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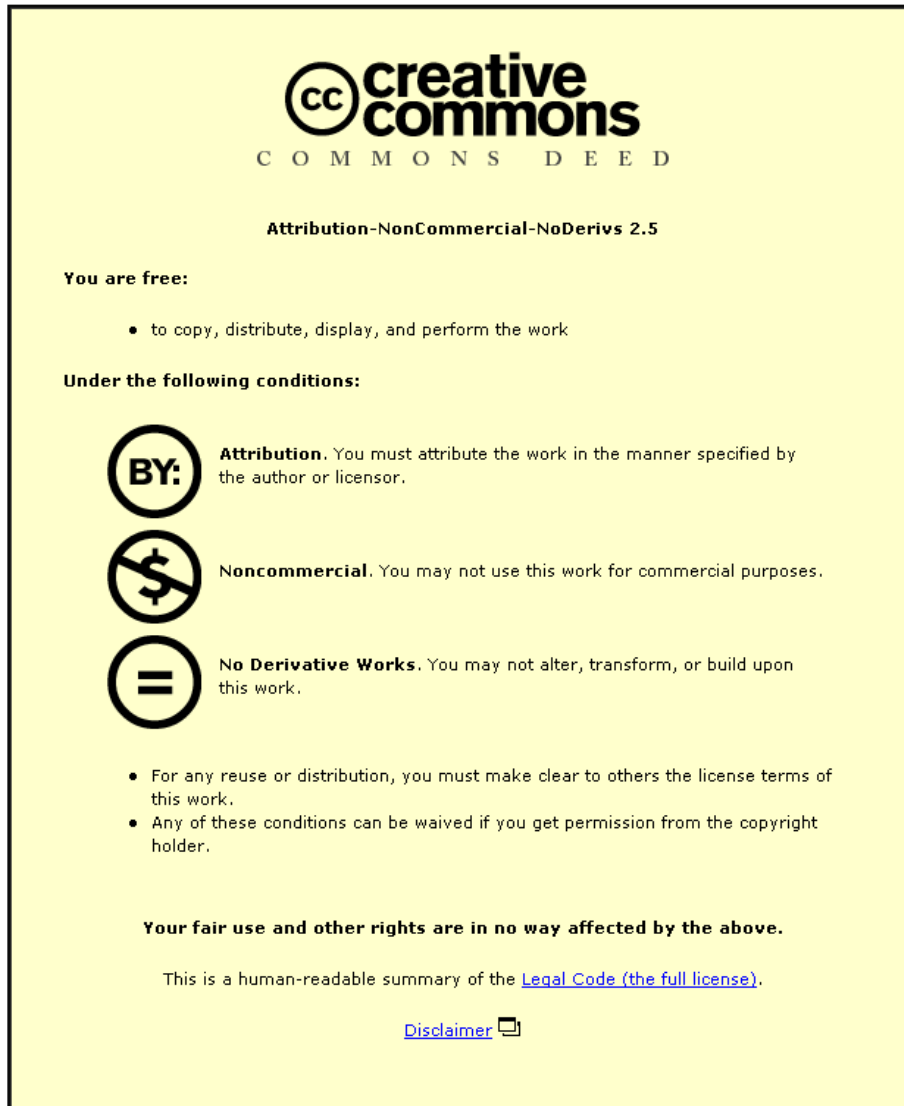
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**COMPULSIVE EXERCISE AND EATING DISORDER
RELATED PATHOLOGY**

By

LORIN TARANIS

Doctoral Thesis

Submitted in partial fulfilment of the requirements for the award of
Doctor of Philosophy of Loughborough University

2010

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Abstract

Background: Compulsive exercise has been observed as a significant feature of the eating disorders throughout their history. It has variously been conceptualised as primarily an analogue of purgation, an emotion regulation strategy, an addiction, or an obsessive-compulsive behaviour, with evidence supporting each to varying degrees. The importance of compulsive exercise is underlined by the finding that it often precedes the onset of an eating disorder and is one of the last symptoms to subside. In addition, it is associated with a longer length of hospitalisation and higher rates of relapse. As a result, compulsive exercise is now recognised as a significant factor in the aetiology, development and maintenance of the eating disorders across diagnoses. Yet despite the importance of compulsive exercise and previous recommendations to target it, no clear conceptual model of compulsive exercise exists upon which an intervention could be based.

Objectives: This thesis has three broad aims: (1) critically review the evidence for and against factors implicated in the maintenance of compulsive exercise and propose a new theoretically coherent and empirically derived model of compulsive exercise that could be used to inform future cognitive-behavioural interventions; (2) develop and provide preliminary validation for a new measure of compulsive exercise; and (3) present six studies utilising the new measure of compulsive exercise to empirically test some of the relationships suggested by the proposed model.

Main findings: The resulting Compulsive Exercise Test (CET) is a new multidimensional measure of compulsive exercise, consistent with the proposed cognitive-behavioural conceptualisation, and demonstrating good psychometric properties. Utilising the CET, the empirical chapters demonstrate that compulsive exercise was associated with (a) elevated levels of eating-disordered cognitions and increased frequency of eating-disordered behaviours, (b) avoidance-oriented coping and a range of difficulties in regulating emotions, and (c) perfectionism (particularly the self-critical dimension).

Implications: The current findings provide preliminary support for the proposed cognitive-behavioural maintenance model of compulsive exercise. This may inform clinical interventions and prevention programs designed to address compulsive exercise, as well as enhancing current treatment efficacy by providing specific targets for intervention. In addition, the new measure of compulsive exercise is potentially a useful screening tool in formulating the maintenance of an individual's exercise behaviour, and is further a potentially useful research and outcome tool.

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Published Papers

Chapter 1 in part forms the basis of a review that has been accepted for publication as:

Meyer, C., Taranis, L., Goodwin, H., & Haycraft, E. (*in press*). Compulsive exercise and eating disorders. *European Eating Disorders Review*,

Chapter 2 has been accepted for publication as: Taranis, L., Touyz, S., & Meyer, C. (*in press*).

Disordered eating and exercise: Development and preliminary validation of the Compulsive Exercise Test (CET). *European Eating Disorders Review*,

Chapter 3 has been accepted for publication as: Taranis, L., & Meyer, C. (*in press*).

Associations between specific components of compulsive exercise and eating disorder pathology among young women. *International Journal of Eating Disorders*

Chapter 4 has been accepted for publication as: Taranis, L., Touyz, S., & Meyer, C. (*in press*).

Compulsive exercise and emotion regulation among young women. *International Journal of Eating Disorders*,

Chapter 5 has been submitted for publication as: Taranis, L., & Meyer, C. (under review).

Dimensions of perfectionism and eating psychopathology: High personal standards versus self-criticism? *Eating Behaviors*,

Chapter 6 has been published as: Taranis, L., & Meyer, C. (2010). Perfectionism and

compulsive exercise among female exercisers: High personal standards or self-criticism? *Personality and Individual Differences*, 49, 3-7.

Note: the format of some of these papers has been altered from the original submissions to maintain consistency across the thesis.

Chapter 1

Literature Review

Compulsive Exercise and Eating Disorder

Related Pathology

Compulsive Exercise and Eating Disorder

Related Pathology

1.1 Literature Review: Search Strategy

A comprehensive three-stage literature search was undertaken to include all relevant literature published from the earliest available date up to and including July 2010. First, key databases were searched consisting of: PsycINFO, ScienceDirect, Web of Science, EBSCO, Ovid, and Scopus. Search terms included, but were not limited to: *exercise, activity, excessive, compulsive, obsessive, obligatory, addiction, dependence, habitual, commitment, abuse, disordered, eating, anorexia, bulimia*. Wildcards were used wherever required to enable all possible permutations of a root word to be found. For example, **exercis** would find the word “*exercise*” together with all possible prefixes and suffixes, such as *over-exercise, over-exercising, over-exerciser, exercising, exerciser, exercised* etc. In addition, in order to narrow the search to relevant findings only, Boolean Operators were used to specify relationships between specific search terms/word. For example, **exercis** AND *eat** OR *excessive*. Second, reference lists of empirical and review articles were systematically searched for additional relevant articles not identified in the original search. Finally, journal volumes identified as having not being included in or covered by the original database search were subjected to individual searches using the search terms.

1.2 Aims of the literature review

The aims of this literature review are fivefold. Following an introduction to the eating disorders and the transdiagnostic cognitive-behavioural maintenance model, the construct of excessive exercise will be introduced and evaluated in terms of its importance in the eating disorders. Second, definitions of excessive exercise will be critiqued. Third,

evidence of factors implicated in the maintenance of excessive exercise will be reviewed and a new cognitive-behavioural model of excessive exercise will be introduced. The aim is to propose a way of integrating the proposed maintaining factors into an empirically derived and theoretically coherent model that could inform future cognitive-behavioural interventions to address excessive exercise. In addition, gaps in the model will be identified and critically considered in terms of current findings. Fourth, existing measures of excessive exercise will be critically reviewed. Finally, conclusions drawn from the evidence reviewed will be used to generate future research directions.

Part of this chapter forms the basis of a review that has been accepted for publication as:

Meyer, C., Taranis, L., Goodwin, H., & Haycraft, E. (*in press*). Compulsive exercise and eating disorders. *European Eating Disorders Review*,

1.3 Introduction to the eating disorders

Eating disorders (EDs) comprise a range of syndromes encompassing physical, psychological and social features (National Institute for Health and Clinical Excellence: NICE, 2004), and are collectively defined as “a persistent disturbance of eating behaviour or behaviour intended to control weight, which significantly impairs physical health or psychosocial functioning” (Fairburn & Walsh, 2002: pp. 171). The first documented eating disorder (ED) was Anorexia Nervosa (Gull, 1874; Lasegue, 1873), having first been medically described by Richard Morton in 1689 (Pearce, 2004). This was later sub-typed into those who simply restricted and exercised (restricting type), and those who purged and possibly binge ate (purging type) (Russell, 1979).

Bulimia Nervosa was first categorised as a separate disorder in the Diagnostic and Statistical Manual of Mental Disorders (DSM-III: American Psychiatric Association, 1980). It was later recognised that there was a further sub-group of patients with EDs that closely resemble Anorexia Nervosa and Bulimia Nervosa, but which are considered atypical, as they do not meet the precise diagnostic criteria for these conditions (Fairburn & Harrison,

2003; Turner & Bryant-Waugh, 2003). These patients were grouped together into the category of eating disorder not otherwise specified, first categorised as a separate disorder in the DSM-III-R (American Psychiatric Association, 1987).

The current Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR: American Psychiatric Association, 2000) details three diagnostic categories of EDs: Anorexia Nervosa (AN); Bulimia Nervosa (BN); and Eating Disorder Not Otherwise Specified (EDNOS), also called 'atypical eating disorders' (Fairburn & Harrison, 2003). However, the relationship between AN and BN and atypical eating disorders has been observed to change frequently, with both AN and BN often subsiding into a "sub-threshold" phase of continued disordered eating that whilst not meeting the criteria for AN or BN, may still qualify as EDNOS (Fairburn & Walsh, 2002). Furthermore, as many as 30-60% of ED patients fall into the EDNOS category (Fairburn & Walsh, 2002).

Eating disorders typically begin with what may look like normal dieting (Touyz, Polivy, & Hay, 2008). They are characterised by restricted and/or binge eating, a relentless pursuit of thinness, and obsessive fears of becoming fat (American Psychiatric Association, 2000). In addition, they are often associated with perfectionism, anxiety, depression, and obsessional traits (Godart, Flament, Lecrubier & Jeammet, 2000; Lilenfeld, Wonderlich, Riso, Crosby & Mitchell, 2006; Pearlstein, 2002; Strober, 1980). Although these disorders are often thought to be caused by psychosocial factors (Mills, Polivy, Herman, & Tiggemann, 2002), studies show substantial genetic and neurobiological aetiological influences (e.g., Collier & Treasure, 2004; Grilo, 2006; Klump & Gobrogge, 2005). As a consequence, in common with most other psychiatric disorders, the aetiology of EDs is considered to be multi-factorial such that no single aetiological factor is able to account for the development of the disorder (Collier & Treasure, 2004).

Eating disorders typically onset in adolescence and occur more frequently in females (Fairburn & Harrison, 2003), with community and clinical epidemiological studies reported to consistently find a sex ratio of one male patient to every 10-15 females except in preadolescents, where the ratio is closer to equal (Touyz, Polivy, & Hay, 2008).

Whereas AN typically occurs most often in pubertal girls, BN typically develops slightly later in older teenage girls or young women in their twenties (Fairburn & Harrison, 2003; Polivy, Herman, Mills, & Wheeler, 2003). Unfortunately, the typical onset of EDNOS is less well known.

Eating disorders are serious conditions with a high lifetime mortality, mainly from suicide (Robin, Gilroy, & Dennis, 1998). Suicide attempts occur in approximately 3–20% of patients with Anorexia Nervosa and in 25–35% of patients with Bulimia Nervosa (Franko & Keel, 2006). In addition, EDs can result in irreparable physical damage ranging from oral and dental tissue erosion, through to infertility, cardiac complications, permanent skeletal destruction and osteoporosis (Golden, 2003; Little, 2002; Mehler, 2003)

Further underlining the importance of the EDs is the fact they are difficult to treat (Ben-Tovin, 2003; Fairburn & Harrison, 2003) with the chance of recovery from EDs in ten years being reported at approximately 50% for AN and 75% for BN (Keel & Brown, 2010). Whereas BN often responds to psychological and pharmacological treatments, AN remains more difficult to treat (Fairburn & Harrison, 2003). Indeed, recent reviews of evidence-based treatment, conclude that there was almost no empirical support for any specific treatment of AN (e.g., Fairburn 2005; Hay, 2008; Steinhausen, 2002). Consequently, AN often has a chronic and relapsing course and substantial morbidity and mortality (Beumont & Touyz, 2003; Herpertz-Dahlmann, Müller, Herpertz, Heussen, Hebebrand et al., 2001; Papadopoulos, Ekborn, Brandt, & Ekselius, 2009). Indeed, AN has the highest mortality rate of any psychiatric disorder (Harris & Barraclough, 1998; Sullivan, 2002), almost three times higher than other psychiatric illnesses (NICE, 2004). It is estimated that as many as 20% of individuals with a diagnosis of AN die as a direct or indirect result of their illness (Tamburrino & McGuinnis, 2002), either as a result of medical complications or from suicide (Fairburn & Harrison, 2003).

1.3.1 Diagnostic criteria for eating disorders

This section will outline the DSM-IV-TR diagnostic criteria for AN, BN and EDNOS (American Psychiatric Association, 2000).

1.3.1.1 *Anorexia Nervosa*

- 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 the 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., oestrogen, administration.)
-
- **Restricting Type (AN-R):** 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 (AN-BP):** 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)

1.3.1.2 *Bulimia Nervosa*

- A. Recurrent episodes of binge eating. An episode of binge eating is characterized 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 most people would eat during a similar period of time and under similar circumstances
 2. a sense of lack of control over eating 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 both occur, on 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.
- **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
 - **Nonpurging 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.

It is important to note that it is not possible to receive a dual diagnosis of AN and BN (DSM-IV-TR, 2000). Therefore, individuals presenting with symptoms of both syndromes are diagnosed as AN-BP. This revision was based on evidence that outcome associated with AN is worse than for BN, and having AN and BN in combination is associated with the poorest prognosis (Steinhausen, 2002; Ward, Campbell, Brown, & Treasure, 2003).

1.3.1.3 *Eating Disorder Not Otherwise Specified*

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.

1.3.2 Incidence and prevalence of the eating disorders

This section will critically review the prevalence and incidence figures for AN, BN and EDNOS.

1.3.2.1 *Prevalence*

Despite a large number of epidemiological studies, there remains considerable debate about the prevalence of EDs in the community (Machado, Machado, Gonclaves, & Hoek, 2007). However, whilst it remains relatively rare for an individual to meet the full DSM-IV-TR diagnostic criteria for AN or BN (e.g., Tamburrino & McGuinnis, 2002), there has been a belief that EDs have become more frequent over recent decades (Fairburn & Harrison, 2003). Whilst studies of prevalence rates have tended to suggest that the prevalence of AN and BN combined in the population at risk (i.e., young females) is

somewhere between 1.5-10%, with at least a 2:1 ratio of BN to AN patients (Polivy & Herman, 2002), reviews have suggested the lower number is more accurate (e.g., Hoek, 2002). Indeed, Machado et al. (2007) report the prevalence of AN and BN combined as 3.1%. According to a review by Fairburn and Harrison (2003) the prevalence for AN is 0.7% among teenage girls, whereas BN is 1-2% among sixteen to twenty-five year old females. However, a more recent review found that the average prevalence rates among young females was 0.3% for AN and 1% for BN (Hoek, 2006). In contrast, the prevalence for EDNOS is reported to be as much as twice that of AN and BN (Polivy & Herman, 2002). Certainly a diagnosis of EDNOS is more common than a diagnosis of AN or BN (Ricca, Mannucci, Mezzani, DiBernardo, Zucchi et al., 2001; Turner & Bryant-Waugh, 2004), with a recent study suggesting a prevalence of 2.4% (Machado et al., 2007).

1.3.2.2 Incidence

A major criticism of studies of incidence is that rather than being based on general population studies, they are typically based on cases reported to health care systems (e.g., Touyz, Polivy, & Hay, 2008). As a consequence, they are likely underestimates of the true incidence as individuals with EDs often do not seek medical attention (e.g., Fairburn & Harrison, 2003; Hoek, 2003). Such studies suggest rates for AN of 5-19 per 100,000 per year, and for BN is 11-29 per 100,000 per year (e.g., Hoek, 2002; Fairburn & Harrison, 2003). These incidence figures have tended to be thought of as lower than the prevalence figures because treatment for AN and BN is often difficult and drawn out (Steinhausen, 2002). However, whilst the incidence of AN has remained fairly consistent over time, the incidence of BN is reported to be increasing (Currin, Schmidt, Treasure, & Jick, 2005). In an attempt to address the limitations of past studies, a recent study assessed the incidence rate for BN in the general population reporting a rate of 300 per 100,000 per year at the peak age of incidence (16-20 years) (Keski-Rahkonen, Hoek, Linna, Raevuori, Sihvola et al., 2009). Unfortunately, perhaps due to its more recent emergence, incidence figures for EDNOS are not reported in the literature. However,

figures from clinical populations suggest that 25-60% of ED cases are diagnosed as EDNOS (Andersen, Bowers, & Watson, 2001).

1.3.3 Definitional and diagnostic issues for eating disorders

As empirical research has tended to follow formal definition of the EDs rather than precede it, the DSM criteria have been revised many times and continues to be challenged (Herzog & Delinsky, 2001). Indeed, many of the particular diagnostic criteria for EDs are somewhat subjective (and contentious) (Thaw, Williamson, & Martin, 2001; Walsh & Garner, 1997). As a consequence, the current DSM-IV-TR scheme for classifying EDs is suggested to have certain fundamental flaws and limitations (Chavez & Insel, 2007; Fairburn & Cooper, 2007; Walsh & Sysko, 2009). Key among these limitations is the questionable clinical utility of amenorrhea as a diagnostic criterion for AN (Attia & Roberto, 2009; Dalle Grave, Calugi, & Marchesini, 2008a; Garfinkel, Lin, Goering, Spegg, Goldbloom et al., 1996), and the minimal empirical justification for what constitutes the size and frequency of a clinically significant binge episode (Johnson, Boutelle, Torgrud, Davig, & Turner, 2000; Garfinkel, Kennedy, & Kaplan, 1995; Wolfe, Baker, Smith, & Kelly-Weeder, 2009). Indeed, the draft version of DSM-V indicates that both these criteria have been revised such that amenorrhea is no longer included as a diagnostic criterion for AN and the minimum required frequency of binge eating for a diagnosis of BN has been reduced from twice a week to once a week over the last three months (American Psychiatric Association, 2010). The other important issue relates to concerns about the validity of the AN and BN subtypes (van Hoeken, Veling, Sinke, Mitchell, Hoek, 2009), and the overall validity of the distinctions between AN, BN, and EDNOS (Franko, Wonderlich, Little, & Herzog, 2004). However, the draft version of DSM-V has retained the existing subtypes (American Psychiatric Association, 2010).

1.3.4 Transdiagnostic model of the eating disorders

The transdiagnostic model (Fairburn, Cooper, & Shafran, 2003) is a cognitive-behavioural model of the key factors implicated in the maintenance of eating disorders across diagnoses (see Figure 1.1). Whilst there are many cognitive-behavioural models of the eating disorders, they are all specific to either one particular eating disorder diagnostic category (e.g., Fairburn, Cooper, & Cooper, 1986; Garner & Bemis, 1982; Guidano & Liotti, 1983; Slade, 1982), or to a specific eating disordered feature, such as binge-eating (Heatherton & Baumeister, 1991; McManus & Waller, 1995). The transdiagnostic model is unique in its attempt to address the shortcomings of existing models by being applicable to the full range of eating disorders. It is based on the idea that a core pathology is common to all eating disorders characterised by the over-evaluation of eating, shape and weight and their control. In addition, the model includes four additional mechanisms that when present may also function to maintain the eating disorder and as such, would when present, constitute crucial targets for cognitive-behavioural intervention. These additional mechanisms are perfectionism, core low self-esteem, mood intolerance (inability to cope appropriately with certain mood states), and interpersonal difficulties (Life). Preliminary results suggest that cognitive-behavioural interventions based on the transdiagnostic model show promising results in the treatment of patients who present with the identified maintaining factors (Fairburn, Cooper, Doll, O'Connor, Bohn et al., 2009).

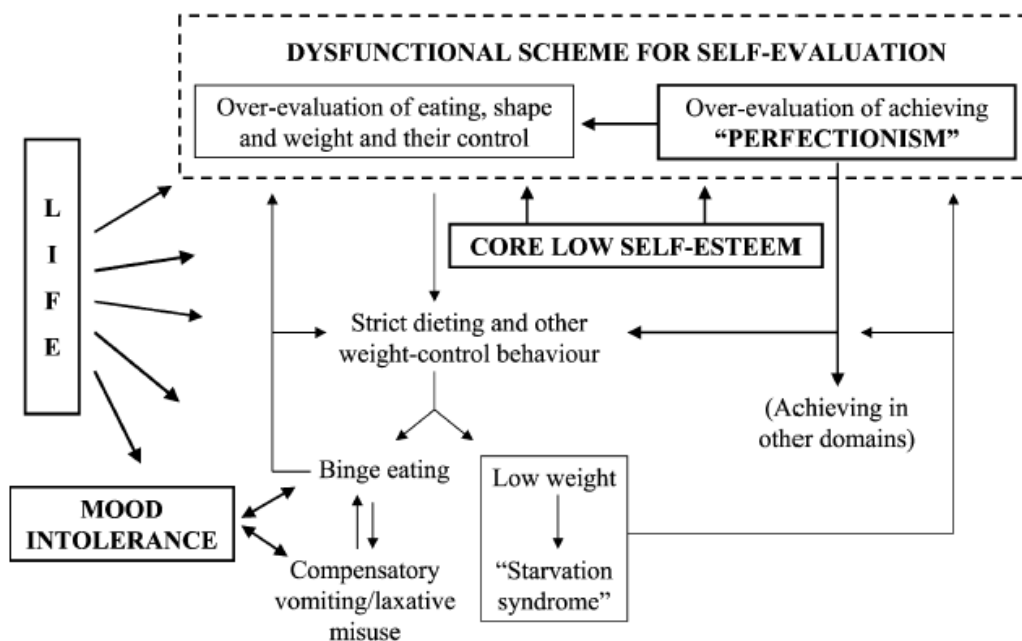


Figure 1.1. A schematic representation of the transdiagnostic model of the maintenance of the eating disorders (Fairburn, Cooper, & Shafran, 2003).

1.3.5 Summary

In summary, section 1.3 provided an introduction to the eating disorders in terms of their history, clinical importance, incidence and prevalence, and diagnostic features. In addition, the transdiagnostic cognitive-behavioural model of the maintenance of the eating disorders was introduced. The next section of the literature review will critically consider the relationship of exercise to the eating disorders.

1.4 Introduction to exercise in the eating disorders

From the earliest clinical descriptions and throughout the history of the eating disorders, clinicians have observed a tenacious drive for physical activity as a prominent characteristic of many patients with AN, even in the face of severe emaciation (e.g., Bruch, 1965; Crisp, 1967; Dally, 1969; Eisler & LeGrange, 1990; Gull, 1874; Inches, 1895; Kron, Katz, Gorzynski, & Viner, 1978; Lasegue, 1873; Long, Smith, Midgley, & Cassidy, 1993; Penas-Lledo, Vaz Leal, & Waller, 2002; Shroff, Reba, Thornton, Tozzi, Klump et al., 2006; Touyz, Beumont & Hoek, 1987). As a consequence, excessive exercise, often

conducted in a ritualistic and compulsive manner, has been suggested as a secondary diagnostic criterion for classifying anorexics (Feighner, Robins, Guze, Woodruff, Winokur et al., 1972). Furthermore, it has been reported that from a clinical perspective, the two striking characteristics of AN, and the only ones that consistently distinguish it from other psychiatric disorders, are severe and wilful restriction and excessive exercise (Bergh & Sodersten, 1996). Yet despite the importance of excessive exercise, little consensus is evident on how best to define it, or even on which term should be used to describe it (Adkins & Keel, 2005; Shroff et al., 2006), something that will be critically reviewed in section 1.4.6. However, for the purpose of this chapter, the term *excessive exercise* will be used to describe the problematic exercise associated with eating disordered pathology (i.e., eating disordered cognitions/psychopathology and behaviours).

The aim of the chapter is to review the literature on exercise and eating disorders. First, an overview of the links will be provided. Second, a review of the relevant prevalence studies will be presented. Third, the aetiology and development of excessive exercise will be discussed, followed by the role of physical activity and sport in the aetiology of eating problems. Fourth, evidence regarding the treatment and management of exercise will be reviewed along with a consideration of where exercise fits within the transdiagnostic model of the maintenance of the eating disorders. Finally, the problem of defining excessive exercise will be critically considered.

1.4.1 Links between excessive exercise and the eating disorders

Over the last few decades there has been a considerable amount of research into excessive exercise in people with eating disorders (Davis, 2000). As a result, excessive exercise is no longer considered exclusive to Anorexic Nervosa, also occurring in Bulimia Nervosa (Dara, 2003; Penas-Lledo, Vaz Leal & Waller, 2002; Solenberger, 2001). Traditionally, excessive exercise has been viewed simply as an analogue of purgation, that is, as a deliberate method of expending unwanted calories (e.g., Davis, Kennedy, Ralevski, Dionne, Brewer et al., 1995). Indeed, DSM-III-R (American Psychiatric

Association, 1987) expressly states that the weight loss in AN is “often [accomplished] with extensive exercise” (p.65). Similarly, the 4th edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV: American Psychiatric Association, 1994) lists “excessive exercise” as a defining feature of the non-purging subtype of Bulimia Nervosa. However, some have argued that excessive exercise occupies a more central role in the pathogenesis of the eating disorders (e.g., Cook & Hausenblas, 2008; Davis, Kennedy, Ralevski, & Dionne, 1994; Epling & Pierce, 1992; Kron et al., 1978), and it is now recognised as a significant factor in the aetiology, development and maintenance of eating disorders across diagnoses (Brewerton, Stollefson, Hibbs, Hodges & Cochrane, 1995; Davis, Katzman, Kaptein, Kirsh, Brewer et al., 1997; Hechler, Beumont, Marks, & Touyz, 2005), though especially in Anorexia Nervosa (Beumont, Arthur, Russell, & Touyz, 1994; Davis, 1997; Davis et al., 1997; Katz, 1996; Touyz, Beumont & Hoek, 1987; Thien, Thomas, Markin, & Birmingham, 2000).

The significance of excessive exercise in the EDs is underlined by the fact that it is often one of the last symptoms to subside (Crisp, Hsu, Harding & Hartshorn, 1980; Davis et al., 1994; Kron et al., 1978). For example, a 3-year in-patient hospital records analysis that found eating disorder patients across diagnoses who were excessive exercisers required a longer length of hospitalisation than non-excessive exercisers (Solenberger, 2001). In addition, excessive exercise has been identified as a significant risk factor for relapse in AN (Carter, Blackmore, Sutandar-Pinnock & Woodside, 2004; Casper & Jabine, 1996). A 10-year follow up study of 95 patients with Anorexia Nervosa, found excessive exercise not only significantly predicted an earlier time to relapse, but was also one of only two variables out of more than 50 that was associated with a chronic outcome (Strober, Freeman & Morrell, 1997).

1.4.2 Prevalence of excessive exercise

This section will critically review the prevalence figures for excessive exercise in the eating disorders. Unfortunately, to date, no incidence figures have been reported in the literature.

1.4.2.1 *Community prevalence estimates*

Prevalence rates for excessive exercise among community samples vary depending upon the definition and measurement criteria used. For example, Davis and Fox (1993) found that 12.5% of a community sample of adult women (mean age approx 28) could be classified as high-exercisers (at least 6 times a week for at least 1 hour per session), with just 2.4% being classified as high-exercisers with weight and shape concerns (above norm on EDI-DT). However, Seigel and Hetta (2001) found that 2.9% of a community sample of young women (mean age 20) could be classified as high-exercisers (at least 6 times a week for at least 1 hour per session), with 4.1% being classified as obligatory (compulsive) exercisers (>95th percentile on the OEQ), and with only 0.8% of the sample being classified as both high-ex and compulsive. In contrast, Mond, Hay, Rodgers and Owen (2006a) moved away from a quantitative definition and found that only 3.3% of a community female sample (mean age 29.9 years) were classified as excessive exercisers (defined as exercise solely for weight or shape and intense guilt on postponement).

In summary, no firm conclusions can be drawn as all the three reported prevalence figures utilised different definitions of excessive exercise.

1.4.2.2 *Patient prevalence estimates*

Prevalence rates within clinical groups are also beset with definition and measurement problems (See Crisp et al., 1980; Davis et al., 1997). Three studies are reported that provide either unclear or arbitrary criteria for definition. First, Kron et al., (1978) found that prior to hospitalisation, 76% of anorexics engaged in a level of physical

activity in excess of that considered typical for women of a similar age, and more importantly, that 84% of these patients were extremely active well before they ever started dieting or lost weight (N=33). Second, Crisp et al., (1980) found that excessive exercise occurred in 38% of AN patients (N=102). Finally, the multisite international Price Foundation Genetic Study found a prevalence of excessive exercising in 44.4% of AN patients, 20.6% of BN patients, and 20.8% of EDNOS patients (N=1857) (Shroff et al., 2006).

A further four studies have reported prevalence rates defined on the basis of both qualitative and quantitative information. First, Brewerton et al., (1995) reported that 23% of bulimic patients and 39% of anorexic patients (N=110) were excessively exercising at the time of their admission (i.e., exercise status at the time of diagnosis); defined according to the frequency and duration of exercise to control weight for at least 1 hour a day every day. Second, Penas-Lledo, Vaz Leal and Waller (2002) found that in a sample of female eating disorder out-patients, (N=124) 46% of AN and 46% of BN were classified as excessive exercisers (defined as exercise ≥ 5 times a week with the aim of burning up calories). Thirdly, Davis et al., (1997) found that up to 81% of AN and 57% of BN patients (N=127); defined according to frequency and duration – at least 1 hour a day every day over past 28 days – and was described as “obsessive,” “driven,” and “out of control”, were exercising excessively during an acute phase of their disorder. Finally, Dalle Grave, Calugi and Marchesini (2008b) found that 63% of AN (80% AN-R, 43% AN-BP), 39% of BN, and 32% of EDNOS in-patients were compulsive exercisers at admission (N=165). Defined according to EDE criteria as exercising with the aim of burning up calories to control shape or weight, and a positive answer to any one of the following: have you felt compelled or obliged to exercise?; have you exercised even when it caused severe interference with important activities?; have you exercised to a level that might be harmful to you; have you felt distressed if unable to exercise?

Reviews of prevalence rates in this field have been scarce. In an early review of data collected during the 1960s and 1970s, Katz (1996) concluded that about 65% to 75%

of acutely anorexic patients have been excessively physically active at some point during their disorder. In contrast, Davis (1997) reports prevalence rates of up to 84% among hospitalised AN patients and 54% among BN patients based on lifetime occurrence of excessive exercising, with little difference between adult as opposed to adolescent patients. Unfortunately, as Davis points out, it is often not clear from the information provided what has actually been assessed (Davis, 1997).

In addition to definitional issues, virtually none of the aforementioned studies used data that had been obtained for the purpose of determining prevalence rates. In contrast, most of the findings were based on data extracted post hoc from patient charts and hospital records (e.g., Crisp et al., 1980; Kron et al., 1978; Brewerton et al., 1995). Similarly, much of the data were obtained from hospital in-patients who may have been too ill or weak to engage in the strenuous exercising that characterised an earlier phase of their disorder (Davis et al., 1997). In this respect, hospital data based on activity status at the time of admission may actually underestimate prevalence rates when compared with the broader community-based population of eating disordered patients (Davis et al., 1997). Also problematic is the fact that some studies have relied on very small sample sizes (e.g., Crisp et al., 1980; Kron et al., 1978), and have failed to distinguish between adult and adolescent patients (e.g., Brewerton et al., 1995; Penas-Lledo, Vaz Leal, & Waller, 2002; Shroff et al., 2006).

In summary, the studies discussed so far illustrate the multitude of definitions currently used to classify excessive exercise resulting in equivocal prevalence literature to date. However, what is clear is that irrespective of the definitions used, with prevalence rates ranging from 20-80% excessive exercise remains a significant feature of the eating disorders.

1.4.3 Aetiology of excessive exercise

There are currently no published empirical studies specifically concerning the aetiology of excessive exercise within the context of the eating disorders. Indeed, this is

an area of considerable paucity. However, three psychological hypotheses have been proposed to explain the high levels of physical activity in the EDs (i.e., compensation, affect regulation and compulsivity). In addition, there is one well supported physiological model (activity anorexia). These four models will be reviewed in the following section.

1.4.3.1 Psychological models

First, is the hypothesis that excessive exercise is driven by a drive for thinness and a need to compensate for ingested food (e.g., Garfinkel & Goldbloom, 1988; Garfinkel, Lin, Goering, Spegg, Goldbloom et al., 1995; Garner, Rockert, Olmstead, Johnson, & Coscina, 1985; Fairburn, Cooper, & Shafran, 2003). According to this view, excessive exercise is essentially a consequence of cognitive processing associated with eating psychopathology (i.e., weight preoccupation). The primary function of excessive exercise is therefore to facilitate weight loss. Indeed, many eating disordered patients retrospectively clearly attribute their high activity levels to the desire to lose weight, especially at the beginning of weight loss (McDonald & Thompson, 1992).

Second, is the hypothesis that excessive exercise is a way of regulating chronic negative affect (e.g., Casper, 1997; Davis & Fox, 1993; Davis & Woodside, 2002; Fairburn, Cooper & Shafran, 2003; Holtkamp, Hebebrand, & Herpertz-Dahlman, 2004; Markland & Ingledew, 1997; Penas-Lledo, Vaz Leal, & Waller, 2002; Thome & Espelage, 2004). It is certainly the case that eating disorder patients frequently report using exercise as much to regulate mood as to expend calories (Blumenthal, O'Toole, & Chang, 1984; Davis & Woodside, 2002; Long et al., 1993). There is also considerable empirical support for the affect regulatory properties of exercise (e.g., Callaghan, 2004). Interestingly, one study suggested an overlap between the first two psychological hypotheses, reporting that in the acute phase of AN anxiety and food restriction may synergistically contribute to increased levels of physical activity (Holtkamp, Hebebrand, & Herpertz-Dahlman, 2004).

Third, is the hypothesis that obsessive-compulsiveness results in exercise behaviour becoming ritualised, stereotyped and excessive (Davis, Kaptein, Kaplan,

Olmstead, & Woodside, 1998; Davis et al., 1995). Supporting this, excessive exercise has been shown to be associated with greater obsessive-compulsive symptomatology and personality traits both in eating disordered and non-eating disordered exercisers (Davis et al., 1998). Indeed, in many cases the pattern of behaviour can be very similar to the rituals of obsessive-compulsive disorder, where excessive exercise is in effect a type of safety behaviour (Beumont et al., 1994; Davis & Kaptein, 2006). It is also true that many excessive exercisers report continuing to exercise even when it is no longer rewarding (Davis & Woodside, 2002). However, a recent study found evidence of an inverse relationship between obsessive-compulsive symptomatology and excessive exercise in Anorexia Nervosa, thereby calling into question the validity of this particular aetiological model (Bewell-Weiss & Carter, 2010).

In summary, whilst it is evident is that all three models have some explanatory value, the lack of specific research into the aetiology of excessive exercise makes it difficult to draw any firm conclusions. As a consequence the aetiology of excessive exercise in terms of psychological factors remains poorly understood.

1.4.3.2 Physiological model

In addition to the above three psychological models, one key physiological mechanism has also been proposed. The activity anorexia model (Epling, Pierce, & Stefan, 1983; Epling & Pierce, 1992) refers to the hypothesis that excessive exercise in AN may be a consequence of low leptin levels (hypoleptinemia) caused by reduced energy intake/food restriction (Holtkamp, Herpertz-Dahlmann, Hebebrand, Mika, Kratzsch et al., 2006).

Both human (Keys, Bozek, Henschel, Mickelsen, & Taylor, 1950) and animal experiments (Epling, Pierce, & Stefan, 1983; Epling & Pierce, 1992) have demonstrated an association between increasing activity and decreasing food intake in some subjects. Indeed, many eating disorder patients with very low bodyweight show high levels of restless hyperactivity and report an urge to be active that appears to be exacerbated by

further weight loss and independent of their exercise status (Caspar, 2006; Davis, 1997). Certainly there is evidence to suggest that hypoleptinemia is associated with increased motor activity and restlessness in AN patients (Holtkamp, Herpertz-Dahlmann, Mika, Heer, Heussen et al., 2003; Holtkamp et al., 2006) and animal models have demonstrated a reciprocally reinforcing relationship between food restriction and increased activity (Epling, Pierce, & Stefan, 1983; Epling & Pierce, 1992). However, this model cannot account for the development of excessive exercise that predates food restriction.

An important feature of activity anorexia is that increasing calorie intake, such as when refeeding, does not on its own result in a reduction in the activity levels (Epling & Pierce, 1992; Hebebrand et al., 2003). Only a significant increase in bodymass to a healthy level will result in both leptin and activity levels returning to normal (Epling & Pierce, 1992; Hebebrand et al., 2003). However, studies have shown that whereas in some ED patients hyperactivity is indeed self-correcting with weight restoration (Crisp 1967), in others it is not (Windauer, Lennerts, Talbot, Touyz, & Beumont, 1993).

In summary, it needs to be recognised that in those patients who are severely underweight, activity anorexia may play an important role in the development *and* maintenance of excessive exercise. For those patients who already exercise, the increased energy and urge to be active that they experience as a result of weight loss, may initially prove highly reinforcing thereby maintaining their exercise behaviour. It is probable that in these patients, weight restoration will not be enough to correct their urge to be active. For non-exercising patients, there is a very real risk that the hyperactivity as a result of weight loss will establish a previously non-existent association between physical activity and weight loss, one that may then prove difficult to remove even with weight restoration.

Overall, the lack of studies explicitly addressing the question of aetiological factors in excessive exercise means that no real conclusions can be drawn regarding the aetiology of excessive exercise. Indeed, the prevalent social-cognitive/cognitive-behavioural perspective views assiduous exercise as symptomatic of, rather than

antecedent to, the disorder (Davis, Fox, Cowles, Hastings, & Schwass, 1990; Fairburn, Cooper, & Shafran, 2003). In conclusion, given the findings reviewed above, it is likely that excessive exercise has multiple underlying mechanisms whose relative contribution might differ according to the stage of the eating disorder (Holtkamp et al., 2003).

