negative overtones. Nevertheless, overall the majority of the food and body words included had negative overtones, such as high calorie food words and weight- and shape-related words associated with large body physiques or body parts of concern for many women, such as stomach.

5) Sufficient information to compute effect size for Stroop interference had to be available or from authors kindly provided on request.

6) Only trials presenting words supraliminally were analysed since there were so few studies using subliminal presentations of stimuli.

7) Participants had to be tested on the Stroop test only once. In studies investigating change in Stroop interference after treatment only pre-treatment results were included.

8) No priming condition should be introduced prior to the Stroop test.

Where this was the case only the results from the control group not undergoing priming were analysed.

## Results

Cohen's  $d$  for Stroop interference was calculated by subtracting the mean response time for neutral words from the mean response time for emotional words divided by the pooled standard deviation, as suggested by Dunlap, Cortina, Valsow and Burke (1996) for matched groups or repeated measures designs. A positive value indicated that emotional words were colour named more slowly than neutral words whereas a negative value indicated that neutral words were colour named more slowly than emotional words. Table 1 presents the within-group mean effect sizes, weighted mean effect sizes, 95 % confidence intervals and homogeneity  $Q$ -statistics for ED, NED and NC for food and body words combined. These statistics are also shown for participant groups referred to as AN and BN for food words and body words separately. As can be seen, the mean effect sizes were positive for all participant groups for food- and body-related words indicating that all groups overall were slower in colour naming emotional words compared to neutral words. Individuals with ED had an effect size that was just below medium whereas participants with NED and NC both had small effect sizes. When participants with ED had been separated into AN and BN and emotional words into food and body words, the effect sizes were somewhat higher but still around medium. Participants categorised as AN had larger effect size for food words than for body words whereas participants with BN had similar effect sizes for both food and body words. However, as can also be seen, the weighted mean effect sizes were slightly smaller than the unweighted mean effect sizes for all participant groups for both food and body words combined and separately. Test of heterogeneity revealed that the effect sizes

across studies and participant groups were homogeneous for food and body words combined and separated. There were significant differences between ED and NED  $t(29) = 3.54$ ,  $p = 0.001$  and between ED and NC  $t(40) = 2.97$ ,  $p = 0.005$ . There were no significant differences between NED and NC or between food and body words for AN and BN separately (all  $p > 0.5$ ).

Table 1. *Within-group mean effect size, weighted mean effect size, confidence intervals and Q-statistic for participant groups separately for food and body words.*

Participant Groups	Word types	Number of studies	d (SD)	weighted d	95 % CI	Q
ED	Food + Body	21	0.48 (0.30)	0.43	0.34 - 0.62	9.50
NED	Food + Body	10	0.21 (0.13)	0.19	0.13 - 0.29	0.64
NC	Food + Body	21	0.21 (0.30)	0.17	0.07 - 0.35	11.93
AN	Food	11	0.58 (0.51)	0.49	0.29 - 0.87	11.61
AN	Body	12	0.49 (0.38)	0.44	0.27 - 0.71	8.11
BN	Food	8	0.58 (0.33)	0.55	0.34 - 0.82	2.87
BN	Body	8	0.57 (0.22)	0.56	0.41 - 0.73	1.49

Note: ED = Eating disordered, NED = Non-eating disordered nevertheless over concerned with eating and body weight, NC = normal control, AN = Anorexia nervosa, BN = Bulimia nervosa.

## Discussion

The small interference effect size found for NED and NC may suggest that NED, in line with NC, is not characterised by Stroop interference for food- and body-related words, and that such interference is specific to females with clinical ED. However, a small effect size is not necessarily analogous to absence of an effect. Small effect sizes for NED and NC may be a result of small sample sizes used in the analysed studies where NED, as well as NC females, also demonstrate Stroop interference for ED relevant words, although not to the same extent as females with ED. As mentioned previously, many women of contemporary societies are concerned about body appearance and weight issues. One explanation for the small interference effect observed in NED may be that researchers have used different means of classifying participants into high or low groups with regard to over concerns about eating and body appearance, where some participants categorised as NED would thus perhaps have been better categorised as NC. It is possible that non-clinical concerns about food and body weight and shape have to be genuinely sub-clinical in order to observe a Stroop interference effect for food and body relevant words.

Findings from the present meta-analysis, especially with regard to the ED group, were thus inconsistent with the results obtained by Dobson and Do-

zois (2004) who found no differences in colour naming times between ED relevant words and neutral words across any of the participant groups included in their meta-analysis. Furthermore, while Dobson and Dozois (2004) found negative effect sizes close to zero for NC as well as dieters and restrained eaters, the groups referred to as NC and NED in the present meta-analysis showed small interference effects. One possible reason for these discrepant results is that the same studies were not included in the two meta-analyses. For example, Dobson and Dozois (2004) incorporated fewer studies, and some of the studies used in their review were not incorporated in the present meta-analysis due to the inclusion criteria adopted. Furthermore, effect sizes were calculated differently; Dobson and Dozois (2004) used Glass' (1976)  $g$  whereas Cohen's  $d$  was used in the present study.

In summary, results from the present meta-analysis confirm the findings of many previous Stroop studies indicating that individuals with ED demonstrate delayed colour naming of food- and body-related words relative to neutral words. However, this interference effect is of fairly modest magnitude and it is unclear whether such interference can be said to be specific to females with ED. Nevertheless, results indicate that groups can be distinguished in terms of Stroop interference for food- and body-related words, which suggests that the emotional Stroop task offers a useful tool for exploring individual differences in terms of concerns about eating and body appearance. More research is, however, required in order to fully understand the underlying mechanisms and meaning of such ED relevant Stroop interference effects.