1.4.4 Role of exercise in the aetiology of eating pathology

There is a certain amount of ambiguity in the literature regarding the role of exercise in the aetiology of eating pathology. The following section will outline the evidence for and against this assertion, and the empirical uncertainty regarding the role of sport participation.

The role of exercise in the development and maintenance of the eating disorders has been well documented, particularly within Anorexia Nervosa (e.g., Abraham, 2003; Davis et al., 1994; Kron et al., 1978). In particular, high-levels of physical activity are believed to play a causal role in the development of AN (Davis, 1997; Davis et al., 1994, 1999; Epling & Pierce, 1996; Hebebrand, Exner, Hebebrand, Holtkamp, Caspar et al., 2003; Katz, 1996). The work of Davis and colleagues suggests that AN patients were significantly more active than controls prior to the onset of their disorder (Davis, Blackmore, Katzman, & Fox, 2005), specifically showing a dramatic increase in physical activity approximately one year prior to formal diagnosis (Davis et al., 2005). Likewise, Kron et al. (1978) reported that, prior to hospitalisation, 25 of 33 anorexics engaged in a level of physical activity in excess of that considered typical for women of a similar age, and more importantly, that 21 of 25 were extremely active well before they had ever dieted or lost weight. However, it is important to note that no detail is provided as to what exactly is considered a 'typical' amount of physical activity. Nor is any information provided as to what 'extremely active' entails, thereby highlighting the type of definitional issues that unfortunately make interpretation of the evidence so difficult. Despite these difficulties, the potential importance of high-levels of physical activity is further supported by other evidence suggesting that high level exercising (defined as ≥ 8 sessions per week) is one of

the strongest predictors of subsequent eating problems among adolescent females (Wichstrom, 1995). Self-defined problems with exercise have also been shown to predict eating pathology. For example, Boyd, Abraham and Luscombe (2007) found that a self-reported history of current or past problems with exercise predicts an ED diagnosis. In addition, consistent with earlier findings (e.g., Martin & Hausenblas, 1998; Pinkston, Martz, Domer, Curtin, Bazzini et al., 2001) Cook and Hausenblas (2008) found that a compulsion to exercise mediates the relationship between exercise behaviour and eating psychopathology. This suggests that a compulsion to exercise is implicated as a factor in the causal pathway from exercise behaviour to eating pathology (Cook & Hausenblas, 2008).

1.4.4.1 Role of sport participation in the aetiology of eating pathology

The role of sport participation has also been implicated in the aetiology of eating disorders. For example, the results of a study by Davis et al., (1994) strongly support the hypothesis that sport and assiduous exercise participation can play a pathogenic role in the development and maintenance of eating disorders, at least among seriously ill patients requiring hospital treatment. In addition, it has been reported that participation in regular sport or exercise precedes dieting in many patients who develop AN (Davis et al., 1997), and a greater than expected percentage of AN patients are competitive athletes before the development (or onset) of their disorder (Davis et al., 1994; Davis & Strachan, 2001). Indeed, excessive exercise appears to be a particular issue for individuals who have been athletes, dancers or gymnasts (Calogero & Pedrotty, 2004), or who have high pre-morbid activity levels (Davis et al., 1997).

With respect to aetiology, evidence suggests that participation in an exercise program, and the social value attached to physical fitness, tends to increase a concern with weight, and the tendency to diet, at least among women (Davis, Katzman, & Kirsch, 1999). It is entirely plausible that sport and exercise activities may directly foster a desire for weight loss, or at least provide positive reinforcement when it occurs.

Whilst the preceding evidence suggests that participation in exercise and sport might contribute to the aetiology of eating pathology, there is another body of evidence suggesting that this is not the case. For example, it has been reported that the extent of exercise undertaken does not predict the onset of a new eating disorder (Patton, Selzer, Coffey, Carlin, & Wolpe, 1999). Similarly, Boyd, Abraham and Luscombe (2007) found no association between the amount of exercise performed and the presence of an ED, in either comparative or predictive analyses. Likewise, several studies have now reported that there is no link between exercise frequency and eating disorder psychopathology, both in adolescents (Patton et al., 1999) and adults (Adkins & Keel, 2005).

The aforementioned discrepancy in the literature points to the complexity of the relationship between exercise and the onset of eating disorders and supports the assertion that it may not be the amount of exercise per se that is important in the pathogenesis of eating disorders. This relationship appears to be diagnosis dependent. For example, Davis et al (1997) found that whereas exercise tended to precede dieting in AN patients, the reverse was true for BN patients, thereby supporting the role of exercise as a compensatory behaviour in BN and a pathogenic variable in AN. This presents a problem with interpretation of the literature, since previous findings of a link between exercise frequency and ED onset have tended to be restricted to hospitalised AN patients thereby limiting their generalisability (e.g., Davis et al., 1994).

1.4.5 Treatment/management of excessive exercise

Given the increasing recognition of excessive exercise in the pathogenesis of eating disorders, the clinical significance of excessive exercise in the eating disorders and previous recommendations to target it (e.g., Beumont et al., 1994, Solenburger, 2001), surprisingly few studies have sought to either incorporate it into maintaining models or address with a treatment. As a result, no formal protocol for the treatment of excessive exercise currently exists (Calogero & Pedrotty, 2004). A review of the literature identified only two interventions specifically aimed at addressing excessive exercise in eating

disordered patients. First, a small study of a specific CBT based excessive exercise intervention found promising results with AN patients (Long & Hollin, 1995). Second, a large (N=254) study found that the inclusion of a cognitive/mindful exercise program in an inpatient unit significantly reduced: obligatory attitudes to exercise across diagnoses; exercise involvement at discharge; exercise rigidity at discharge; and resulted in significantly greater weight gain in AN patients during inpatient treatment (Calogero & Pedrotty, 2004). However, despite promising results, neither study published the treatment protocol they used. In addition, whilst manual-based cognitive-behaviour therapy (CBT) remains the 'gold-standard' of psychological treatment for the eating disorders (NICE, 2004), no such manual exists for the treatment of excessive exercise.

Collectively, the importance of addressing excessive exercise within the eating disorders together with the lack of an available evidence-based treatment protocol support a re-conceptualisation of excessive exercise within a cognitive-behavioural framework and the need to develop a cognitive-behavioural intervention to treat excessive exercise in the eating disorders. However, the transdiagnostic cognitive-behavioural model of eating disorders (see Figure 1.1) does not include excessive exercise as a core maintenance factor for disordered eating and as such it is not considered a specific target for intervention (Fairburn, Cooper & Shafran, 2003). Although excessive exercise does appear in the model, it is only included as a symptom of the eating disorder in terms of an "other weight-control behaviour" and a "dysfunctional mood modulatory behaviour". Neither the model nor the treatment based on it informs clinical practice in terms of treating excessive exercise. In fact, the transdiagnostic conception of eating disorder maintenance factors clearly contradicts the prevailing view in the literature that excessive exercise is a significant factor in the maintenance of the eating disorders across diagnoses (e.g., Beumont et al., 1994; Brewerton et al., 1995; Bruch, 1973; Davis, 1997; Davis et al., 1997; Touyz et al., 1987).

1.4.6 Definitions of excessive exercise

The following section will critically consider the problem of defining excessive exercise, focusing on terminology and existing working definitions that involve both quantitative and qualitative descriptions. Unfortunately, to date, no consensus currently exists on how to define excessive exercise (Adkins & Keel, 2005), particularly in psychological terms (Dishman, 1985). In fact, excessive exercise, as a definable syndrome has remained a conceptual entity, its features having been formulated, to a large extent on speculation and clinical judgement (e.g., Davis & Fox, 1993; Katz, 1996). The principle reason for the lack of a consensus is the continued absence of a consistent operational definition of what exactly constitutes excessive exercising (Davis et al., 1997; Shroff et al., 2006). Furthermore, not only are researchers unable to agree on a precise definition of the phenomenon, they are also unable to agree on a term or phrase to adequately describe it (Adkins & Keel, 2005; Hall, Kerr, Kozub, & Finnie, 2007; Mond, Hay, Rodgers, Owen, & Beumont, 2004). Due to the multitude of definitions and terms used to characterise excessive exercise no firm conclusions can be drawn from within the existing literature. At best, the only conclusion that can be safely drawn from existing empirical findings is that there is an exercise-related construct that appears to be of significant importance in the EDs, but, as yet we can make few reliable claims about it. As a consequence, much of the literature on excessive exercise remains largely equivocal, due to the aforementioned inconsistencies in terminology and definition, as well as disparate measurement of the construct.

1.4.6.1 *Terminology*

The term 'excessive exercise' has many putative synonyms, including *compulsive exercise* (e.g., Brewerton et al., 1995; Dalle Grave et al., 2008b; Yates, 1991), *obligatory exercise* (e.g., Brehm & Steffen, 1998; Coen & Ogles, 1993; Elbourne & Chen, 2007), *exercise dependence* (e.g., Adams, 2009; Adams & Kirkby, 2001; Bamber, Cockerill, & Carroll, 2000; Hausenblas & Downs, 2002a), and *exercise addiction* (e.g., Aidman &

Woolard, 2003; Kagan, 1987; Sachs & Pargman, 1979) to name a few. Unfortunately, it is not always clear whether these terms represent the same phenomena, as effective definitions are often lacking in the research papers (le Grange & Eisler, 1993). While it is likely that the phenomena represented by these terms are overlapping or related to one another, each term doesn't necessarily encapsulate the other. Indeed, the definitions underpinning many of these terms are clearly distinct, both clinically and as psychological constructs (Adkins & Keel, 2005; Davis, 2000; Draeger, Yates, & Crowell, 2005; Mond et al., 2006a). In addition, whereas some terms imply pathology by definition (e.g., compulsive) others do not (e.g., obligatory), so it is erroneous to categorise an individual's exercise using terms that suggest pathology, and then report that they show no evidence of any psychological dysfunction and disturbance – a mistake evident in many studies (e.g., Guidi, Pender, Hollon, Zisook, Schwartz et al., 2009; Powers, Schocken & Boyd, 1998). It is of little surprise then, that this careless miss-labelling of the constructs being measured has resulted in the extant literature being contaminated with studies on for example, compulsive exercise that in fact measured excessive exercise (e.g., Brewerton et al., 1995).

Further complication with regards to terminology has resulted from the widespread interchanging of terms both between and within papers. Indeed, many research papers appear to use two or more terms to describe the exercise construct of interest, changing between alternate terms at will without any clear theoretical, clinical, or practical justification (e.g., Ackard, Brehm, & Steffen, 2002; Hausenblas & Fallon, 2002). In a relatively recent review, Adkins and Keel (2005) found that regardless of the terms used to describe excessive exercise, existing definitions tended to fall on one of two related dimensions: a quantitative dimension defined in terms of duration, frequency and/or intensity; and a qualitative dimension defined in terms of compulsivity. The following section will critique these two definitional dimensions separately.

1.4.6.2 Quantitative dimension: 'Excessive' exercise

Excessive exercise typically refers to the quantitative dimension of unhealthy exercise (Adkins & Keel, 2005) and is therefore often defined in terms of frequency, duration and/or intensity (e.g., Davis & Fox, 1993). Such operational definitions of *excessive* exercise based on quantity and/or frequency of exercise have quite clearly been informed by the observation that eating disorder patients tend to exercise to an excess in terms of quantity and/or frequency. For example, in classifying a patient sample as either excessive or non-excessive, Davis (1997) noted that "classification was not difficult, since most patients who were (or had been) exercising excessively did so for much more than one hour per day" (p.323).

Quantifying *excessive* exercise in the way described above raises an interesting question regarding the classification of the amount of exercise required to be labelled as "excessive". Indeed, Davis (1997) highlights this point when considering the frequency criterion used to classify exercising patients as excessive, pointing out that 6 hours of strenuous exercise per week could not be described as "excessive" for healthy normal-weight women, with many healthy weight competitive athletes training for considerably more than this. However, within the context of women who are (or were at the time) emaciated and/or malnourished, according to Davis, it is reasonable to describe 6 hours of exercise per week as excessive. Indeed, many would agree that 6 hours a week of exercise is not excessive despite exceeding the recommended requirement to derive physiological benefits for a healthy adult (Pate, Pratt, & Blair, 1995; Blair, LaMonte, & Nichaman, 2004). However, for AN patients who are emaciated and medically unstable, it is arguable that any strenuous exercise can be construed as excessive.

Not only is a model of quantifying *excessive* exercise fundamentally flawed, the issue of reviewing the current literature adequately is further complicated by the fact that researchers have been unable to come up with a specific set of quantitative criteria that are valid across different populations. Different definitions of *excessive* exercise have included: exercising for more than three hours a day (Shroff et al., 2006); exercising at

least 5 times a week for at least one hour without stopping (Penas-Lledo, Vaz Leal, & Waller, 2002); intense exercising on average at least 5 days a week over the past three months (Fairburn, Marcus, & Wilson, 1993); exercising for a minimum of 6 hours a week (Davis & Kaptein, 2006); participating in exercise for a minimum of 6 hours a week averaged over the past 12 months (Davis et al., 1998); strenuous exercise exceeding an hour a day, for at least 6 days a week, for a period of a month or more (Davis et al., 1997; Davis, Katzman, & Kirsh, 1999); exercising on average for a minimum of 5 hours a week for the past year (Davis et al., 1995); exercising for at least 1 hour a day (Brewerton et al., 1995); a median split of total exercise (Solenberger, 2001).

In addition to overall amount, there are two further problems associated with defining *excessive* exercise at a quantitative level. First, whereas in some studies classification is based upon activity level at time of diagnosis (e.g., Brewerton et al., 1995), others have evaluated the historical incidence of *excessive* exercise throughout the course of the disorder (e.g., Davis et al., 1994) further complicating a thorough review. Second, some studies further defined excessive exercise as having an additional component, namely, being undertaken for weight or shape reasons (e.g., Davis & Kaptein, 2006; Fairburn, Marcus, & Wilson, 1993). However, recent findings suggest that the “for weight or shape” component of the definition is of more consequence than the quantitative component (Mond et al., 2006a).

In conclusion, there is no empirical support for a model defining *excessive* exercise purely in terms of the quantitative dimension. In addition, the validity of such a model has been undermined by studies finding consistent and strong support for the fact that frequency and duration of exercise is unrelated to eating pathology in both clinical and non-clinical samples (e.g., Adkins & Keel, 2005; Boyd, Abraham, & Luscombe, 2007; Davis & Fox, 1993; Lipsey, Barton, Hulley, & Hill, 2006; Mond et al., 2004; 2006a; Mond, Myers, Crosby, Hay, & Mitchell, 2008; Siegel & Hetta, 2001). Furthermore, the evidence to date strongly suggests that despite the fact the quantitative and qualitative dimensions of exercise are not disentangled (Adkins & Keel, 2005; Dalle Grave et al., 2008b) the

quantitative criterion is not relevant to the definition of the problematic exercise evident within the eating disorders.

1.4.6.3 Qualitative dimension: 'Compulsive' exercise

Whilst a high level of exercise has been consistently observed in the eating disorders since they were first described (Bruch, 1965; Crisp, 1967; Gull, 1874; Inches, 1895), it is also true that the exercise observed in eating disorder patients has consistently been described as “driven,” “out of control” and motivated by intrinsic factors – all characteristic of compulsivity (Davis et al., 1994; Epling & Pierce, 1992; Touyz, Beumont & Hoek, 1987). The following section will present the rationale for the conceptualisation of eating-disordered exercise as *compulsive*.

Evidence from eating disordered patients has highlighted the compulsive nature of exercise. For example, in a study of hospitalised AN patients, exercising patients subjectively described their exercise activity as progressing from an enjoyable and voluntary behaviour, to a state where it became a compulsive and ritualised behaviour, which they themselves described as “obsessive”, “driven”, and “out of control”. In addition, patients described their exercise as something they often wanted to stop doing but simply could not (Davis et al., 1994). However, despite excessive exercise having been described as one of the most obvious compulsions in the eating disorders (Davis, 1997), Dalle Grave et al., (2008b) make the point that a consensus definition of *compulsive exercise* is lacking.

Whilst flagging the importance of a consensus definition, Dalle Grave et al (2008b) point out that the “*compulsive origin [of exercise] may be more clearly defined*” (p.2). However, this is in itself problematic since there appears little agreement on the compulsive attributes of the behaviour, as outlined in the next three examples. First, the DSM-IV defines exercise as excessive when it “*significantly interferes with important activities, occurs at inappropriate times or in inappropriate settings, or continues despite injury or other medical complications*” (p. 546), although there is little empirical evidence to

support the validity of this criterion (e.g., Mond et al., 2004; 2006a; 2008; Mond & Calogero, 2009). Similarly, Yates (1991) defines exercise as compulsive when it is continued despite exercise-sustained injuries and is preferred to a social life. However, Yates' definition also includes missed sessions being compensated for (i.e., made up), feelings of guilt and/or anxiety when exercise is unable to be taken, a ritualistic pattern of exercising, and a preference for exercising alone. Third, yet another different definition was postulated by Polivy (1994) who defined exercise as compulsive similarly when it is continued despite pain, interferes with significant relationships or work, and results in a lack of time for other leisure pursuits. However, Polivy (1994) also included definitional criteria pertaining to a recognisable obsessional component, and an association with other psychological problems. Finally, Dalle Grave et al., (2008b) defined exercise using criteria adopted from Fairburn, Marcus and Wilson (1993) as *compulsive* when it is undertaken with the aim of burning up calories to control shape or weight, and either felt compelled, was continued despite causing severe interference with important activities, was undertaken to a level that was harmful, or resulted in distress when unable to exercise.

Regardless of the definitional indices used, studies have consistently shown that, in contrast to quantitative criteria, the compulsive dimension of exercise is significantly associated with increased disordered eating attitudes and behaviours among both clinical and non-clinical samples (e.g., Adkins & Keel, 2005; Boyd et al., 2007; Brehm & Steffen, 1998; Gulker, Laskis, & Kuba, 2001; Matheson & Crawford-Wright, 2000; Mond et al., 2004; 2006a; 2008; 2009; Wyatt, 1997). In addition, the compulsive dimension of exercise has been shown to clearly differentiate between eating disordered and non-eating disordered samples (Boyd et al., 2007; Mond & Calogero, 2009). These pathology markers are important since crucially within the context of the eating disorders the exercise construct of interest is inherently pathological. Therefore, it is essential to make the distinction between compulsive and non-compulsive exercise in this context. Specifically, not all quantitatively defined (i.e., excessive) exercise is compulsive and not all compulsively defined exercise is quantitatively excessive, therefore quantitatively

defined exercise may or may not be pathological. However, in contrast, compulsively defined exercise is, by definition, always pathological since it is closely and reliably associated with increased levels of disordered eating attitudes and behaviours.

In conclusion, “excessive exercise” is a confusing term for exercise that is not actually quantitatively excessive. It is therefore suggested that the term “excessive” be discarded within this context. In addition, despite the plethora of terms being used to describe the phenomena/construct of excessive exercise, the evidence presented so far suggests the most consistent support would appear to be for the term compulsive exercise (Adkins & Keel, 2005). Therefore, the term *compulsive exercise* will be used throughout the rest of this thesis.

1.4.7 Summary

In section 1.4, evidence was reviewed supporting the significance of compulsive exercise in the aetiology, development and maintenance of eating disorders across diagnoses (Beumont et al., 1994; Brewerton et al., 1995; Davis, 1997; Davis et al., 1997; Hechler et al., 2005; Katz, 1996; Thien et al., 2000; Touyz, Beumont, & Hoek, 1987). In addition, the importance of reconceptualising compulsive exercise in terms of a cognitive-behavioural model that could inform potential interventions was highlighted. Lastly, evidence that support defining compulsive in terms of its compulsive features was presented.

Whilst no consensus exists on the specific compulsive attributes that define compulsive exercise, a review of the literature reveals several clinical indices of the compulsive dimension of exercise that are consistently described. Furthermore, each of the indices may be viewed from a cognitive-behavioural perspective as constituting potential maintenance factors for compulsive exercise. Therefore, the next section will critically consider the evidence supporting these indices in the maintenance of compulsive exercise.

1.5 Factors implicated in the maintenance of compulsive exercise

1.5.1 Eating pathology and compulsive exercise

The next section will critically consider the role of eating pathology in the maintenance of compulsive exercise.

1.5.1.1 *Compulsive exercise as a compensatory behaviour*

Historically, the prevailing view in the eating disorders field is that compulsive exercise is primarily a weight-control behaviour (Davis, 1997, Fairburn, Cooper, & Shafran, 2003; Hechler et al., 2005). Indeed, compulsive exercise is described as a secondary diagnostic criterion for the eating disorders, either as a drive for thinness in Anorexia Nervosa, or as a non-purging compensatory behaviour in Bulimia Nervosa (American Psychiatric Association, 1994). This assumption is further supported by clinical colleagues who routinely include exercise for weight and shape reasons in the clinical assessment of patients (Cooper & Fairburn, 1987; Fairburn & Beglin, 1994; Fairburn & Cooper, 1993; Waller, Cordery, Corstorphine, Hinrichsen, Lawson, Mountford, & Russell, 2007). According to DSM-IV (American Psychiatric Association, 1994), people with EDs engage in excessive exercise to promote weight loss, either in a drive for thinness in AN, or as a non-purging (compensatory) behaviour in BN. Supporting this, Vansteelandt, Rijmen, Pieters, Probst and Vanderlinden (2007) found that in ED patients a high disposition for drive for thinness was associated with the highest mean levels of physical activity. In addition, compulsive exercise was found to be the most commonly employed method of weight control among individuals with bulimic type eating disorders in the general population (Garfinkel et al., 1995). Traditionally, this view is also shared by other colleagues, with compulsive exercise, like food deprivation (restriction) or the use of purgatives, being viewed by most, simply as an effective method of calorie expenditure and hence weight loss (Garfinkel & Goldbloom, 1988; Garfinkel et al., 1995; Garner et al., 1985).

1.5.1.2 Links between compulsive exercise and eating pathology

Among eating disordered samples, compulsive exercise has been shown to be associated with higher levels of dietary restraint, weight and shape concerns (Dalle Grave, Calugi, & Marchesini, 2008b), drive for thinness (Solenburger, 2001), and body dissatisfaction (Brewerton et al., 1995; Solenburger, 2001). Likewise, among non-eating disordered samples, the relationship between compulsive exercise and elevated scores on measures of eating psychopathology is similarly well established (e.g., Elbourne & Chen, 2007; Lipsey et al., 2006). For example, compulsive exercise has been shown to be associated with higher scores on measures of eating and weight restriction (Thome & Espelage, 2007), drive for thinness (Ackard, Brehm, & Steffen, 2002; Adkins & Keel, 2005; Gulker, Laskis, & Kuba, 2001; Matheson & Crawford-Wright, 2000; Steffen & Brehm, 1999), bulimic tendencies (Ackard, Brehm, & Steffen, 2002; Adkins & Keel, 2005; Steffen & Brehm, 1999), and body dissatisfaction (Ackard, Brehm, & Steffen, 2002; Adkins & Keel, 2005; Gulker et al., 2001; Steffen & Brehm, 1999). In addition, Mond et al., (2004; 2006a; 2008; 2009) have consistently demonstrated that the extent to which exercise is undertaken solely or primarily to change weight or shape is one of the dimensions of compulsive exercise most strongly associated with eating disorder psychopathology and reduced quality of life. Indeed, such compulsive exercise was shown to clearly differentiate between eating disordered and non-eating disordered samples (Mond & Calogero, 2009).

1.5.1.3 The role of dieting and social reinforcement

The notion that exercise is an adjunct to weight and shape regulation and restriction emerged from the dieting literature with well established links between exercise and dieting among women in the general population (Davis et al., 1990; Davis, Shapiro, Elliott, & Dionne, 1993; Silberstein, Streigel-Moore, Timko, & Rodin, 1988). Specifically, comparisons between chronic dieters and non-dieters found that the dieters expressed weight and diet concerns (i.e., eating psychopathology) equivalent to eating disordered

patients and significantly higher than non-dieters, and that dieters engaged in much more frequent and intense physical activity than non-dieters (Davis et al., 1990).

Furthermore, it has been noted that behaviours such as dieting and exercise tend to reinforce each other because of the many personal and social benefits that accrue (Davis, 1997). Indeed, several studies have shown that exercising for weight loss is one of the principle reasons reported by men and women for beginning an exercise program (Davis et al., 1995; Markland & Hardy, 1993; McDonald & Thompson, 1992). However, worryingly, exercise can foster weight and diet concerns in certain susceptible individuals because the initial weight loss that often accompanies regular exercise elicits certain social reinforcers which, in turn, may lead to a heightened interest in physical appearance (Katz, 1986). This is in contrast to the more prevalent social-cognitive/cognitive-behavioural perspective that views compulsive exercise as symptomatic of, rather than antecedent to, an eating disorder (Davis et al., 1990; Fairburn, Cooper, & Shafran, 2003) and suggest a reciprocally reinforcing relationship between compulsive exercise and eating pathology.

The importance of the links between exercise and eating pathology are underpinned by compelling empirical support for weight and shape concerns being a central feature of compulsive exercise, such that in the absence of eating pathology, compulsive exercise is not considered to constitute a clinically significant syndrome (Keski-Rahkonen, 2001; Mond et al., 2006a). Indeed, Mond et al. (2006a) demonstrated that there was no association between exercise and reduced quality of life when eating pathology was controlled for.

1.5.1.4 Summary

The evidence presented above clearly supports eating pathology as a central component of compulsive exercise, both in terms of its development and maintenance. There is little wonder then that, within the eating disorders field, compulsive exercise is still viewed as essentially a weight-control behaviour specifically maintained by weight and

shape concerns (e.g., Fairburn, Cooper, & Shafran, 2003). Critically, the evidence also suggests that the relationship between compulsive exercise and eating pathology is not one sided. Rather, each is suggested to reciprocally reinforce the other (see Figure 1.2).

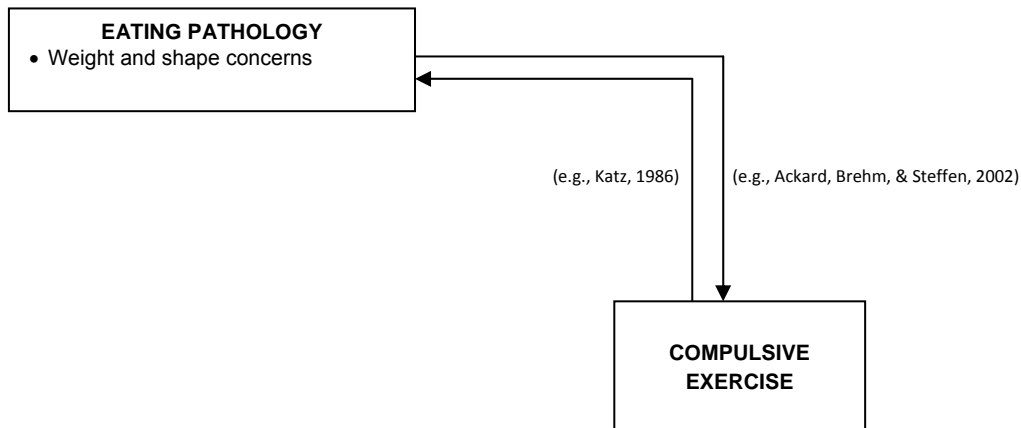


Figure 1.2. A schematic representation of the reciprocally reinforcing relationship between eating pathology and compulsive exercise.

However, despite the central importance of eating pathology in the development and maintenance of compulsive exercise, it is now recognised that compulsive exercise is more than simply a strategy for wasting energy or burning calories in weight preoccupied individuals (Davis, Katzman, & Kirsh, 1999). Whilst weight and shape concerns remain an essential component of compulsive exercise (Hubbard, Gray, & Parker, 1998; Keski-Rahkonen, 2001; Mond et al., 2006a), there is evidence to suggest that this model is too simplistic. Indeed, a review of the literature clearly suggests other key factors (in addition to weight and shape concerns) that may be contributing to the maintenance of compulsive exercise. One such factor is the regulation of negative affect (Thome & Espelage, 2004), which will now be considered.

1.5.2 Emotion regulation and compulsive exercise

This section will critically consider the role of emotion regulation in the maintenance of compulsive exercise.

1.5.2.1 *Affect regulation*

Researchers and clinicians have long recognised eating disorders as, in part, ineffective coping mechanisms used to manage uncomfortable emotions (Heilbrun & Harris, 1986; Slade, 1982; Soukup, Beiler, & Terrell, 1998). Indeed, links between affect regulation and eating pathology are well established (e.g., Killen, Taylor, Hayward, Wilson, Haydel et al., 1996; Meyer, Waller & Waters, 1998). Given the affect regulatory function of restriction and bulimic behaviours (Fairburn, 1997; Fairburn, Cooper, & Shafran, 2003; Hawkins & Clement, 1984; Heatherton & Baumeister, 1991; Meyer, Waller, & Waters, 1998), it could be suggested that compulsive behaviours (such as exercise) serve a similar regulatory function in the eating disorders, indeed this was the conclusion reached by Lawson, Waller and Lockwood (2007). This is supported by the fact that, in general, compulsivity is associated with a wide range of negative emotions (Spinella, 2005).

Within the exercise science literature, the affect regulatory role of exercise has been well established (e.g., Callaghan, 2004), with mood regulation being one of the most frequently endorsed motivations for exercising (Markland & Ingledew, 1997). As has been pointed out by several researchers, any behaviour that is under voluntary control and that can influence mood can be used to regulate emotions (e.g., Jackson, Cooper, Mintz, & Albino, 2003; Parkinson & Totterdell, 1999; Sher & Trull, 1994). The suggestion that physical activity may be used as a compensatory behaviour not just to burn calories but to alleviate or counteract dysphoric mood states, is further supported by frequent patient reports that exercise is often being maintained primarily for the control of negative affect as much as it is to expend calories (Blumenthal, O'Toole, & Chang, 1984; Davis & Woodside, 2002; Long et al., 1993).

Certainly among eating disordered patients, compulsive exercise has been shown to be associated with elevated levels of negative affect (Brewerton et al., 1995; Penas-Lledo, Vaz Leal, & Waller, 2002; Vansteelandt et al., 2007; Vansteelandt, Vandereycken, Claes, Probst, & Mechelen, 2004). In addition, amongst ED patients, chronic negative affect has been found to be associated with the greatest urge to be physically active (Vansteelandt et al., 2007). Furthermore, the association between drive for thinness and physical activity is most pronounced in those patients with the highest levels of chronic negative affect (Vansteelandt et al., 2007).

Similar associations between compulsive exercise and increased levels of negative affect have also been found in non-eating disordered samples (Siegel & Hetta, 2001; Spano, 2001). For example, in non-eating disordered females with high levels of eating psychopathology, exercise is associated with elevated negative affect (Thome & Espelage, 2004) replicating the association found in ED samples (e.g., Brewerton et al., 1995). Conversely, among females with low eating psychopathology, exercise is associated with increased positive affect (Thome & Espelage, 2004). Taken together, the evidence presented above not only suggests that exercise might be differentially associated with mental health based on the presence or absence of eating pathology (Thome & Espelage, 2004), but also adds further support to the previously proposed model that exercise does not constitute a clinically significant syndrome in the absence of eating pathology (Keski-Rahkonen, 2002; Mond et al., 2006a).

There is also evidence that increased exercise is associated with specific negative emotional states. The following sections will address these associations.

1.5.2.2 Anxiety

The importance of anxiety in the EDs is well established. Anxiety disorders have been found to precede the onset of eating disorders in 75-94% of ED patients (Bulik, Sullivan, Fear & Joyce, 1997; Godart, Flament, Lecrubier & Jeammet, 2000), with lifetime

prevalence estimates of 20-83% in AN and 13-75% in BN (Bulik, Sullivan, Carter & Joyce, 1996; Godart et al., 2000; Iwasaki, Matsunaga, Kiriike, Tanaka & Matsui, 2000).

In both AN and BN patients, compulsive exercise has consistently been found to be associated with elevated ratings of anxiety symptoms (Brewerton et al., 1995; Klein, Bennett, Schebendach, Foltin, Devlin & Walsh, 2004; Penas-Lledo, Vaz Leal, & Waller, 2002). The anxiolytic properties of strenuous physical activity are well established in both animal and human studies (e.g., Binder, Droste, Ohl, & Reul, 2004; Cox, Thomas, Hinton, & Donahue, 2004; Greenwood, Foley, Day, Burhans, Brooks et al., 2005). To date, there have been over 35 published reviews dealing with the anxiolytic effects of exercise. Despite methodological flaws in many of the studies (e.g., inadequate randomisation, lack of blinding, brief follow-up, selection bias, uncontrolled or inadequately controlled), there is consistent empirical support for the anxiolytic effects of exercise in clinical and non-clinical populations (e.g., Callaghan, 2004; Salmon, 2001; Scully, Kremer, Meade, Graham & Dudgeon, 1998). Indeed, it has been repeatedly shown that exercise can reduce anxiety symptoms in healthy adults (Hale & Raglin, 2002), in anxious women (Breus & O'Connor, 1998), and in psychiatric patients (Broocks, Bandelow, Pekrun, George, Meyer et al., 1998). In one study, among patients in the acute phase of AN, physical activity levels were predicted only by level of food restriction and anxiety symptoms supporting the notion that physical activity may be a way of coping with anxiety in some patients (Holtkamp et al., 2004).

1.5.2.3 Depression

The importance of considering depression in the ED is highlighted by the fact that major depression is the most commonly diagnosed comorbid disorder in both AN and BN patients (Herzog, Keller, Sacks, Yeh & Lavori, 1992). Lifetime prevalence estimates of major depression in the EDs range from 46-74% in AN, and 50-65% in BN (Pearlstein, 2002), and the presence of depression is associated with poorer outcome in both AN (Fichter and Quadflieg, 1999; Herpertz-Dahlmann et al., 2001; Ivarsson, Rastram, Wentz,

Gillberg & Gillberg, 2000) and BN (Bulik, Sullivan, Joyce, Carter & McIntosh, 1998; Keel, Mitchell, Miller, Davis & Crow, 2000).

Compulsive exercise is associated with higher levels of depression in both ED patients (Penas-Lledo, Vaz Leal & Waller, 2002) and in non-clinical samples (Seigel & Hetta, 2001; Thome & Espelage, 2004). In addition, exercise has been shown to significantly decrease depressive symptoms following a single bout of exercise in both non-exercisers (Maraki, Tsofliou, Pitsiladis, Malkova, Mutrie & Higgins, 2005) and in regular exercisers (Steinberg, Nicholls, Sykes, LeBoutillier, Ramlakham et al., 1998). Meta-analyses of studies examining the efficacy of exercise in the prevention and/or alleviation of depression have consistently found that despite similar methodological flaws to the anxiety studies, there is reliable empirical support for the efficacy of exercise in preventing and alleviating the symptoms of depression in clinically and non-clinically depressed populations (e.g., Craft & Landers, 1998; North, McCullagh & Tran, 1990). In addition, this effect of exercise on depression has been shown to be largely independent of the frequency, mode, or intensity of exercise, and exercise is now suggested to be as effective as alternative treatments for some people (Craft & Landers, 1998). Similarly, several more recent reviews have also concluded that exercise is both associated with decreased depression and effective at reducing depression in clinically and non-clinically depressed populations (Callaghan, 2004; Phillips, Kiernan & King, 2003).

1.5.2.4 Mood intolerance

The suggestion that compulsive exercise may function as a means of compensating for or suppressing adverse emotional states in ED patients is not new (e.g., Geller, Cockell & Goldner, 2000; Markland & Ingledrew, 1997; Penas-Lledo, Vaz Leal & Waller, 2002). For example, Fairburn, Cooper and Shafran (2003) suggest that the inability to cope appropriately with adverse mood states, such as anxiety and depression is a central component in the maintenance of the eating disorders (see Figure 1). Termed “mood intolerance”, it is characterised by engagement in various dysfunctional mood

modulatory behaviours (such as, compulsive exercising) that serve the purpose of neutralising the mood state as well as reducing awareness of the associated cognitions (Fairburn, Cooper, & Shafran, 1993). They further suggest that these mood modulatory behaviours may then become habitual forms of mood modulation. This too supports the suggestion that compulsive exercise may be functioning as mood modulatory behaviour in ED patients. The use of exercise as a mood modulatory behaviour may not be so great in BN patients as they have a range of behaviours (e.g., bingeing, purging, self-harm, or drug abuse) that have been shown to similarly function in the regulation of affect (McManus & Waller, 1995). The idea that compulsive exercise may become a habitual method of affect regulation is supported by evidence that among eating disordered patients who exercise compulsively, exercise may become the primary and even the only means by which they regulate their emotional state (Geller, Cockell, & Goldner, 2000; Markland & Ingledrew, 1997).

1.5.2.5 Summary

The evidence presented so far clearly supports the functional ability of exercise to regulate emotion and further suggests a functional equivalence with eating-disordered symptomatology. It is probable that an inability to cope appropriately with adverse mood states, results in exercise being maintained as an affect regulation strategy. It follows therefore, that affect regulation may constitute a further maintenance factor for compulsive exercise (see Figure 1.3). Furthermore, given the assumption that the use of exercise to regulate affect can become habitual, it is little wonder that the concepts of exercise dependence and/or exercise addiction have been proposed to explain the observed reliance on exercise among eating disordered patients to regulate their emotional state. The next section will critique these concepts.

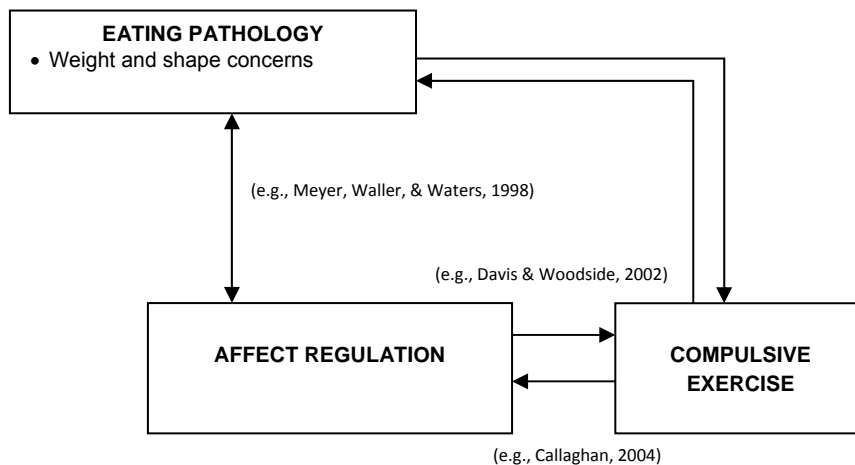


Figure 1.3. A schematic representation of the maintenance of compulsive exercise to include affect regulation.

1.5.3 Compulsive exercise as an addiction/dependence

A popular viewpoint within the literature is that the problematic exercise observed in both eating disordered and non-eating disordered samples is a type of addiction or dependence (Hausenblas & Downs, 2002a), with *exercise dependence* having been posited as the preferred term for a seemingly unhealthy preoccupation with exercising (Bamber, Cockerill, Rodgers, & Carroll, 2003). Indeed, the suggestion that compulsive exercise may be a type of dependence or addiction has received considerable interest (e.g., Adams, 2009; Adams & Kirkby, 2002; Hausenblas & Downs, 2002a; Klein et al., 2004), with a wealth of literature concerning its aetiology, development, maintenance and measurement (e.g., Adams, 2009; Adams & Kirkby, 2001; Adams & Kirkby, 2002; Allegre, Souville, Therme, & Griffiths, 2006; Bamber, Cockerill, & Carroll, 2000; Davis 2000; Hamer & Karageorghis, 2007; Hausenblas & Downs, 2002a; 2002b).

Within the broader literature, there is evidence of an association between exercise dependence symptoms and eating psychopathology in non-eating disordered samples (Cook, 1996; Cook & Hausenblas, 2008; Zmijewski & Howard, 2003). Specifically,

addictiveness has been shown to be positively associated with eating disorder symptomatology in regular exercisers, but not in non-exercisers (Davis, 1990). Furthermore, Zmijewski and Howard's (2003) findings suggest that elevated levels of eating psychopathology were a significant risk factor for the subsequent development of exercise dependence symptoms. However, only one study has specifically considered exercise dependence in an eating disordered sample, finding that 48% of a sample of anorexic exercisers endorsed symptoms consistent with exercise dependence (Klein et al., 2004).

Despite the lack of studies among eating disordered samples, recent findings support the notion that exercise dependence does not constitute a clinically significant syndrome in the absence of eating pathology (Bamber, Cockerill, & Carroll, 2000; Davis, 2000; Keski-Rahkonen, 2001). In line with this, Bamber, Cockerill and Carroll (2003) suggested that given the apparent secondary nature of exercise dependence to eating pathology, "associated exercise dependence" may be a more appropriate term.

1.5.3.1 Similarities with other addictive behaviours

The observation that compulsive exercise behaviour seen in patients with eating disorders often displays a striking phenomenological similarity to compulsive drug-taking behaviour in disorders of substance dependence has given credence to the concept of compulsive exercise as a type of dependence (Klein et al., 2004). Supporting this Werme and colleagues (Werme, Thoren, Olsun, & Brene, 2000; Werme, Messer, Olsun, Gilden, Thoren et al., 2002) highlighted the striking similarities of addictive drugs and strenuous physical activity on brain reward pathways implying that compulsive exercising may have the potential, over time, to become a dependence (Davis & Kaptein, 2006).

It has been observed that compulsively exercising patients with AN will often expend tremendous effort to engage in exercise, even after it ceases to be rewarding (Davis & Woodside, 2002). Similarly, individuals with substance dependence issues will often continue to engage in the drug-taking behaviour even when no pleasure can be

obtained (Berridge & Robinson, 1995). In addition, among the most prominent characteristics of addictive behaviours is their progressively compulsive nature, even in the face of adverse consequences to health and safety (Berridge & Robinson, 1995; Heyman, 1996; Tiffany, 1990). Indeed, Dodes (1996) has highlighted the importance of recognising the compulsive nature of addictions and the addictive nature of some compulsions. In terms of exercise, a dependence on exercise often presents as an inability or unwillingness to cut down or stop exercising despite adverse consequences (Bamber, Cockerill, Rodgers, & Carroll, 2003).

Taken together, the evidence presented above supports the suggestion that compulsive exercise may result in dependency in some individuals (Adams, 2009; Adams & Kirkby, 1998). Unfortunately, much of the literature is marred by the lack of a coherent and conceptually driven quantification of exercise dependence, and as a consequence a standard or universally accepted definition of the construct does not exist (Adams, 2009; Allegre et al., 2006; Hausenblas & Downs, 2002a; Johnson, 1995). In addition, the psychological underpinnings of the dependence are often overlooked. One such area involves the positive and negative reinforcement aspects of exercise.

1.5.3.2 Behavioural reinforcement of exercise

Davis (2000) makes the point that in order for exercise to have the potential for addiction, it has to be either a positively or negatively reinforcing activity. In other words, it must either increase pleasure (positive reinforcement) or ameliorate distress and suffering (negative reinforcement). Indeed, on the nature of addiction, Goodman (1990) notes that the behaviour engaged in (albeit no longer able to be controlled) is of a kind that can function not only to produce pleasure, but also to provide escape (avoidance/alleviate) from internal discomfort.

The positive reinforcement function of exercise is reflected in the positive addiction model of exercise dependence which proposed that exercise dependence was attributable to exercise induced euphoric states that were highly enjoyable (Glasser, 1976). However,

strenuous exercising of the type typical of compulsive exercise is not a primary reinforcing behaviour for most people, since relatively few individuals engage in exercise for the euphoria it produces (Davis, 2000).

Whilst there is evidence that exercise is associated with positive affect (e.g., Thome & Espelage, 2004) which no doubt is a positively reinforcing factor, other studies have demonstrated that doing exercise for enjoyment is by far the least endorsed reason among men and women (e.g., Davis et al., 1995). In particular, there is strong evidence that compulsive exercise is primarily maintained by secondary negative reinforcement factors of which the amelioration of weight and shape concerns are the most strongly implicated (Brehm & Steffen, 1998; Davis, Brewer, & Ratusny, 1993) followed by the alleviation of negative affect (Geller et al., 2000; Markland & Ingledrew, 1997). Indeed, Morgan's (1979) model of negative addiction posited the negative reinforcement function of exercise as central to the maintenance of the exercise behaviour.

Further supporting the affect regulatory model of compulsive exercise is the model of exercise dependence whereby exercise is maintained primarily to mitigate the affective withdrawal symptoms that manifest when unable to exercise (Bamber, Cockerill, & Carroll, 2003; Hausenblas & Downs, 2002a; Morgan, 1979; Veale, 1987; 1995). This model again highlights the central role of negative reinforcement in the maintenance of exercise behaviour.

1.5.3.3 Withdrawal symptoms

Of all the various definitional and diagnostic criteria proposed for exercise dependence (e.g., Hausenblas & Downs, 2002b; Veale, 1995), the largest body of evidence is for the experience of affective withdrawal symptoms as a consequence of being unable to exercise (Bamber, Cockerill, & Carroll, 2003). Indeed, Aidman and Woollard (2003) make the point that exercise dependence is characterised by a pattern of withdrawal symptoms. Based on the premise that in some exercisers the cessation of regular exercise may result in negative psychological states (Hausenblas & Downs,

2002a; 2002b), withdrawal symptoms have been posited as the cardinal characteristic of exercise dependence (Szabo, 1995).

Withdrawal symptoms have been described as the psychological effects that occur as a result of not exercising, and are manifested either by emotional symptoms, or further exercise to avoid such symptoms (American Psychiatric Association, 1994). The most frequently reported symptoms of withdrawal when unable to exercise were guilt, anxiety, depression, and irritability (Bamber, Cockerill, & Carroll, 2000; Szabo, Frenkl, & Caputo, 1997). It has been suggested that in some individuals, as little as 24 hours without exercise may be sufficient to produce significant withdrawal symptoms (e.g., Sachs, 1981; Thaxton, 1982).

Whilst the experience of withdrawal symptoms is common to many regular exercisers, it has been suggested that only some can be classed as dependent (Szabo, 1995). However, in a study attempting to delineate diagnostic criteria, withdrawal symptoms emerged as one of only two criteria implying dependence (Bamber, Cockerill, & Carroll, 2003). It has certainly been suggested, that habitual exercisers may learn to rely on exercise to counteract anxiety or depression, control mood states, or lose weight, and that a subsequent inability to exercise results in negative psychological consequences in the form of withdrawal symptoms (e.g., Baekeland, 1970; Morris, Steinberg, Sykes, & Salmon, 1990; Thaxton, 1982). Indeed, such exercise-related dysphoria has even been shown to discriminate between ED and non-ED groups (Boyd et al., 2007).

Withdrawal symptoms are known to be universally present at, if not responsible for, the onset of most addictions, including opiates, nicotine and alcohol (Galanter, 1993; Niaura, Rohsenow, Binkoff, & Monti, 1988; Powel, Bradley, & Gray, 1992), and the withdrawal phenomenon is considered a common consequence of dependence (Farrell, 1994). From the earliest descriptions, emotional withdrawal symptoms have been consistently reported as a consequence of exercise deprivation among habitual exercisers (e.g., Aidman & Woollard, 2003; Baekeland, 1970; Chan & Grossman, 1988; Conboy, 1994; Mondin, Morgan, Piering, Stegner, Stotesbery et al., 1996; Morgan, 1979; Morris et

al., 1990; Ogles, Masters, & Richardson, 1995; Veale, 1987; Yates, Leehey, & Shisslak, 1983). Similarly, within ED populations there is evidence to suggest that exercise is often being maintained specifically to avoid the emotional consequences that would result from being unable to exercise (Blumenthal, O'Toole, & Chang, 1984; Davis & Woodside, 2002; Long et al., 1993).

Whilst it has been suggested that withdrawal can take the forms of physiological and/or psychological disturbance (Sachs & Pargman, 1979; West & Gossop, 1994), the evidence for a physiological basis to exercise dependence remains equivocal (Adams, 2009; Adams & Kirkby, 2002; Davis, 2000; Hamer & Karageorghis, 2007). Indeed, the model currently most supported by the empirical literature suggests that the presence of affective withdrawal symptoms is indicative of a *psychological* dependence on exercise whereby exercise is maintained via negative reinforcement specifically to avoid the experience of such withdrawal (Figure 1.4).

1.5.3.4 Summary

In this section, evidence has been presented suggesting that among habitual exercisers, the experience of affective withdrawal symptoms when unable to exercise is common in both clinical and non-clinical samples (Szabo, 1995). This may in some cases result in a psychological dependency/addiction upon exercise whereby exercise behaviour is maintained specifically to avoid the withdrawal symptoms (i.e., negative reinforcement). In addition, for some individuals there is potentially a further powerful maintenance factor of positive reinforcement as a result of elevated positive affect (i.e., positive addiction) (Glasser, 1976). Taken together, the evidence discussed so far supports the notion that in some susceptible individuals (i.e., those who are mood intolerant), engaging in exercise may inadvertently result in a psychological dependence, which then reciprocally maintains the exercise behaviour (Figure 1.4). Furthermore, it is important to note that the maintenance of exercise behaviour via negative reinforcement, particularly in the context of the amelioration of anxiety, highlights the similarities between addictive and compulsive

behaviours. Therefore, the next section will specifically consider the role of compulsivity in the maintenance of exercise behaviour.

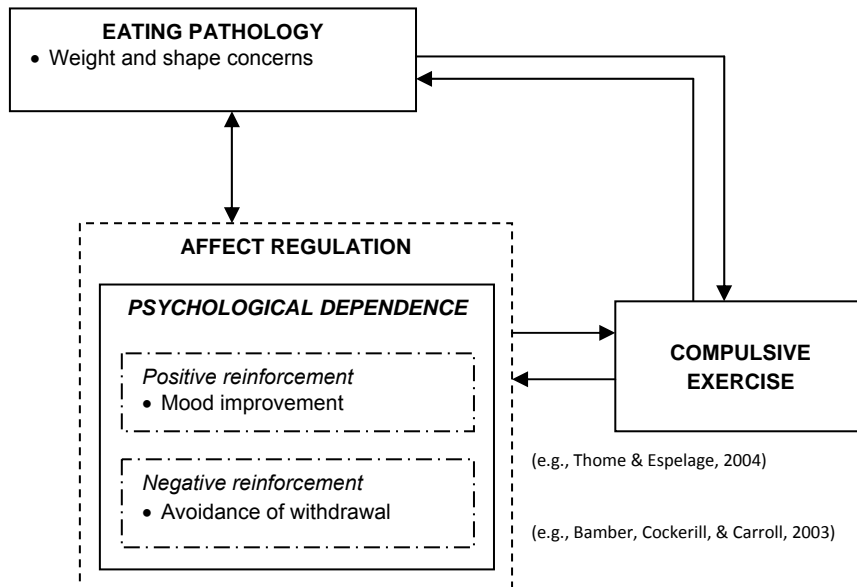


Figure 1.4. A schematic representation of the maintenance of compulsive exercise to include psychological dependence.

1.5.4 Compulsivity and the maintenance of exercise

Given the evidence presented in the preceding section, it is suggested that *addictive* behaviours and *compulsive* behaviours are essentially similar, since they are both characterised by a need to perform a behaviour that is no longer intrinsically rewarding. The following section will focus on the compulsivity element of exercise in more detail. The broad aim of this section is to review the literature surrounding the relationship between compulsivity and exercise. First, compulsivity will be defined. Second, the relationships of compulsivity to exercise, and obsessive-compulsive disorder and obsessive-compulsive personality disorder to compulsive exercise will be critiqued. Finally, a specific component of compulsivity implicated in the maintenance of compulsive exercise will be critically considered.

1.5.4.1 Definition of compulsivity

Compulsivity describes an insistent urge to perform a behaviour to relieve the *anxiety* stemming from a fear of perceived negative consequences if the behaviour is not performed (American Psychiatric Association, 2000; Frost, Steketee, Cohn, & Griess, 1994). Therefore, the primary function of compulsive behaviours is to mitigate *anxiety* via the *avoidance* of perceived negative consequences. Furthermore, such compulsive behaviours are typically characterised by being performed persistently, repetitively and excessively, without leading to any reward or pleasure (Evans, Lewis, & Lobst, 2004).

1.5.4.2 Compulsivity and exercise

Compulsivity has been shown to be significantly related to levels of activity in both eating disordered patients and non-eating disordered exercisers (e.g., Gulker, Laskis, & Kuba, 2001; Davis et al., 1995; Shroff et al., 2006). Furthermore, eating disorder symptomatology has been shown to be associated with compulsive attitudes to exercise, rather than just exercise quantity (Adkins & Keel, 2005; Seigel & Hetta, 2000). Indeed, excessive exercising has been described as one of the most obvious compulsions in the eating disorders with a lifetime occurrence in up to 84% of patients (Davis, 1997).

Supporting the importance of the avoidance of perceived negative consequences component of compulsivity, it has been demonstrated that compulsive exercise is associated with heightened concerns about the consequences of not exercising (e.g., Bamber, Cockerill, & Carroll, 2000; Penas-Lledo, Sancho, & Waller, 2002). For example, avoidance of failure has been identified as a maintaining factor for compulsive exercise (Hall et al., 2007). In addition, a tendency towards avoidance (i.e., an avoidant coping style) has been found to be associated with disordered eating attitudes and behaviours among both eating disordered and non-eating disordered women (e.g., Sherwood, Crowther, Wills, & Ben-Porath, 2000; VanBoven & Espelage, 2006). More specifically, avoidance of emotional arousal has been shown to be associated with increased compulsivity in both eating disordered (Lawson, Waller, & Lockwood, 2007) and non-

eating disordered samples (Abramowitz, Lackey, & Wheaton, 2009). It is plausible that the experience of affective withdrawal symptoms when unable to exercise leads to a fear of such negative consequences, resulting in compulsive exercise behaviour in order to avoid experiencing such withdrawal. Therefore, exercise behaviour becomes compulsively maintained by the need to avoid the experience of withdrawal. This suggestion that a fear of the negative consequences of not exercising is a maintaining factor for compulsive exercise is not new (Penas-Lledo, Sancho, & Waller, 2002; Thaxton, 1982) and supports the centrality of compulsivity in the maintenance of compulsive exercise.

In addition to the evidence described above, there are also established links between low body weight and compulsivity. For example, Crisp (1967) concluded that starvation facilitates generalised compulsive behaviour so that exercising, like various other activities, can involuntarily become stereotyped, ritualised, and excessive, simply as a consequence of the disorder. Supporting this, serotonin dysregulation, a frequent consequence of malnutrition, has been implicated in the development of compulsive behaviours (Barr, Goodman, Price, McDougle, & Charney, 1992; Holden, 1990; Kaye, Weltzin, & Hsu, 1993). The links between starvation and compulsivity can readily be observed within the context of Anorexia Nervosa. Specifically, it is frequently observed in AN that as the condition worsens, patients feel an increasingly strong compulsion to be physically active even when they no longer enjoy it, indeed when the process is painful and exhausting (Davis, 1997). Indeed, AN patients showed both a higher level of physical activity and more compulsive exercise than controls (Davis et al., 2005).

1.5.4.3 Obsessive-compulsive disorder and obsessive-compulsive personality disorder

Both EDs and compulsive exercise share a strong relationship with obsessionality. For example, it has been suggested that an inherent obsessionality may underlie both compulsive exercise and eating pathology (Davis & Kaptein, 2004; Gulker, Laskis, & Kuba., 2001) and several studies report that compulsive exercisers typically display an obsessional and rigid personality profile as well as a compulsive behaviour pattern (Davis

et al., 1993; Goldfarb & Plante, 1984; Kagan, 1987; Yates, 1991). As a result, compulsive exercise is often viewed as being related to obsessive-compulsiveness (Davis & Claridge, 1998; Davis et al., 1998; Davis, Kennedy, Ralevski, Dionne, Brewer et al., 1995; Davis, Katzman, & Kirsch, 1999). Consequently, much of the research into compulsive exercise has tended to focus on its links with obsessive-compulsive personality traits and obsessive-compulsive symptomatology (Penas-Lledo, Vaz Leal, & Waller, 2002). Indeed, it has even been suggested that it may be useful to consider compulsive exercise as stemming from an anxiety disorder (Gulker, Laskis, & Kuba, 2001), which fits with the idea that the function of compulsive exercise in the EDs is to reduce anxiety, much like the function of compulsions in obsessive-compulsive disorder (Davis & Kaptein, 2006).

Obsessive-compulsive disorder (OCD) and associated symptomatology are well documented in individuals with eating disorders (Serpell, Livingstone, Niederman, & Lask, 2002; Shafran, 2002). Indeed, there is a wealth of reported evidence suggesting positive associations among both clinical and non-clinical populations between compulsive exercising and obsessive-compulsive symptomatology (Cook, 1996; Davis, Brewer & Ratusny, 1993; Davis & Claridge, 1998; Davis et al., 1995; Gulker, Laskis & Kuba, 2001; Wyatt, 1997), and an obsessive-compulsive personality profile (Davis & Claridge, 1998; Davis Katzman & Kirsh, 1999; Serpell, Livingstone, Neiderman & Lask, 2002; Spano, 2001). In addition, substantial evidence exists supporting an overlap between Anorexia Nervosa (AN) and both OCD and OCD symptomatology at both a psychological and physiological level, and obsessive-compulsive personality traits have been implicated as common factors in the development of both AN and OCD (Anderluh, Tchanturia, Rabe-Hesketh & Treasure, 2003; Jarry & Vaccarino, 1996; Serpell et al., 2002).

In fact, the existing literature clearly suggests a significant relationship between AN and obsessive-compulsive personality traits (Serpell et al., 2002), with evidence to support a more obsessive-compulsive personality profile in exercising AN patients than their non-exercising counterparts (Davis & Claridge, 1998; Davis et al., 1998; Davis & Kaptein, 2006). Similarly, both anorexic and bulimic patients classified as compulsive exercisers

had higher scores on measures of obsessive-compulsive personality than their non-exercising counterparts (Davis & Claridge, 1998). As a result, obsessive-compulsive personality factors are presumed to be probable risk factors for both disordered eating (Wonderlich, Lilienfeld, Riso, Engel, & Mitchell, 2005) and compulsive exercising (Gulker, Laskis & Kuba, 2001).

1.5.4.4 Guilt

A further component of compulsivity that has been specifically implicated in the maintenance of compulsive behaviours is guilt (Mancini, Perdighe, Serrani, & Gangemi, 2009). Guilt has been shown to be associated with obsessive-compulsive symptomatology in both clinical and non-clinical samples (Frost et al., 1994; Mancini, Gangemi, Perdighe, & Marini, 2008; Shafran, Watkins, & Charman, 1996). Indeed, guilt has been shown to predict compulsivity independent of anxiety and depression (Shafran, Watkins, & Charman, 1996) and fear of guilt has been linked to increased rates of compulsive behaviours (Mancini & Gangemi, 2006). In addition, guilt has been implicated as an aetiological factor in the development of OCD (Gibbs, 1996).

In terms of compulsive exercise, Mond et al., (2004; 2006a; 2008; 2009) have consistently demonstrated that the degree of guilt (feeling bad if one has been prevented from exercising a certain amount) experienced whenever exercise is unable to be undertaken is one of the components of compulsive exercise most strongly associated with eating disorder psychopathology and reduced quality of life. Indeed, the experience of guilt has consistently been reported as a consequence of being unable to exercise among compulsive exercisers (Bamber, Cockerill, & Carroll, 2000; Szabo, Frenkl, & Caputo, 1997). The importance of guilt is further supported by the finding that guilt when unable to exercise discriminated between ED and non-ED groups (Boyd et al., 2007; Mond & Calogero, 2009).

1.5.4.5 Summary

In the preceding section, evidence was presented demonstrating the relationship of compulsivity to both exercise and EDs. Specifically, the avoidance of perceived negative consequences and the experience of guilt when exercise is unable to be undertaken have been shown to be the components of compulsivity most strongly implicated in the maintenance of compulsive exercise.

Taken together, the evidence presented so far clearly supports compulsivity as an important factor in the maintenance of compulsive exercise (Figure 1.5) and further supports the conception of problematic exercise as a compulsive behaviour.

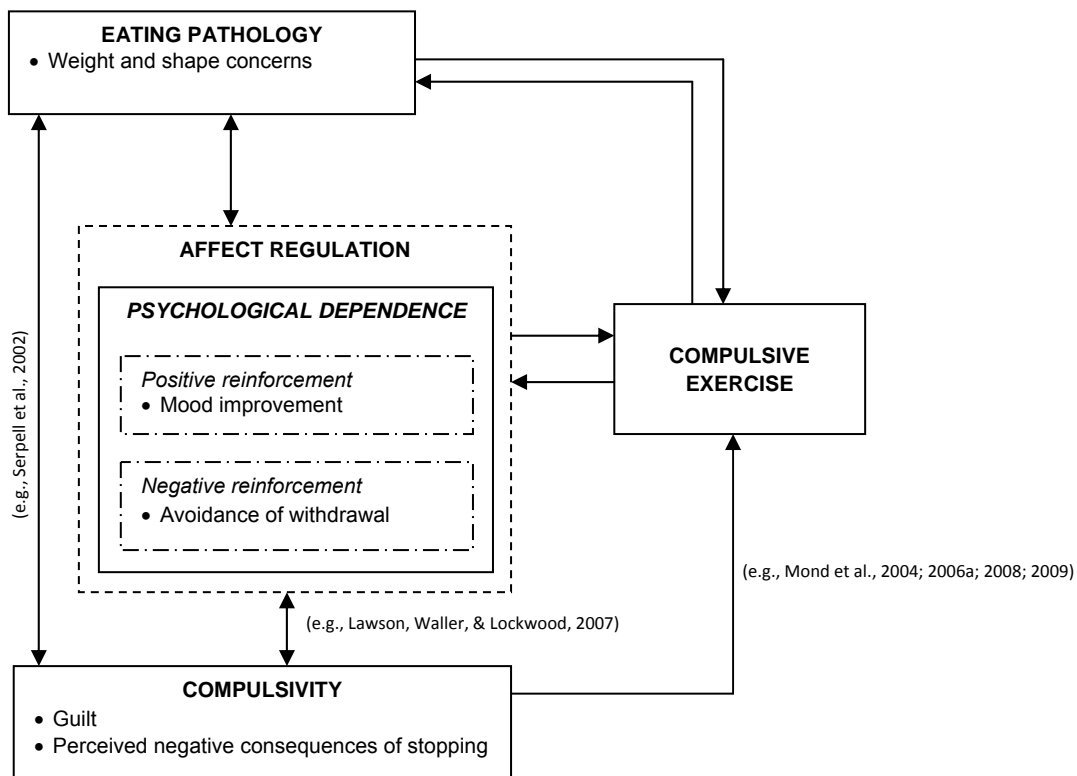


Figure 1.5. A schematic representation of the maintenance of compulsive exercise to include compulsivity.

1.5.5 Perfectionism and rigidity in the maintenance of compulsive exercise

Of all the obsessive-compulsive personality traits associated with disordered eating such as perfectionism, inflexibility, rigidity, and preoccupation with interpersonal and mental control (Halmi, 2005), it is perfectionism that is posited as the most strongly associated with both compulsive exercising (Flett & Hewitt, 2005) and disordered eating (Cassidy, Allsopp & Williams, 1999; Halmi, Sunday, Strober, Kaplan, Woodside et al., 2000). In addition, rigidity has long been described as a feature of compulsive exercise (e.g., Beumont et al., 1994; Wyatt, 1997; Yates, 1991) and a cluster analysis of personality pathology in ED patients found that nearly half of patients were included in a cluster characterised by rigid compulsivity (Goldner, Srikameswaran, Schroeder, Livesley, & Birmingham, 1999). Therefore, the aims of this next section are to critically consider the relationship of both perfectionism and rigidity to compulsive exercise.

1.5.5.1 *Perfectionism*

Perfectionism typically describes a personality trait characterised by having and striving for high personal standards (Frost, Marten, Lahart, & Rosenblate, 1990), and is well established as an important factor in the development and maintenance of the eating disorders (Fairburn, Cooper, Doll, & Welch, 1999; Fairburn, Cooper, & Shafran, 2003; Fairburn, Shafran, & Cooper, 1999; Lilenfeld, Wonderlich, Riso, Crosby, & Mitchell, 2006; Stice, 2002). Perfectionism has also been shown to be associated with greater compulsivity (Wu & Cortesi, 2009), with evidence to support it as a potential maintenance factor for compulsive behaviour (e.g., Chick, Whittal, & O’Niell, 2008; Egan, Wade, Shafran, 2010; Shafran & Mansell, 2001). In terms of compulsive exercise, evidence suggests that perfectionism is a robust correlate of compulsive exercise (Shroff et al., 2006). Indeed, compulsive exercise has been shown to be consistently associated with higher levels of perfectionism in both eating disordered and non-eating disordered samples (Ackard, Brehm, & Steffen, 2002; Brehm & Steffen, 1998; Coen & Ogles, 1993; Cook 1996; Downs, Hausenblas, & Nigg, 2004; Gulker, Laskis, & Kuba, 2001; Hagan &

Hausenblas, 2003; Hall et al., 2007; Hausenblas & Downs, 2002b; Seigel & Hetta, 2001; Shroff et al., 2006).

The importance of perfectionism is further highlighted by the finding that AN patients classified as compulsive exercisers report significantly higher levels of perfectionism than their non-exercising counterparts (Davis et al., 1998). Perfectionism has been shown to be independent of the state of nutrition in AN (Kaye, 1997), and in a sample of compulsively exercising AN patients, elevated perfectionism was associated with poor outcome from the treatment of their compulsive exercise (Long & Hollin, 1995). This supports the notion that perfectionism is a significant factor in compulsive exercise and furthermore, may be an important maintenance factor in its own right (i.e., independent of compulsivity).

Despite the preceding evidence, understanding of the relationship between perfectionism and compulsive exercise is impaired by the use of disparate conceptualizations of perfectionism (e.g., Frost et al., 1990; Hewitt & Flett, 1991). For example, empirical findings have suggested that whilst high personal standards remain an undisputed component of perfectionism they are not necessarily, by themselves, pathological (Dunkley, Blankstein, Halsall, Williams & Winkworth, 2000; Frost et al., 1990; Serpell, Waller, Fearon, & Meyer, 2009). Indeed, recent findings have consistently demonstrated the existence of two distinct, albeit related, dimensions of perfectionism (e.g., Bieling, Israeli, & Antony, 2004; Blankstein & Dunkley, 2002). Whereas the first reflects the setting and striving for high personal standards, the second reflects a tendency towards self-criticism (Dunkley, Blankstein, Masheb, & Grilo, 2006) and it is the self-critical dimension that is posited as the primary indicator of the dysfunctional component of perfectionism (Dunkley et al., 2006).

Unfortunately, no studies examining the relationship between perfectionism and compulsive exercise have specifically considered the self-critical dimension of perfectionism. However, despite the lack of studies explicitly considering the two proposed dimensions of perfectionism, there is evidence that both are associated with compulsive

exercise. For example, whilst not explicitly considered, many current perfectionism measures have been shown to tap both dimensions (Bieling, Israeli, & Antony, 2004; Dunkley, Zuroff, & Blankstein, 2003). An examination of studies using these measures with measures of compulsive exercise clearly support an association between compulsive exercise and both the high personal standards and self-critical dimensions of perfectionism (Cook 1996; Shroff et al., 2006; Downs, Hausenblas, & Nigg, 2004). In addition, compulsive exercisers are reported to often strive to achieve perfection with any failure to reach this standard resulting in self-criticism (Beumont et al., 1994) and Davis (1997) has posited a co-occurrence of self-criticism and high personal standards as a potential risk factor for compulsive exercise. However, to date no studies have considered how these different facets of perfectionism interact in the maintenance of compulsive exercise.

1.5.5.2 Rigidity

Rigidity has been defined as a pattern of resisting “...*the acquisition of new behaviour patterns by holding onto previous and non-adaptive styles of performance*” (Schaie & Parman, 1975: p. 1) and is regarded as an essential component of dysfunctional perfectionism (Shafran & Mansell, 2001). Indeed, Ferrari and Mautz (1997) previously demonstrated an association between rigidity and perfectionism, and a recent qualitative analysis of perfectionism identified rigidity as a consistent theme implicated in its maintenance (Riley & Shafran, 2005), thereby supporting previous descriptions of dysfunctional perfectionism (Burns, 1980). Supporting rigidity as a significant component of compulsive exercise is the fact that it remains central to the definition of obsessive-compulsive personality disorder, which has been demonstrated to have a significant association with both EDs (Halmi, 2005) and compulsive exercise (Davis & Claridge, 1998; Davis Katzman & Kirsh, 1999; Serpell et al., 2002). Furthermore, rigidity has been shown to be a robust correlate of increased compulsivity (e.g., Schultz & Searleman, 2002).

In terms of compulsive exercise, rigidity has been linked to the emotional consequences of not meeting personal standards. Specifically, it is suggested that repetitive behaviour helps filter out both extraneous stimuli and disruptive affect-laden cognitions (Rauch & Savage, 2000). Rauch and Savage (2000) proposed that repetitive behaviours in the anxious state represent an attempt to homeostatically reduce anxiety-caused increased levels of arousal by soothing limbic tone. In addition, because compulsive exercisers often express their exercise in a stereotyped and repetitive manner (Beumont et al., 1994; Wyatt, 1997; Yates, 1991), it has been suggested that this characteristic of their exercise further supports the anxiolytic effect of the exercise (Holtkamp, Hebebrand, & Herpertz-Dahlmann, 2004). Indeed, Bamber et al. (2003) found that inflexible attitudes towards exercising was an important signifier of compulsive exercise resulting in inflexible and stereotyped exercise behaviour. Furthermore, Boyd, Abraham and Luscombe (2007) found that the setting of rigid exercise rules was a significant predictor of an ED diagnosis.

1.5.5.3 Summary

The evidence presented so far clearly supports perfectionism as a significant component of compulsive exercise. Evidence was presented supporting perfectionism as a maintenance factor for compulsive exercise in the EDs. Similarly, evidence was presented that suggests rigidity may also be a central component in the maintenance of compulsive exercise, likely stemming from its anxiolytic function and association with perfectionism. Whilst both perfectionism and rigidity overlap with the construct of compulsivity (i.e., Obsessive Compulsive Personality), the evidence presented supports their conceptualisation as a separate (from compulsivity) though interlinked construct in terms of maintaining compulsive exercise (Figure 1.6).

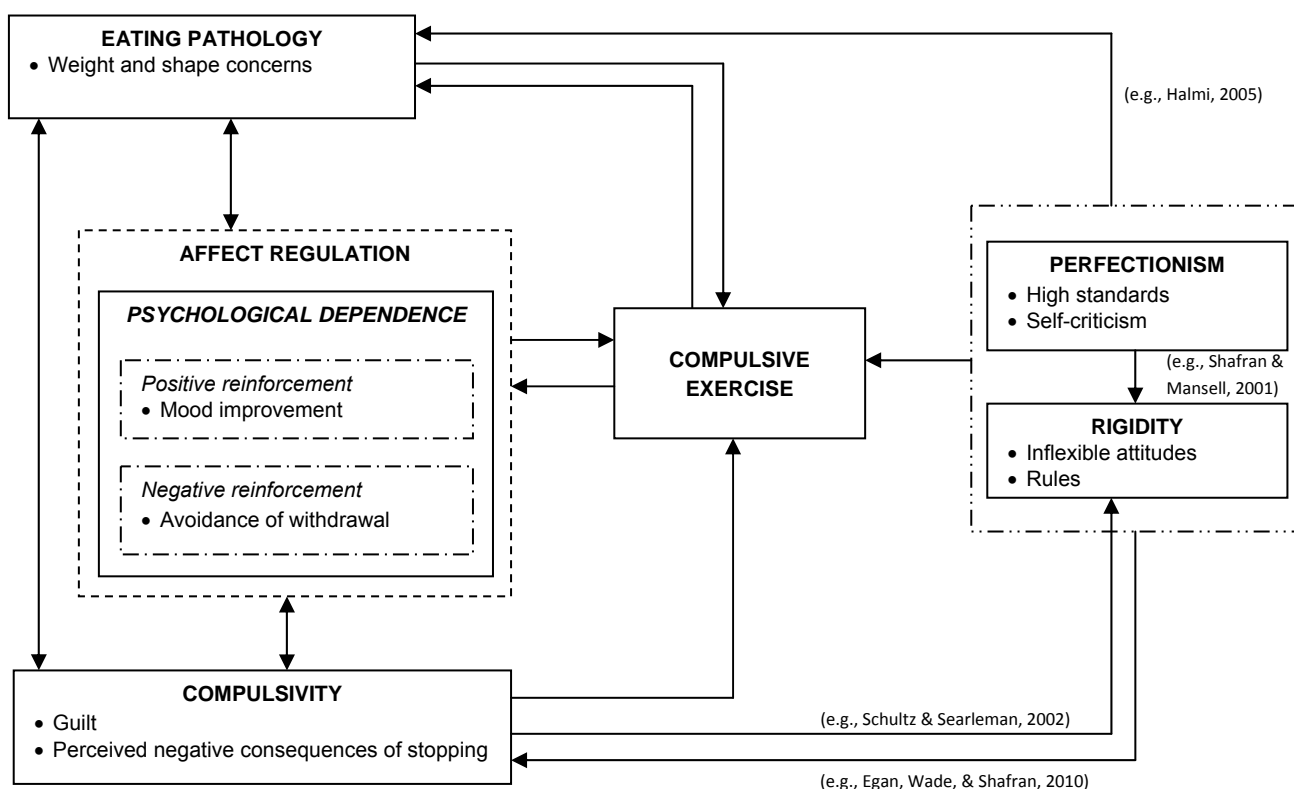


Figure 1.6. A schematic representation of the maintenance of compulsive exercise to include perfectionism and rigidity.

1.6 A maintenance model of compulsive exercise

The preceding sections have outlined five specific factors that a review of the literature suggests are implicated in the maintenance of compulsive exercise. Each of the factors has been represented diagrammatically to produce a schematic representation of the factors operating in the maintenance of compulsive exercise. Figure 1.7 details each of the implicated maintenance factors and their relationships to each other. Whilst each of the maintenance factors and their inter-relationships are supported by the evidence reviewed in the preceding sections, the proposed model remains speculative at best. Although some of the factors are supported by a wealth of evidence (e.g., eating pathology) others require further empirical investigation in order to establish their validity (e.g., the self-critical dimension of perfectionism). In addition, as outlined previously, much

of the evidence is beset with definition and measurement problems rendering much of it equivocal. Future studies should seek to empirically validate the relationships suggested in the proposed maintenance model.

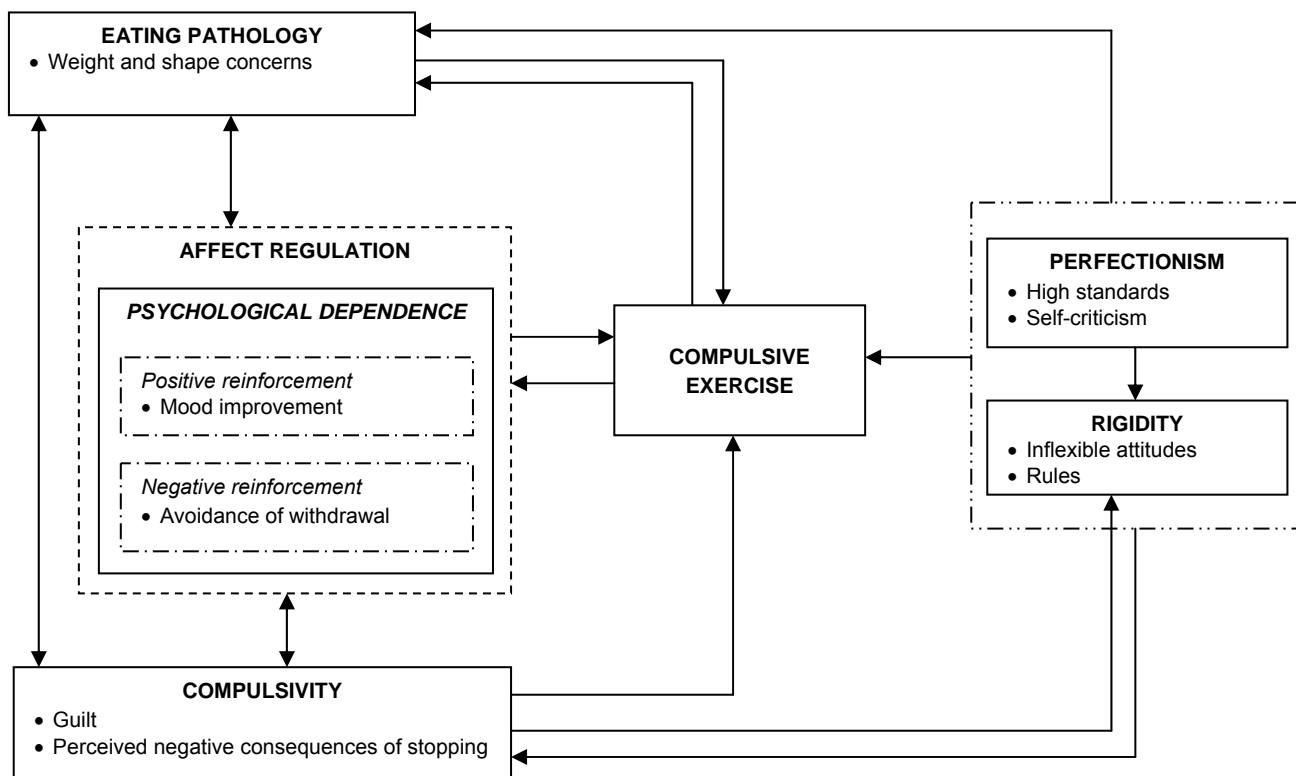


Figure 1.7. A schematic representation of all the factors implicated in the maintenance of compulsive exercise.

1.7 Measurement of compulsive exercise

As previously described, much of the literature on compulsive exercise remains largely equivocal, mostly due to inconsistency in terminology, definition and measurement of the construct. The preceding sections outline several factors identified as important in the maintenance of excessive exercise and clearly suggest a multidimensional nature. It therefore follows that a valid measure of compulsive exercise would need to include all these factors. The following section reviews existing questionnaire measures, critically considering whether the factors they assess include all the factors identified as important in the construct of compulsive exercise.

1.7.1 Review of measures of compulsive exercise

A review of the literature (see section 1.1 for details of the search strategy) identified 14 self-report questionnaire measures described as assessing compulsive exercise or related exercise constructs (i.e., obligatory exercise, excessive exercise, exercise dependence etc). These measures are presented in Table 1.1 with information regarding their psychometric and assessment characteristics. A sub-sample of those questionnaires that have been used most frequently (i.e., more than twice) to assess compulsive exercise and related exercise constructs specifically in relation to eating pathology (assessed via validated measures) are expanded upon below.

The Commitment to Exercise Scale (CES)

The CES (Davis, Brewer, & Ratusny, 1993) was developed to measure the core features believed to characterise excessive exercisers. The development sample consisted of 88 male and 97 female adult exercisers, recruited from fitness centres. The original factor analysis identified two moderately correlated factors assessing the obligatory (e.g., feeling guilty when exercise is missed or postponed) and pathological (e.g., continuing to exercise when unwell) aspects of exercising. However, recent findings have suggested that the items actually comprise a unidimensional scale (Mond et al., 2008). Whilst the CES does contain several items that appear to tap compulsivity construct, the main limitation of the CES is the lack of any items that assess either eating disordered exercise or withdrawal symptoms. In addition, many of the individual items fail to show any association with disordered eating variables (Mond et al., 2004; 2006a).