## Study III

### Introduction

The development of the Internet has provided a new method of conducting research. Some of the advantages over traditional methods are access to larger and more heterogeneous samples, more ecologically valid situations, reduced costs and minimisation of demand characteristics (Birnbaum, 2000). In a study by Linnman, Carlbring, Åhman, Andersson and Andersson (2006), a comparison was made between administering the classical Stroop colour naming task via the Internet and using the conventional computerised version. Results revealed strong Stroop interference effects for both versions, although the response times were delayed on the Web based version. This was interpreted as an effect of the changes required for task delivery and response mode.

In two other studies, the same Web based Stroop task as used by Linnman et al. (2006) was modified into emotional Stroop tasks for social phobia (Andersson, Westöö, Johansson & Carlbring, 2006) and tinnitus (Andersson,

Bakhsh, Johansson, Kaldo & Carlbring, 2005), respectively. In both studies responses were made faster for words relevant to participants' emotional concerns relative to neutral words. Hence, Stroop facilitation, rather than Stroop interference, was demonstrated for emotionally relevant words. In study III the Internet based classical Stroop task used by Linnman et al. (2006) was adapted for ED. Since a large number of previous studies have found Stroop interference for food- and body-related words in individuals with ED (e.g., see Johansson, Ghaderi & Andersson, 2005), it was hypothesised that emotional Stroop interference would also be found using this Web based Stroop task, despite the reverse being demonstrated in social phobia and tinnitus. Furthermore, more specifically, based on previous research (see Faunce, 2002, for a review), individuals with AN were expected to demonstrate Stroop interference for food-related words whereas individuals with BN instead were expected to demonstrate Stroop interference for body-related words. A sample of women with NED was also included in the present study in order to investigate whether Stroop interference would be exclusive to clinical ED concerns. Since results from studies with non-clinically concerned women have been ambiguous (see Faunce, 2002, for a review), this group was not expected to differ significantly from NC individuals.

## Method

The emotional Stroop task was run via Internet. Manual colour naming responding was employed where participants were required to indicate their colour naming choice by clicking on the box representing the colour in which each word was displayed as quickly as possible. Previous research suggests that manual Stroop colour responses are more reliable and accurate than verbally activated responses (Davidson & Wright, 2002). The stimulus words used consisted of 24 neutral words, 12 words related to high calorie foods and 12 words related to over sized body shape and body parts assumed to be of concern for many women with ED. All words were matched for word length and written usage in the Swedish language (Språkbanken, 2003).

## Participants

Data from 33 women with ED (20 BN and 13 AN participants), 27 women with NED and 31 NC women was analysed in study III. Mean ages for participant groups were: AN = 23.1 (SD = 4.1), BN = 24.6 (SD = 3.9), NED = 24.9 (SD = 4.5) and NC = 23.8 (SD = 2.6).

## Self-report measures

The Survey for Eating Disorders (SEDs, short version; Ghaderi & Scott, 2002) was used to assess BN and AN according to the DSM-IV and also to assess whether NC and NED participants had features of an ED. As previous research has shown Stroop interference to be associated with anxiety and perhaps also depression (see Williams et al., 1997 for a review) participants were also given self-report measures assessing anxiety and depression: the BDI (Beck et al., 1961) and the trait and state versions of the STAI (Spielberger et al., 1983). Participants were asked to complete these measures after the emotional Stroop test. All participants received these in the following order; BDI, the state and the trait versions of the STAI followed by the SEDs.

## Results

Previous standard emotional computer-based Stroop studies on participants with ED typically demonstrate response times below 1000 milliseconds for food- and body-related words (e.g., Davidson & Wright, 2002; Formea & Burns, 1996). The response times obtained in the present study were comparatively longer, in line with previous research using this Web based Stroop task (e.g., Linnman, et al., 2006; Andersson et al., 2006; Andersson et al., 2005). This delay was probably caused by the changes required to task delivery and response mode.

Stroop interference indexes were calculated by subtracting mean response time for the neutral word category from food-related words and body-related words, respectively. Consequently, two index scores were produced for each participant: one for food words and one for body words. Table 2 shows the mean and standard deviation (SD) times, in milliseconds, for each word type and for the index scores separately for AN, BN, NED and NC. A mixed 2 x 4 ANOVA with Stroop index word type (food index and body index) as within subjects factor and group (AN, BN, NED and NC) as between subjects factor was carried out. Results revealed a significant interaction between word type and group  $F(3,87) = 5.04, p = 0.003$ . Two independent one-way ANOVAs showed that participant groups differed both on body index  $F(3,87) = 4.92, p = 0.003$  and food index  $F(3,87) = 2.73, p = 0.049$ . Post hoc tests with Bonferroni corrections demonstrated that for the body index BN had significantly longer response times than NC ( $p = 0.042$ , Cohen's  $d = 0.78$ ) and AN ( $p = 0.028$ , Cohen's  $d = 0.96$ ). For the food index AN had significantly longer responses than NC ( $p = 0.043$ , Cohen's  $d = 0.84$ ). Participants with BN thus demonstrated emotional Stroop interference for body words whereas participants with AN instead demonstrated emotional Stroop interference for food words. Paired samples t-tests revealed that for BN it took significantly longer to respond to body words compared both to neutral

words and to food words,  $t(19) = 3.41$ ,  $p = 0.003$  and  $t(19) = 2.19$ ,  $p = 0.041$ , respectively. For AN there were significantly delayed responses to food words compared to neutral words  $t(12) = 2.59$ ,  $p = 0.024$ . For NED body words were responded to significantly more slowly compared to both neutral words and food words,  $t(26) = 3.76$ ,  $p = 0.001$  and  $t(26) = 2.23$ ,  $p = 0.035$ , respectively. The proportion of BN and NED demonstrating longer response times for body words compared to neutral words was 75% ( $n=14$ ) and 81% ( $n=22$ ), respectively. The proportion of AN demonstrating longer response times for food words compared to neutral words was 85% ( $n=11$ ).

Table 2. Mean (M) and standard deviation (SD) Stroop response times, in milliseconds, for word type and index scores for AN, BN, NED and NC separately.

	AN (n = 13) M (SD)	BN (n = 20) M (SD)	NED (n = 27) M (SD)	NC (n = 31) M (SD)
Neutral words	1217.4 (276.1)	1136.3 (223.9)	1052.0 (196.3)	1104.5 (262.7)
Food words	1265.5 (299.1)	1132.2 (214.7)	1060.5 (181.2)	1095.4 (233.5)
Body words	1203.7 (262.6)	1183.8 (240.7)	1091.4 (204.0)	1105.1 (255.0)
Food Index	48.2 <sup>1</sup> (67.0)	-4.1 (65.1)	8.5 (50.0)	-9.1 <sup>2</sup> (69.4)
Body Index	-13.7 <sup>2</sup> (65.2)	47.6 <sup>1</sup> (62.4)	39.3 (54.3)	0.65 <sup>2</sup> (58.4)

AN = Anorexia Nervosa, BN = Bulimia Nervosa, NED = non clinical eating disorder related concerns, NC = Normal Control. Row means with different superscripts differ significantly at  $p < 0.05$ .

## Discussion

In line with expectations, participants with ED thus showed Stroop interference for ED relevant words in line with previous studies using the standard emotional Stroop task (see Faunce, 2002, for a review). Furthermore, the present results indicate that what type of ED related information Stroop interference is demonstrated for depends on type of ED. These findings are in line with previous research using the standard emotional Stroop task indicating that individuals with BN may be more sensitive to body-related material whereas individuals with AN instead may be more sensitive to food-related material (see Faunce, 2002, for a review). As mentioned previously, Cooper and Fairburn (1992a) suggested that individuals with BN were primarily concerned with body weight and appearance whereas individuals with AN

instead were more concerned with eating. Considering that individuals with BN weigh more than individuals with AN, individuals with BN may be more dissatisfied with their body appearance (Mizes & Christiano, 1995). Furthermore, since individuals with AN restrain from food, to the extent that they become severely emaciated, whereas individuals with BN instead binge on high caloric food, individuals with AN may be more sensitive to food-related information due to their extreme level of restraint. Alternatively, since individuals with BN compensate after they binge in order to prevent weight gain, food-related material may not be as anxiety provoking as for individuals with AN. However, a proportion of individuals with AN also compensate after they have eaten (Steinhausen, 2002). Although, presumably they do not binge and compensate to the same extent as individuals with BN, since this type of behaviour tends to lead to weight gain in the long run (Walsh & Garner, 1997).

However, in study II no such difference in Stroop interference was found between individuals with AN and individuals with BN. One possibility is that because all available Stroop studies could not be included in the meta-analysis due to specific inclusion criteria and that some studies did not report the information necessary for calculating effect sizes, this greater sensitivity for body words in individuals with BN and for food words in individuals with AN was not revealed. Another possibility is that such specificity effects can only be seen when the response mode is delayed. As mentioned previously, administration of the emotional Stroop task via the Internet required some changes with regard to task delivery and response mode which, in turn, caused the time duration for indicating colour naming to be delayed. Delaying the process of indicating colour naming choice may allow more thorough evaluation of the emotional valence of stimuli. This may, in turn, lead to Stroop interference only for those words that are of primary significance. This would thus explain why participants with BN in the present study showed Stroop interference for body words but not for food words whereas participants with AN showed Stroop interference for food words.

Participants with NED did not differ significantly on either body or food index scores compared to NC, which was in line with expectations. However, NED did have significantly longer time responses on body words compared to neutral words, which indicates Stroop interference for body words. This group of participants thus seemed to be more concerned about body-related material than neutral material. Is it plausible to assume that these participants are more similar to BN than AN? Presumably, considering that the NED group were characterised by meeting all but one or two diagnostic criteria for BN.

Why was Stroop facilitation seen in participants with tinnitus and social phobia, using the present Web based emotional Stroop task, but not in ED? The emotional value of the stimuli presented in the Stroop task probably influences Stroop responses. It may be plausible to propose that highly emo-

tionally charged material could be more difficult to avoid than less emotionally charged material. The words used in the study investigating Web Stroop responses in both tinnitus and social phobia were drawn from previous research failing to find significant differences in cognitive bias between patients and NC (Andersson, Eriksson, Lundh & Lyttkens, 2000; Lundh & Öst, 1997). The Stroop facilitation effect seen in these two studies may thus have been a reflection of that the emotional relevant words were not concern relevant enough to interfere with the primary task of colour naming. Instead participants may have been able to colour name the emotion relevant word more quickly than neutral words as a defence mechanism serving to discard the emotion relevant words quickly from the computer screen. Such a facilitation response would not be expected for emotional words of primary concern because they would presumably distract so much from the primary colour naming task that they would interfere with this primary task, in turn, producing Stroop interference.