The Obligatory Exercise Questionnaire (OEQ)

The OEQ (Pasman & Thompson, 1988) is a modified version of the Obligatory Running Scale (Blumenthal, O'Toole, & Change, 1984) designed to assess an obligation to exercise. The development sample consisted of 30 runners, 30 weightlifters and 30 sedentary controls, with 15 males and 15 females in each group. Based on this sample,

the original factor analysis identified a single construct reflecting a subjective need to engage in repetitive exercise behaviours. However, subsequent factor analyses have suggested a multidimensional nature, though unfortunately, little agreement exists in terms of the emerging factors (Ackard, Brehm, & Steffen, 2002; Steffen & Brehm, 1999). A key strength of the OEQ is that it successfully discriminates between exercisers and control subjects and has demonstrated a relationship between anxiety and an inability to exercise or reluctance to stop exercising when injured. In addition, the OEQ does contain an item specifically assessing the experience of withdrawal symptoms when unable to exercise and eating disordered exercise. However, it is questionable whether single items are sufficient to adequately encapsulate a multifaceted construct such as withdrawal symptoms (Gorsuch, 1983). The main limitations of the OEQ are: the use of single items to assess complex aspects of compulsive exercise; a failure to include any reference to anxiety which is specifically indicated as a key symptom of withdrawal (Bamber, Cockerill, & Carroll, 2003); and the inclusion of items addressing frequency of exercise which are not supported as a valid component of compulsive exercise (Adkins & Keel, 2005; Mond et al., 2004).

The Exercise Dependence Questionnaire (EDQ)

The EDQ (Ogden, Veale, & Summers, 1999) was developed to assess the biomedical and psychosocial dimensions of exercise dependence. The development sample consisted of 449 participants (161 men and 288 women) who exercised for more than 4 hours per week on average. Factor analysis identified eight subscales assessing interference with social/family/work life, positive reward, withdrawal symptoms, exercise for weight control, insight into problem, exercise for social reasons, exercise for health reasons, and stereotyped behaviour. Notable strengths of the EDQ were the inclusion of distinct subscales assessing eating disordered exercise, withdrawal symptoms and positive reward. However, limitations were the inclusion of a subscale with only two items and poor internal consistency (i.e., stereotyped behaviour) and the fact that many items

described attitudes and social aspects of exercising as opposed to aspects identified as relevant to the maintenance of compulsive exercise.

The Exercise Dependence Scale (EDS)

The EDS (Hausenblas & Downs, 2002b; Downs; Hausenblas, & Nigg, 2004) is a theoretical-based measure of exercise dependence symptoms operationalised on DSM-IV (American Psychiatric Association, 1994) criteria for substance dependence. The development sample consisted of 3683 participants across 7 studies (1657 men and 2026 women). Factor analysis confirmed seven subscales assessing tolerance, withdrawal, intention effects, lack of control, time, reduction in other activities, and continuance. The EDS distinguishes between individuals who are at risk, have some symptoms, or have no symptoms for exercise dependence. Limitations of the EDS include a lack of any items assessing eating disordered exercise or compulsivity. In addition, many of the items of the EDS assess dimensions that have not been implicated in the construct of compulsive exercise and have no empirical basis in the eating disorder literature.

The Exercise Orientation Questionnaire (EOQ)

The EOQ (Yates, Edman, Crago, Crowell, & Zimmerman, 1999) was developed to assess exercise motivation and perception in a normal population. The development sample consisted of 254 participants (102 men and 152 women). Factor analysis identified six factors assessing self-control, exercise orientation, self-loathing, weight loss, identity and competition. A strength of the EOQ is the finding that the self-loathing factor is associated with elevated eating pathology and can discriminate between anorexic patients and healthy controls (Yates, Edman, Crago, & Crowell, 2001). Limitations of the EOQ include the fact that concurrent validity was established with ratings of exercise frequency, which is not considered to be a valid component of compulsive exercise (e.g., Adkins & Keel, 2005). In addition, the EOQ fails to include any items assessing affective withdrawal symptoms, or any of the components of compulsivity highlighted as central to the

definition of compulsive exercise. Furthermore, despite the inclusion of weight loss factor, none of the items of the EOQ assess eating-disordered exercise. Rather, they are more focussed on the healthy use of exercise for weight loss among a normal population.

Table 1.1 Description of measures that assess compulsive exercise or related exercise constructs.

Scale and Author	Sample	Description	Reliability
Bodybuilding Dependence Scale (BDS: Smith, Hale, & Collins, 1998)	N = 102: 73 males and 29 females (mean age = 31.0). 47 bodybuilders, 31 recreational weight-lifters, 24 Olympic weight-lifters.	9 items, assesses exercise dependence in bodybuilding. Three subscales: social dependency, training dependency, mastery.	$\alpha = 0.76, 0.75, 0.78$
Commitment to Exercise Scale (CES: Davis, Brewer, & Ratusny, 1993)	N = 185: 88 males and 97 females (mean age = 27.8). Recreational exercisers.	8 items, assessing the obligatory and pathological aspects of exercising. Two subscales: obligatory exercise, pathological exercise.	$\alpha = 0.77$
Commitment to Running Scale (CRS: Carmack & Martens, 1979)	N = 315: 250 males and 65 females (mean age = 28.8). Runners.	12 items, assessing feelings about running.	$\alpha = 0.93$
Exercise Addiction Inventory (EAI: Terry, Szabo, & Griffiths, 2004)	N = 200: 111 males and 89 females (mean age = 21.2). 102 sport science students, 98 regular exercisers.	6 items, assessing attitudes and beliefs about exercise, and identifies people at risk from exercise addiction.	$\alpha = 0.84$
Exercise Beliefs Questionnaire (EBQ: Loumidis & Wells, 1998)	N = 201: 96 males and 105 females (mean age 22.3). 168 students, 33 full-time employees.	21 items, assessing beliefs people have about the consequences of not being able to exercise regularly. Four subscales: social desirability, physical appearance, mental and emotional functioning, vulnerability to disease and aging.	$\alpha = 0.87, 0.83, 0.89, 0.67$
Exercise Dependence Scale (EDS: Hausenblas & Downs, 2002b)	N = 2420 across five studies: 1283 males and 1137 females (mean age = 21.25). Undergraduate students.	21 items, assessing exercise dependence symptomatology. Seven subscales: tolerance, withdrawal, continuance, lack of control, reduction in other activities, time, intention effects.	$\alpha = 0.78, 0.90, 0.90, 0.82, 0.67, 0.86, 0.89$
Exercise Dependence Questionnaire (EDQ: Ogden, Veale, & Summers, 1997)	N = 449: 161 males and 288 females (mean age N/A). Regular exercisers.	29 items, assessing exercise dependence. Eight subscales: social-occupational interference, positive reward, withdrawal symptoms, exercise for weight control, insight into problem, exercise for social reasons, exercise for health reasons, stereotyped behaviour.	$\alpha = 0.81, 0.80, 0.80, 0.78, 0.76, 0.76, 0.70, 0.52$
Excessive Exercise Scale (EXQ 27: Long et al., 1993)	N = 91: 25 males and 66 females (mean age 24.8). 21 females with Anorexia Nervosa, 70 undergraduate students	26 items, assessing exercise cognitions and behaviours. Two subscales: exercise behaviour, exercise cognitions.	$\alpha = 0.81$
Exercise Orientation Questionnaire (EOQ: Yates, Edman, Crago, Crowell, & Zimmerman, 1999)	N = 254: 102 males and 152 females (mean age = 35.7). 103 undergraduate students, 111 prospective jurors, 40 attendees at a professional conference.	49 items, assessing exercise attitudes and behaviour including those associated with psychopathology. Six subscales: self-control, orientation to exercise, self-loathing, weight reduction, competition, identity.	$\alpha = 0.92$ (total scale)

Exercise Saliency Scale (ESS: Morrow & Harvey, 1990; Kline Franken, & Rowland, 1994)	N = 74: 32 male and 42 female (mean age = 23.2). Undergraduate students.	40 items, assessing exercise dependence. Two subscales: response omission anxiety, response persistence.	$\alpha = \text{N/A}$
Negative Addiction Scale (NAS: Hailey & Bailey, 1982)	N = 60: 60 males (mean age N/A). Runners.	13 items, assessing psychological aspects of negative addiction.	$\alpha = \text{N/A}$
Obligatory Exercise Questionnaire (OEQ: Pasmán & Thompson, 1988)	N = 90: 45 male and 45 female (mean age = 31.0). 30 runners, 30 weight lifters, so sedentary.	21 items, assessing the need to engage in repetitive exercise behaviour.	$\alpha = 0.96$
Obligatory Running Questionnaire (ORQ: Blumenthal, O'Toole, & Chang, 1984)	N = 67: (mean age 31.2). 43 runners, 24 females with Anorexia Nervosa.	21 items, assessing the need to engage in repetitive running.	$\alpha = \text{N/A}$
Running Addiction Scale (RAS: Rudy & Estok, 1989)	N = 315: all female (mean age N/A). Joggers.	18 items, assessing characteristics associated with an addiction to running.	$\alpha = 0.82$

Note: α = alpha coefficient; N.A. = not available

1.7.2 Summary

All of the measures reviewed thus far were designed to assess compulsive exercise and related constructs (e.g., exercise dependence). However, as has been described, none of these measures adequately assesses the full range of factors implicated in the maintenance of compulsive exercise by the existing literature. Similarly, all of these measures fail to isolate one or more specific aspects of exercise that are likely to have differential links with particular facets of eating pathology. In addition, none of the identified measures was specifically designed for use in the eating disorders field. As a consequence, none of the existing measures of compulsive exercise and related constructs are deemed appropriate as research tools in the current thesis. It is therefore necessary to develop a new multidimensional measure of compulsive exercise that is theoretically coherent and empirically derived. Such a measure would also need to address both the psychometric and conceptual shortcomings of existing measures, and assess compulsive exercise within the context of the most recent empirical recommendations regarding definitions and maintenance factors.

1.8 Overall summary and future directions for research

It has been established that compulsive exercise is a significant factor in the aetiology, development, and maintenance of the EDs. Furthermore, despite the recognised clinical significance of compulsive exercise, no treatment currently exists to address compulsive exercise, nor is there a maintenance model of compulsive exercise on which any such treatment could be based. Therefore, there is a need to further our understanding of compulsive exercise by integrating the existing literature in such a way as to begin to put together an empirically derived and theoretically coherent conceptualisation of compulsive exercise. This review aimed to address this need through a critical review of the existing literature pertaining to compulsive exercise. Whilst a number of factors can be identified from the literature from which a speculative

maintenance model of compulsive exercise can be derived, much of the literature remains equivocal due to inconsistency in the definition and measurement of the compulsive exercise construct. Therefore, there is a need to re-evaluate the proposed maintenance factors and their relationship to compulsive exercise and eating pathology.

1.9 Aims and hypotheses of the present thesis

The broad aims of the present thesis are three-fold. The first is to develop an empirically supported and theoretically coherent maintenance model of compulsive exercise from the existing literature. This has been the focus of the preceding chapter. The second is to develop a new measure of compulsive exercise that is both empirically derived and theoretically consistent. Such a measure will be informed both by existing measures and recommendations in the literature, and by the factors identified as significant in the proposed maintenance model of compulsive exercise. Third, the new measure will be used to replicate and extend upon the existing literature by specifically testing the validity of some of the relationships proposed by the maintenance model of compulsive exercise. These last two aims are addressed in the subsequent chapters. The specific aims and hypotheses for the subsequent chapters are detailed below. In addition, each of the links being tested in the proposed model of compulsive exercise is indicated in Figure 1.8 by the corresponding number for each hypothesis in the text below.

Chapter 2:

The aim of this chapter is to develop a new measure of compulsive exercise. It is hypothesised that: (a) the factor structure of the new measure will be equivalent to the factors that make up the maintenance model of compulsive exercise (Figure 1.8); (b) the new measure will support a multidimensional conceptualisation of compulsive exercise; and (c) it will explain greater variance in eating psychopathology than existing measures of compulsive exercise or related constructs (i.e., Obligatory Exercise Questionnaire).

Chapter 3:

The aims of this chapter are twofold. The first is to explore the links between compulsive exercise and eating-disordered cognitions (i.e., eating psychopathology). The second is to determine the relationship between compulsive exercise and eating-disordered behaviours. It is hypothesised that compulsive exercise will be positively associated with higher levels of eating-disordered cognitions and a greater frequency of eating-disordered behaviours [1].

Chapter 4:

The aims of this chapter are twofold. The first is to examine the associations between compulsive exercise and both adaptive and maladaptive emotion coping strategies. The second is to determine the associations between compulsive exercise and a range of difficulties regulating emotions. It is hypothesised that compulsive exercise will be positively associated with both a greater use of maladaptive affect regulation strategies as well as higher levels of specific difficulties regulating emotions [2].

Chapter 5:

The aims of this chapter are twofold. The first is to examine the links between the high personal standards and self-critical dimensions of perfectionism, and a broad range of eating psychopathology (i.e., relevant to both the restrictive and bulimic disorders). The second is to examine the link between high personal standards and eating psychopathology when the self-critical dimension is taken into account. It is hypothesised that: (a) both the high personal standards and self-critical dimensions of perfectionism will be positively associated with restrictive and bulimic eating psychopathology [3]; and (b) once the variance attributable to the self-critical dimension of perfectionism is taken into account, the association between high personal standards and eating psychopathology will no longer be significant [3].

Chapter 6:

The aims of this chapter are twofold. The first is to examine the associations between the high personal standards and self-critical dimensions of perfectionism, and components of compulsive exercise. The second is to determine the extent to which the self-critical dimension of perfectionism accounts for the relationship between compulsive exercise and high personal standards. It is hypothesised that: (a) compulsive exercise will be positively associated with both the high personal standards and self-critical dimensions of perfectionism [4]; and (b) the association between high personal standards and compulsive exercise will no longer be significant once the variance attributable to the self-critical dimension of perfectionism is taken into account [4].

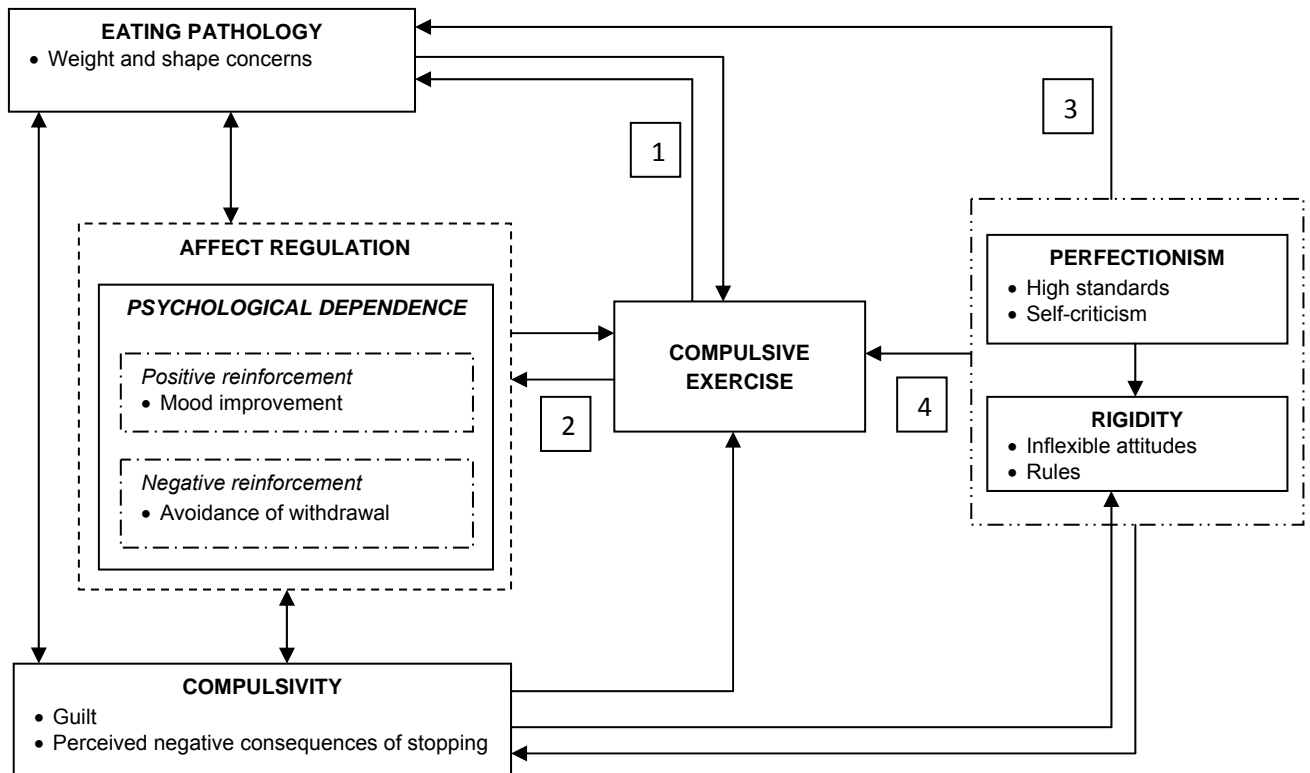


Figure 1.8. A schematic representation of all the factors implicated in the maintenance of compulsive exercise showing the links being tested by each of the hypotheses in Chapters 3 - 6.

Chapter 2:

Studies 1, 2 and 3

**Disordered eating and exercise: Development
and preliminary validation of the Compulsive
Exercise Test (CET)**

Studies 1, 2 and 3

Disordered eating and exercise: Development and preliminary validation of the Compulsive Exercise Test (CET)

As mentioned in the previous chapter, the first aim of this thesis is to develop a new multidimensional measure based on the proposed cognitive-behavioural conceptualisation of compulsive exercise (Figure 2.1). The new measure was specifically designed to address some of the psychometric and conceptual shortcomings of existing measures by incorporating the most recent empirical recommendations regarding the definition and maintenance of compulsive exercise, and was specifically designed for use within the eating disorders domain.

This next chapter includes three studies which detail the construction, development and preliminary validation of the Compulsive Exercise Test (CET) among a young female sample of exercisers. Some of the data presented in this chapter are also presented in Chapters 3, 4, 5 (Study 7 only) and 6.

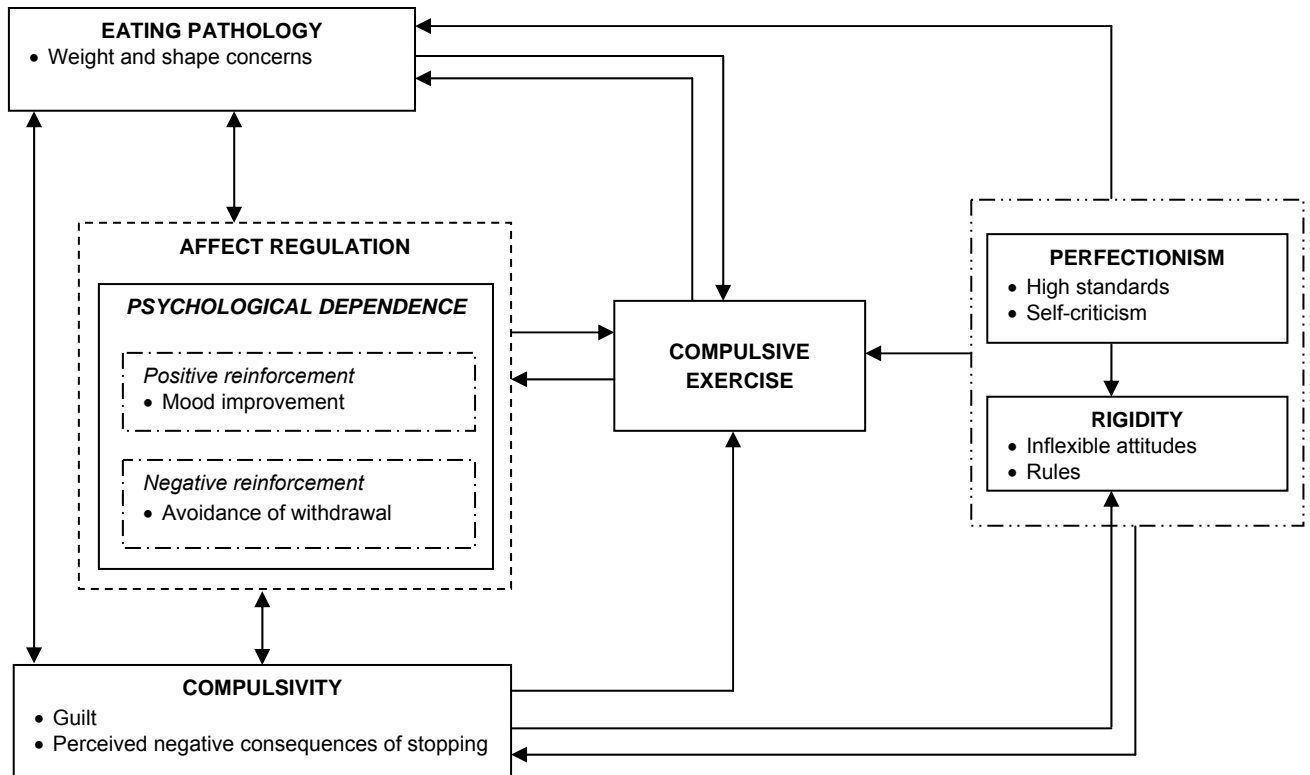


Figure 2.1. A schematic representation of the proposed cognitive-behavioural conceptualisation of compulsive exercise.

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**Disordered eating and exercise: Development and preliminary validation of the
Compulsive Exercise Test (CET)**

Abstract

Objective: The Compulsive Exercise Test (CET) was developed to assess the primary factors operating in the maintenance of excessive exercise.

Methods: A total of 367 young female exercisers were recruited from University campuses. Across three separate studies, the participants completed either the CET alone, or the CET and other standard self-report measures of excessive exercise and eating psychopathology.

Results: Factor analyses yielded five factors from which a final 24-item, five subscale measure was constructed. The CET demonstrated high internal consistency across the three samples. Supporting the concurrent and convergent validity of the scale, the CET correlated in the expected direction with existing measures of excessive exercise and eating psychopathology. As expected, the CET explained greater variance in eating psychopathology than existing measures of excessive exercise.

Discussion: The resulting subscales of the CET are consistent with a cognitive-behavioural maintenance model of excessive exercise and support the multidimensionality of the excessive exercise construct. Further research is required to validate the instrument within a sample of eating disordered women.

**Disordered eating and exercise: Development and preliminary validation of the
Compulsive Exercise Test (CET)**

Excessive exercise is an important component of eating disorders, with consistent support for it playing a significant role in the aetiology, development and maintenance of eating disorders across diagnoses (Beumont, Arthur, Russell & Touyz, 1994; Brewerton, Stelfox, Hibbs, Hodges & Cochrane, 1995; Davis, 1997; Epling & Pierce, 1996; Garner, Rosen, & Barry, 1998). Excessive exercise is present in up to 55% of eating disorder patients (Shroff, Reba, Thornton, Tozzi, Klump et al., 2006), often precedes the onset of an eating disorder (Davis, Blackmore, Katzman, & Fox, 2005), and is one of the last symptoms to subside (Kron, Katz, Gorynski, & Weiner, 1978). Such behaviour is further associated with a longer length of hospitalisation (Solenburger, 2001), a higher risk of relapse (Carter, Blackmore, Sutandar-Pinnock, & Woodside, 2004), and a poor long-term outcome (Strober, Freeman, & Morrell, 1997). Yet despite this clear importance, much of the literature on excessive exercise remains equivocal due to the lack of a coherent maintenance model and measurement inconsistencies.

At present, the prevailing view in the eating disorders field is that excessive exercise is primarily a weight-control behaviour maintained by weight and shape concerns (e.g., Fairburn, Cooper, & Shafran, 2003; Hechler, Beumont, Marks, & Touyz, 2005), an assumption supported by clinical colleagues who routinely include exercise for weight and shape reasons in the clinical assessment of patients (Cooper & Fairburn, 1987; Fairburn & Beglin, 1994; Fairburn & Cooper, 1993; Waller, Cordery, Corstorphine, Hinrichsen, Lawson, Mountford, & Russell, 2007). Whilst weight and shape concerns remain an essential component of excessive exercise (Hubbard, Gray, & Parker, 1998; Keski-Rahkonen, 2001; Mond, Hay, Rodgers, & Owen, 2006a), there is evidence to suggest that this model is too simplistic (Taranis, Meyer, & Touyz, 2007). A review of the literature clearly suggests other key factors in addition to weight and shape concerns that may also

be contributing to the maintenance of excessive exercise: specifically, the regulation of negative affect (Thome & Espelage, 2004) and compulsivity (Davis & Kaptein, 2006).

Affect regulation is one of the most frequently endorsed reasons for continuing to exercise among eating disordered patients (Long, Smith, Midgley, & Cassidy, 1993). In addition, there is considerable empirical support for excessive exercise being characterised by the experience of negative affective 'withdrawal symptoms' when unable to exercise (e.g., Beumont et al., 1994; Long & Hollin, 1995; Morgan, 1979; Touyz, Beumont, & Hoek, 1987; Wyatt, 1997). These findings support the suggestion that the functional utility of excessive exercise may lie in its capacity to regulate negative affect (Davis & Kaptein, 2006; Holtkamp, Hebebrand, & Herpertz-Dahlmann, 2004; Penas-Lledo, Vaz Leal, & Waller, 2002; Thome & Espelage, 2004).

However, it is important to note that exercising driven by a need to avoid the negative affect typical of withdrawal symptoms is functionally different to exercising primarily for an increase in positive affect (i.e, mood improvement). Whereas both are types of mood/affect regulation, exercising to avoid negative affect is an avoidance behaviour maintained by negative reinforcement, and is typical of compulsivity. In contrast, exercising for positive affect is primarily an adaptive behaviour maintained by positive reinforcement, and is typical of most regular exercisers (Thome & Espelage, 2004). Although withdrawal effects are often cited as indicative of a dependence or addiction to exercise (Morgan, 1979; Sachs & Pargman, 1979; Szabo, 1995; Veale, 1995), there is a lack of empirical support for the existence of exercise dependence in the absence of eating psychopathology (Bamber, Cockerill, & Carroll, 2000; Keski-Rahkonen, 2001). Instead it is suggested that in the context of excessive exercise, withdrawal symptoms are more likely a component of compulsivity and that continued exercising to avoid experiencing withdrawal may constitute a primary maintenance factor for excessive exercise.

The suggestion that excessive exercise is a compulsive behaviour is not new (e.g., Adkins & Keel, 2005). Excessive exercise is characterised by an inability or unwillingness

to cut down or stop the behaviour despite often adverse consequences. In addition, findings suggest that excessive exercise is associated with compulsivity in both eating disordered and non-eating disordered samples (Gulker, Laskis, & Kuba, 2001; Shroff et al., 2006), and both anorexic and bulimic patients classified as excessive exercisers score higher on measures of compulsivity than their non-exercising counterparts (Davis, Kaptein, Kaplan, Olmstead, & Woodside, 1998; Davis & Kaptein, 2006). Similarly, features of compulsivity such as guilt and behavioural rigidity are well documented correlates of excessive exercise (Mond, Hay, Rodgers, Owen, & Beumont, 2004; Mond et al., 2006a; Wyatt, 1997).

The preceding sections outline several factors identified as important in the maintenance of excessive exercise and clearly suggest a multidimensional nature. Unfortunately, existing measures of excessive exercise do not adequately assess the full range of factors that are likely to maintain excessive exercise. Similarly, existing measures fail to isolate specific aspects of exercise that are likely to have differential links with particular facets of eating pathology. Therefore, the remaining sections of this chapter report on the development and preliminary psychometric evaluation of a new multidimensional measure of excessive exercise in a non-clinical sample of female exercisers. The Compulsive Exercise Test (CET) is based on a cognitive-behavioural conceptualisation of excessive exercise and is designed to assess the core maintaining factors for excessive exercise. It has been specifically designed for use within the eating disorders domain, addressing some of the psychometric and conceptual shortcomings of existing measures and assessing excessive exercise within the context of the most recent empirical recommendations regarding definitions and maintenance factors.

Study 1: Development of the Compulsive Exercise Test

The aim of Study 1 was to develop a novel multidimensional measure of the core maintaining factors of excessive exercise.

Method

Construction of the Compulsive Exercise Test (CET): Initial item development

Items were generated from a comprehensive appraisal of the eating disorder and excessive exercise literature, interviews with eating disorder patients, a critical review of existing scales, and secondary analyses from existing data sets of the correlations between items from existing excessive exercise scales and measures of eating psychopathology. In addition, clinical eating disorder specialists were consulted regarding what they perceived to be the key constructs (i.e., maintenance factors) for excessive exercise, the validity and specificity of the initial items to be included in the analysis, and further provided input into the wording of the items. Items were aimed at addressing the hypothesized maintenance factors for excessive exercise: *compulsivity* (e.g., rigid adherence to a strict and repetitive exercise routine, continuing to exercise despite illness or injury, lack of exercise enjoyment, extreme guilt when unable to exercise, making up for missed exercise sessions), *affect regulation* (e.g., the positive and negative reinforcement properties of exercise), and *weight control exercise* (e.g., compensatory exercise such as debting). Thirty-one items were included based on theoretical relevance and clinical specificity. For each item, respondents were asked to rate how true the statement was of them on a Likert scale anchored by 0 (never true) and 5 (always true).

Participants and procedure

Following appropriate ethical clearance, 367 young women were recruited from two university campuses: Loughborough University, UK (72.5%) and The University of Sydney, Australia (27.5%). Individuals were recruited on an opportunity basis via email, direct approach, and lectures at the universities. All participants either volunteered, or received course credit or payment for taking part. A sample of over 10 participants per item ensured the extraction of reliable factors from the factor analysis (Gorsuch, 1983). Participants were invited to participate if they had engaged in some form of regular

exercise or sport over the past 4 weeks (mean exercise per week = 4.27 hours, SD = 3.64, range = 0.5 - 22 hours), were aged between 18 and 30 (mean age = 20.76 years, SD = 2.39, range = 18 - 30 years), and all spoke English as their first language. Their mean BMI was 21.86, SD = 2.77, range 16.3 - 38.2. Participants described themselves as either university students (93.2%) or full-time employees (6.8%). The participants were not screened for a past or present diagnosis of an eating disorder to allow a wide range of attitudes to be included.

Following informed consent, participants were instructed to complete the CET whilst alone without discussing their responses with anyone and return it to the researcher.

Results

Initial factor analysis and item elimination

To explore the factor structure of the CET, data from the 367 respondents was subject to a principal components factor analysis with oblique (direct oblimin criterion) rotation. An oblique rotation was used on the assumption that the factors would be correlated (Floyd & Widaman, 1995). The retention of factors was determined by the Kaiser (1961) criterion (i.e. eigenvalues greater than 1), Scree plot analysis (Cattell, 1966), and the interpretability of the resulting factor structures (Gorsuch, 1983). Six factors were identified with eigenvalues greater than 1 explaining 61.3% of the variance (Factor 1, Eigenvalue = 8.92, Variance = 28.76; Factor 2, Eigenvalue = 3.58, Variance = 11.55; Factor 3, Eigenvalue = 2.21, Variance = 7.11; Factor 4, Eigenvalue = 1.76, Variance = 5.69; Factor 5, Eigenvalue = 1.47, Variance = 4.75; Factor 6, Eigenvalue = 1.07, Variance = 3.45). Analysis of the Scree plot supported a six factor solution. Consequently, a six factor solution was attempted and subjected to oblique (oblimin) rotation.

The resultant 6 factor 31-item rotated matrix was further examined to reduce item overlap and exclude poor items. To determine inclusion items were eliminated that

satisfied any of the following criteria: (1) failed to show a salient loading on any of the factors (i.e., hyperplane items) or had a factor loading of less than 0.50, thereby ensuring that individual items could be considered salient to one specific factor (3 items); (2) constituted a factor with less than three items, ensuring a meaningful interpretation of stable factors (1 item); (3) loaded simultaneously on two or more factors with a difference between loadings of less than 0.10, ensuring a high degree of association between the item and the factor (0 items); and (4) lacked conceptual (face) validity, ensuring that items were valid indicators of the construct being measured (3 items). In total, seven items were eliminated.

Analysis of the remaining 24 items

The remaining 24 items were then subject to second (confirmatory) principal components factor analysis with oblique (direct oblimin criterion) rotation. Scree plot analysis suggested extraction of 5 factors explaining 63.9% of the total variance. All items loaded on their respective factors with a factor loading of 0.56 or greater and none met any of the criteria for exclusion. On the basis of the factor analyses five subscales were constructed. The first factor (8 items) contained items reflecting rule-driven behaviour (e.g., making up for missed sessions, continued exercise despite injury, experiencing guilt and feelings of having let the self down when unable to exercise) and continued exercise to avoid affective withdrawal symptoms, and was labeled 'Avoidance and rule-driven behaviour'. Items in factor 2 (5 items) related to exercising for weight and shape reasons and the use of dysfunctional weight control practices, and was therefore labeled 'Weight control exercise'. Factor 3 (5 items) reflected the positive reinforcement component of exercise in terms of mood and was labeled 'Mood improvement'. Factor 4 (3 items) reflects experiencing exercise as a chore and deriving no enjoyment from it, and was labeled 'Lack of exercise enjoyment'. Finally, factor 5 (3 items) reflects a rigid behavioural pattern in terms of exercise and was labeled 'Exercise rigidity'. Each subscale represented the mean score of that factor (i.e., sum of items / number of items). The items

and factor loadings of the final Compulsive Exercise Test are presented in Table 2.1 (see Appendix B for a copy of the CET).

Table 2.1. Study 1: Factor loadings and corrected item-total correlations (r^{it}) of the final CET items ($n = 367$)

Factors, items numbers, and item text	Factor loadings					r^{it}
	F1	F2	F3	F4	F5	
<i>Factor 1: Avoidance and rule-driven behaviour</i>						
9 If I cannot exercise I feel low or depressed	0.66	6.67E-005	-0.24	0.12	-0.08	.50
10 I feel extremely guilty if I miss an exercise session	0.61	0.17	0.08	-0.09	0.27	.62
11 I usually continue to exercise despite injury or illness, unless I am very ill or too injured	0.66	-0.07	0.17	-0.31	0.06	.35
15 If I miss an exercise session, I will try and make up for it when I next exercise	0.56	0.24	0.13	-0.19	0.18	.57
16 If I cannot exercise I feel agitated and/or irritable	0.68	-0.02	-0.19	-0.02	0.03	.54
20 If I cannot exercise I feel angry and/or frustrated	0.71	-0.02	-0.19	-0.08	0.06	.56
22 I feel like I've let myself down if I miss an exercise session	0.57	0.19	-0.02	0.06	0.28	.66
23 If I cannot exercise I feel anxious	0.73	0.03	-0.20	0.08	-0.00	.58
<i>Factor 2: Weight control exercise</i>						
2 I exercise to improve my appearance	-0.14	0.84	-0.13	0.08	0.03	.55
6 If I feel I have eaten too much, I will do more exercise	0.29	0.66	0.10	-0.05	-0.05	.57
8 I do not exercise to be slim (Reversed)	-0.11	0.83	0.02	0.04	-0.06	.44
13 I exercise to burn calories and lose weight	-0.02	0.88	-0.03	0.05	0.01	.60
18 If I cannot exercise, I worry that I will gain weight	0.34	0.69	-0.04	0.02	0.05	.73
<i>Factor 3: Mood improvement</i>						
1 I feel happier and/or more positive after I exercise	-0.16	0.22	-0.58	-0.30	0.09	.35
4 I feel less anxious after I exercise	0.21	-0.07	-0.68	0.14	0.09	.48

14	I feel less stressed and/or tense after I exercise	0.10	0.02	-0.63	-0.20	0.06	.40
17	Exercise improves my mood	0.02	0.13	-0.66	-0.23	0.08	.44
24	I feel less depressed or low after I exercise	0.17	-0.03	-0.62	0.08	-0.08	.36
<i>Factor 4: Lack of exercise enjoyment</i>							
5	I find exercise a chore	-0.10	0.01	-0.07	0.85	0.08	.12
12	I enjoy exercising (Reversed)	0.08	0.08	0.26	0.78	-0.05	-.01
21	I do not enjoy exercising	0.03	0.11	0.07	0.85	-0.04	.13
<i>Factor 5: Exercise rigidity</i>							
3	I like my days to be organised and structured of which exercise is just one part	0.02	-0.03	-0.15	-0.06	0.66	.48
7	My weekly pattern of exercise is repetitive	0.11	-0.08	0.09	-0.06	0.79	.49
19	I follow a set routine for my exercise sessions e.g., walk or run the same route, particular exercises, same amount of time, and so on	-0.08	0.02	0.00	0.15	0.92	.54
Eigenvalues		7.29	3.29	1.85	1.62	1.28	
Variance explained (%)		30.39	13.72	7.71	6.74	5.32	
Cronbach's alpha		0.88	0.86	0.75	0.84	0.73	
Mean (SD)		1.80 (0.96)	2.91 (1.14)	3.34 (0.89)	1.47 (1.05)	2.63 (1.13)	

Note: Salient factor loadings (>0.50) are in bold

Salience Criteria: (1) Only item loadings greater than 0.50 were included; (2) Items constituting a factor with less than three items were eliminated; (3) Items loading simultaneously on two or more factors with a difference between loadings of less than 0.10 were eliminated; (4) Items lacking conceptual (face) validity were eliminated.

Internal consistency

Results supported the internal consistency of the CET. Cronbach's alpha for the overall scale was good (alpha = 0.85), with alpha coefficients for each of the subscales ranging from acceptable to high (Nunnally, 1978) and a mean item-total correlation of 0.48 (see Table 1). Although items 5, 12 and 21 (Lack of enjoyment subscale) did not correlate above 0.13 with the scale total, these items were retained in the final version of the

questionnaire on the basis of previous research supporting their importance (Davis, 1997; Thome & Espelage, 2007). All other item-total correlations were greater than 0.35.

Subscale intercorrelations

Correlations (Pearson's r) between the five subscales (i.e., factors) of the CET and each of the CET subscales and CET total score (sum of subscales) are shown in Table 2.2. One-tailed tests were used in keeping with the directional predictions. Although there were significant correlations between the subscales of the CET and between CET total score and subscales, none of the correlations exceeded a correlation of 0.80 and consequently no multicollinearity was present which would violate the assumptions of using multivariate statistics (Bryman & Cramer, 1994).

Table 2.2. Study 1: Subscale intercorrelations for the Compulsive Exercise Test.

	1	2	3	4	5	6
1. Avoidance and rule-driven behaviour	-	-	-	-	-	-
2. Weight control exercise	0.39**	-	-	-	-	-
3. Mood improvement	0.52**	0.25**	-	-	-	-
4. Lack of exercise enjoyment	-0.31**	0.10	-0.35**	-	-	-
5. Exercise rigidity	0.48**	0.18*	0.27**	-0.25**	-	-
6. CET total	0.73**	0.72**	0.57**	0.10	0.62**	-

Note: Significance of correlation coefficients: * $p < 0.01$, ** $p < 0.001$ (one-tailed).

Study 2: Concurrent and convergent validity of the CET

The aims of Study 2 were to assess the concurrent and convergent validity of the CET. In addition, the relative predictive contribution of the CET and another commonly used measure of excessive exercise (The Commitment to Exercise Scale (CES); Davis, Brewer & Ratusny, 1993) to the variance in eating psychopathology was examined. It was expected that the CET would explain substantially more variance in eating psychopathology than the CES.