Alternatively, Williams et al. (1997) propose that different emotional disorders could be associated with cognitive bias at different stages in information processing. Emotional disorders associated with bias at early automatic stages may thus be associated with Stroop interference. Bias at later stages may allow for controlled strategic processes to be adopted resulting in avoidance of the emotionally provoking information, hence being reflected as Stroop facilitation. However, previous studies, using standard emotional Stroop tasks, have repeatedly demonstrated that individuals with social phobia colour name words related to social threats more slowly than neutral words (e.g., Hope, Rapee, Heimberg & Dombek, 1990; Lundh & Öst, 1996). Although, it is possible that the more complex colour naming procedure involved in the Web Stroop task caused participants to be beyond the stage of initial attentional bias during colour responding, in turn, allowing them to strategically avoid the emotionally salient words. Such avoidance could be reflected by faster colour responding for such words, relative to neutral words, since a speedy response would cause the emotional words to disappear quickly from the computer screen. It is possible that on the standard emotional Stroop task, the stage of early automatic processing is tapped where initial attentional bias operates during colour responding. Instead, participants performing the emotional Web Stroop task may have been beyond the stage of initial bias and instead used strategic processing to try and avoid the emotionally salient words. Such results are in accordance with the vigilance-avoidance hypothesis stating that initial shifts of attention toward threat-relevant material is counteracted by controlled strategic avoidance (Mogg, Bradley, Bono & Painter, 1997). Such avoidant strategies may serve to maintain the anxiety in social phobia since the individual is not exposed to fearful situations and so habituation and objective evaluation is prevented (Heinrichs & Hofmann, 2001).

Research on the cognitive factors involved in tinnitus is still in its infancy and so it is difficult to speculate regarding the mechanisms maintaining this disorder. However, in terms of ED, there is a lot of research supporting the importance of cognitive factors (e.g., see Vitousek & Hollon, 1990). As mentioned previously, research has repeatedly shown Stroop interference for ED relevant material in ED (e.g., Johansson et al., 2005). The finding in the present study showing that such interference is also demonstrated when using the emotional Web Stroop task may suggest that the mechanisms underlying ED differ from those underlying social phobia. Is it possible that ED are associated with initial bias for a longer duration than social phobia? In light of the above discussion, it appears as though the delay in time to indicate colour name choice in the emotional Web Stroop task, relative to the standard emotional Stroop task, is not sufficiently long for this initial interference bias effect to disappear in ED. At least not for material of primary importance. It may be important to keep in mind differences between emotional disorders when attempting to explain results relating to Stroop research. For example, individuals with social phobia would initially scan the environment to detect potential pressure to engage in social interaction, such as bumping in to an acquaintance. They would subsequently go to great lengths to avoid such social interaction, perhaps by walking away or pretending not to see the acquaintance. This prevents exposure to the anxiety provoking situation which, as mentioned previously, prevents habituation and objective evaluation. Individuals with ED can similarly react automatically with anxiety when, for example, presented with food high in calories that they are expected to eat. However, individuals with ED do not always attempt to avoid food high in calories. Restricted eating tends to lead to excessive preoccupation with food, increased external sensitivity to food and binge eating (Polivy, 1996). Individuals with BN regularly binge on high caloric foods. Hence, it may be plausible to propose that the maintaining mechanisms involved in ED are different to those involved in, for example, social phobia. Individuals with ED do not always attempt to avoid the stimuli that they find anxiety provoking. This may in turn explain why individuals with ED in the present study demonstrated Stroop interference for ED relevant stimuli of particular concern despite perhaps being beyond the initial bias at automatic stages in information processing.

In conclusion, results of the present study suggest that it is possible to administer the emotional Stroop task via the Internet to individuals with ED where similar results to previous studies using standard emotional Stroop tasks are obtained. Furthermore, the slower response times overall caused by changes to task delivery and response mode may have positive effects of differentiating between core concerns of individuals. Administration of the emotional Stroop task via the Internet could have many advantages, such as time efficiency, reduced costs, minimisation of demand characteristics and access to larger and more heterogeneous samples.

## Study IV

### Introduction

As mentioned previously, a number of studies have found support for an explicit memory bias in individuals with ED for ED relevant words (Hermans et al., 1998; Hunt & Cooper, 2001, King et al., 1991; Sebastian et al., 1996). However, there is only one published study, to our knowledge, that has investigated implicit memory bias for such information in participants with ED, carried out by Hermans et al. (1998) using word stem completion. As previous investigators have proposed that word stem completion may not be an adequate test of implicit memory for emotional concerns we instead used Jacoby's white noise judgement task. It was hypothesised that women with clinical ED would rate the background noise of previously presented sentences related to eating and body appearance as softer than previously presented neutral sentences whereas no such differences in implicit memory would be expected for NC women and NED women. Furthermore, we wanted to see whether previous results of explicit memory in participants with ED could be replicated using a different task of explicit memory: a recognition test. As previous findings of explicit memory bias has been equivocal for samples of NED, with a number of studies failing to show such bias (e.g., Ben-Tovim & Walker, 1991; Jansen et al., 1998; Sackville et al., 1998), these individuals were not expected to differ from NC.