Method

Participants

One-hundred and one female undergraduates were recruited on an opportunity basis from The University of Sydney via direct approach. All were volunteers and received no course credit or payment for taking part. Participants were invited to participate if they had engaged in some form of regular exercise or sport over the past 4 weeks (mean exercise per week 2.76 hours, SD = 2.39; range = 0.50-15.00), were aged between 18 and 30 (mean age 20.9, SD = 2.04; range = 18.0 -28.9), and all spoke English as their first language. Their mean BMI = 21.8 (SD = 2.58; range = 17.2 - 30.7). The participants were not screened for a past or present diagnosis of an eating disorder to allow a wide range of attitudes to be included. After obtaining informed consent, participants were instructed to complete the questionnaires and return them to the researcher.

Measures

In addition to the CET, participants completed another measure of excessive exercise (The Commitment to Exercise Scale (CES; Davis et al., 1993), disordered eating (The Eating Disorders Inventory-2 (EDI; Garner, 1991), and provided information regarding frequency of exercise, in accordance with the procedure used by Davis, Kennedy, Ralevski & Dionne (1994). In the current study Cronbach's alpha for the CET total was 0.83. Alpha coefficients for each of the subscales were: Avoidance and rule-driven behaviour 0.88, Weight control exercise 0.85, Mood improvement 0.72, Lack of exercise enjoyment 0.82, and Exercise rigidity 0.82.

The Commitment to Exercise Scale

The CES is a well validated, reliable 8-item self-report measure designed to assess a pathological commitment to exercising that has been used extensively in eating disorders research (e.g., Davis et al., 1998; Mond et al., 2006a). Participants respond for each item of bi-polar adjectives (e.g., "never" and "always") by circling a number on a

horizontal line between 0 and 10 that best indicates their level of agreement with the statement in question, with higher scores being indicative of more pathological behaviour (Mond et al., 2006a). In the current study Cronbach's alpha was 0.85. See Appendix C for a copy of the CES.

The Eating Disorders Inventory

The EDI is a well validated, reliable 91-item self-report measure of eating attitudes and related characteristics. Respondents indicate whether items apply; "never," "rarely," "sometimes," "often," "usually," or "always." The questionnaire yields 11 sub-scales, with higher scores reflecting greater levels of psychopathology (more unhealthy attitudes). For this study, only the three sub-scales that directly relate to eating were used. These address restriction (Drive for thinness: DT), bulimic tendencies (Bulimia: B) and body concept (Body dissatisfaction: BD). In the current study Cronbach's alpha for the overall scale was 0.85. Alpha coefficients for each of the subscales were: Drive for thinness 0.85; Bulimia 0.68; and Body dissatisfaction 0.87. See Appendix D for a copy of the EDI.

Exercise Frequency

Participants were asked to indicate for all their exercise activities, the number of weeks of participation out of the past 4 weeks (i.e.1-4), the average number of sessions per week, and the average duration of each session in minutes. A measure of 'exercise frequency' was obtained by multiplying the number of weeks x number of sessions per week x average duration (Davis et al., 1994).

Data analysis

Cronbach's alpha for internal consistency was used to assess the reliability of the measures used in the study. Concurrent and convergent validity was assessed by computing correlation coefficients (Pearson's r) between the CET and measures of interest. As Kolmogorov-Smirnov Z tests showed that EDI data were not normally

distributed, nonparametric tests were used with this data (i.e., Spearman's rho). Parametric tests were used only when nonparametric tests were unavailable (i.e., when multivariate analyses were necessary) and the results of these analyses should be treated with caution. In order to assess the relative predictive contributions of the CET and CES on eating psychopathology two sets of hierarchical multiple regression analyses were conducted. The reason for using this two-step method of analysis is that it enables an examination of both the unique contribution of a single independent variable and the incremental contribution of a related independent variable over and above the other (i.e., whilst controlling for the other) on the dependent variable (Dunkley et al., 2006). Inspection of the scatterplots, residuals and tolerance values indicated that all further assumptions of regression analysis were met in terms of linearity, homoscedacity and independence of residuals (Tabachnick & Fidell, 2001), and that multicollinearity was not a significant problem (Myers, 1990). In keeping with the directional hypotheses one-tailed tests were used throughout. The significance limit was set at $p < .01$.

Results

The means, standard deviations and intercorrelations between exercise frequency, CET and validity measures are reported in Table 2.3. Exercise frequency was significantly positively associated with Avoidance and rule-driven behaviour, Mood improvement, Exercise rigidity, and CET total, and negatively associated with Lack of exercise enjoyment. In line with previous findings (e.g., Adkins & Keel, 2005) there was no association between exercise frequency and eating psychopathology. Similarly, there was no association between exercise frequency and Weight control exercise.

Results supported the concurrent validity of the CET. CET total was significantly associated with the CES and with the exception of Lack of exercise enjoyment that showed a negative association with the CES, there were significant positive correlations between the CET subscales and the CES. Supporting convergent validity, there were

significant positive correlations between CET total and both EDI total, and the EDI subscales; Drive for thinness, and Body dissatisfaction. Similarly, Avoidance and rule-driven behaviour was significantly associated with the EDI subscale; Drive for thinness, and Weight control exercise correlated significantly with the EDI subscales; Drive for thinness, Bulimia, and Body dissatisfaction. There were no significant associations between three of the CET subscales (Mood improvement, Lack of exercise enjoyment, and Exercise rigidity) and the EDI scores. Similarly, there were no reliable associations between Avoidance and rule-driven behaviour and either Bulimia or Body dissatisfaction.

Table 2.3. Study 2: Means, standard deviations and intercorrelations between Exercise frequency, CET and validity measures ($n = 101$).

Variables	1	2	3	4	5	6	7	8	9	10	11	12
1. Exercise frequency	-											
2. CET Avoidance and rule-driven behaviour	.46**	-										
3. CET Weight control exercise	.11	.43**	-									
4. CET Mood improvement	.47**	.45**	.20	-								
5. CET Lack of exercise enjoyment	-.51**	-.17	.17	-.41**	-							
6. CET Exercise rigidity	.35**	.40**	-.02	.15	-.34**	-						
7. CET total	.31*	.78**	.69**	.46**	.14	.52**	-					
8. CES	.57**	.70**	.41**	.44**	-.42**	.51**	.62**	-				
9. EDI Drive for thinness ¹	.11	.29*	.75**	.14	.12	.05	.53**	.37**	-			
10. EDI Bulimia ¹	.04	.12	.28*	.04	.11	.08	.20	.14	.48**	-		
11. EDI Body dissatisfaction ¹	-.01	.15	.73**	-.02	.18	-.04	.40**	.18	.68**	.39**	-	
12. EDI total ¹	.03	.21	.77**	.05	.17	.00	.47**	.24*	.85**	.60**	.92**	-
<i>M</i>	19.7	1.46	2.64	3.32	1.82	2.49	11.73	3.41	3.99	2.02	7.86	13.87
<i>SD</i>	20.44	0.91	1.13	.089	1.14	1.31	2.72	1.96	4.97	2.76	6.55	12.23

Note: Significance of correlation coefficients: * $p < 0.01$, ** $p < 0.001$ (one-tailed).

¹As EDI scores were not normally distributed, all correlations are Spearman's rho

In the first set of hierarchical regressions, the predictive validity of the CES without controlling for the CET and the incremental predictive validity of the CET over and above the CES was examined. Specifically, EDI total and subscales were used as the dependent variables with the CES entered in the first block and the CET subscales entered in the second block. As shown in Table 2.4, these analyses demonstrated that whilst the CES accounted for between 11% and 18% of the variance of EDI total and Drive for thinness, it failed to make a significant contribution to Bulimia or Body dissatisfaction. In contrast, the additive contribution of the CET subscales accounted for between 14% and 45% additional variance across all four dependent variables after controlling for the CES. However, only Weight control exercise emerged as a unique predictor and only in terms of EDI total, Drive for thinness and Body dissatisfaction.

The second set of hierarchical multiple regressions examined the incremental predictive validity of the CES over and above the CET subscales by entering the CET subscales in the first block and the CES in the second block. Table 4 shows that the CET subscales accounted for between 14% and 71% across the four dependent variables. After controlling for the CET, the second block containing the CES failed to make a statistically significant contribution to three of the four dependent variables, making a small but significant contribution to the prediction of Drive for thinness (4%). Thus these results support the CET as having a stronger relation with eating psychopathology than the CES.

Table 2.4. Study 2: Hierarchical regression analyses predicting EDI scores with components of excessive exercise in a female student population ($N = 101$)

Variable	Outcome measures							
	EDI total		EDI drive for thinness		EDI bulimia		EDI body dissatisfaction	
	<i>B</i>	ΔR^2	<i>B</i>	ΔR^2	<i>B</i>	ΔR^2	β	ΔR^2
Step 1		.11**		.18**		.04		.05
CES	.33**		.42**		.20		.22	
Step 2		.45**		.38**		.14*		.44**
Avoidance and rule-driven behaviour	-.09		-.14		.09		-.10	
Weight control exercise	.69**		.63**		.23		.71**	
Mood improvement	-.01		.02		.09		-.07	
Lack of exercise enjoyment	.13		.10		.24		.07	
Exercise rigidity	.03		-.05		.07		.06	
Step 1		.55**		.52**		.18**		.49**
Avoidance and rule-driven behaviour	-.02		-.01		.12		-.09	
Weight control exercise	.73**		.72**		.25*		.72**	
Mood improvement	-.00		.03		.09		-.07	
Lack of exercise enjoyment	.09		.05		.22		.06	
Exercise rigidity	.07		.03		.09		.06	
Step 2		.01		.04*		.00		.00
CES	.17		.33*		.08		.03	

Note: Significance of correlation coefficients: * $p < 0.01$, ** $p < 0.001$ (one-tailed).

Study 3: Further validation of the CET

The aim of Study 3 was to further examine the construct and concurrent validity of the CET through comparison with alternative measures of excessive exercise and disordered eating. As in Study 2, the relative predictive contribution of the CET and OEQ to eating psychopathology was also examined and it was expected that the CET would account for substantially more variance in eating psychopathology than the OEQ.

Method

Participants

Ninety-seven female undergraduates were recruited on an opportunity basis from Loughborough University via email, direct approach, and lectures at the universities, and either volunteered, or received course credit or payment for taking part. Participants were invited to participate if they had engaged in some form of regular exercise or sport over the past 4 weeks (mean exercise per week 5.84 hours, SD = 4.02; range = 1.50-21.00), were aged between 18 and 30 (mean age 20.98, SD = 2.53; range = 18.08-30.00), and all spoke English as their first language. Their mean BMI = 21.91 (SD = 2.62; range = 16.32-31.64). The participants were not screened for a past or present diagnosis of an eating disorder to allow a wide range of attitudes to be included.

Measures & Procedure

In addition to the CET, participants completed further measures of excessive exercise (The Obligatory Exercise Questionnaire (OEQ; Pasman & Thompson, 1988), disordered eating (The Eating Disorders Examination Questionnaire (EDE-Q; Fairburn & Beglin, 1994) and frequency of exercise (Davis et al, 1994). The decision to change from the EDI as used in Study 2 to the EDE-Q was based on several factors: firstly, the EDE-Q is based on the Eating Disorders Examination which is considered to be the 'gold standard' of eating pathology assessment (Guest, 2000); secondly, the EDE-Q is based on DSM-IV criteria for eating disorders (Fairburn & Beglin, 1994); and thirdly, the EDE-Q

is more specific in assessing only the *main* attitudinal *and* behavioural features of eating disorders (Fairburn & Beglin, 1994). In the current study, Cronbach's alpha for the CET total was 0.83. Alpha coefficients for each of the subscales were: Avoidance and rule-driven behaviour 0.84, Weight control exercise 0.84, Mood improvement 0.71, Lack of exercise enjoyment 0.79, and Exercise rigidity 0.73. After obtaining informed consent, participants were instructed to complete the questionnaires and return them to the researcher.

The Obligatory Exercise Questionnaire

The OEQ is a 20-item self-report measure of activities and attitudes related to exercise. Individuals respond on a 4-point Likert-type scale anchored at 1 (never) and 4 (always) how often they experience each exercise-related situation, with higher scores indicative of greater obligatory exercise. The OEQ has previously demonstrated excellent psychometric properties (Pasman & Thompson, 1988; Thompson & Pasman, 1991). In the current study Cronbach's alpha was 0.84. See Appendix E for a copy of the OEQ.

The Eating Disorders Examination Questionnaire

The EDE-Q is a well validated, reliable self-report measure of eating disorder psychopathology based on the Eating Disorder Examination interview (EDE; Cooper & Fairburn, 1987; Fairburn & Cooper, 1993). It comprises 36 items focusing on the preceding 28 days that assess the main behavioural and attitudinal features of eating disorders. It uses a 7-point forced choice rating scheme and generates four subscales of: Restraint, Eating concern, Shape concern and Weight concern. Scores of four or more on key items are indicative of clinical pathology. In the current study Cronbach's alpha for the overall scale was 0.85. Alpha coefficients for each of the subscales were: Restraint 0.85; Eating concern 0.74; Shape concern, 0.82; and Weight concern 0.83. See Appendix F for a copy of the EDE-Q.

Participants were asked to report their exercise activities as described previously in Study 2.

Data analysis

Cronbach's alpha for internal consistency was used to assess the reliability of the measures. Kolmogorov-Smirnov Z tests showed the data to be normally distributed. Concurrent and convergent validity was assessed by computing correlation coefficients (Pearson's r) between the CET and measures of interest, and the relative predictive contributions of the CET and OEQ on eating psychopathology were assessed by two sets of hierarchical multiple regression analyses. The reason for using this two-step method of analysis is that it enables an examination of both the unique contribution of a single independent variable and the incremental contribution of a related independent variable over and above the other (i.e., whilst controlling for the other) on the dependent variable (Dunkley et al., 2006). Inspection of the scatterplots, residuals and tolerance values indicated that all assumptions of regression analysis were met in terms of linearity, homoscedacity and independence of residuals (Tabachnick & Fidell, 2001), and that multicollinearity was not a significant problem (Myers, 1990). In keeping with the directional hypotheses one-tailed tests were used throughout. The significance limit was set at $p < .01$.

Results

The means, standard deviations and intercorrelations between exercise frequency, CET and validity measures are reported in Table 2.5. Exercise frequency was significantly positively associated with Avoidance and rule-driven behaviour and Exercise rigidity, and negatively associated with weight control exercise and a lack of exercise enjoyment. There was no association between exercise frequency and Mood improvement or CET total. As in Study 2 there were no associations between exercise frequency and any of the disordered eating variables.

Table 2.5. Study 3: Means, standard deviations and intercorrelations between Exercise frequency, CET and validity measures ($n = 97$).

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Exercise frequency	-												
2. CET Avoidance and rule-driven behaviour	.28*	-											
3. CET Weight control exercise	-.27*	.26*	-										
4. CET Mood improvement	.15	.51**	.18	-									
5. CET Lack of exercise enjoyment	-.25*	-.16	.14	-.23	-								
6. CET Exercise rigidity	.39**	.47**	.19	.19	-.10	-							
7. CET total	.09	.73**	.68**	.56**	.22	.62**	-						
8. OEQ	.47**	.74**	.27*	.36**	-.27*	.52**	.58**	-					
9. EDE-Q Restraint	-.06	.29*	.62**	.15	.03	.21	.49**	.36**	-				
10. EDE-Q Eating concern	-.15	.34**	.52**	.20	.08	.20	.50**	.36**	.68**	-			
11. EDE-Q Shape concern	-.11	.33**	.58**	.19	.07	.24	.53**	.37**	.70**	.71**	-		
12. EDE-Q Weight concern	-.18	.26*	.61**	.17	.08	.15	.48**	.29*	.78**	.78**	.79**	-	
13. EDE-Q total	-.14	.33**	.65**	.19	.07	.22	.55**	.38**	.90**	.87**	.88**	.94**	-
<i>M</i>	5.84	2.21	3.22	3.59	1.06	3.02	13.11	48.85	2.10	1.32	2.53	2.27	2.06
<i>SD</i>	4.02	0.90	1.08	0.79	0.81	0.89	2.56	8.33	1.52	1.12	1.08	1.48	1.17

Note: Significance of correlation coefficients: * $p < 0.01$, ** $p < 0.001$ (one-tailed).

Consistent with Study 2, the correlations between the CET and OEQ provide further support for the concurrent validity of the CET. CET total was significantly associated with the OEQ and with the exception of Lack of exercise enjoyment that showed a significant negative association with the OEQ, there were significant positive correlations between the CET subscales and the OEQ. In terms of convergent validity, the pattern of associations between the CET and EDE-Q were again similar to those found in Study 2. There were significant positive correlations between CET total and both EDE-Q total and subscales. Similarly, both Avoidance and rule-driven behaviour and Weight control exercise were significantly associated with EDE-Q total and subscales. There was no association between the CET subscales; Mood improvement, Lack of exercise enjoyment, and Exercise rigidity; and the EDE-Q subscales or total.

In the first set of hierarchical regressions, the OEQ was entered in the first block and the CET subscales were entered in the second block. As shown in Table 2.6, these analyses demonstrated the predictive power of the OEQ, as it accounted for between 9% and 14% of the variance across the five dependent variables. In addition, these analyses demonstrated the strong incremental predictive power of the CET over and above the OEQ with the additive contribution of the CET subscales accounting for between 21% and 33% additional variance across the five dependent variables after controlling for the OEQ. It is noteworthy that in all cases only Weight control exercise emerged as a unique predictor.

In the second set of five regressions, the incremental predictive validity of the OEQ over and above the CET was tested by entering the CET subscales in the first block and the OEQ in the second block. It can be seen in Table 6 that the CET demonstrated strong relations with all five dependent variables, accounting for between 32% and 46% of the variance across the five dependent variables. After controlling for the CET subscales, the OEQ failed to make statistically significant contributions for all five dependent variables. Thus these results provide support for the CET as having a stronger predictive effect upon eating psychopathology than the OEQ.

Table 2.6. Study 3: Hierarchical regression analyses predicting EDE-Q scores with components of excessive exercise in a female student population ($N = 97$)

Variable	Outcome measures									
	EDE-Q total		EDE-Q restraint		EDE-Q eating control		EDE-Q shape control		EDE-Q weight control	
	<i>B</i>	ΔR^2	<i>B</i>	ΔR^2	<i>B</i>	ΔR^2	<i>B</i>	ΔR^2	β	ΔR^2
Step 1		.14**		.13**		.13**		.14**		.09*
OEQ	.38**		.36**		.36**		.37**		.29*	
Step 2		.33**		.30**		.21**		.26**		.31**
Avoidance and rule-driven behaviour	.04		.01		.08		.03		.02	
Weight control exercise	.57**		.56**		.42**		.50**		.55**	
Mood improvement	.03		-.02		.05		.04		.04	
Lack of exercise enjoyment	.08		.02		.11		.08		.07	
Exercise rigidity	-.03		-.02		-.04		.02		-.06	
Step 1		.46**		.40**		.32**		.38**		.38**
Avoidance and rule-driven behaviour	.18		.15		.22		.16		.12	
Weight control exercise	.60**		.58**		.45**		.52**		.57**	
Mood improvement	.01		-.03		.04		.03		.03	
Lack of exercise enjoyment	.03		-.03		.07		.04		.04	
Exercise rigidity	.02		.03		.01		.06		-.02	
Step 2		.02		.02		.02		.02		.01
OEQ	.23		.23		.22		.22		.17	

Note: Significance of correlation coefficients: * $p < 0.01$, ** $p < 0.001$ (one-tailed).

Discussion

The aim of this research was to develop and test the preliminary psychometric properties of a new multidimensional measure of excessive exercise relevant to the eating disorders. The CET was constructed using items aimed at addressing the primary factors operating in the maintenance of excessive exercise. The CET demonstrated high internal consistency across the three samples and with the exception of Lack of exercise enjoyment, item-total correlations further supported the reliability of the scale. Supporting the content validity of the CET as a measure of excessive exercise, its items were rated as relevant to and representative of excessive exercise symptomatology by a panel of clinical eating disorder specialists. Supporting the concurrent and convergent validity of the scale, the CET correlated in the expected direction with existing measures of excessive exercise and eating psychopathology. In addition, the finding that the CET explains greater variance in eating psychopathology than existing measures of excessive exercise support our hypotheses and conceptual framework regarding the multidimensional nature of excessive exercise. In this non-clinical group of young female exercisers, five factors emerged which were taken to constitute subscales: Avoidance and rule-driven behaviour; Weight control exercise; Mood improvement; Lack of exercise enjoyment; and Exercise rigidity. These factors support the multidimensionality of the excessive exercise construct and are consistent with a cognitive-behavioural conceptualisation of excessive exercise.

The Avoidance and rule-driven behaviour subscale of the CET consisted of those items reflecting the avoidance of affective withdrawal symptoms and guilt when unable to exercise, and the following of exercise rules (i.e., making up for missed sessions, exercising despite illness or injury). The clustering of items in this way and the positive associations with eating psychopathology supports previous research detailing the compulsive nature of exercise for eating disordered individuals (Adkins & Keel, 2005; Beumont et al., 1994). It was expected that those items reflecting Lack of exercise

enjoyment and Exercise rigidity would have clustered with the items comprising the Avoidance and rule-driven behaviour subscale of the CET. In addition, in the present study neither factor was associated with eating psychopathology. However, their emergence as distinct factors is in line with the previous findings that excessive exercisers often view exercise as a chore to be completed from which they derive little or no enjoyment (Davis, 1997; Thome & Espelage, 2007), and adopt a rigid and inflexible exercise schedule to which they strictly adhere (Morgan 1979; Wyatt, 1997). In light of these findings, it is likely that these factors will be associated with eating pathology in eating disordered samples.

As expected, the Weight control exercise subscale of the CET was composed of those items reflecting exercise for weight and shape reasons, and dysfunctional weight control practices (i.e., debting), and consistently demonstrated the strongest association with eating psychopathology. In addition, the absence of a positive association between Weight control exercise or indeed eating psychopathology as measured by the EDI or EDE-Q and exercise frequency, is supported by previous findings that exercise frequency is not a valid indicator of excessive exercise in non-clinical samples (Boyd et al., 2007; Lipsey et al., 2006; Mond et al., 2004; 2006a).

Finally, the Mood improvement subscale represented the positive reinforcement aspect of exercise in terms of mood. Although it was not associated with eating psychopathology, it's emergence as a distinct factor separate from the experience of affective withdrawal symptoms is important in light of findings suggesting that exercise is associated with both increased positive affect and decreased negative affect in eating-disordered exercisers (Vansteelandt et al., 2007).

These findings support a model in which specific aspects of excessive exercise are differentially linked with particular facets of eating psychopathology and further support the conception of excessive exercise as a compulsive behaviour (Wyatt, 1997). Whilst these findings require replication in an eating disordered sample, they do suggest

that a therapeutic focus on the avoidance of affective withdrawal symptoms and following of exercise rules might serve to reduce an individual's compulsive drive to exercise.

In summary, the CET fulfils some of the identified limitations of existing measures of excessive exercise. First, it provides a multidimensional break down of the identified maintaining factors of exercise. Second, it comprises a subscale that specifically measures eating-related exercise psychopathology, including exercising for weight control, and debting behaviours. Finally, the CET measures the full range of affect regulatory functions of exercise, including both the positive and negative reinforcement properties. For these reasons, the CET is potentially a useful assessment tool, when striving to formulate the maintenance of an individual's exercise behaviour. In addition, whilst validation in a clinical sample is crucial, the CET is potentially a useful research and outcome tool, providing a clearer picture of those factors that maintain exercise and predict the observed poor outcome and reduced relapse in those women for who exercise is a component of their eating disorder.

Despite these encouraging preliminary findings, there are obvious limitations with the current research. First, the current sample was non-clinical exercising women. Clearly, the utility of this measure relies upon the factor structure being stable with eating disordered groups. In addition, the data presented here were gathered from Universities in the UK and Australia that are renowned for sport and exercise. Therefore, these samples are arguably un-representative of other non-clinical groups. Finally, the CET is a self-report measure. Both within research and clinical settings, an interview based assessment would be preferable. These limitations aside, with further validation and replication of the identified factor structure with clinical and community groups, the CET is potentially a useful tool for use in the research and clinical practice

Chapter 3:

Study 4

**Associations between specific components of
compulsive exercise and eating disorder
pathology among young women**

Study 4

Associations between specific components of compulsive exercise and eating disorder pathology among young women

In line with the first aim of this thesis, Chapter 2 established the CET as a reliable and valid measure of compulsive exercise. Specifically, the main finding was the emergence of a stable five factor measure of compulsive exercise that demonstrated high internal consistency across samples as well as adequate content, convergent and concurrent validity. In addition, the CET demonstrated differential links between components of compulsive exercise and eating psychopathology and was found to explain more of the variance in eating psychopathology than currently existing measures of the compulsive exercise construct.

These findings not only support the multidimensionality of the compulsive exercise construct but also support a model in which specific aspects of excessive exercise are differentially linked with particular facets of eating psychopathology. In addition, the current findings are also consistent with the proposed cognitive-behavioural conceptualisation of compulsive exercise. Furthermore, the finding that the CET explained greater variance in eating psychopathology than existing measures of compulsive exercise supports the specificity of the CET to the eating disorders domain. Taken together, these findings suggest the CET is potentially a useful research tool, providing a clearer picture of those factors central to the compulsive exercise construct.

In line with the aims detailed in Chapter 1, the next step is to use the CET to start to explore in more detail the links between compulsive exercise and the hypothesised maintenance factors that make up the proposed maintenance model of compulsive exercise including eating disorder pathology (Chapter 3), affect regulation (Chapter 4), and perfectionism (Chapters 5 and 6). Therefore, in keeping with the second aim of this thesis, this next chapter replicates and expands upon the findings of Chapter 2 by exploring the differential links between the components of compulsive exercise as

measured by the CET, and both eating-disordered cognitions and eating-disordered behaviours in a non-clinical young female sample. The aim is to determine the relationship between the different facets of compulsive exercise to both levels of eating-disordered cognitions, and the frequency of eating-disordered behaviours. The specific relationship being tested is indicated by the number 1 in Figure 3.1 below.

Some of the data presented in this chapter are also presented in Chapters: 2 (Studies 1 and 3 only); 4 (Study 6 only); 5; and 6.

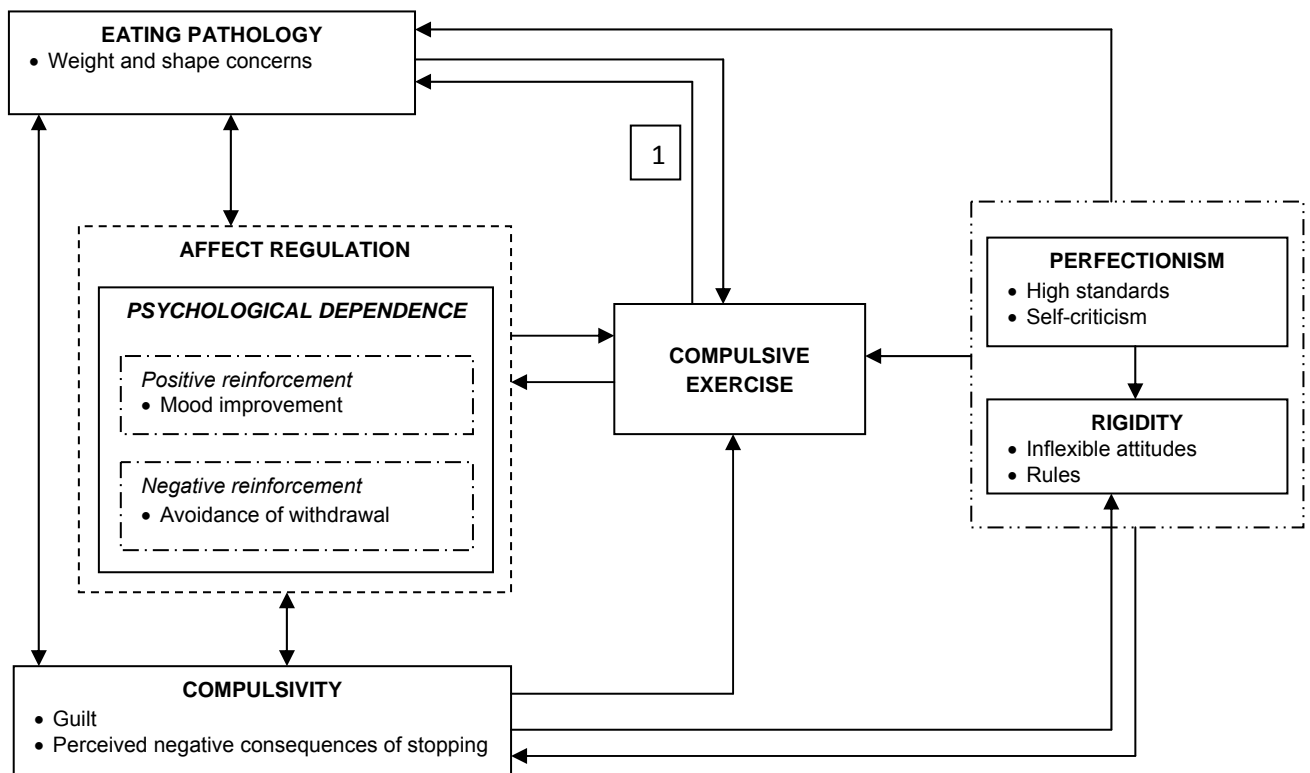


Figure 3.1. A schematic representation of all the factors implicated in the maintenance of compulsive exercise showing the relationship being tested [1] in Chapter 3.

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Associations between specific components of compulsive exercise and eating disorder pathology among young women

Abstract

Objective: To explore the associations between specific elements of compulsive exercise and both eating-disordered cognitions and eating-disordered behaviours in a non-clinical sample of young women.

Method: A sample of young women (n = 498) completed self-report measures of eating pathology (EDE-Q Fairburn & Beglin, 1994) and a relatively new measure of compulsive exercise (CET; Taranis, Touyz, & Meyer, in press).

Results: Specific elements of compulsive exercise were associated with elevated levels of eating-disordered cognitions and increased frequency of eating-disordered behaviours.

Discussion: These results support a multifunctional conceptualisation of compulsive exercise, suggesting that some of the functionality of compulsive exercise may be akin to other forms of purging, and further supporting the notion of a possible functional equivalence between compulsive exercise and specific eating disordered behaviours in terms of affect regulation.

Associations between specific components of compulsive exercise and eating-disordered psychopathology among young women

Compulsive exercise has long been recognised as a common and prominent feature among individuals treated for eating disorders (Bruch, 1965; Crisp, 1967; Gull, 1874; Touyz, Beumont, & Hoek, 1987). It is present in 46-55% of eating-disordered patients (Dalle Grave, Calugi, & Marchesini, 2008b; Shroff, Reba, Thornton, Tozzi, Klump et al., 2006), with an estimated lifetime occurrence of up to 84% (Davis, Kennedy, Ralevski, & Dionne, 1994). Such compulsive exercising has been implicated in the aetiology, development and maintenance of the eating disorders across diagnoses (Beumont, Arthur, Russell & Touyz, 1994; Davis, Kaptein, Kaplan, Olmsted & Woodside 1998; Davis, Katzman & Kirsh, 1999; Epling & Pierce, 1996), and is associated with poor treatment outcome (Strober, Freeman, & Morrell, 1997), an increased risk of relapse (Carter, Blackmore, Sutandar-Pinnock, & Woodside, 2004), and a longer length of hospitalisation (Solenburger, 2001).

Despite the importance of compulsive exercise in understanding the eating disorders (Carter et al., 2004; Solenburger, 2001; Strober, Freeman, & Morrell, 1997), to date there have been few considered attempts to understand the precise nature of the links between compulsive exercise and eating-related attitudes and behaviours. Traditionally, within the context of the eating disorders, compulsive exercise has been viewed simply as an analogue of purgation, that is, as a deliberate method of expending unwanted calories (Davis et al., 1995). However, more recent research suggests that compulsive exercise is best understood as a multidimensional and multifunctional phenomenon (Ackard, Brehm, & Steffen, 2002; Taranis, Touyz, & Meyer, in press), encompassing elements of weight and shape regulation (Hubbard, Gray, & Parker, 1998; Keski-Rahkonen, 2001; Mond, Hay, Rodgers, & Owen, 2006a), affect regulation (Fairburn, Cooper, & Shafran, 2003; Long, Smith, Midgley, & Cassidy, 1993; Thome & Espelage, 2004), compulsivity and rigidity (Adkins & Keel, 2005; Davis & Kaptein, 2006; Wyatt,

1997). Understanding the specific links between these different elements of compulsive exercise and the full range of eating psychopathology and behaviours is essential for tailoring therapeutic interventions. Despite these findings, to date, only two studies have considered different facets of compulsive exercise (Ackard, Brehm, & Steffen, 2002; Steffen & Brehm, 1999). However, neither of these studies encompassed the full range of factors implicated in the construct of compulsive exercise that are likely to be relevant to the eating disorders.

The bi-variate associations between compulsive exercise and eating pathology are well established among both eating-disordered and non-eating-disordered samples (e.g., Elbourne & Chen, 2007; Lipsey, Barton, Hulley, & Hill, 2006). In particular, among eating-disordered patients, compulsive exercise is associated with increased levels of pathological cognition, especially among anorexics (Penas-Lledo, Vaz Leal, & Waller, 2002). Specifically, compulsive exercise is associated with higher levels of dietary restraint, weight and shape concerns (Dalle Grave, Calugi, & Marchesini, 2008b), drive for thinness (Solenburger, 2001), and body dissatisfaction (Brewerton, Stelfox, Hibbs, Hodges, & Cochrane, 1995; Solenburger, 2001). Similarly, among non-eating-disordered samples, compulsive exercise is associated with higher scores on measures of eating and weight restriction (Thome & Espelage, 2007), drive for thinness (Ackard, Brehm, & Steffen, 2002; Adkins & Keel, 2005; Gulker, Laskis, & Kuba, 2001; Matheson & Crawford-Wright, 2000; Steffen & Brehm, 1999), bulimic tendencies (Ackard et al., 2002; Adkins & Keel, 2005; Steffen & Brehm, 1999), and body dissatisfaction (Ackard, Brehm, & Steffen, 2002; Adkins & Keel, 2005; Gulker et al., 2001; Steffen & Brehm, 1999).

In contrast, the association between compulsive exercise and eating-disordered behaviours remains largely equivocal. Whilst there is some evidence that compulsive exercise is associated with pathological eating behaviour (Mond & Calogero, 2009; Shroff, Reba, Thornton, Tozzi, Klump et al., 2006), these studies simply reported the prevalence of compulsive exercise in each eating disorder diagnostic category. Furthermore, only two studies have specifically examined the relationship of eating-disordered behaviours with

compulsive exercise among eating-disordered patients, finding that compulsive exercisers were significantly less likely to exhibit bingeing, or purging behaviours than non-compulsive exercisers (Brewerton et al., 1995; Dalle Grave, Calugi, & Marchesini, 2008b). Whilst no studies have specifically considered whether compulsive exercise is dimensionally associated with eating-disordered behaviours among a non-eating-disordered sample, one study did report greater frequencies of eating-disordered behaviours among sub-groups of compulsive exercisers (Mond, Myers, Crosby, Hay, & Mitchell, 2008).

In summary, compulsive exercise has been empirically linked to eating pathology, both in terms of cognitions and behaviours. However, compulsive exercise is a multidimensional construct and the precise associations of different facets of compulsive exercise with eating-disordered cognitions and behaviours remain unclear. The current study utilises a relatively new multidimensional measure of compulsive exercise encompassing the full range of factors posited as relevant to the construct of compulsive exercise, and specifically designed to be particularly relevant within the context of the eating disorders (Taranis, Touyz, & Meyer, in press). The aim is to explore the associations between specific elements of compulsive exercise and both eating-disordered cognitions and eating behaviours in a sample of young women. In line with recent findings (Elbourne & Chen, 2007; Mond & Calogero, 2009; Mond et al., 2008), it is expected that each element of compulsive exercise will be significantly and positively associated with eating-disordered cognitions and behaviours.

Method

Participants

Four-hundred and ninety-eight females were recruited on an opportunity basis from a UK university campus via email, direct approach, and lectures at the university. All participants were volunteers and received no incentive for taking part. Participants were invited to participate so long as they were female and spoke English as their first

language. No data was collected regarding individuals who declined to participate. Participants had a mean (SD) age of 25.0 (8.5) and reported a mean (SD) body mass index (BMI) of 22.5 (3.8) m/kg². The participants were not screened for a past or present diagnosis of an eating disorder to allow a wide range of eating-related attitudes to be included.

Procedure

Following ethical clearance and informed consent, participants were instructed to complete a background information sheet and self-report measures of eating pathology and compulsive exercise. Exercise frequency was not assessed given that previous findings report no association with eating pathology (e.g., Adkins & Keel, 2005; Boyd, Abraham, & Luscombe, 2007; Davis & Fox, 1993; Lipsey et al., 2006; Mond et al., 2006a; Mond et al., 2008; Seigel & Hetta, 2001). Participants were asked to complete the questionnaires alone and return them directly to the researcher.

Measures

Eating Pathology

The Eating Disorders Examination Questionnaire (EDE-Q; Fairburn & Beglin, 1994) is a well validated, reliable self-report measure of eating pathology based on the Eating Disorder Examination interview (EDE; Cooper & Fairburn, 1987; Fairburn & Cooper, 1993). It uses a 7-point forced choice rating scheme and comprises 36 items focusing on the preceding 28 days that assess the main behavioural and attitudinal features of eating disorders. Eating disorder psychopathology is assessed on four subscales: restraint, eating concern, shape concern and weight concern with scores of four or more on key items being indicative of clinical pathology (Fairburn & Cooper, 1993). These subscales have previously demonstrated good psychometric properties with Cronbach's alphas ranging from 0.78 to 0.93 and test-retest correlations ranging from 0.87 to 0.91 (Luce & Crowther, 1999). Frequencies of eating-disordered behaviours are

assessed in terms of the number of episodes occurring in the past 4 weeks. These items do not contribute to subscale scores. As in the EDE, the EDE-Q attempts to discriminate between objective episodes of overeating involving loss of control (Objective binge), and subjective episodes of overeating which although distressing did not involve the consumption of a large amount of food (Subjective binge). In addition, the EDE-Q assesses the frequency of compensatory behaviours: self-induced vomiting, laxative abuse, diuretic abuse, and hard exercise to control weight or shape. See Appendix F for a copy of the EDE-Q.

Compulsive Exercise

The Compulsive Exercise Test (CET; Taranis, Touyz, & Meyer, in press) is a 24-item self-report measure designed to assess the core cognitive, behavioural and emotional features of compulsive exercise. Items are rated on a 6-point Likert type scale and generate the 5 subscales of: *Avoidance and rule-driven behaviour* (continued exercise despite injury or illness, making up for missed exercise sessions, the experience of affective withdrawal symptoms, guilt, and feelings of having let the self down when unable to exercise), *Weight control exercise* (exercising for weight and shape reasons, compensatory exercise such as debting), *Mood improvement* (positive reinforcement component of exercise), *Lack of exercise enjoyment* (experiencing exercise as a chore and deriving no enjoyment from it), and *Exercise rigidity* (rigid adherence to a strict and repetitive exercise routine). Higher scores are indicative of greater pathology. The CET has previously demonstrated good psychometric properties in a non-clinical sample with excellent concurrent and convergent validity, and Cronbach's alphas ranging from 0.72 to 0.88 (Taranis, Touyz, & Meyer, in press). See Appendix B for a copy of the CET.

Data analysis

Cronbach's alpha was used to assess the reliability of the measures. A series of multiple regression analyses were conducted in order to determine the associations

between compulsive exercise and eating-disordered psychopathology and behaviours. CET subscale scores were entered as independent predictor variables using forced entry, with EDE-Q subscale scores being the dependent variables. All assumptions of homoscedasticity, linearity, normality, independence of residuals and absence of multicollinearity were met. In keeping with the directional hypotheses, one-tailed tests were used throughout. The significance limit was set at $p < .01$ to reduce the risk of type 1 errors.