### Methods

Participants were in the white noise task, via headphones, presented auditorially with 36 sentences related to eating and body weight (e.g., "Eating chocolate makes you fat", "There is plenty of sugar in the cake"), as well as 36 neutral sentences related to domestic situations, objects and chores (e.g., "Gardening work makes your hands dirty", "There are some wooden candlesticks in the cupboard") for comparison. The emotional and neutral sentences were matched according to word and sentence length and for total frequency used in the Swedish language (Språkbanken, 2003). The 72 sentences used in the experimental trials were divided into three equivalent sets (A, B, and C). Each set comprised of 12 emotional sentences and 12 neutral sentences. These sentences were matched on word and sentence length, total frequency as well as emotional valence, the latter being matched by a clinical psychologist with extensive experience of ED and patients with ED.

The order of presentation of sentences in each of the three equivalent sets was randomised. There were two phases in the noise judgement task: encoding and test phase. There was only one phase in the recognition task. From the three sets of sentences three orders of presentation of sets were created so that in the test phase and in the recognition phase new sentences were pre-

sented intermixed with the old sentences encountered in the encoding phase (e.g., A for encoding, A and B for the test phase and A and C for the recognition phase). Furthermore, the order of sentences in each set was counter-balanced. Six different CDs were thus recorded. Each participant was randomly allocated to one of these CDs.

The speech sound level was 65 dB SPL (Sound Pressure Level) (equivalent level). Background noise levels were presented simultaneously with the spoken sentences during the test phase. There were low, medium and high background noise levels of 60, 64 and 68 dB SPL, respectively, in line with previous research (e.g., Amir et al. 2000). These levels of background noise were randomly allocated to the three equivalent sets where there were equal amounts of low, medium and high levels for emotional and neutral sentences.

Participants were all individually tested on the white noise judgement task first and then the recognition task. In the encoding phase of the noise judgement test they were required to listen to 12 of the neutral sentences randomly intermixed with 12 of the ED relevant sentences (i.e., set A, B or C) and to repeat each sentence aloud immediately after its presentation. These sentences were referred to as old sentences. Participants were subsequently presented with five levels of noise: 56, 60, 64, 68 and 72 dB SPL, in order to give them a varied experience of noise to judge, provide them with noise levels for comparison before the upcoming test phase and to prevent their decision from being made too easily.

In order to ensure that participants understood the instructions of the test phase they were allowed to practice listening to nine neutral sentences, not previously heard and never presented again, mixed with the three levels of background noise. They were again required to repeat each sentence aloud and in addition to subsequently rate the level of the background noise on a scale from 1 to 5 (1 being the softest and 5 being the loudest).

In the test phase of the noise judgement task participants were again presented with the old sentences first heard in the encoding phase intermixed with another 12 neutral sentences and 12 ED relevant sentences not previously heard, referred to as new sentences, accompanied by the three different levels of background noise. Participants were required to repeat each sentence immediately after its presentation and to rate the accompanying background noise. Accuracy of sentence repetition was recorded manually.

After completion of the white noise judgement task, participants were required to perform a recognition test of the old sentences presented in the encoding phase of the noise judgement test. They were presented with the 12 old emotionally relevant sentences and the 12 old neutral sentences that they had heard in the encoding phase of the noise judgement task, not accompanied by background noise, intermixed with 12 emotionally relevant sentences and 12 neutral sentences that they had not heard before, again referred to as new sentences. Participants were required to report whether they had

previously heard each sentence immediately after presentation and also to indicate how confident they were in their decisions on a scale from 1 to 3 where 1 indicated sure of decision, 2 fairly sure of decision and 3 guessing.

Participants were subsequently asked to complete four self-report measures (see below for description). Measures assessing depression and state and trait anxiety were completed first, where the order of these measures given was randomised for each participant. A measure assessing ED concerns was given last in order to prevent potential reactions of anxiety and depression, due to completing this measure, to have consequences on the measures assessing depression and anxiety.

## Participants

Data from 33 women with ED (7 with AN and 26 with BN), 29 women with NED and 36 NC women was analysed in the present study. Mean ages for participant groups were: ED = 24.9 (SD = 4.3), NED = 25.6 (SD = 4.3) and NC = 25.1 (SD = 2.8). For one participant (ED) measurement errors occurred during noise judgement task and for two participants (ED) measurement errors occurred during the recognition task and so this data was not included in analyses involving the noise judgment task and the recognition task, respectively.

## Self-report measures

As previous research has shown that memory bias is associated with depression and perhaps also with anxiety (Williams et al., 1997) participants were asked to complete Swedish versions of depression and anxiety self-report questionnaires: These were the BDI (Beck et al., 1961) and the trait and state versions of the STAI (Spielberger et al., 1983). In order to assess ED and levels of non-clinically ED related concerns the SEDs (Ghaderi & Scott, 2002; Göttestam & Agras, 1995) was used which diagnoses ED according to the classification in the DSM-IV.

## Results

Results from Jacoby's white noise task revealed a significant interaction of presentation (old vs. new), sentence type (emotional vs. neutral) and group (ED, NED, NC)  $F(2,94) = 5.04$ ,  $p = 0.008$ . There was a difference between old sentence types for ED participants  $t(31) = 2.76$ ,  $p = 0.01$ . Women with ED rated the background noise as softer when old emotional sentences were presented compared to when old neutral sentences were presented. No such differences were obtained in the other groups. There were no significant differences between participant groups for old sentences. Hence, participants with ED displayed implicit memory bias only within their participant group.

Figure 1 presents mean noise ratings for sentence type, presentation and group, separately. Results for the recognition task revealed no significant differences between participant groups nor any explicit memory bias within the participant group of ED. Participants across groups were more confident in their recognition for emotional sentences compared to neutral sentences  $t(95) = 2.55, p = 0.012$  and also more confident in their recognition of old sentences as compared to new sentences  $t(95) = 7.40, p < 0.001$ . However, when looking at false alarms: the percentage of new sentences recognised incorrectly as old, all participants overall recognised neutral sentences more accurately than emotional sentences  $F(1,93) = 4.93, p = 0.029$ .