Results

Table 3.1. Study 4: Means (SD) and reliability coefficients for the measures used.

Variable	Mean	SD	A
<u>Compulsive Exercise Test (CET)</u>			
Avoidance and rule-driven behaviour	1.62	1.13	.92
Weight control exercise	2.80	1.18	.82
Mood improvement	3.25	1.05	.80
Lack of exercise enjoyment	1.60	1.15	.81
Exercise rigidity	2.45	1.25	.72
CET total	11.73	3.37	.88
<u>Eating Disorders Examination Questionnaire (EDE-Q)</u>			
Restraint	1.59	1.47	.85
Eating concerns	0.97	1.06	.79
Shape concerns	2.04	1.30	.87
Weight concerns	1.97	1.46	.82
EDE-Q total	1.67	1.19	.94

Participant characteristics

Means and standard deviations of participants' scores, and reliability coefficients for each of the measures are presented in Table 3.1. The mean age of the whole sample was 25.0 (SD = 8.5; range = 18 – 54) and mean self-reported body mass index (BMI) was 22.5 (SD = 3.8; range = 13.7 – 58.5). Seventeen women had a BMI below 18 and 11 were

obese (BMI > 30). Means, standard deviations, prevalence of eating-disordered behaviours, and number of participants reporting recurrent behaviours are reported in Table 3.2.

Table 3.2. Study 4: Proportion of participants reporting engaging in any or recurrent eating-disordered behaviours (past four weeks) as measured by the EDE-Q.

Variable	Any occurrence (%)	Recurrent behaviours (%)
Objective binge	22	9
Subjective binge	26	11
Purging behaviour [*]	6	3
Hard exercise for weight or shape	40	5

Note: Recurrent bingeing and purging behaviours were defined as an average of at least once per week over the past four weeks (Luce, Crowther, & Pole, 2008). Recurrent hard exercise for weight or shape was defined as an average of at least five times per week over the past four weeks (Luce, Crowther, & Pole, 2008; Mond, Hay, Rodgers, & Owen, 2006b).

^{*}Purging behaviour was created by combining any occurrence of self-induced vomiting, laxative abuse, or diuretic abuse to control weight into one composite variable (Mond et al., 2008).

Associations between compulsive exercise and eating disordered cognitions

Results of the multiple regression analyses are presented in Table 3.3. Compulsive exercise made a significant contribution of between 34% and 40% of the variance across all four of the EDE-Q psychopathology subscales. Specifically, there were significant positive associations between CET Avoidance and rule-driven behaviour, and CET Weight control exercise and all four EDE-Q psychopathology subscales. CET Lack of exercise enjoyment was similarly significantly, positively associated with three of the four EDE-Q psychopathology subscales with the exception of EDE-Q Restraint. In contrast, CET Exercise rigidity had a significant negative association with EDE-Q Weight concerns only, with no further significant associations with any of the remaining EDE-Q psychopathology subscales. There was no significant association between CET Mood

improvement and any of the EDE-Q psychopathology subscales. These results suggest that high levels of compulsive exercise are generally associated with increased levels of eating psychopathology, aside from exercise rigidity which was associated with lower levels of weight concern.

Associations between compulsive exercise and eating behaviours

Results of the multiple regression analyses outlining associations between compulsive exercise and eating behaviours are outlined in Table 3.4. Compulsive exercise made a significant contribution of between 6% and 30% of the variance across all four of the EDE-Q behaviours. Specifically, there were significant associations between CET Avoidance and rule-driven behaviour, and CET Weight control exercise, and increased frequency of all four EDE-Q behaviours. CET Exercise rigidity was significantly associated with a reduced frequency of EDE-Q Objective Bingeing, and increased frequency of EDE-Q Hard exercise for weight or shape reasons, but was not significantly associated with either EDE-Q Subjective bingeing or EDE-Q Purging behaviours. CET Lack of exercise enjoyment was significantly associated with a reduced frequency of EDE-Q Hard exercise for weight or shape only, not being significantly associated with any of the remaining EDE-Q behaviours. There were no significant associations between CET Mood improvement and the frequency of any EDE-Q behaviour. These results suggest that with the exception of mood improvement which showed no associations and lack of exercise enjoyment which was associated with a reduction in EDE-Q hard exercise for weight and shape, high levels of compulsive exercise are generally associated with increased frequency of eating disordered behaviours.

Table 3.3. Study 4: Multiple regression analyses of the relationship between eating psychopathology and compulsive exercise in a female population ($N = 498$)

<i>Dependent variable</i>	Significant predictors	Model R ²	Model F	t	Beta
EDE-Q subscales	CET				
Restraint	Avoidance and rule-driven behaviour	.37	56.49**	3.29**	.17
	Weight control exercise			12.17**	.52
Eating concerns	Avoidance and rule-driven behaviour	.34	48.27**	6.14**	.33
	Weight control exercise			10.18**	.45
	Lack of exercise enjoyment			3.30**	.14
Shape concerns	Avoidance and rule-driven behaviour	.39	62.90**	3.07**	.16
	Weight control exercise			13.93**	.59
	Lack of exercise enjoyment			3.78**	.15
Weight concerns	Avoidance and rule-driven behaviour	.40	65.25**	4.43**	.23
	Weight control exercise			13.19**	.55
	Lack of exercise enjoyment			5.37**	.22
	Exercise rigidity			-3.07*	-.14

Note: Significance of correlation coefficients: * $p < 0.01$, ** $p < 0.001$ (one-tailed).

Table 3.4. Study 4: Multiple regression analyses of the relationship between eating-disordered behaviours and compulsive exercise in a female population ($N = 384$)

<i>Dependent variable</i>	Significant predictors	Model R ²	Model F	t	Beta
EDE-Q behaviours	CET				
Objective binge	Avoidance and rule-driven behaviour	.10	8.38**	2.70*	.20
	Weight control exercise			3.41**	.20
	Exercise rigidity			-2.51*	-.17
Subjective binge	Avoidance and rule-driven behaviour	.08	6.60**	2.72*	.20
	Weight control exercise			3.15**	.19
Purging behaviour ¹	Avoidance and rule-driven behaviour	.06	4.86**	3.26**	.24
	Weight control exercise			2.48*	.15
Hard exercise	Avoidance and rule-driven behaviour	.30	32.62**	4.80**	.31
	Weight control exercise			4.14**	.21
	Lack of exercise enjoyment			-3.62**	-.18
	Exercise rigidity			2.59*	.15

Note: Significance of correlation coefficients: * $p < 0.01$, ** $p < 0.001$ (one-tailed).

¹Purging behaviour was created by combining any occurrence of self-induced vomiting, laxative abuse, or diuretic abuse to control weight into one composite variable.

Discussion

The aim of this study was to determine the associations between compulsive exercise and eating-disordered pathology in a young female sample. As predicted, the findings indicate that compulsive exercise is associated with elevated levels of both eating disorder psychopathology and behaviour. Whilst these findings are consistent with those previously found in terms of the association between compulsive exercise and eating psychopathology (e.g., Ackard et al., 2002; Adkins & Keel, 2005; Steffen & Brehm, 1999; Matheson & Crawford-Wright, 2000; Thome & Espelage, 2007), the finding that compulsive exercise is associated with an increased frequency of eating-disordered behaviours in a non-clinical sample is a novel one. In addition, these findings extend those previously found by detailing the particular components of compulsive exercise that are associated with higher levels of eating psychopathology and increased frequency of eating-disordered behaviours.

Specifically, the negative reinforcement component of compulsive exercise, defined in terms of continued exercise to avoid negative emotional consequences such as affective withdrawal and guilt, was significantly associated with increased eating psychopathology and frequency of behaviours. Indeed, this component of compulsive exercise showed the strongest associations with increased frequency of purging behaviours and hard exercise for weight or shape (as measured by the EDE-Q). These findings not only support the centrality of dysfunctional mood regulation in compulsive exercise (Fairburn, Cooper, & Shafran, 2003; Thome & Espelage, 2007), but also support the importance of affective withdrawal symptoms such as guilt to the construct of compulsive exercise (e.g., Boyd et al., 2007; Mond et al., 2006a; 2008; Mond & Calogero, 2009). Interestingly, in stark contrast, the positive reinforcement component of exercising defined in terms of mood improvement showed no associations with eating psychopathology or behaviours, raising the question of its validity as a component of compulsive exercise.

The exercising for weight control component of compulsive exercise was also significantly associated with greater eating psychopathology and frequency of behaviours. In addition, it showed the strongest associations with all the aspects of eating psychopathology as well as increased frequency of objective and subjective binge behaviours. Not only is this consistent with previous findings (e.g., Mond et al., 2006a; 2008; 2009), but it extends them by demonstrating a significant association between exercising for weight control and an increased frequency of all eating-disordered behaviours. In contrast, the exercise rigidity component of compulsive exercise showed no positive associations with eating psychopathology, being significantly associated with a decrease in weight concerns with a similar trend for negative association in terms of both eating and shape concerns as measured by the EDE-Q and was correspondingly associated with a decreased occurrence of objective bingeing, with a similar trend evident for subjective bingeing and purging behaviours. One explanation may be that in a non-eating-disordered population, exercise rigidity is more indicative of the avid exerciser following a structured exercise routine/schedule than the inflexible behavioural rigidity characteristic of compulsive exercise (Wyatt, 1997). Alternatively, such eating-disordered behaviours may be associated with a more impulsive behaviour profile (Claes, Vandereycken, & Vertommen, 2005; Fischer, Smith, & Anderson, 2003) and as such are discordant with a rigid and inflexible pattern of behaviour more typical of a compulsive behaviour profile. However, exercise rigidity was associated with an increased occurrence of hard exercise for weight and shape reasons, suggesting that this EDE-Q question is specifically tapping the type of exerciser who adopts a rigid exercise profile.

These findings clearly support the multifunctional conceptualisation of compulsive exercise as has been suggested previously (Taranis, Touyz, & Meyer, in press). Indeed, in line with previous findings (Davis et al., 1995) the association between components of compulsive exercise and purging behaviours suggest that some of the functionality of compulsive exercise may be akin to other forms of purging (i.e., compulsive exercise as a compensatory strategy in terms of caloric purgation). In addition, the associations

between components of compulsive exercise and both bingeing and purging behaviours also support the notion of a possible functional equivalence between compulsive exercise and specific eating-disorder behaviours in terms of affect regulation (Fairburn, Cooper, & Shafran, 2003; Meyer, Waller & Waters, 1998). Taken together, these results suggest that compulsive exercise may serve both a purgative and affect regulatory function.

A major strength of this study was the use of an empirically derived multidimensional measure of compulsive exercise that addressed many of the shortcomings of existing measures (Taranis, Touyz, & Meyer, in press). As a result, the present findings have valuable methodological implications, highlighting the importance of differentially exploring the relationship between the different components of compulsive exercise and eating-disordered cognitions and behaviours.

Whilst the present research provides preliminary empirical support for an association between components of compulsive exercise and increased frequency of eating-disordered behaviours, it should be acknowledged that several limitations apply. First, these findings are limited by their cross-sectional nature. Future research should aim to replicate these findings and consider using longitudinal or experimental designs to verify the causal relationship between compulsive exercise and eating pathology. In addition, 'real-time' data gathering methods such as ecological momentary assessment (EMA) could be used to overcome any potential retrospective recall bias and provide objective assessment on the nature of the relationship between compulsive exercise and eating pathology in the naturalistic environment. Specifically, EMA could be used to examine the relationship between levels of affect and frequency of compulsive exercise and eating behaviours. Second, the use of a young female university sample may limit the generalisability of our findings to eating-disordered samples. Therefore, these studies require replication within a range of eating and non-eating-disordered populations.

Despite the need for clinical validation, these findings highlight the potential importance of compulsive exercise in the aetiology and development of the eating disorders. Further research is clearly warranted to delineate the precise nature of the

relationship between compulsive exercise and eating-disordered behaviours in an eating-disordered sample. This may inform clinical interventions designed to address compulsive exercise and may further inform prevention programs and screening assessments for use among non-clinical populations.

Chapter 4:

Studies 5 and 6

**Compulsive exercise and emotion regulation
among young women**

Studies 5 and 6

Compulsive exercise and emotion regulation among young women

Chapter 3 had two major findings: First, in a replication of previous findings, the components of compulsive exercise were shown to be differentially associated with elevated levels of eating-disordered cognitions (i.e., psychopathology). Second, specific components of compulsive exercise were found to be associated with increased frequency of eating disordered behaviours, which was a novel finding in a non-clinical sample. These findings supported the multifunctional conceptualisation of compulsive exercise central to the proposed cognitive-behavioural model of compulsive exercise. Specifically, that whilst some of the functionality of compulsive exercise may be akin to other forms of purgation (i.e., compensatory exercise in terms of caloric expenditure), compulsive exercise may also share a functional equivalence with specific eating-disorder behaviours (e.g., bingeing) in terms of affect regulation. These findings highlight the potential importance of compulsive exercise in the aetiology of the eating disorders, and further support the notion of a reciprocally reinforcing relationship between compulsive exercise and eating pathology.

In keeping with the second aim of this thesis, this next chapter expands upon the findings of Chapter 3 by examining the links between compulsive exercise and both specific emotion coping strategies (Study 5) and difficulties regulating emotions (Study 6), whilst controlling for levels of eating psychopathology. The aim is to provide further support for the links between compulsive exercise and affect regulation proposed in the cognitive-behavioural conceptualisation of compulsive exercise. The specific relationship being tested is indicated by the number 2 in Figure 4.1 below.

Some of the data presented in this chapter are also presented in Chapters: 2; 3; 5 (Study 7 only); and 6.

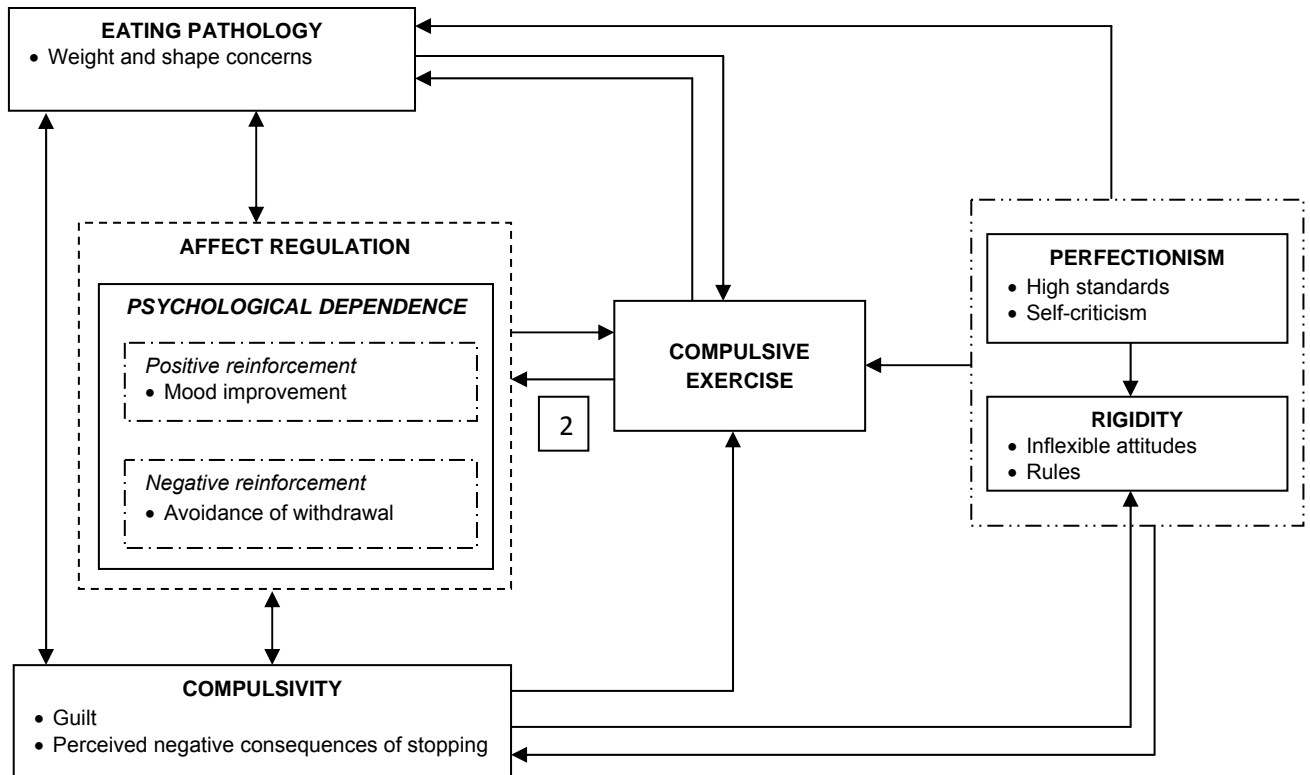


Figure 4.1. A schematic representation of all the factors implicated in the maintenance of compulsive exercise showing the relationship being tested [2] in Chapter 4.

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Compulsive exercise and emotion regulation among young women

Abstract

Objective: It has been suggested that the functional utility of compulsive exercise may extend beyond the control of weight or shape, and could be as a means of coping with or regulating emotions. The current cross-sectional studies examined the associations between compulsive exercise and both emotional coping strategies and difficulties regulating emotions in a non-eating disordered sample of young female exercisers.

Methods: In Study 5, 118 young females completed measures of compulsive exercise and emotional coping strategies. In Study 6, 119 young females completed measures of compulsive exercise and difficulties regulating emotions.

Results: The results of Study 5 indicate that compulsive exercise is uniquely associated with the maladaptive coping strategy of avoidance of affect. Study 6 extends these findings by demonstrating that compulsive exercise is associated with a range of difficulties in regulating emotions even after controlling for levels of eating psychopathology.

Discussion: Collectively, this data support the functional utility of compulsive exercise in regulating emotions and further highlight emotion regulation as a potential maintenance factor for compulsive exercise.

Key words: exercise; eating; psychopathology; emotion; emotion regulation; coping

Compulsive exercise and emotion regulation among young women

Compulsive exercise is characterised by an inability or unwillingness to cut down or stop exercising despite adverse social and health-related consequences (Polizy, 1994; Szabo, 1998; Yates, 1991). Such exercise behaviour can be construed as existing along a continuum (Elbourne & Chen, 2007), and is positively associated with elevated scores on measures of eating psychopathology among both clinical (Dalle Grave, Calugi, & Marchesini, 2008b) and non-clinical samples (Seigel & Hetta, 2001). Within patient groups, compulsive exercise has often been found to precede the onset of an eating disorder (Davis Blackmore, Katzman, & Fox, 2005) and evidence suggests that its presence may adversely affect both the course of the disorder and treatment outcome (e.g., Beumont, Arthur, Russell, & Touyz, 1994; Carter, Blackmore, Sutandar-Pinnock, & Woodside, 2004; Strober, Freeman, & Morrell, 1997).

Despite the clear importance of compulsive exercise within the eating disorders domain, little is known about the functional utility and hence potential maintaining factors of such exercise. While it is well established that exercise has a role as a weight control behaviour (e.g., Garfinkel, Lin, Goering, Spegg, Goldbloom et al., 1995), a recently proposed model of compulsive exercise suggests its maintenance factors are multifaceted and much more complex than simple weight and shape control (Taranis, Meyer, & Touyz, 2007). One of these factors involves the regulation of emotional states. Several studies have found evidence of an association between compulsive exercise and increased levels of negative affect in both eating disordered (Penas-Lledo, Vaz Leal, & Waller, 2002; Vansteelandt, Rijmen, Pieters, Pobst, & Vanderlinden, 2007) and non-eating disordered samples (Siegel & Hetta, 2001; Spano, 2001). In addition, within the exercise science literature, the affect regulatory role of exercise has been well established (Callaghan, 2004), with mood regulation being one of the most frequently endorsed motivations for exercising (Markland & Ingledew, 1997). Therefore, it is highly plausible

that the functional utility of compulsive exercise for women with eating problems lies in its use as a way of coping with negative affect.

This affect regulatory model is supported by evidence suggesting that among eating disordered patients, compulsive exercise is often maintained primarily for the control of negative affect (e.g., Blumenthal, O'Toole, & Chang, 1984; Long, Smith, Midgley, & Cassidy, 1993). Moreover, among eating disordered patients who exercise compulsively, there is evidence to suggest that exercise may become the primary and even the only means by which they regulate their emotional state (Geller, Cockell, & Goldner, 2000; Markland & Ingledrew, 1997). In addition, compulsive exercise is further characterised by the experience of affective withdrawal symptoms (such as anxiety) when one is prevented from exercising (Yates, 1991). The experience of such dysphoric withdrawal symptoms has been found to discriminate between eating disordered and non-eating disordered groups (Boyd, Abraham, & Luscombe, 2007). Therefore, compulsive exercise may be maintained not only to regulate negative affect but also to avoid the affective withdrawal symptoms associated with being unable to exercise.

The model proposed here is compatible with the concept of "mood intolerance" identified as a potential maintenance factor for eating pathology (Fairburn, Cooper, & Shafran, 2003). Mood intolerance is defined as "an inability to cope appropriately with certain emotional states" resulting in the use of "dysfunctional mood modulatory behaviour" such as compulsive exercise that serves the function of regulating the aversive mood state (p.517). However, while previous research supports the notion of compulsive exercise as a dysfunctional emotion regulation strategy, the relationship between compulsive exercise and emotion regulation remains poorly understood.

Study 5

Given the context of understanding compulsive exercise as a form of dysfunctional emotion regulation, it is necessary to determine whether dysfunctional emotional regulation strategies are associated with compulsive exercise. Therefore, the aim of Study

5 is to investigate the associations between functional (i.e., adaptive) and dysfunctional (i.e., maladaptive) strategies for coping with affect and compulsive exercise. It is hypothesised that relatively high levels of compulsive exercise will be associated with maladaptive as opposed to adaptive emotional coping strategies.

Method

Participants

One-hundred and eighteen females were recruited on an opportunity basis from The University of Sydney via direct approach. All were volunteers and received no incentive for taking part. Participants were invited to participate if they had engaged in some form of regular exercise or sport over the past 4 weeks (mean exercise per week 3.08 hours, SD = 2.74; range = .50 - 17.50), were aged between 18 and 30 (mean age 21.3, SD = 2.61; range = 18.0 - 30.0), and spoke English as their first language. They had a mean self-reported body-mass index (BMI) of 21.6 (SD = 2.80; range = 15.4 - 30.7). The participants were not screened for a past or present diagnosis of an eating disorder to allow a wide range of eating-related attitudes to be included in the analyses.

Procedure

Following ethical clearance and informed consent, participants were instructed to complete two self-report questionnaires whilst alone and to return them directly to the researcher.

Measures

Exercise Frequency

Participants were asked to indicate for all their exercise activities, the number of weeks of participation out of the past 4 weeks (i.e. 1 - 4), the average number of sessions per week, and the average duration of each session in minutes. A measure of 'exercise frequency' was obtained by multiplying the number of weeks x number of sessions per week x average duration (Davis, Kennedy, Ralevski, & Dionne, 1994).

Compulsive Exercise

The Compulsive Exercise Test (CET; Taranis, Touyz, & Meyer, in press) is a 24-item self-report measure designed to assess the core features of compulsive exercise. Items are rated on a 6-point Likert type scale and generate the 5 subscales of: *Avoidance and rule-driven behaviour* (continued exercise despite injury or illness, making up for missed exercise sessions, the experience of affective withdrawal symptoms, guilt, and feelings of having let the self down when unable to exercise), *Weight control exercise* (exercising for weight and shape reasons, compensatory exercise such as debting), *Mood improvement* (positive reinforcement component of exercise), *Lack of exercise enjoyment* (experiencing exercise as a chore and deriving no enjoyment from it), and *Exercise rigidity* (rigid adherence to a strict and repetitive exercise routine). Higher scores are indicative of greater pathology. The CET has previously demonstrated good psychometric properties in a non-clinical sample (Taranis, Touyz, & Meyer, in press). Alpha coefficients for the current study are given in Table 4.1. See Appendix B for a copy of the CET.

Emotion Regulation

The Distress Tolerance Scale (DTS; Corstophine, Mountford, Tomlinson, Waller & Meyer, 2007) is a 14-item self-report measure of adaptive and maladaptive styles of emotional coping. It uses a five-point forced choice rating scheme and generates three subscales, reflecting different methods of dealing with emotion: *Avoidance of affect* (maladaptive form of emotional coping. E.g., “I avoid situations in which I know I will become overexcited”); *Accept and manage affect* (adaptive emotional coping. E.g., “If I find I am getting too anxious, I will do something to soothe myself (e.g., listen to music, read a book)”); and *Anticipate affect and distract* (Adaptive emotional coping. E.g., “If I think that I might feel lonely, I will make sure I am surrounded by people”). Higher scores indicate greater use of the specific method of coping with affect. The DTS has previously demonstrated acceptable psychometric properties in a non-clinical sample (Corstophine et

al., 2007). Alpha coefficients for the current study are given in Table 4.1. See Appendix G for a copy of the DTS.

Data analysis

Kolmogorov-Smirnov \underline{Z} tests showed the data were normally distributed and inspection of the scatterplot indicated that the assumption of linearity had been met, therefore parametric analyses were used. Cronbach's alpha was used to assess the reliability of the measures. Pearson's r was used to determine the associations between compulsive exercise and DTS scores. In keeping with the directional hypotheses one-tailed tests were used throughout. Due to the number of tests performed, the significance limit was set at $p < .01$.

Results

Characteristics of the sample

The women's mean scores on the measures used are given in Table 4.1. The scores for both measures were similar to those reported previously for young female samples (Corstophine et al., 2007; Taranis et al., 2008).

Table 4.1. Study 5: Means (SD) and reliability coefficients for the measures used.

Variable	Mean	SD	A
<i>Compulsive Exercise Test</i>			
Avoidance and rule-driven behaviour	1.57	1.02	.91
Weight control exercise	2.73	1.16	.86
Mood improvement	3.34	0.91	.73
Lack of exercise enjoyment	1.84	1.10	.80
Exercise rigidity	2.44	1.35	.84
CET total	13.57	2.63	.86
<i>Distress Tolerance Scale</i>			
Accept and manage affect	2.07	0.71	.62
Avoidance of affect	1.46	0.63	.71
Anticipate affect and distract	1.94	0.73	.58

Table 4.2. Study 5: Associations (Pearson's r) between compulsive exercise and emotional coping strategies ($n = 118$)

Variable	Compulsive Exercise Test (CET)				
	Avoidance and rule-driven behaviour	Weight control exercise	Mood improvement	Lack of exercise enjoyment	Exercise rigidity
<i>Distress Tolerance Scale</i>					
Accept and manage affect	.13	.10	.15	.06	-.05
Avoidance of affect	.31**	.22*	.04	.22*	.10
Anticipate affect and distract	-.02	-.13	.10	.11	-.03

Note: Significance of correlation coefficients: * $p < 0.01$, ** $p < 0.001$ (one-tailed).

Association between compulsive exercise and emotion coping strategies

There were no significant associations between exercise frequency and DTS scores ($r < .12$, $p > .09$ in all cases). Table 4.2 shows the associations between DTS scores and compulsive exercise. There were no significant associations between either of the two DTS adaptive coping subscales (Accept and manage affect, or Anticipate affect and distract) and any CET subscales. However, as predicted, DTS Avoidance of affect was reliably associated with compulsive exercise. Specifically, DTS Avoidance of affect was significantly, positively associated with CET Avoidance and rule-driven behaviour, CET Weight control exercise, and CET Lack of exercise enjoyment. There were no significant associations of DTS Avoidance of affect with CET Mood improvement or CET Exercise rigidity.

Discussion

The aim of Study 5 was to determine the associations of compulsive exercise with functional (i.e., adaptive) and dysfunctional (i.e., maladaptive) strategies for coping with affect. As predicted, the findings indicate that compulsive exercise is associated with the maladaptive emotional coping strategy of avoidance of affect. Given the affect regulation function of restriction and bulimic behaviours (Fairburn, 1997; Meyer, Waller, & Waters, 1998) our results support the notion that compulsive exercise may serve a similar function of regulating affect in the eating disorders. Indeed, our results are consistent with previous findings suggesting that the functional utility of compulsive exercise in the eating disorders may be the regulation of emotions (e.g., Geller et al., 2000; Long et al., 1993) and further support an affect regulatory maintenance model of compulsive exercise.

Study 6

The results of Study 5 suggest that the avoidance of negative affect is an important feature of compulsive exercise. However, the association of this maladaptive

emotional coping strategy with compulsive exercise requires further exploration. Specifically, avoidance of emotion is likely to be underpinned by difficulties in processing or dealing appropriately with negative emotion once the emotion occurs. The aim of Study 6 is to investigate whether compulsive exercise is associated with emotion regulation difficulties. Given the association between eating psychopathology and both difficulties regulating emotions (Sim & Zeman, 2006) and compulsive exercise (Dalle Grave et al., 2008b; Seigel & Hetta, 2001), it is necessary to determine whether any association between compulsive exercise and emotion regulation difficulties remains when eating psychopathology is taken into account. It is hypothesised that, after controlling for eating psychopathology, higher levels of compulsive exercise will be associated with increased difficulties in regulating emotional states.

Method

Participants

Following ethical clearance, 119 women were recruited on an opportunity basis from Loughborough University via email, direct approach, and lectures at the university. All participants either volunteered, or received course credit or payment for taking part. Participants were invited to participate if they had engaged in some form of regular exercise or sport over the past 4 weeks (mean exercise per week 5.84 hours, SD = 4.03; range = 1.50 - 21.00), were aged between 18 and 30 (mean age 20.88, SD = 2.39; range = 18.08 - 30.00), and spoke English as their first language. Their mean self-reported body mass index (BMI) was 21.92 (SD = 2.56; range = 16.32 - 31.64). The participants were not screened for a past or present diagnosis of an eating disorder to allow a wide range of attitudes to be included.

Procedure

After completing an informed consent form, participants were instructed to complete three self-report questionnaires whilst alone and to return them directly to the researcher.

Measures

Exercise Frequency: For description see Study 5.

Compulsive Exercise

Compulsive Exercise Test (CET). For description of the CET see Study 5. Alpha coefficients for the current study are given in Table 4.3. See Appendix B for a copy of the CET.

Emotion Regulation

The Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004) is a 36 item self-report measure of emotion dysregulation that assesses difficulties in the regulating emotions: Items are rated on a 5-point Likert type scale and are used to generate a total score and the six subscales of: *Non-acceptance of emotional responses* (DERS Non-acceptance; e.g., “When I am upset, I become irritated with myself for feeling that way”); *Difficulties engaging in goal directed behaviour* (DERS Goals; e.g., “When I am upset, I have difficulty concentrating”); *Impulse control difficulties* (DERS Impulse; e.g., “When I am upset, I lose control over my behaviours”); *Lack of emotional awareness* (DERS Awareness; e.g., “When I am upset, I acknowledge my emotions” [reversed]); *Limited access to emotion regulation strategies* (DERS Strategies; e.g., “When I am upset, it takes me a long time to feel better”); and *Lack of emotional clarity* (DERS Clarity; e.g., “I am confused about how I feel”). The DERS has previously demonstrated good psychometric and predictive properties within a non-clinical student sample (Gratz & Roemer, 2004; Whiteside, Chen, Neighbors, Hunter, Lo, & Larimer, 2006). Alpha

coefficients for the current study are given in Table 4.3. See Appendix H for a copy of the DERS.

Eating Psychopathology

The Eating Disorders Examination Questionnaire (EDE-Q; Fairburn & Beglin, 1994) is a well validated, reliable self-report measure of eating disorder psychopathology based on the Eating Disorder Examination interview (Cooper & Fairburn, 1987; Fairburn & Cooper, 1993). It comprises 36 items focusing on the preceding 28 days that assess the main behavioural and attitudinal features of eating disorders. It uses a 7-point forced choice rating scheme and generates a total score and the four subscales of: Restraint, Eating concern, Shape concern and Weight concern. Scores of four or more on key items are indicative of clinical pathology (Fairburn & Cooper, 1993). For the current study only EDE-Q total score was used. The alpha coefficient for the current study is given in Table 4.3. See Appendix F for a copy of the EDE-Q.

Data analysis

Cronbach's alpha was used to assess the reliability of the measures. Inspection of the scatterplots indicated that the assumption of linearity had been met. However, Kolmogorov-Smirnov χ^2 tests showed the data were not normally distributed; therefore, the results of parametric analyses should be interpreted with caution. Partial correlations (controlling for EDE-Q scores) were used to determine the associations between CET and DERS scores. In keeping with the directional hypotheses one-tailed tests were used throughout. Due to the number of tests performed, the significance limit was set at $p < .01$.

Results

Characteristics of the sample

The women's mean scores (SD) on the measures used are given in Table 4.3. The scores for all three measures were similar to those reported previously for other female samples (Gratz & Roemer, 2004; Luce, Crowther, & Pole, 2008; Taranis et al., 2008).

Table 4.3. Study 6: Means (SD) and reliability coefficients for the measures used.

Variable	Mean	SD	A
<i>Compulsive Exercise Test</i>			
Avoidance and rule-driven behaviour	2.32	0.95	.86
Weight control exercise	3.37	1.06	.85
Mood improvement	3.67	0.79	.71
Lack of exercise enjoyment	1.08	0.84	.79
Exercise rigidity	3.10	0.89	.73
CET total	13.57	2.63	.85
<i>Difficulties in Emotion Regulation Scale</i>			
Non-acceptance	2.49	1.13	.94
Goals	3.22	0.97	.90
Impulse	2.12	0.96	.92
Awareness	2.66	0.69	.75
Strategies	2.26	0.96	.92
Clarity	2.38	0.85	.88
DERS total	2.52	0.67	.95
<i>Eating Disorders Examination Questionnaire</i>			
EDE-Q total	2.26	1.20	.93

Association between compulsive exercise and difficulties regulating emotions

There were no significant associations between exercise frequency and any of the DERS subscale scores ($r < .10$, $p > .05$ in all cases). Table 4.4 shows the results of the partial correlations between CET and DERS scores, controlling for EDE-Q scores. There were no reliable associations between DERS Goals and CET scores. Similarly, there were no significant associations between any of the DERS subscales and CET Weight control

exercise or CET Mood improvement. However, DERS Non-acceptance was significantly, positively associated with CET Avoidance and rule-driven behaviour. In addition, both DERS Impulse and DERS Strategies were significantly, positively associated with CET Lack of exercise enjoyment. Finally, DERS Awareness and DERS Clarity were significantly positively associated with CET Exercise rigidity.

Table 4.4. Study 6: Partial correlations controlling for eating psychopathology (EDE-Q total) between compulsive exercise and difficulties regulating emotion ($n = 119$).

Variable	Compulsive Exercise Test (CET)				
	Avoidance and rule-driven behaviour	Weight control exercise	Mood improvement	Lack of exercise enjoyment	Exercise rigidity
<i>Difficulties in Emotion Regulation Scale</i>					
Non-acceptance of emotional Responses	.29**	-.07	.17	.14	.19
Difficulties engaging in goal directed behaviour	.11	-.14	.03	.04	-.06
Impulse control difficulties	.19	-.05	.05	.26*	.07
Lack of emotional awareness	.15	-.06	-.04	-.09	.25*
Limited access to emotion regulation strategies	.15	-.11	.09	.32**	.08
Lack of emotional clarity	.20	.09	-.06	.04	.23*

Note: Significance of correlation coefficients: * $p < 0.01$, ** $p < 0.001$ (one-tailed).

Discussion

The current study investigated the associations between difficulties in regulating emotions and compulsive exercise. As predicted, even after controlling for levels of eating psychopathology, difficulties regulating emotions remained significantly associated with compulsive exercise. Specifically, non-acceptance of emotional responses was associated with avoidance and rule-driven exercise; impulse control difficulties, and limited access to emotion regulation strategies were both associated with lack of exercise enjoyment; and lack of emotional awareness and lack of emotional clarity were associated with exercise rigidity. The lack of an association between weight control exercise and emotion regulation difficulties was to be expected given the statistical control of eating psychopathology.

The association of non-acceptance of emotional responses with avoidance and rule-driven behaviour is in line with previous findings that non-acceptance is associated with emotional avoidance (Gratz & Roemer, 2004), and suggests that compulsive exercisers who exercise to avoid the experience of affective withdrawal symptoms may show a tendency to experience negative secondary emotions in response their own emotional reactions. Similarly, the association between lack of exercise enjoyment and limited access to emotion regulation strategies suggests that compulsive exercisers might have fewer adaptive strategies for dealing with their emotions and may therefore resort to maladaptive emotion regulation strategies such as compulsive exercising. This model is also supported by the findings of Study 5.

The link between a lack of exercise enjoyment and impulse control difficulties is consistent with the use of dysfunctional affect regulatory behaviours common to the eating disorders, such as bingeing and purging (Fairburn et al., 2003) that are often continued despite being ego-dystonic. The association between exercise rigidity and both a lack of emotional awareness and a lack of emotional clarity suggests that among compulsive exercisers the adoption of a rigid exercise routine is indicative of difficulties attending to

and acknowledging emotions, and being clear about the emotion being experienced. This finding is especially pertinent given the importance of being able to clearly identify emotional states for competent emotional functioning (Saarni, 1999).

At a general level these results support and extend the findings of Study 5 and are in line with the concept of “mood intolerance” proposed by Fairburn et al., (2003), and an affect regulatory model of compulsive exercise.

General Discussion

These two studies have examined the associations between compulsive exercise and emotion dysregulation in a group of young women. In Study 5, compulsive exercise was shown to be associated with the use of the maladaptive emotional coping strategy of avoidance of affect. The results of Study 6 further support and extend the conclusions of Study 5 by showing that compulsive exercise is associated with specific difficulties regulating emotions.

While previous studies have suggested an association between compulsive exercise and emotion regulation (e.g., Long et al., 1993), our results extend these findings by showing that compulsive exercise is associated with difficulties regulating emotions and the adoption of maladaptive emotional coping strategies. These results are consistent with previous evidence suggesting that emotion regulation may be a significant maintenance factor for compulsive exercise (e.g., Long et al., 1993), and further support the functional utility of compulsive exercise in regulating affect.

Taken together the findings of Studies 5 and 6 support an affect-regulatory model of compulsive exercise and are compatible with cognitive models of eating pathology in which dysfunctional mood modulatory behaviours (such as binge-eating, vomiting and compulsive exercise) may serve the function of alleviating aversive mood states (Fairburn et al., 2003; Meyer et al., 1998).

The cross-sectional nature of the data and small sample sizes limit the external validity of the studies and the ability to make causal inferences. However, the present findings have valuable methodological implications. In particular they highlight the importance of exploring the different functions of compulsive exercise in the context of emotion regulation. Longitudinal research is now required to verify the causal nature of these emotion regulation difficulties in the development of compulsive exercise. In addition, the study requires replication within an eating disordered sample to establish the generalisability of these findings, and to determine links between emotion regulation difficulties and different types of eating disordered behaviour (including bingeing, vomiting, and restriction). Despite the need for clinical validation, it can be suggested that within clinical settings treatment efficacy may be enhanced if therapists are made aware of the functional utility of compulsive exercise in terms of affect regulation.

Chapter 5:

Studies 7 and 8

Dimensions of perfectionism and eating

psychopathology:

High personal standards versus self-criticism

Studies 7 and 8

Dimensions of perfectionism and eating psychopathology:

High personal standards versus self-criticism

In line with expectations, Chapter 4 found that compulsive exercise was associated with an avoidant coping strategy in terms of the avoidance of negative affect. In addition, compulsive exercise was shown to be associated with specific difficulties in emotion regulation, even after controlling for levels of eating psychopathology. These findings not only support the proposed centrality of avoidant coping, especially in terms of the avoidance of affective withdrawal symptoms so central to the proposed cognitive-behavioural conceptualisation of compulsive exercise, but also add further support to the suggested functional equivalence between compulsive exercise and eating-disordered behaviours in terms of affect regulation. Taken together, these results further reinforce the links delineated in the proposed cognitive-behavioural conceptualisation of compulsive exercise and may provide useful information in terms of enhancing the clinical utility of any intervention designed to tackle compulsive exercise.