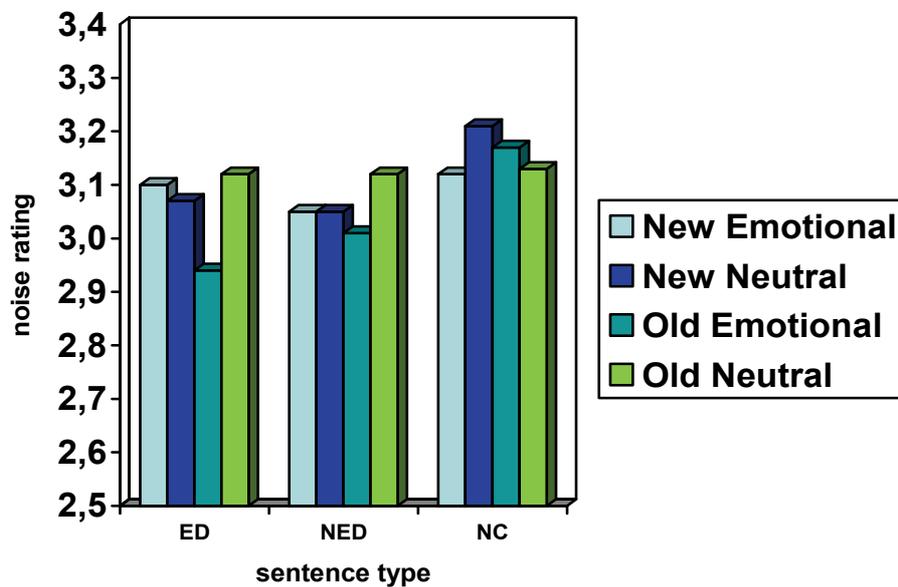


Figure 1. Mean noise ratings for sentence type, presentation and group separately. ED = eating disorder, NED = Non-clinical eating disorder related concerns, NC = Normal controls.

## Discussion

The present findings were in line with previous research where implicit memory bias has been seen in other emotional disorders for information relevant to emotional concerns (Amir et al. 2000; Amir et al. 1996a; Amir et al. 1996b). However, there were no significant differences between the

groups in terms of implicit memory bias. Hence, ED did not judge the noise accompanying old emotional sentences as softer than NC and NED. Participants with ED did, however, demonstrate a relative implicit memory bias within their own participant group where, as mentioned above, they rated the background noise of old emotional sentences as softer than the background noise of old neutral sentences. The present findings thus only provide partial support for implicit memory bias in ED for eating and body appearance related sentences. In line with expectations, no implicit memory bias was seen for participants with NED.

There was no support for the idea that participants with ED recognised ED related sentences better than neutral sentences, compared to the other participant groups. Hence, there was no support for an explicit memory bias in participants with ED. This finding was thus in contrast to previous studies showing explicit memory bias in individuals with ED (Hermans et al., 1998; Hunt & Cooper, 2001, King et al., 1991; Sebastian et al., 1996). However, as mentioned previously, these studies all used different explicit tests of memory than the present study, which may explain this discrepancy in findings. Alternatively, it is possible that the Jacoby task performed prior to the explicit recognition task somehow interfered with explicit memory. Results revealed that, across participant groups, participants were more confident in their recognition of sentences related to eating, food and negative body appearance than of neutral sentences. Considering that non-clinical concerns about eating and body appearance are very common among women of Western societies (Grogan, 1999) this may not be surprising.

However, when looking at false alarms, instead of confidence in recognition, a different picture emerged. Overall participants recognised emotional sentences more poorly than neutral sentences. Hence, it appears as if they believed that they were more confident in their recognition of emotional sentences compared to neutral sentences. However, when analysing false alarms, participants were instead found to recognise neutral sentences better than emotional sentences. Participants in the present study thus incorrectly classified more new emotional sentences as old than new neutral sentences. How can these results be explained? One possibility is that the ED related category of sentences was more homogeneous in meaning than the category of neutral sentences which made participants more prone to erroneously believing that they had previously heard ED related sentences never encountered compared to neutral sentences not previously encountered. Old and new neutral sentences may thus have been easier to disentangle because they were more heterogeneous in meaning. However, care was taken in order to also make the neutral sentences homogeneous in meaning where they were all, as mentioned previously, related to domestic situations, objects and chores. It is still possible that such attempts to make neutral sentences as homogenous as ED related sentences were not successful.

Another possibility is that participants overall were demonstrating a reversed bias that is associated with defensiveness (Eysenck, 1997). Participants may thus have adopted strategic avoidant processing where they avoided emotionally provoking sentences. Such avoidance would thus result in less accurate recognition of the emotional sentences compared to neutral sentences. Yet another possibility is that participants overall were more distracted by the emotional sentences which made it more difficult for them to determine which of the emotional sentences they had heard before than to decide which neutral sentences they had heard before. The distraction with emotional sentences may have caused them to believe that they had been presented with such sentences previously to a greater extent than to neutral sentences. Individuals with ED, but also dieters and NC to a lesser extent, have been found to become preoccupied with thoughts related to eating and body appearance when exposed to ED concern relevant situations, such as looking at themselves in a full-length mirror, weighing themselves and eating chocolate (Cooper & Fairburn, 1992a). Such preoccupation when exposed to issues related to eating and body appearance may lead to distraction where memory becomes inaccurate.

In conclusion, the present study, in line with previous studies (Amir et al. 2000; Amir et al. 1996a; Amir et al. 1996b), support the utility of the noise judgement task as a measure of implicit memory for emotionally relevant information in individuals for whom such information is of specific concern. Furthermore, the finding that only participants with ED showed partial implicit memory for ED related sentences but not participants with NED indicates that such bias may be a distinguishing feature of ED.

## General discussion

### Main findings in the studies

The findings of the studies in the present thesis provide some support for the idea that individuals with ED are characterised by cognitive biases. Study II and III indicates that attentional bias toward eating- and body-related information on the emotional Stroop task may be specific to clinical ED. However, it may be appropriate to make this suggestion cautiously considering that, in study III, NED showed comparatively longer Stroop responses for body words compared to neutral words, within their own participant group. Study II indicates that Stroop interference effects generally are of medium effect size where NED females as well as NC females show small effect sizes. Hence, even though significant differences can be found between participants with ED compared with NC and NED, it is possible that women of Western societies overall are sensitive to issues related to eating and body appearance perhaps due to cultural perceptions of slenderness as one of the most important indicators of female beauty. Furthermore, in contrast to expectations in study II, individuals with AN and individuals with BN did not differ with regard to sensitivity for food- and body-related words on the emotional Stroop task. However, study III indicates that manipulating the response mode, as was necessary when administering the emotional Stroop task via the Internet, may make this measure of selective attention more sensitive to specific concerns of participants. In this study, participants with AN demonstrated attentional bias only for food-related words whereas participants with BN demonstrated attentional bias only for body-related words. These findings may thus reflect differences in the primary concerns of these two participant groups, in line with previous research findings (see Faunce for a review, 2002). Study IV partly supports predictions from cognitive models that individuals with ED should also show selective memory for information related to eating and body appearance, at least with regard to implicit memory. As no significant difference was found for ED relevant sentences between participants with ED and NC but only within the sample of individuals with ED, only partial support can be said to have been gained for implicit memory. There was no support for explicit memory bias in participants with ED, despite several previous studies having demonstrated such memory bias (Hermans et al., 1998; Hunt & Cooper, 2001, King et al., 1991;

Sebastian et al., 1996). It is possible that this discrepancy between results is due to administration of different measures of explicit memory.

Study I employed the emotional Stroop task in order to investigate whether the use of this task could be extended to more complex investigations than that of selective attention. Since previous research indicates that responses on this task can be influenced by priming, images of stereotypically slim female body ideals were presented prior to the Stroop task in order to test whether such priming would affect information processing of negative self referent information in women dissatisfied with their body appearance. Results did not support the hypothesis that exposing women with non-clinical concerns about body appearance to thin ideal images would lead to activation of negative self-schemata. Although, the results were in the predicted direction where high BSQ women were significantly slower to colour name performance-related threat words compared to low BSQ women after thin ideal priming. However, high BSQ women exposed to thin ideal priming did not differ significantly on Stroop responses for these words compared to high BSQ women exposed to neutral priming. In light of results from study II and III it is possible that the emotional Stroop task is not sufficiently sensitive to non-clinical ED relevant concerns. It would be interesting to replicate study I using a clinical sample of ED. The main finding of study I instead concerned women satisfied with their bodies and indicated that well being may actually increase in these women when they have the opportunity to express positive body image, and perhaps also following thin ideal exposure. The latter interpretation was speculative as more research is required in order to understand the mechanisms involved in Stroop facilitation. The results of study I do however support the idea that responses to negative self referent information following thin ideal exposure depends on initial body dissatisfaction.

## Theoretical discussion

Results thus provide support for cognitive theories of ED suggesting that these disorders are characterised by cognitive bias toward information related to eating and body appearance (Fairburn, Cooper & Cooper, 1986; Garner & Bemis, 1982; Vitousek & Hollon, 1990). This, in turn, suggests that cognitive distortions are important for the understanding of these disorders. Furthermore, with regards to the integrative model put forward by Williams et al. (1997), the present findings may be interpreted to suggest that ED are associated primarily with bias at early stages of information processing. This suggestion stems from the finding of partial support for implicit memory in individuals with ED in study IV in combination with findings from the Stroop research in study II and III. However, since previous studies have demonstrated explicit memory bias for individuals with ED (Hermans

et al., 1998; Hunt & Cooper, 2001; King et al., 1991; Sebastian et al., 1996), this may be a premature proposal. More research is required in order to investigate further bias at later stages in information processing.

## Clinical implications

The findings suggesting that ED are associated with cognitive biases for information related to food and body appearance, perhaps primarily at an unconscious level, may have important clinical implications. As mentioned previously, it is important to gain insight into distorted cognitive processing at both conscious and non-conscious levels in order to develop efficient treatment strategies. A patient with an ED may recognise and acknowledge on a conscious level that her attitudes toward eating and body appearance are disturbed. However, if she continues to automatically selectively focus on information that confirms such dysfunctional attitudes it may not be sufficient to deal with only conscious recognitions in therapy. Methods to target automatic cognitively biased responses may also be necessary for treatment to be optimally successful. Further research is required in order to disentangle exactly what type of therapeutic techniques could serve to target such initial automatic cognitive biases. Therapy needs to target all levels of cognition where processing is distorted. Increased understanding of the cognitive processes involved in ED may further provide invaluable information about the mechanisms behind development and maintenance of an ED. Such information may serve to identify individuals at risk of an ED and serve to guide the development of more efficient treatment strategies. This research could have significant value for individuals suffering from the enormously debilitating impact of these disorders at emotional, physical and functional levels, and for their families.