In demonstrating the links between compulsive exercise and both eating pathology (i.e., cognitions and behaviours), and affect regulation respectively, the findings from Chapters 3 and 4 add further support to the relationships highlighted in the proposed cognitive-behavioural conceptualisation of compulsive exercise, specifically in terms of the eating pathology, affect regulation, and compulsivity components. The following chapter will now begin to explore the relationship of perfectionism to compulsive exercise by first examining its links with eating psychopathology in general. The reason it is necessary to first consider the relationship between perfectionism and eating psychopathology is that, as outlined in Chapter 1, whilst perfectionism is a robust correlate of eating psychopathology, understanding of this relationship has been impaired by the use of disparate conceptualisations of perfectionism. Therefore, the aim of the current chapter is to replicate and extend upon previous findings by conceptualising perfectionism in terms

of the self-critical and high personal standards dimensions that have been shown to be the core dimensions of perfectionism. The specific relationship being tested is indicated by the number 3 in Figure 5.1 below.

The data presented in this chapter are also presented in Chapters: 2 (Studies 1 and 3 only); 3; 4 (Study 6 only); and 6.

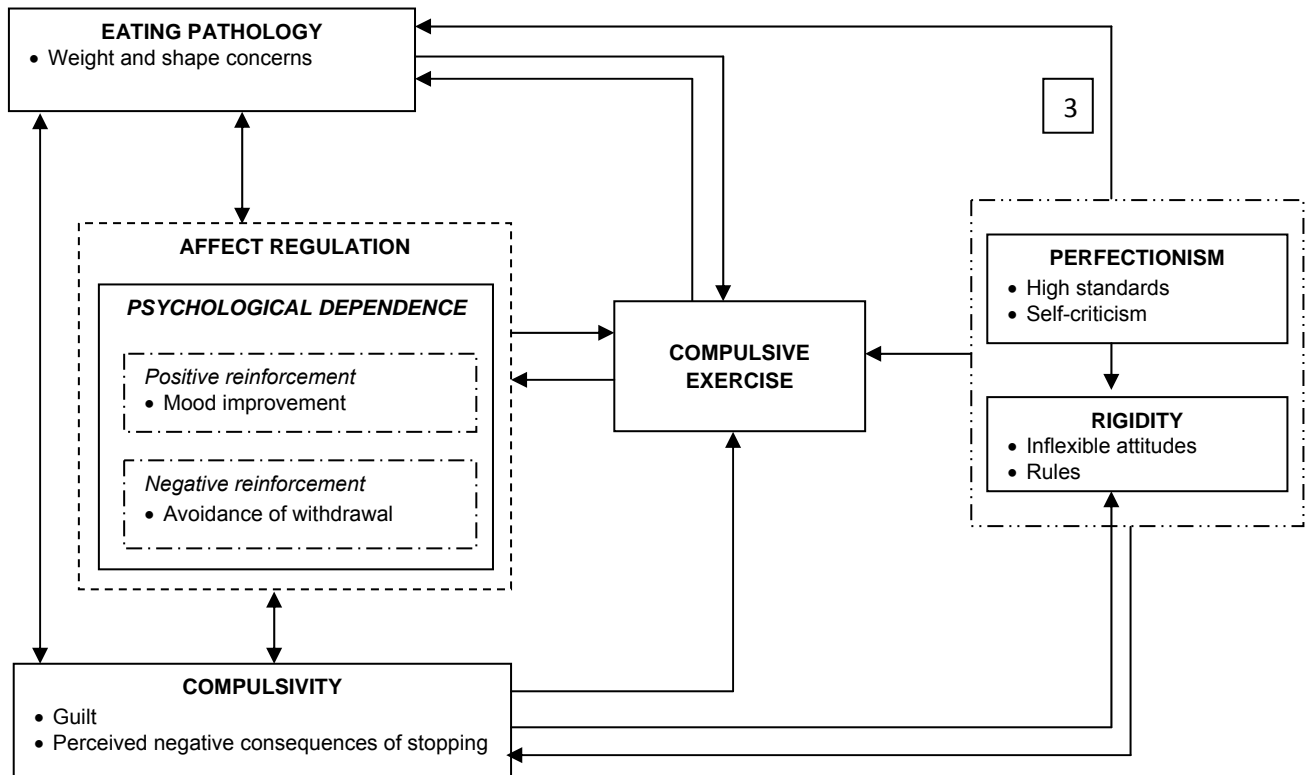


Figure 5.1. A schematic representation of all the factors implicated in the maintenance of compulsive exercise showing the relationship being tested [3] in Chapter 5.

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Dimensions of perfectionism and eating psychopathology:

High personal standards versus self-criticism

Abstract

Objective: These cross-sectional studies examined high personal standards and self-critical dimensions of perfectionism as correlates of eating psychopathology, and investigated the forms and functions of self-criticism in relation to levels of eating disturbance among young women.

Methods: In Study 7, 97 young females completed measures of perfectionistic high standards, self-criticism, and eating psychopathology. In Study 8, 107 young females completed measures of the forms and functions of self-criticism, and eating psychopathology.

Results: Self-criticism substantially accounted for the relationship between high personal standards and eating psychopathology. Eating psychopathology was associated with self-critical forms regarding a failure to meet with *internal personal standards* and a view of the self as *inadequate*, and the function of wanting to *persecute the self*.

Discussion: Together with previous findings, these results clearly suggest that specific self-critical tendencies are significantly implicated in the relationship between perfectionism and eating disorder psychopathology.

Key words: eating disorders; psychopathology; perfectionism; self-criticism

Dimensions of perfectionism and eating psychopathology:

High personal standards versus self-criticism

There is a well established link between perfectionism and the eating disorders (Bulik, Tozzi, Anderson, Mazzeo, Aggen et al., 2003; Halmi, Sunday, Strober, Kaplan, Woodside, et al., 2000; Lilenfeld, Stein, Bulik, Strober, Plotnicov, 2000). Whilst perfectionism has been implicated as a specific risk factor for the development of both Anorexia Nervosa and Bulimia Nervosa (Fairburn, Cooper, Doll & Welch, 1999; Fairburn, Shafran & Cooper, 1999; Lilenfeld, Wonderlich, Riso, Crosby & Mitchell, 2006), particularly strong associations have been found with anorexic psychopathology (Garner, Olmstead & Polivy 1983; Vitousek & Manke, 1994). In addition, perfectionism is an enduring trait, often persisting following recovery from eating disorders (Kaye, Gendal & Strober, 1998; Srinivasagam, Kaye, Plotnicov, Greeno, Weltzin et al., 1995; Sutandar-Pinnock, Woodside, Carter, Olmstead & Kaplan, 2003). In Anorexia Nervosa, perfectionism is also predictive of poor treatment outcome (Bardone-Cone, Wonderlich, Frost, Bulik, Mitchell, Uppala et al., 2007), and is believed to contribute to treatment resistance and relapse (Bastiani, Rao, Weltzin & Kaye, 1995).

Although much of the perfectionism literature emerged over a decade ago, there has been a relatively recent resurgence of literature implicating perfectionism in the maintenance of eating disorders (Fairburn, Cooper, & Shafran, 2003; Stice, 2002). However, despite considerable empirical support for the importance of perfectionism in the eating disorders it remains an ill-defined and poorly understood phenomenon (Shafran, Cooper & Fairburn, 2002). Shafran et al. (2002) have made a significant contribution to our understanding and definitions of perfectionism by proposing a cognitive-behavioural conceptualisation that specifically refers to the type of dysfunctional perfectionism common to the eating disorders. Termed "clinical perfectionism" it is characterised by the adoption of high personal standards that are determinedly pursued despite adverse consequences (Shafran, Cooper & Fairburn, 2002).

Although high personal standards remain an undisputed component of perfectionism, recent findings suggest that they are not necessarily, by themselves, pathological (Dunkley, Blankstein, Halsall, Williams & Winkworth, 2000; Frost, Marten, Lahart & Rosenblate, 1990). Setting and striving for high personal standards is considered to be the core component of an adaptive, functional form of perfectionism (Frost et al., 1990; Alden, Ryder & Mellings, 2002). However, if a failure to meet the high standards negatively impacts on the individual's self-evaluation, the perfectionism becomes dysfunctional and maladaptive (Alden Ryder & Meelings, 2002; Burns, 1980). Indeed, central to the definition of clinical perfectionism is the impact upon self-evaluation of not meeting high personal standards, an effect posited to be mediated by self-criticism (Shafran, Cooper & Fairburn, 2002). In keeping with this model, recent conceptualisations of dysfunctional perfectionism have highlighted the importance of critical self-evaluation (Dunkley, Blankstein, Masheb & Grilo, 2006). For example, Dunkley et al. (2006) showed that in a binge-eating disorder (BED) sample, the established association between specific aspects of eating psychopathology (i.e., weight and shape concerns) and high personal standards is essentially a product of self-criticism. They concluded that these findings generally concur with those of others (e.g., Vohs, Bardone, Joiner, Abramson & Heatherton, 1999) and suggest that self-criticism plays a critical role in the relation between high personal standards and eating psychopathology. However, due to the nature of the sample, Dunkley et al (2006) did not examine the relationships between the high personal standards and self-criticism dimensions of perfectionism and psychopathology relevant to a broader range of eating problems (i.e., restrictive or bulimic disorders). This is likely to be important since levels of both self-criticism and high personal standards have been found to be significantly elevated across both anorexic and bulimic patient groups, compared to psychiatric and non-clinical controls (Steiger, Goldstein, Mongrain & Van der Feen, 1990; Castro-Fornieles, Gual, Lahortiga, Gila, Casula et al., 2007). In addition, there is some preliminary support for the self-critical dimension of perfectionism potentially having greater explanatory value in predicting the

occurrence of non-BED eating pathology than the high personal standards dimension (Bulik et al., 2003).

In summary, there is preliminary evidence that the pathological component of perfectionism in the context of eating disorders is the self-criticism that ensues when high personal standards are not met (Shafran, Cooper & Fairburn, 2002; Dunkley et al., 2000; 2007). Given the importance of self-criticism in explaining the specific link between high personal standards and BED psychopathology (Bardone-Cone, 2007), it is important to determine whether self-criticism has similar explanatory value in the relationships between high personal standards and psychopathology relevant to restrictive or bulimic disorders. Given the role of perfectionism in the pathogenesis of eating disorders (Fairburn et al., 1999; Fairburn, Shafran & Cooper, 1999; Lilenfeld et al., 2006), understanding the specific roles of self-criticism and high standards among young women is critical. Testing this model within a group of women with a broad range of eating attitudes and behaviours (as found in unselected non-clinical groups) is therefore warranted.

The aim of the first study is to examine the predictive effects of high personal standards upon different facets of eating psychopathology when self-criticism is taken into account. In line with previous findings (Steiger et al., 1990; Bardone-Cone, 2007; Chang, Ivezay, Downey, Kashima & Morady, 2008; Downey & Chang, 2007), it is predicted that high personal standards will be associated with a broad range of eating psychopathology. However, once the variance attributed to self-criticism is taken into account, the association between high personal standards and eating psychopathology will no longer be significant.

Study 7

Method

Participants

Ninety-seven young women were recruited on an opportunity basis from a UK University via email, direct approach, and lectures. All participants either volunteered, or

received course credit or payment for taking part. They were aged between 18 and 30 (mean age 21 years, SD = 2.53; range = 18.1 – 30.0), had a mean self-reported Body Mass Index (BMI) of 21.9 (SD = 2.62, range = 16.3 – 31.6) and spoke English as their first language. Participants were not screened for a past or present diagnosis of an eating disorder to allow a wide range of eating-related attitudes to be included in the analyses.

Procedure

Following ethical clearance and informed consent, participants were instructed to complete three self-report questionnaires; The Frost Multidimensional Perfectionism Scale (FMPS; Frost et al., 1990), the Depressive Experiences Questionnaire (DEQ; Blatt & D’Afflitti, 1976), and the Eating Disorders Examination Questionnaire (EDE-Q; Fairburn & Beglin, 1994). They were asked to complete the measures whilst alone without discussing their responses with anyone and return it to the researcher.

Frost Multidimensional Perfectionism Scale (FMPS)

The FMPS (Frost et al., 1990) is a 35-item self-report measure of multidimensional perfectionism. Items are rated on a 5-point Likert type scale and the measure comprises 6 subscales: *personal standards, concern over mistakes, doubts about actions, parental expectations, parental criticism, and organization*, with higher scores reflecting greater levels of pathology. In line with Shafran et al.’s (2002) assertion that the 7-item FMPS *personal standards* subscale is “closest to the clinical concept of perfectionism” (p. 777) only this subscale was used (e.g., “I have extremely high goals”) in this study. In addition, previous research has identified the personal standards subscale as being the primary FMPS indicator of the high standards dimension of perfectionism (Bieling, Israeli & Antony, 2004; Blankstein & Dunkley, 2002). The FMPS has previously demonstrated good psychometric properties in non-clinical groups (Frost et al., 1990; Coen & Ogles, 1993; Hall, Kerr & Matthews, 1998), with reported alpha coefficients for the personal standards subscale ranging from 0.79 to 0.81 (Dunkley, Zuroff & Blankstein, 2006; Pearson &

Gleaves, 2006). In the current study, Cronbach's alpha for the personal standards subscale was 0.84. See Appendix I for a copy of the FMPS.

Depressive Experiences Questionnaire (DEQ)

The DEQ (Blatt & D'Afflitti, 1976) is a 66-item self-report measure of dependency and self-criticism. Items are rated on a 7-point Likert type scale and generate 2 subscales: *dependency*, and *self-criticism*, with higher scores reflecting greater levels of pathology. As used in previous research (Dunkley et al., 2000; 2006), only the *self-criticism* subscale was used in this study (e.g., "I tend to be very critical of myself"). The self-criticism subscale of the DEQ is highly stable, has high internal consistency (Zuroff, Quinlan & Blatt, 1990), and has shown good convergent and discriminant validity across a variety of samples (Blatt, 2004; Zuroff, Mongrain & Santor, 2004). Cronbach's alphas were not computed for DEQ self-criticism because it was not scored in the conventional fashion of summing a series of items. Rather, as recommended by Zuroff et al (1990), DEQ self-criticism was scored using the factor scoring coefficients obtained for female subjects in the original standardization sample (Blatt, D'Afflitti & Quinlan, 1976), where scores were standardized so that the mean was zero and the standard deviation was 1. See Appendix J for a copy of the DEQ.

Eating Disorders Examination Questionnaire (EDE-Q)

The EDE-Q (Fairburn & Beglin, 1994) is a well validated, reliable self-report measure of eating disorder psychopathology based on the Eating Disorder Examination interview (Cooper & Fairburn, 1987; Fairburn & Cooper, 1993). It comprises 36 items focusing on the preceding 28 days that assess the main behavioural and attitudinal features of eating disorders. It uses a 7-point forced choice rating scheme and generates four subscales of: restraint, eating concern, shape concern and weight concern. Scores of four or more on key items are indicative of clinical pathology (Fairburn & Cooper, 1993). In the current study, Cronbach's alpha for the overall scale was 0.85. Alpha coefficients for

each of the subscales were: restraint 0.85; eating concern 0.74; shape concern, 0.82; and weight concern 0.83. See Appendix F for a copy of the EDE-Q.

Data Analyses

Kolmogorov-Smirnov χ^2 tests showed the data were normally distributed, therefore parametric analyses were used throughout. The data were analysed in three ways. First, Cronbach's alpha tests were used to assess the reliability of the relevant FMPS and EDE-Q subscales. Second, Pearson's r correlations were performed to determine any associations of FMPS and DEQ scores with EDE-Q scores. Finally, in order to assess whether any association between the high personal standards dimension of perfectionism and eating psychopathology remains once the variance attributed to self-criticism was taken into account, two sets of hierarchical multiple regressions were conducted, each using EDE-Q total and subscale scores as the dependent variables. The reason for using this two-step method of analysis is that it enables an examination of both the unique contribution of a single independent variable and the incremental contribution of a related independent variable over and above the other (i.e., whilst controlling for the other) on the dependent variable (Dunkley et al., 2006). In the first set of regression analyses, FMPS personal standards was entered in the first block and DEQ self-criticism was entered in the second block. In the second set of regressions, DEQ self-criticism was entered in the first block and FMPS personal standards was entered in the second block. Inspection of the scatterplots, tolerance values and residuals indicated that all further assumptions of regression analysis were met in terms of linearity, homoscedacity, independence of residuals and absence of multicollinearity (Tabachnick & Fidell, 2001). In keeping with the directional hypotheses one-tailed tests were used throughout. Due to the number of tests performed, the significance limit was set at $p < .01$.

Results

Characteristics of the sample

The women's mean score on the FMPS personal standards subscale was 3.41 (SD = .76, range = 1.71 – 5.00). Their mean score on the DEQ self-criticism subscale was -.19 (SD = .97, range = -2.52 – 2.02). Finally, their scores on the EDE-Q subscales were Restraint = 2.10 (SD = 1.52, range = .00 – 6.00), Eating concerns = 1.32 (SD = 1.12, range = .00 – 4.60), Shape concerns = 2.54 (SD = 1.08, range .00 – 4.88), and Weight concerns = 2.27 (SD = 1.48, range .00 – 4.69). The scores for all three measures were similar to those reported previously for young female samples (Dunkley, Zuroff & Blankstein, 2006; Luce, Crowther & Pole, 2008; Powers, Zuroff & Topciu, 2004).

Associations between perfectionism and eating psychopathology

As predicted, increased perfectionism was reliably associated with elevated eating psychopathology. Specifically, FMPS personal standards was significantly and positively associated with EDE-Q total ($r = .25, p < .01$), EDE-Q restraint ($r = .28, p < .01$), EDE-Q eating concerns ($r = .24, p < .01$), and EDE-Q weight concerns ($r = .26, p < .01$). There was no significant association between FMPS personal standards and EDE-Q shape concerns ($r < .01, p > .17$). In addition, there were significant, positive associations of DEQ self-criticism with EDE-Q total ($r = .50, p < .001$), EDE-Q restraint ($r = .39, p < .001$), EDE-Q eating concerns ($r = .55, p < .001$), EDE-Q shape concerns ($r = .40, p < .001$), and EDE-Q weight concerns ($r = .26, p < .01$).

The first set of hierarchical multiple regression analyses examined the predictive validity of FMPS personal standards without controlling for DEQ self-criticism and the incremental predictive validity of DEQ self-criticism over and above FMPS personal standards. As shown in Table 5.1, FMPS personal standards made a significant contribution of between 6% and 8% of the variance across four of the five EDE-Q scores. In addition, the incremental predictive power of DEQ self-criticism was demonstrated. Specifically, it accounted for between 9% and 25% of unique variance across the five

eating subscales over and above FMPS personal standards (i.e., once the variance accounted for by personal standards had been taken into account).

The second set of regressions tested the incremental predictive validity of FMPS personal standards over and above DEQ self-criticism. Table 5.1 shows that DEQ self-criticism made a significant contribution of between 15% and 31% of the criterion variance across the five eating criteria. After controlling for DEQ self-criticism, FMPS personal standards failed to make a statistically significant contribution to the variance in any of the five EDE-Q scores.

In summary, these findings indicate that the association between the personal standards dimension of perfectionism and eating psychopathology is no longer statistically significant once the shared variance with self-criticism is controlled for.

Table 5.1. Study 7: Hierarchical regression analyses predicting EDE-Q scores with dimensions of perfectionism ($N = 97$)

Predictor variables	Dependent variables									
	EDE-Q total		EDE-Q restraint		EDE-Q eating concerns		EDE-Q shape concerns		EDE-Q weight concerns	
	<i>B</i>	ΔR^2	<i>B</i>	ΔR^2	<i>B</i>	ΔR^2	<i>B</i>	ΔR^2	β	ΔR^2
Step 1		.06*		.08*		.06*		.01		.07*
FMPS Personal standards	.25*		.28*		.24*		.10		.26*	
Step 2		.19**		.09**		.25**		.16**		.14**
DEQ Self-criticism	.48**		.33**		.55**		.44**		.42**	
Step 1		.25**		.15**		.31**		.16**		.20**
DEQ Self-criticism	.50**		.39**		.55**		.40**		.45**	
Step 2		.00		.02		.00		.01		.01
FMPS Personal standards	.05		.13		.00		-.09		.08	

* $p < 0.01$, ** $p < 0.001$ (one-tailed).

Discussion

The aim of Study 7 was to examine the predictive effects of the high personal standards dimension of perfectionism upon different facets of eating psychopathology when self-criticism was taken into account. As predicted, the findings indicate that self-criticism substantially accounts for the relationship between high personal standards and eating psychopathology. These results are consistent with previous findings (Dunkley et al., 2006; Dunkley, Zuroff & Blankstein, 2003) and support the model of “clinical perfectionism” proposed by Shafran et al. (2002). These findings extend those of Dunkley et al. (2006) by showing that among young women, self-criticism accounts for the relationship between high personal standards and a broad range of eating psychopathology relevant to restrictive and bulimic eating disorders, as measured by the EDE-Q.

Study 8

While self-criticism is clearly important in the context of eating disorders, the specific *form* these self-critical tendencies take (i.e., people’s typical style of thinking about themselves when faced with failure), and the *functional utility* of these cognitions for the individual remain unknown.

In relation to forms of self-criticism, Thompson and Zuroff (2004) proposed a model of self-criticism that specifically identifies two different forms. The first results from negative comparisons with others (i.e., comparative self-criticism), while the second relates to self-directed criticism over failing to meet internal, personal standards (i.e., internalized self-criticism). Given that the key aspect of Shafran et al.’s (2002) clinical perfectionism model is that self-criticism occurs in response to a perceived failure to meet personal standards that are self-imposed and internalized, it follows that internalized self-criticism should be a stronger predictor of eating psychopathology than the comparative

form. In addition, Gilbert, Clarke, Hempel, Miles and Irons (2004) found that the form self-criticism takes can differ on three dimensions. On the one-hand self-criticism can be maladaptive/dysfunctional and take the form of either specific self-criticisms that focus on disappointment, inferiority, and feelings of inadequacy (i.e., inadequate self), or self-criticisms that focus on self-disgust and self-hatred (i.e., hated self). Alternatively, the self-criticisms can be adaptive and focus on self-reassurance (i.e., reassure self). Feelings of inadequacy and inferiority have been identified within eating disordered women (Garner, 1991) and associated with increased levels of eating psychopathology (Bellew, Gilbert, Mills, McEwan & Gale, 2006; Ferrier & Martins, 2008). It therefore follows that a thinking style focused on feelings of inadequacy is likely to be most strongly associated with eating psychopathology.

With regard to the functional utility of self-criticism (i.e., the reasons people give for engaging in self-critical cognition), Gilbert et al. (2004) found that these reasons fall upon two dimensions: a relatively adaptive dimension of self-criticism for self improvement (i.e., self-correction), or a maladaptive dimension of self-criticism to persecute the self (i.e., self-persecution). Given the negative impact of self-criticism on self-evaluation within the context of the eating disorders (Shafran, Cooper & Fairburn, 2002) it follows that self persecution is likely to have the strongest association with eating psychopathology.

In summary, whilst self-criticism has been found to be important in relation to eating psychopathology, and to be the critical component of dysfunctional (i.e., clinical) perfectionism, little is known about the specific forms of thinking style or the functional utility of these self-critical tendencies for the individual. In addition, the relationships of the differing forms and functions of self-criticism with eating psychopathology may be expected to differ according to particular eating symptomatology. Therefore, the aim of Study 8 is to investigate the associations between the forms and functions of self criticism and eating psychopathology in a young female sample. In line with the clinical perfectionism model it is expected that internalised self-criticism will be a stronger predictor of increased eating psychopathology than comparative self-criticism. It is also

expected that the “inadequate self” thinking style will be the cognitive style most strongly related to eating psychopathology, and that “self-persecution” will be the predominant function of the self-criticism.

Method

Participants

One hundred and seven young women were recruited on an opportunity basis from a UK University via email, direct approach, and lectures at the university. All participants either volunteered, or received course credit or payment for taking part. They were aged between 18 and 39 (mean age 20.3 years, SD = 4.53), had a mean Body Mass Index of 22.19 (SD = 3.17, range = 16.6 – 36.1) and spoke English as their first language. Participants were not screened for a past or present diagnosis of an eating disorder to allow a wide range of attitudes to be included.

Procedure

Following informed consent, participants were instructed to complete four self-report questionnaires: the Levels of Self Criticism Scale (LOSC; Thompson & Zuroff, 2004); the Forms of Self-criticising and Self-reassuring Scale (FSCRS; Gilbert, Clarke, Hempel, Miles & Irons, 2004); the Functions of Self-criticism Scale (FSCS; Gilbert et al., 2004); and the Eating Disorders Examination Questionnaire (EDE-Q; Fairburn & Beglin, 1994). They were asked to complete the measures whilst alone without discussing their responses with anyone and return it to the researcher.

Levels of Self-Criticism Scale (LOSC)

The LOSC (Thompson & Zuroff, 2004) is a 34-item self-report measure of dysfunctional negative self-evaluation. Items are rated on a 7-point Likert-type scale and the measure comprises two subscales: *comparative self-criticism*, defined as a negative view of the self in comparison with others (e.g., “I often worry that other people will find out

what I'm really like and be upset with me"); and *internalised self-criticism*, defined as a negative view of the self in comparison with internal, personal standards that are high and constantly receding (e.g., "I frequently compare myself with my goals and ideals"). The LOSC has previously demonstrated good psychometric properties in non-clinical groups (Gilbert et al., 2004; Thompson & Zuroff, 2004). In the current study, Cronbach's alpha coefficients for each of the subscales were as follows: comparative self-criticism = 0.77; and internalised self-criticism = 0.86. See Appendix K for a copy of the LOSC.

Forms of Self-Criticising and Self-Reassuring Scale (FSCRS)

The FSCRS (Gilbert et al., 2004) is a 24-item self-report measure of people's typical style of thinking about themselves when something goes wrong. Items are rated on a 5-point Likert-type scale and generate the subscales of: *inadequate self*, defined as thoughts/feelings of inadequacy and self-disappointment (e.g., "When things go wrong for me I am easily disappointed with myself"); *hated self*, defined as thoughts/feelings of wanting to hurt the self and disliking the self (e.g., "When things go wrong for me I have become so angry with myself that I have wanted to hurt or injure myself"); and *reassured self*, defined as the ability to be self-reassuring (e.g., "When things go wrong for me I am able to remind myself of positive things about myself"). The FSCRS has previously demonstrated good psychometric properties in non-clinical groups (Gilbert et al., 2004; Gilbert, Durrant & McEwan, 2003). In the current study, Cronbach's alpha co-efficients for each of the subscales were as follows: inadequate self 0.87; hated self = 0.82; and reassure self = 0.87. See Appendix L for a copy of the FSCRS.

Functions of Self-Criticism Scale (FSCS)

The FSCS (Gilbert et al., 2004) is a 21-item self-report measure of the reasons people engage in self-criticism. Items are rated on a five-point Likert-type scale and generate two subscales of *self correction*, defined as self-criticism for self improvement (e.g., "I get critical and angry with myself to make sure I keep up my standards"); and *self*

persecution, defined as self-criticism to harm and persecute the self (e.g., “I get critical and angry with myself because if I punish myself I feel better”). The FSCS has previously demonstrated good psychometric properties in non-clinical groups (Gilbert et al., 2004; Gilbert, Durrant & McEwan, 2003). In the current study, Cronbach’s alpha co-efficients for each of the subscales were as follows: self correction = 0.86; self persecution = 0.92. See Appendix M for a copy of the FSCS.

Eating Disorders Examination Questionnaire (EDE-Q)

For description see Study 7. In the current study (Study 8) Cronbach’s alpha for the overall scale was 0.86. Alpha coefficients for each of the subscales were: restraint = 0.86; eating concern = 0.82; shape concern = 0.92; and weight concern = 0.85. See Appendix F for a copy of the EDE-Q.

Data analyses

Kolmogorov-Smirnov Z tests showed the data to be normally distributed; therefore parametric analyses were used throughout. Cronbach’s alpha was used to assess the reliability of the LOSC, FSCRS, FSCS and EDE-Q subscales. A series of Pearson’s correlations were performed to determine any associations of LOSC, FSCRS and FSCS scores with EDE-Q scores. Due to the number of tests performed, the significance limit was set at $p < .001$. Finally, in order to determine the individual predictive effect of the three self-criticism measures upon EDE-Q scores, a series of hierarchical multiple regression analyses were performed. Fifteen separate regression analyses were conducted, each using the EDE-Q total score and four EDE-Q subscales (restrain, eating concerns, shape concerns, and weight concerns) as the dependent variable, and either the LOSC, FSCRS or FSCS as the independent variable. Inspection of the scatterplots, tolerance values and residuals indicated that all further assumptions of regression analysis were met in terms of linearity, homoscedacity, independence of residuals and absence of multicollinearity (Tabachnick & Fidell, 2001). Due to the number of tests

performed, the significance limit was set at $p < .01$. In keeping with the directional hypotheses one-tailed tests were used throughout.

Results

Characteristics of the sample

The women's mean scores on the LOSC were: Comparative self-criticism = 40.81 (SD = 9.92, range = 18.00 – 67.00) and Internalised self-criticism = 46.81 (SD = 9.77, range 25.00 – 70.00). Their mean scores on the FSCRS were: Inadequate self = 20.11 (SD = 7.16, range = 4.00 – 36.00); Hated self = 4.43 (SD = 4.23, range .00 – 20.00); and Reassure self = 20.94 (SD = 5.57, range 5.00 – 31.00). Finally, their scores on the EDE-Q were: Restraint = 1.55 (SD = 1.52, range = 00 – 6.00); Eating concerns = 1.05 (SD = 1.17, range = 00 – 5.00); Shape concerns = 2.68 (SD = 1.60, range 00 – 5.75); and Weight concerns = 2.21 (SD = 1.52, range 00 – 5.40). The scores for all three measures were similar to those reported previously for young female samples (Gilbert et al., 2004; Luce, Crowther & Pole, 2008).

Associations between forms of self-criticism and eating psychopathology

As expected, increased levels of self-criticism were positively associated with elevated eating psychopathology. LOSC comparative self-criticism was significantly positively associated with EDE-Q total ($r = .38$ $p < .001$), EDE-Q eating concerns ($r = .32$, $p < .001$), EDE-Q shape concerns ($r = .39$, $p < .001$), and EDE-Q weight concerns ($r = .36$, $p < .001$). The association with EDE-Q restraint failed to reach corrected significance ($r = .28$, $p = \text{NS}$). LOSC internalised self-criticism was significantly positively associated with EDE-Q total ($r = .41$ $p < .001$), EDE-Q restraint ($r = .31$, $p < .001$), EDE-Q eating concerns ($r = .36$, $p < .001$), EDE-Q shape concerns ($r = .44$, $p < .001$), and EDE-Q weight concerns ($r = .37$, $p < .001$).

FSCRS inadequate self was significantly positively associated with EDE-Q total ($r = .55$ $p < .001$), EDE-Q restraint ($r = .35$, $p < .001$), EDE-Q eating concerns ($r = .53$, $p <$

.001), EDE-Q shape concerns ($r = .57, p < .001$), and EDE-Q weight concerns ($r = .53, p < .001$). FSCRS hated self was significantly positively associated with EDE-Q total ($r = .47, p < .001$), EDE-Q eating concerns ($r = .53, p < .001$), EDE-Q shape concerns ($r = .52, p < .001$), and EDE-Q weight concerns ($r = .44, p < .001$). As before, the association with EDE-Q restraint failed to reach corrected significance ($r = .28, p = \text{NS}$). FSCRS reassure self was significantly negatively associated with EDE-Q total ($r = -.41, p < .001$), EDE-Q eating concerns ($r = -.35, p < .001$), EDE-Q shape concerns ($r = -.45, p < .001$), and EDE-Q weight concerns ($r = -.40, p < .001$). Again, the association with EDE-Q restraint failed to reach corrected significance ($r = -.26, p = \text{NS}$).

Associations between functions of self-criticism and eating psychopathology

FSCS self correction was significantly positively associated with EDE-Q total ($r = .30, p < .001$) and EDE-Q eating concerns ($r = .34, p < .001$). There was no association between FSCS self correction and EDE-Q restraint ($r = .26, p = \text{NS}$), EDE-Q shape concerns ($r = .26, p = \text{NS}$), or EDE-Q weight concerns ($r = .24, p = \text{NS}$). FSCS self persecution was significantly positively associated with EDE-Q total ($r = .35, p < .001$), EDE-Q eating concerns ($r = .41, p < .001$), EDE-Q shape concerns ($r = .34, p < .001$), and EDE-Q weight concerns ($r = .32, p < .001$). The association with EDE-Q restraint failed to reach significance ($r = .21, p = \text{NS}$).

Table 5.2. Study 8: Multiple regression analysis predicting EDE-Q scores with levels of self criticism (dysfunctional forms of negative self-evaluation)

Predictor variable	Dependent variables									
	EDE-Q total		EDE-Q restraint		EDE-Q eating concerns		EDE-Q shape concerns		EDE-Q weight concerns	
	β	ΔR^2	B	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2
LOSC		.21**		.11**		.15**		.24**		.18**
Internalised self-criticism	.33**		.26*		.30*		.35**		.29*	
Comparative self-criticism	.22		.16		.17		.23*		.22	

* $p < 0.01$, ** $p < 0.001$ (one-tailed).

Table 5.3. Study 8: Multiple regression analysis predicting EDE-Q scores with forms of self-criticism (cognitive/thinking style)

Predictor variable	Dependent variables									
	EDE-Q total		EDE-Q restraint		EDE-Q eating concerns		EDE-Q shape concerns		EDE-Q weight concerns	
	β	ΔR^2	B	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2
FSCRS		.29**		.10**		.32**		.33**		.26**
Inadequate self	.41*		.36*		.37*		.36*		.39*	
Hated self	.23		.02		.38*		.27		.18	
Reassure self	.05		.03		.17		.00		.00	

* $p < 0.01$, ** $p < 0.001$ (one-tailed).

Prediction of eating psychopathology with forms of self-criticism

The first set of five hierarchical multiple regression analyses examined the predictive validity of the LOSC on EDE-Q total and subscale scores. As shown in Table 5.2, the LOSC made a significant contribution of between 11% and 24% of the criterion variance across all five of the eating criteria. When considering the individual predictors of EDE-Q total and subscale scores, LOSC internalised self-criticism had individual predictive power across all five eating criteria. In contrast, LOSC comparative self-criticism was a significant predictor of EDE-Q shape concerns only.

The second set of five regressions tested the predictive validity of the FSCRS on EDE-Q total and subscale scores. As shown in Table 5.3, these analyses demonstrated the predictive power of the FSCRS subscales, as they contributed between 10% and 33% of the criterion variance across the five eating criteria. Whereas FSCRS inadequate self had significant predictive power across all five of the eating criteria, FSCRS hated self had a significant effect on EDE-Q eating concerns only. In contrast, FSCRS reassure self did not make a significant contribution across any of the five eating criteria.

Prediction of eating psychopathology with functions of self-criticism

Finally, the third set of five hierarchical regressions examined the predictive validity of the FSCS on EDE-Q total and subscale scores. As shown in Table 5.4, these analyses demonstrated the predictive power of the FSCS subscales, as they contributed between 9% and 17% of the criterion variance across the four of the five eating criteria. However, with the exception of EDE-Q restraint for which neither FSCS subscale emerged as a significant predictor, only FSCS self-persecution was a significant predictor in each case.

Table 5.4. Study 8: Multiple regression analysis predicting EDE-Q scores with functions of self criticism (reasons people suggest they engage in self-criticism)

Predictor variable	Dependent variables									
	EDE-Q total		EDE-Q restraint		EDE-Q eating concerns		EDE-Q shape concerns		EDE-Q weight concerns	
	β	ΔR^2	B	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2
FSCS		.12**		.06		.17**		.11**		.09*
Self-correction	.16		.21		.19		.12		.09	
Self-persecution	.27*		.11		.31*		.29*		.28*	

* $p < 0.01$, ** $p < 0.001$ (one-tailed).

Discussion

The aim of Study 8 was to investigate the associations between the forms and functions of self-criticism and eating psychopathology. As predicted, increased levels of both internalised self-criticism and the inadequate self thinking style forms of self-criticism were significantly associated with elevated eating psychopathology. Furthermore, as expected, the self-persecution function of self-criticism was also significantly associated with elevated eating psychopathology. At a general level these results support and extend the findings of Study 7 and lend further support to the model of “clinical perfectionism” proposed by Shafran et al. (2002).

General Discussion

These two studies examined the high personal standards and self-criticism dimensions of perfectionism as predictors of a broad range of eating psychopathology in a group of young women. In Study 7, self-criticism was shown to substantially account for the relationship between high personal standards and eating disorder psychopathology. Our results are consistent with previous findings (Dunkley et al., 2006; Dunkley, Zuroff & Blankstein, 2003) and extend them by showing that self-criticism also accounts for the relationship between high personal standards and eating psychopathology relevant to both restrictive and bulimic disorders. The results of Study 8 further support and extend the conclusions of Study 7. Self-criticism that focused on a failure to meet internal, personal standards coupled with feelings of inadequacy and disappointment was found to be the form associated with elevated eating psychopathology. In addition, the functional utility of the self-critical tendencies associated with eating psychopathology was shown to be driven by self-persecution. Furthermore, Dunkley et al (2006) cautioned against their use of the EDI perfectionism subscales as they represented only a partial representation of the high personal standards construct. Therefore, an additional strength of Studies 7

and 8 was the use of the FMPS personal standards subscale given that it is posited as primary indicator of the personal standards dimension of perfectionism (Dunkley et al., 2000; 2006).

These findings are compatible with a model in which the influence of high personal standards on eating psychopathology is mediated by self-criticism. However, whilst the association between high personal standards and eating psychopathology essentially disappeared once the variance attributed to self-criticism was taken into account, it is important to note that in examining the relationship between specific forms of self-criticism and eating psychopathology, only the specific form of self-criticism in relation to a failure to meet internalised standards was significantly associated with elevated eating psychopathology. A failure to meet these internal standards may result in the feelings of inadequacy and hence the prominence of the self-persecutory function of the self-criticisms.

Dunkley et al (2006) concluded that clinical perfectionism is a two-dimensional construct consisting of two higher order dimensions reflecting high personal standards and self-critical tendencies. However, the current findings demonstrate that the specific form of self-criticism associated with eating psychopathology is characterised by self-criticisms that focus on a failure to live up to internal, personal standards that are high and constantly receding. This supports the view that clinical perfectionism in the context of eating disorders can be considered uni-dimensional (Shafran, Cooper & Fairburn, 2002). Specifically, whilst both 'normal' (i.e., adaptive) and 'clinical' (i.e., maladaptive) dimensions of perfectionism are characterised by high personal standards, clinical perfectionism is uniquely characterised by high standards that are constantly receding and when unmet, are reacted to with punitive self-criticism (Shafran, Cooper & Fairburn, 2002).

The present findings have valuable methodological implications. Whilst previous research highlighted the importance of self-criticism in the relation between high personal standards and BED related eating psychopathology (Dunkley et al., 2006), the current findings highlight the importance of differentially exploring the different forms and

functions of not only self-criticism, but also wider cognitions in the context of a broad range of eating psychopathology. However, these findings are limited by their cross-sectional nature. Therefore, longitudinal research is now required to verify the causal nature of these self-critical tendencies. In addition, these studies require replication within an eating disordered sample to test the generalisability of these findings and to determine links between self-criticism and different types of eating disordered behaviours (including bingeing, vomiting, restriction and compulsive exercise). Despite the need for clinical validation, these findings provide additional support for the suggestion that the focus of therapeutic intervention in treating perfectionism may be better aimed at the self-critical component as opposed to the high standards (Dunkley et al., 2006). In addition, these findings further suggest that treatment efficacy may be enhanced if therapists are aware of the specific cognitive content and functional utility of the self-critical tendencies associated with eating psychopathology.