The finding from study III indicating that it may be possible to distinguish between the primary concerns of individuals with different types of ED when manipulating task delivery and response mode on the emotional Stroop task may have implications for diagnostic utility. It does, however, seem premature to speculate whether the emotional Stroop task can be used as an index of eating pathology, and even type of eating pathology, considering, for example, that some research has failed to find a change in Stroop interference after treatment (Black et al., 1997; Carter et al., 2000). Nevertheless, such changes made to the administration of the emotional Stroop task may provide a means of advancing our understanding of the cognitive and emotional mechanisms involved in AN and BN.

Body perception seems to be one characteristic important to take into account when investigating why women differ in their cognitive responses toward negative self relevant information following thin ideal exposure. Increasing the understanding of what differentiates vulnerable and non vul-

nerable women in terms of cognitive responses toward thin ideal images could provide valuable guidelines when developing interventions to reduce the negative impact of such images on vulnerable women. Such interventions could have implications for prevention of unfavourable comparison with the thin ideal and perhaps, as a result, prevention of further body dissatisfaction and, as a consequence, prevention of disordered eating.

## Methodological considerations

Limitations of the studies presented in the thesis need to be considered. It is possible that the laboratory setting introduced to participants in the studies conducted and in the studies reviewed in the meta-analysis has implications for the generalisation of the results. Participants were presented with controlled laboratory stimuli. It is uncertain to what extent these women would focus on eating- and body-related information in real life situations. Levels of hunger were not assessed which has consequences for the interpretation of the results on the emotional Stroop task and the memory tasks, especially with regard to food words and sentences related to food. Participant groups classified as NED may have been very heterogeneous which may have implications for the generalisation of results for this group. The BSQ groups in study I may, in contrast, not have been heterogeneous enough in terms of body perception which may explain why support for activation of negative self-schemata in the high BSQ exposed to thin ideal priming was not obtained. One consequence of administering the emotional Stroop task via the Internet was lack of control for which type of setting participation took place in and honesty of identity. Some participants with ED were diagnosed only by means of a self-report questionnaire which introduces the risk of faulty diagnoses.

## Future research

Further research on the cognitive factors involved in the development and maintenance of ED is required in order to increase our understanding of the nature of these cognitive distortions and under what conditions they are strengthened and weakened. The precise meaning of cognitive distortions are as of yet not fully understood which has important implications for this area of research. However, as mentioned earlier, previous research suggests that cognitive biases of ED relevant stimuli is primarily related to clinical ED concerns that go beyond factors such as hunger and practice effects which warrants further investigation of such cognitive processes involved in ED. Future research would, however, benefit from controlling for hunger in order to be able to more forcefully rule out that Stroop interference for food-

related information is simply an effect of hunger. In general, it is important for researchers conducting emotional Stroop research, and other measures of cognitive bias, to more clearly define their samples in order to be able to clarify the role of, for example, duration of an ED and severity of symptoms. It would also be interesting to further investigate the effect of therapeutic response on Stroop interference, and other forms of cognitive biases. The food- and body-related words and sentences used in the research presented were negatively toned. It would be interesting to investigate further whether such bias can also be seen for information related to positively toned food and body material, such as healthy food and slim physique, the latter not involving comparison with other idealised women. According to schema-based theories one would not expect individuals with ED to selectively focus on information inconsistent with disorder relevant schemata (Vitousek & Hollon, 1990). Such research could also have clinical implications, serving to guide treatment strategies aimed at cognitive restructuring. Future research would also benefit from further investigation of cognitive bias for negatively toned information unrelated to eating and body appearance, such as negative self relevant information, considering that many studies have found an association between ED and negative self-evaluation (e.g., Fairburn et al., 1999; Fairburn et al., 1997). Furthermore, future research should manipulate response mode on the emotional Stroop task so that different levels of time delays can be observed in order to investigate more thoroughly whether Stroop effects can be manipulated by varying the time it takes to respond to the colour words. It is, however, important to emphasise again that multiple factors contribute to the development of ED, often involving interactions between many different factors. Hence, although the primary focus in the present thesis has been on cognitive factors, it is important for future research to also increase the understanding of other factors involved in the aetiology of ED.

## Summary of the findings in the thesis

1. Support was provided for cognitive theories of ED suggesting that cognitive processing of information related to food and body appearance is biased in individuals with ED, at least at automatic levels of processing. It is, however, unclear whether such cognitive biases can be said to be specific to individuals with clinical ED.
2. Findings suggest that the emotional Stroop task can be extended to investigations of priming where presentation of stimuli prior to performing the Stroop task can influence Stroop responses.
3. Initial body perception may be one factor influencing cognitive responses toward negative self referent words following exposure to thin ideal images,

where a healthy body perception may be interpreted as a potential buffer against negative impact of such images.

4. Manipulating task delivery and response mode on the emotional Stroop task may have the advantage of differentiating between core concerns of different types of ED, due perhaps to increased sensitivity of the Stroop task when allowed more time to determine the emotional value of the words presented.

5. Results suggest that the emotional Stroop task successfully can be administered via the Internet which may have many advantages, such as time efficiency, reduced costs, minimisation of demand characteristics and access to larger and more heterogeneous samples.

6. Findings provide support for that Jacoby's white noise task successfully can be used as a measure of implicit memory bias in ED, at least within this population.

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