Chapter 6:

Study 9

Perfectionism and compulsive exercise

among female exercisers:

High personal standards or self-criticism?

Study 9

Perfectionism and compulsive exercise among female exercisers:

High personal standards or self-criticism?

The major findings of Chapter 5 were as follows. In line with previous findings, the link between the high personal standards dimension of perfectionism and eating psychopathology was replicated. However, this relationship was substantially accounted for by the self-critical dimension of perfectionism. In addition, in an extension to previous research this finding was shown to hold true for a broad range of eating psychopathology relevant to both the restrictive and bulimic eating disorders. Furthermore, the specific form of self-criticism associated with increased eating psychopathology was shown to be that which focused on a failure to meet internal, personal standards coupled with feelings of inadequacy and disappointment, whereas the function of the self-criticism was in terms of self-persecution. These findings were compatible with a model in which the influence of high personal standards on eating psychopathology is mediated by self-criticism, and further supported the proposed cognitive-behavioural conceptualisation of compulsive exercise in terms of the links between perfectionism and eating pathology.

The following chapter will examine whether the same is true of the relationship between the high personal standards dimension of perfectionism and compulsive exercise. Specifically, does the self-critical dimension of perfectionism account for the relationship between high personal standards perfectionism and compulsive exercise. The specific relationship being tested is indicated by the number 4 in Figure 6.1 below.

The data presented in this chapter are also presented in Chapters: 2 (Studies 1 and 3 only); 3; 4 (Study 6 only); and 5 (Study 7 only).

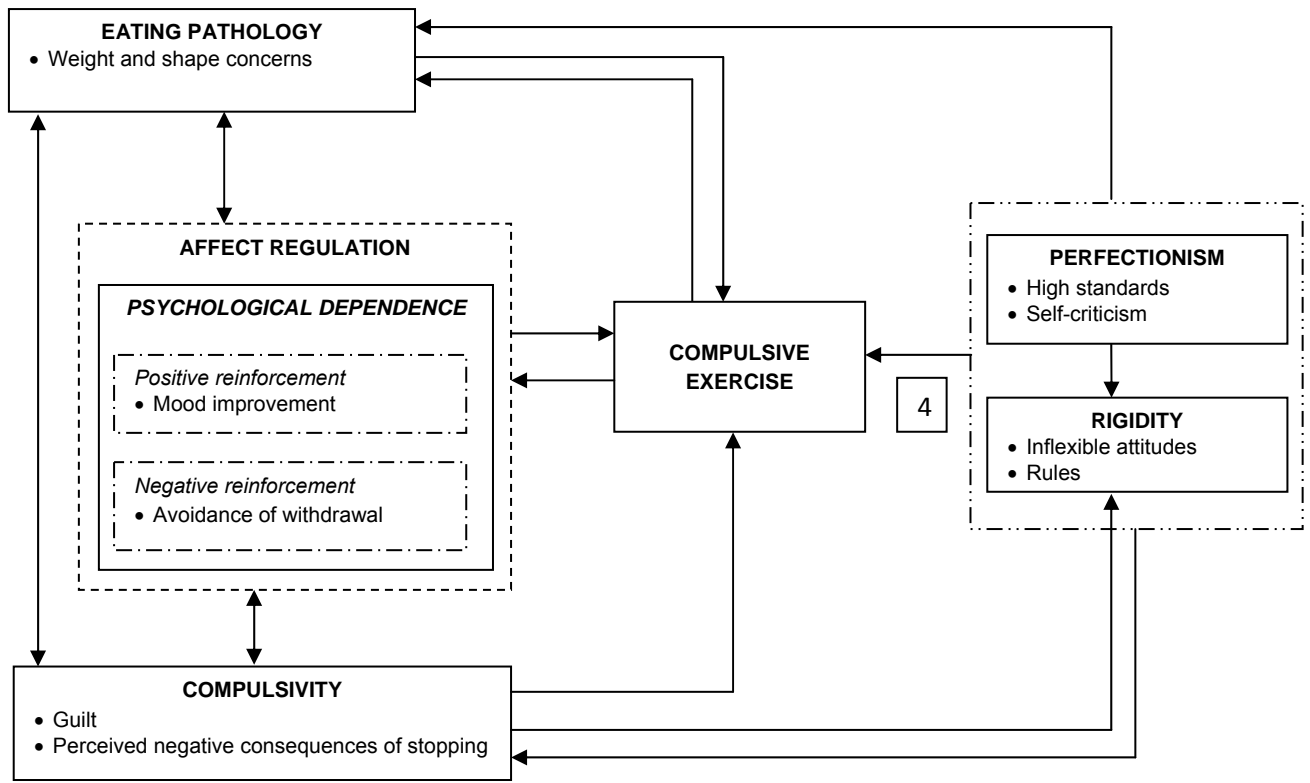


Figure 6.1. A schematic representation of all the factors implicated in the maintenance of compulsive exercise showing the relationship being tested [4] in Chapter 6.

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**Perfectionism and compulsive exercise among female exercisers:
High personal standards or self-criticism?**

Abstract

Objective: The aim of the present study was to determine the relationship of the high personal standards and self-criticism dimensions of perfectionism with compulsive exercise.

Method: Ninety seven young women who exercise regularly completed measures of perfectionistic high personal standards, self-criticism, and compulsive exercise.

Results: Hierarchical multiple regressions analyses indicated that self-criticism substantially accounted for the relationship between high personal standards and compulsive exercise.

Discussion: Compulsive exercisers may require therapeutic interventions that address self-critical tendencies.

Keywords: Compulsive exercise; Perfectionism; Self-criticism

Perfectionism and compulsive exercise among female exercisers:

High personal standards or self-criticism?

Excessive exercise, characterised by its ritualistic and compulsive presentation, has long been recognised as an important aspect of the eating disorders (e.g., Bruch, 1965; Crisp, 1967; Davis, Kennedy, Ralevski, & Dionne, 1994; Epling & Pierce, 1992; Gull, 1874; Inches, 1895; Touyz, Beumont & Hoek, 1987). Indeed, excessive exercise has been described as one of the most obvious compulsions in the eating disorders with a lifetime occurrence in up to 84% of patients (Davis, 1997). Such compulsive exercising has been shown to adversely affect treatment outcomes (Strober, Freeman, & Morrell, 1997), and is associated with a longer length of hospitalisation and increased risk of relapse (Carter, Blackmore, Sutandar-Pinnock, & Woodside, 2004; Solenberger, 2001). Although often conceptualised as simply another weight control behaviour (e.g., Fairburn, Cooper, & Shafran, 2003; Garfinkel & Goldbloom, 1988; Garner, Rockert, Olmstead, Johnson., & Corscina, 1985), empirical findings have implicated compulsive exercise as a significant factor in the development and maintenance of the eating disorders (Abraham, 2003; Beumont, Arthur, Russell & Touyz, 1994; Brewerton, Stelfox, Hibbs, Hodges & Cochrane, 1995; Davis, 1997; Davis et al., 1994; Epling & Pierce, 1996; Garner, Rosen, & Barry, 1998; Kron, Katz, Gorzynski., & Weiner, 1978). Taken together, these conclusions highlight the importance of understanding how compulsive exercise may best be mitigated.

Despite support for compulsive exercise as an important factor in the pathogenesis of the eating disorders, little is known about the factors that operate in the maintenance of compulsive exercise. However, one such factor that has been implicated is perfectionism (Flett & Hewitt, 2005). Typically describing a personality trait characterised by having and striving for high personal standards (Frost et al., 1990), perfectionism is well established as an important factor in the development and maintenance of the eating disorders (Fairburn, Cooper, Doll, & Welch, 1999; Fairburn, Cooper, & Shafran, 2003; Fairburn,

Shafran, & Cooper, 1999; Lilenfeld, Wonderlich, Riso, Crosby, & Mitchell, 2006; Stice, 2002). In terms of compulsive exercise, recent evidence suggests that perfectionism is a robust correlate of compulsive exercise (e.g., Shroff, Reba, Thornton, Tozzi, Klump et al., 2006). Indeed, this relationship has been found among adolescent boys and girls (Brehm & Steffen, 1998), college-aged women (Ackard, Brehm, & Steffen, 2002), competitive and non-competitive runners (Coen & Ogles, 1993; Hall, Kerr, Kozub, & Finnie, 2007), and eating disorder patients across diagnostic groups (Shroff et al., 2006). Unfortunately, despite this evidence, understanding of this relationship is impaired by the use of disparate conceptualizations of both perfectionism (e.g., Frost, Marten, Lahart, & Rosenblate, 1990; Hewitt & Flett, 1991) and compulsive exercise (e.g., Adkins & Keel, 2005; Mond, Hay, Rodgers, Owen, & Beumont, 2004; Taranis, Touyz, & Meyer, in press).

Current empirical findings clearly support defining compulsive exercise within the context of eating disorders as a multidimensional construct consisting of specific cognitive, behavioural, and affective criteria (Taranis, Touyz & Meyer, in press). For example, negative emotion associated with an inability to exercise, specific eating psychopathology-driven exercise, and rigid adherence to an inflexible exercise routine have all been posited as significant components of compulsive exercise that are associated with increased eating pathology (Long & Hollin, 1995; Mond, Hay, Rodgers, & Owen, 2006a; Wyatt, 1997; Yates, 1991). Regrettably, many existing measures of compulsive exercise fail to reflect all of these established constructs, resulting in findings that remain limited (Taranis, Touyz, & Meyer, in press). For example, many such measures fail to include exercising solely for weight or shape reasons despite the finding that in the absence of such, compulsive exercise does not constitute a clinically significant syndrome (Keski-Rahkonen, 2001; Mond et al., 2004; 2006a). It is therefore essential that any conceptualisation of compulsive exercise incorporates all of these defining factors.

With regard to perfectionism, recent findings have consistently demonstrated the existence of two distinct, albeit related, dimensions (e.g., Bieling, Israeli, & Antony, 2004; Blankstein & Dunlkey, 2002). The first is concerned with setting and striving for high

personal standards, while the second reflects a tendency towards self-criticism (Dunkley, Blankstein, Masheb, & Grilo, 2006). Although high personal standards remain an undisputed component of perfectionism, findings suggest that they are not necessarily, by themselves, pathological (e.g., Dunkley, Blankstein, Halsall, Williams, & Winkworth, 2000; Frost et al., 1990; Serpell, Waller, Fearon, & Meyer, 2009). In contrast, self-criticism has been shown to be the primary indicator of the dysfunctional component of perfectionism, substantially accounting for the relationships of high personal standards with depression, anxiety and eating psychopathology (Dunkley et al., 2006).

Compulsive exercisers often strive to achieve a perfect routine and any failure to reach this standard often results in self-recrimination (Beumont et al., 1994). Indeed, Davis (1997) similarly posited a co-occurrence of self-criticism and high personal standards as a potential risk factor for compulsive exercise. Taken together, this suggests that both high personal standards *and* self-criticism are associated with compulsive exercise. To date, no studies have considered whether these different facets of perfectionism interact in the maintenance of compulsive exercise. Specifically, it is not clear to what extent high personal standards are problematic in and of themselves, or whether they are only associated with compulsive exercise when they are accompanied by self-criticism. Therefore, the aims of this study are twofold. First, to determine the associations of both the high personal standards and self-criticism dimensions of perfectionism with a new measure of compulsive exercise based on an empirically derived multidimensional conceptualisation. Second, to determine the extent to which self-criticism accounts for the relationship between high personal standards and compulsive exercise. In line with previous findings, it is predicted that both high personal standards and self-criticism will be positively associated with compulsive exercise (e.g., Beumont et al., 1994; Shroff et al., 2006). Furthermore, given the finding that self-criticism largely accounted for the relationship between high personal standards and psychopathology (Dunkley et al., 2006), it is expected that the association between high personal standards and

compulsive exercise will no longer be significant once the variance attributed to self-criticism is eliminated.

Study 9

Method

Participants

Ninety-seven female exercisers were recruited on an opportunity basis from a UK University via email or direct approach. All participants were undergraduates and either volunteered, or received course credit or payment for taking part. They were aged between 18 and 30 (mean age 21 years, SD = 2.53; range = 18.1 – 30.0), had a mean Body Mass Index of 21.9 (SD = 2.62, range = 16.3 – 31.6) and spoke English as their first language. Women were invited to participate if they reported having engaged in some form of regular sport or exercise over the past 4 weeks for at least 1 hour, 3 times a week (mean exercise per week 5.84 hours, SD = 4.02; range = 1.5 – 21.0).

Procedure

After ethical clearance and completion of informed consent, participants were instructed to complete three self-report questionnaires in the order presented below. The participants were asked to complete the questionnaires alone and to return them directly to the researcher.

Measures

High Personal Standards Perfectionism

The Frost Multidimensional Perfectionism Scale (FMPS; Frost et al., 1990) is a 35-item self-report measure of multidimensional perfectionism. Items are rated on a 5-point Likert type scale and the measure comprises 6 subscales: personal standards, concern over mistakes, doubts about actions, parental expectations, parental criticism, and organization, with higher scores reflecting greater levels of pathology. Previous research

has identified the personal standards subscale as being one of the primary indicators of the high personal standards dimension of perfectionism (e.g., Bieling et al., 2004; Blankstein & Dunkley, 2002; Frost, Heimberg, Holt, Mattia, & Neubauer, 1993). Therefore, only the personal standards subscale was used in this study. The FMPS has previously demonstrated good psychometric properties in non-clinical groups (Coen & Ogles, 1993; Frost et al., 1990; Hall, Kerr, & Matthews, 1998). In the current study, Cronbach's alpha for the personal standards subscale was acceptable (Nunnally, 1978; Nunnally & Bernstein, 1994) at 0.84. See Appendix I for a copy of the FMPS.

Self-criticism

The Depressive Experiences Questionnaire (DEQ; Blatt, D'Affliti, & Quinlan, 1976) is a 66-item self-report measure of dependency and self-criticism. Items are rated on a 7-point Likert type scale and generate 2 subscales: dependency, and self-criticism, with higher scores reflecting greater levels of pathology. In line with previous research (e.g., Dunkley et al., 2000; Dunkley, Zuroff, & Blankstein, 2006), only the self-criticism subscale was used in this study (e.g., "I tend to be very critical of myself"). The self-criticism subscale of the DEQ is highly stable, has high internal consistency (Zuroff, Quinlan, & Blatt, 1990), and has shown good convergent and discriminant validity across a variety of samples (e.g., Blatt, 2004; Zuroff, Mongrain, & Santor, 2004). Cronbach's alphas were not computed for DEQ self-criticism because it was not scored in the conventional fashion of summing a series of items. Rather, as recommended by Zuroff et al (1990), DEQ self-criticism was scored using the factor scoring coefficients obtained for female subjects in the original standardization sample (Blatt et al., 1976), where scores were standardized so that the mean was zero and the standard deviation was 1. See Appendix J for a copy of the DEQ.

Compulsive Exercise

The Compulsive Exercise Test (CET; Taranis, Touyz, & Meyer, in press) is a new, multidimensional, 24-item self-report measure designed to assess the core features of compulsive exercise. It is based on a cognitive-behavioural conceptualization of compulsive exercise and has previously been shown to explain greater variance in eating psychopathology than existing measures of compulsive exercise (Taranis, Touyz, & Meyer, in press). Items are rated on a 6-point Likert type scale and generate the 5 subscales of: Avoidance and rule-driven behaviour (continued exercise despite injury or illness, making up for missed exercise sessions, the experience of affective withdrawal symptoms, guilt and feelings of having let the self down when unable to exercise), Weight control exercise (exercising for weight and shape reasons, compensatory exercise such as debting whereby exercise is moderated according to calorie intake), Mood improvement (positive reinforcement component of exercise), Lack of exercise enjoyment (experiencing exercise as a chore and deriving no enjoyment from it), and Exercise rigidity (rigid adherence to a strict and repetitive exercise routine). Higher scores are indicative of greater pathology. The CET has previously demonstrated good psychometric properties in a non-clinical sample (Taranis, Touyz, & Meyer, in press). In the current study, Cronbach's alpha for each of the subscales were acceptable (Nunnally, 1978; Nunnally & Bernstein, 1994): Avoidance and rule-driven behaviour 0.84, Weight control exercise 0.84, Mood improvement 0.71, Lack of exercise enjoyment 0.79, and Exercise rigidity 0.73. See Appendix B for a copy of the CET.

Data analysis

Kolmogorov-Smirnov Z tests showed the data to be normally distributed; therefore parametric analyses were used throughout. Cronbach's alpha was used to assess the reliability of the relevant FMPS and CET subscales. In order to determine the associations between both the FMPS personal standards and DEQ self-criticism subscales, and compulsive exercise as measured by the CET, correlation coefficients were calculated

(Pearson's r). As used by Dunkley et al. (2006), two sets of hierarchical multiple regression analyses were conducted in order to test the hypothesis and assess whether self-criticism accounts for any relation between high personal standards and compulsive exercise. The reason for using this two-step method of analysis is that it enables an examination of both the unique contribution of a single independent variable and the incremental contribution of a related independent variable over and above the other (i.e., whilst controlling for the other) on the dependent variable (Dunkley et al., 2006). In the first set of regression analyses, FMPS personal standards was entered in the first block and DEQ self-criticism was entered in the second block. In the second set of regressions, DEQ self-criticism was entered in the first block and FMPS personal standards was entered in the second block. Inspection of the scatterplots, tolerance values and residuals indicated that all further assumptions of regression analysis were met in terms of linearity, homoscedacity, independence of residuals and absence of multicollinearity (Tabachnick & Fidell, 2001). In keeping with the directional hypotheses, one-tailed tests were used throughout. Due to the number of tests performed, the significance limit was set at $p < .01$.

Results

Characteristics of the sample

On the perfectionism measures, the women's mean scores were: FMPS Personal standards = 23.84 ($SD = 5.32$, *range* 12.00 – 35.00) and DEQ Self-criticism = -0.19 ($SD = 0.97$, *range* -2.52 – 2.02). Both FMPS and DEQ subscale scores were similar to those reported for other non-clinical student samples (i.e., Dunkley, Zuroff, & Blankstein, 2006; Powers, Zuroff, & Topciu, 2004). The mean scores on the CET were: Avoidance and rule-driven behaviour = 2.22 ($SD = 0.90$, *range* 0.25 – 4.88); Weight control exercise = 3.22 ($SD = 1.08$, *range* 0.00 – 5.00); Mood improvement = 3.59 ($SD = 0.79$, *range* 1.80 – 5.00); Lack of exercise enjoyment = 1.06 ($SD = 0.81$, *range* 0.00 – 3.67); and Exercise rigidity = 3.02 ($SD = 0.89$, *range* 0.67 – 4.67).

Associations between perfectionism and compulsive exercise

As expected, perfectionism was positively associated with compulsive exercise. FMPS personal standards was significantly associated only with avoidance and rule-driven behaviour ($r = .27, p < .01$). However, DEQ self-criticism was significantly, positively associated with avoidance and rule-driven behaviour ($r = .38, p < .001$), weight control exercise ($r = .28, p < .01$), and exercise rigidity ($r = .29, p < .01$). In all other cases $r < .17, p > .05$.

The first set of hierarchical multiple regression analyses examined the predictive validity of FMPS personal standards without controlling for DEQ self-criticism and the incremental predictive validity of DEQ self-criticism over and above FMPS personal standards. As shown in Table 6.1, FMPS personal standards made a significant contribution of between 5% and 7% of the criterion variance across two of the five compulsive exercise subscales. In addition, the incremental predictive power of DEQ self-criticism was demonstrated in that it accounted for between 6% and 14% of unique variance across four of the five compulsive exercise subscales over and above FMPS personal standards.

The second set of regressions tested the incremental predictive effect of FMPS personal standards over and above DEQ self-criticism. Table 6.1 shows that DEQ self-criticism made a significant contribution of between 8% and 19% of the criterion variance across four of the five compulsive exercise subscales. After controlling for DEQ self-criticism, FMPS personal standards failed to make a statistically significant contribution for any of the five compulsive exercise subscales.

Table 6.1. Study 9: Hierarchical regression analyses (one-tailed) predicting components of compulsive exercise with self-criticism and perfectionism dimensions in a female student population ($N = 97$)

Variable	CET									
	Avoidance and rule-driven behaviour		Weight control exercise		Mood improvement		Lack of exercise enjoyment		Exercise rigidity	
	β	ΔR^2	B	ΔR^2	B	ΔR^2	β	ΔR^2	β	ΔR^2
Step 1		.07*		.00		.01		.01		.03
FMPS Personal standards	.27*		.05		.07		.11		.17	
Step 2		.09**		.08*		.00		.02		.06*
DEQ self-criticism	.33**		.32*		.06		.14		.27*	
Step 1		.15**		.08*		.01		.03		.09*
DEQ self-criticism	.38**		.28*		.08		.16		.29*	
Step 2		.01		.01		.00		.00		.00
FMPS Personal standards	.13		-.09		.05		.06		.06	

Note: : * $p < .01$; ** $p < .001$ (one-tailed).

Discussion

The aim of Study 9 was to investigate the relationship between perfectionism and compulsive exercise in a group of young female exercisers. In line with previous findings, compulsive exercise was found to be associated with the high personal standards dimension of perfectionism. However, this association was limited to the avoidance and rule-driven behaviour component of compulsive exercise. It is possible that this reflects the tendency for high personal standards to be operationalised as specific rules that guide behaviour and result in negative emotions when transgressed (Shafran, Cooper & Fairburn, 2002). In contrast, self-criticism was associated with avoidance and rule-driven behaviour, weight and shape exercise, and exercise rigidity. This suggests that the self-critical component of perfectionism may be a more significant factor in compulsive exercise.

Furthermore, in keeping with the hypotheses, the findings suggest that the association between the high personal standards dimension of perfectionism and compulsive exercise is non-significant after accounting for shared variance with self-criticism. These findings expand previous research by suggesting that the previously found association between perfectionism and compulsive exercise may be largely accounted for by the self-critical dimension. The current findings are consistent with Dunkley et al.'s (2006) finding that self-criticism substantially accounts for the relation between perfectionism and depressive, anxious, and eating disorder symptoms, and adds further support to their conceptual framework delineating self-criticism as the primary indicator of dysfunctional perfectionism. While further research is clearly needed to determine whether a similar relationship is present in an eating disordered sample, it would appear that compulsive exercisers may require therapeutic interventions that address self-critical tendencies. This is in line with the suggestion of Dunkley et al. (2006) that the focus of therapeutic intervention in addressing perfectionism may be better aimed at the self-critical component as opposed to the high personal standards. To date, there is

no specific therapeutic intervention aimed at addressing compulsive exercise. Further research may therefore be warranted to consider how best to address self-criticism in the context of compulsive exercise.

Study 9 has two main strengths. Firstly, it used an empirically derived multidimensional measure of compulsive exercise that addressed many of the shortcomings of existing measures (Taranis, Touyz, & Meyer, in press). Secondly, it used measures of perfectionism that are posited to be the best indicators of both the high personal standards and self-critical dimensions of perfectionism (Bieling et al., 2004; Blankstein & Dunkley, 2002; Dunkley et al., 2000; Dunkley et al., 2006; Frost et al., 1993).

Whilst the present research provides preliminary empirical support for the role of self-criticism as an important factor in compulsive exercise, it should be acknowledged that several limitations apply. First, the present study relied upon a cross-sectional design that does not permit causality to be determined. Future research should aim to replicate these findings and consider using longitudinal or experimental designs to verify the causal nature of these self-critical tendencies. Second, the use of young female university sample may limit the generalisability of our findings to eating disordered samples. Therefore, these studies require replication within a range of eating and non-eating disordered populations.

In conclusion, these preliminary findings suggest that it is not necessarily high personal standards that account for the occurrence of compulsive exercise. Instead, self-criticism is posited as the primary indicator of the dysfunctional perfectionism associated with compulsive exercise.

Chapter 7

General discussion

General discussion

7.1 Aims and hypotheses of the present thesis

The rationale of the present thesis was based on the fact that there is a need to develop a theoretically coherent and empirically supported model of the maintenance of compulsive exercise in the eating disorders. The studies that made up the empirical component of this thesis tested the relationships numbered 1 - 4 in the proposed model below.

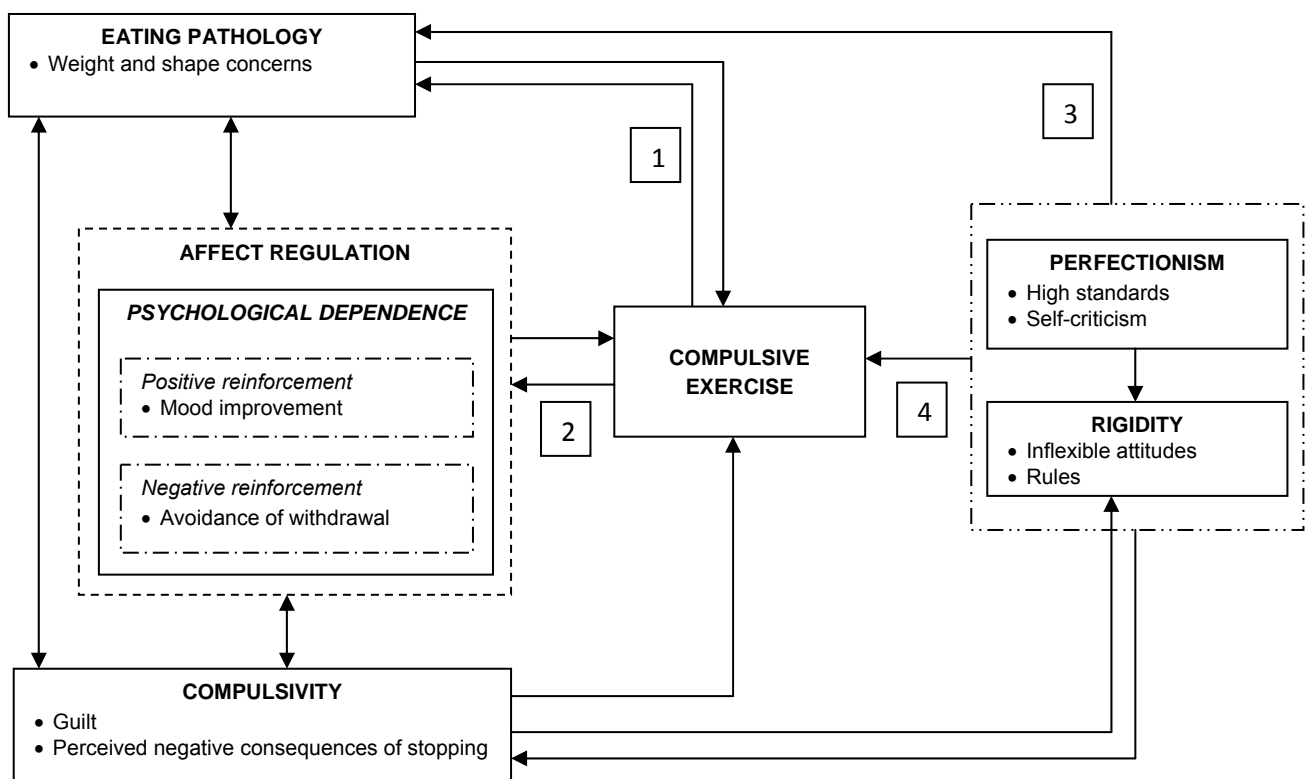


Figure 7.1. A schematic representation of all the factors implicated in the maintenance of compulsive exercise showing the relationships tested by the empirical component of this thesis.

The thesis had three broad aims. The first aim was to develop a theoretically coherent and empirically supported maintenance model of compulsive exercise from the existing literature (Figure 7.1). The second aim was to develop and validate a new self-report measure of compulsive exercise based on the proposed maintenance model of

compulsive exercise. The hypotheses were that: (a) stable factors (components) would emerge that were in accordance with the proposed maintaining factors of compulsive exercise; (b) the factor structure would support a multidimensional conceptualisation of compulsive exercise; and (c) the new measure would explain more variance in eating psychopathology than existing measures of compulsive exercise.

The third aim was to extend the model of compulsive exercise by specifically testing the links between some of the proposed maintaining factors and compulsive exercise, whilst taking into account the latest developments in each of the areas (Figure 7.1). It was hypothesised that compulsive exercise would: (a) be differentially associated with eating-disordered cognitions *and* behaviours; (b) demonstrate links with maladaptive emotional coping strategies and difficulties regulating emotions (i.e., mood intolerance); and (c) be associated with the same dimension of perfectionism implicated in the development and maintenance of eating pathology.

The present thesis has important research and clinical implications. First, it should provide a new measure of compulsive exercise that addresses the shortcomings of previous measures and is a potentially useful tool for use in both research and clinical practice. Such a tool could not only assist in ridding the literature of the equivocality that undermines much of the current evidence but could also prove useful as an outcome measure or aid to clinical formulation. Second, it should help further our understanding of compulsive exercise. Specifically, it should enhance our understanding of the relationship between compulsive exercise and eating pathology. In addition, it should provide further empirical support for the proposed maintenance model of compulsive exercise that details factors potentially operating in the maintenance of compulsive exercise (Figure 7.1). This could provide invaluable insights into how compulsive exercise can best be approached therapeutically and may inform early intervention or preventative strategies. Such insights could potentially reduce the poor prognosis for ED patients who present with compulsive exercise and may further aid in the early detecting of EDs. Lastly, it should provide suggestions for further research.

7.2 Summary of results

Overall, the results obtained in this thesis were broadly consistent with the hypotheses of the empirical chapters. The findings are outlined below.

7.2.1 Studies 1, 2 and 3: Development of the Compulsive Exercise Test (CET):

Factor analyses yielded five factors from which a final 24-item, five subscale measure was constructed. The resulting factors support the multidimensionality of the compulsive exercise construct and are consistent with a cognitive-behavioural conceptualisation of compulsive exercise. The CET demonstrated high internal consistency across three samples. Concurrent, convergent and content validity of the scale was established, with the CET correlating in the expected direction with existing measures of compulsive exercise and eating psychopathology, and its items being rated as relevant to and representative of compulsive exercise symptomatology by a panel of clinical eating disorder specialists. As expected, the CET explained greater variance in eating psychopathology than existing measures of compulsive exercise, further supporting our hypotheses and conceptual framework regarding the multidimensional nature of compulsive exercise.

7.2.2 Study 4: Links between compulsive exercise and eating psychopathology and behaviours

Compulsive exercise was found to be associated with elevated levels of eating-disordered cognitions and increased frequency of eating-disordered behaviours. These results suggest that some of the functionality of compulsive exercise may be akin to other forms of purging (i.e., compulsive exercise as a compensatory strategy in terms of caloric purgation). In addition, given the proposed function of some eating-disordered behaviours such as bingeing and vomiting in regulating affect (Fairburn et al., 2003; Meyer et al., 1998), these results also support the notion of a possible functional equivalence between

compulsive exercise and specific eating-disorder behaviours in terms of affect regulation. Taken together, these results add further support to the multifunctional conceptualisation in the proposed cognitive-behavioural model of compulsive exercise suggesting that compulsive exercise may serve both a purgative and affect regulatory function. However, these results require verification in eating-disordered samples and would further benefit from being examined in 'real time' perhaps via ecological momentary assessment (EMA).

7.2.3 Studies 5 and 6: Compulsive exercise and emotion regulation

The results of Studies 5 and 6 demonstrated that compulsive exercise is associated with a dysfunctional style of emotional coping via avoidance of affect. This further supported the notion of compulsive exercise serving an affect regulatory function, much as restrictive and bulimic behaviours have been shown to do in the eating disorders. In addition, compulsive exercise was shown to be associated with specific difficulties in regulating emotions, even after controlling for levels of eating psychopathology. This finding was in line with the concept of "mood intolerance" as being a maintaining factor for compulsive exercise as well as restrictive and bulimic behaviours. Taken together, these results add further support to the multifunctional conceptualisation of compulsive exercise particularly in terms of affect regulation. Furthermore, these results are not only compatible with existing cognitive-behavioural models of eating disorders, but are also in line with the proposed cognitive behavioural conceptualisation of compulsive exercise.

7.2.4 Studies 7 and 8: Eating psychopathology and perfectionism

The results of Studies 7 and 8 demonstrated that whilst the high personal standards dimension of perfectionism is associated with psychopathology relevant to restrictive and bulimic eating disorders, this relationship was largely accounted for by the self-critical dimension of perfectionism. In addition, the forms of self-criticism associated with eating psychopathology were in terms of a failure to meet with internal personal standards and a view of the self as inadequate. Taken together these results highlighted

the importance of the self-critical dimension of perfectionism in relation to eating psychopathology, as well as being in line with the model of clinical perfectionism that is specific to the eating disorders. Furthermore, these findings are compatible with a model in which the influence of high personal standards on eating psychopathology is mediated by self-criticism. However, this would need to be confirmed using mediational analysis.

7.2.5 Study 9: Compulsive exercise and perfectionism

In line with previous findings, Study 9 replicated the link between high personal standards and compulsive exercise. In addition, in line with the findings of Studies 7 and 8, the results of Study 9 demonstrated that whilst the high personal standards dimension of perfectionism is associated with compulsive exercise, this relationship was substantially accounted for by the self-criticism dimension of perfectionism. These findings therefore expand previous research by suggesting that the association between perfectionism and compulsive exercise may be largely accounted for by the self-critical dimension. Furthermore, these findings add further support to the proposed cognitive-behavioural conceptualisation of compulsive exercise.

7.3 Contribution of the present results to the understanding of compulsive exercise

As mentioned previously, compulsive exercise is implicated as a significant factor in the aetiology, development and maintenance of the eating disorders across diagnoses. Yet despite this obvious importance, there currently exists no protocol for the treatment of compulsive exercise. This may be attributed to the fact that to date, little is understood about the factors operating in the maintenance of compulsive exercise. Given the association between compulsive exercise and greater chronicity in the eating disorders, it follows that an intervention for the treatment of compulsive exercise is warranted, indeed it is required. However, such an intervention would need to be based on a theoretically coherent and empirically supported conceptualisation of compulsive exercise and the

factors operating in its maintenance. Unfortunately, any attempt to construct such a model is hampered by the myriad of definitions and terms used to describe compulsive exercise and associated constructs. As a result, much of the existing literature remains equivocal and requires further validation.

This thesis aimed to enhance our understanding of compulsive exercise by constructing a theoretically coherent model of the factors implicated in the maintenance of compulsive exercise that was amenable to empirical validation, and is compatible with a cognitive-behavioural conceptualisation of compulsive exercise. In addition, in order to provide preliminary validation data for the proposed model that was both reliable and conceptually valid, a new measure of compulsive exercise was constructed in line with the proposed cognitive-behavioural conceptualisation.

The results of the published studies that make up this thesis have undoubtedly increased our understanding of compulsive exercise. The new measure of compulsive exercise has been shown to be conceptually valid and psychometrically sound, and has already been used by colleagues Naylor and Mountford (in press; 2010). Previously suggested relationships between compulsive exercise and potential maintaining factors such as eating pathology, affect regulation and perfectionism have been both replicated and extended. The results of the studies have provided preliminary support for the proposed cognitive-behavioural conceptualisation of compulsive exercise upon which a cognitive-behavioural intervention could be based and empirically tested. Lastly, the present findings provide a foundation upon which further studies can build and begin to develop a better understanding of the role compulsive exercise plays in the aetiology and development of the eating disorders. The contributions that the current findings have made to research in the field of eating disorders will be discussed next.

7.3.1 A new measure of compulsive exercise: The Compulsive Exercise Test (CET)

It was suggested in Chapter 1 that a new measure of compulsive exercise was needed in order to address the equivocality of the literature stemming from the inadequate

and inconsistent definition and measurement of the compulsive exercise construct. In line with this proposal, a new measure of compulsive exercise was developed. The development of the CET has verified the multidimensionality of the compulsive exercise construct. In addition, the CET is the first multidimensional measure of compulsive exercise developed specifically in the context of the eating disorders. It is further the first and only measure of compulsive exercise that includes all of the cognitive, affective and behavioural factors implicated as important in the construct of compulsive exercise. In the current thesis the CET has highlighted the importance of examining the differential links between the disparate components of compulsive exercise and variables of interest such as eating pathology and affect regulation. The CET has further demonstrated that it is potentially a useful research and outcome tool that can be used to further examine and develop understanding of the compulsive exercise construct. In addition, the current results established that the CET may prove effective in providing a clearer picture of those factors that maintain compulsive exercise and predict the observed poor outcome and reduced relapse in those women for whom compulsive exercise is a component of their eating disorder.

7.3.2 Links between compulsive exercise and eating disordered psychopathology and behaviours

In line with previous findings, the current thesis found that compulsive exercise was associated with increased levels of eating psychopathology (Elbourne & Chen, 2007; Lipsey et al., 2006; Penas-Lledo, Vaz Leal, & Waller, 2002). This finding, together with the validation of the 'exercise for weight control' subscale of the CET reinforces the centrality of eating psychopathology to the construct of compulsive exercise (Keski-Rahkonen, 2001; Mond et al., 2006a). However, the finding that specific components of compulsive exercise were differentially associated with disparate aspects of eating psychopathology builds on existing data. Specifically, due to the limitations of existing measures of compulsive exercise and related constructs (see Section 1.7.1), previous studies had not

been able to demonstrate the links between the components of compulsive exercise, such as continued exercise despite no longer enjoying it and exercising to avoid affective withdrawal, and increased eating psychopathology (e.g., Mond et al., 2004; 2006a; 2008; 2009). Furthermore, this thesis presents the first published research suggesting that compulsive exercise is associated with increased frequency of eating disordered behaviours in a non-clinical sample. In addition, these results build on existing data by detailing the associations between specific components of compulsive exercise and the different eating disordered behaviours such as bingeing and purging (Brewerton et al., 1995; Dalle Grave, Calugi, & Marchesini, 2008). For example, the finding that both the negative reinforcement and exercise for weight control components of compulsive exercise were associated with increased frequency of bingeing and purging behaviours provided the first empirical support for a multifunctional conceptualisation of compulsive exercise in non-clinical samples.

7.3.3 Links between compulsive exercise and affect regulation

Links between compulsive exercise and increased levels of negative affect have been verified in both eating disordered and non-eating disordered samples (Seigel & Hetta, 2001; Vansteelandt et al., 2007) and the suggestion that compulsive exercise may serve an affect regulatory function has received consistent support (Fairburn, Cooper, & Shafran, 2003; Geller, Cockell, & Goldner, 2000; Long et al., 1993). The current finding that compulsive exercise is associated with affect regulation is in line with previous findings (Blumenthal, O'Toole, & Chang, 1984; Long et al., 1993). However, the current thesis builds on the existing literature by presenting the first published research demonstrating an association between compulsive exercise and an avoidant coping style. In addition, the current results are the first to examine and detail an association between specific difficulties regulating emotions and compulsive exercise, independent of any effect of eating psychopathology. Lastly, the use of the CET uniquely provided the first

evidence of differential links between the components of compulsive exercise and aspects of affect regulation.

7.3.4 The importance of self-criticism in the relationship between perfectionism and both compulsive exercise and eating psychopathology

Previous studies have shown self-criticism to be a significant factor in the relationship between perfectionistic high standards and eating psychopathology relevant to binge eating disorder (Dunkley et al., 2006; Dunkley, Zuroff & Blankstein, 2003). Whilst the current finding that self-criticism substantially accounted for the relation between perfectionistic high standards and eating psychopathology is consistent with Dunkley et al.'s findings (2003; 2006), the current results also extend this research by presenting the first published study supporting the importance of self-criticism to the relation between perfectionistic high standards and eating psychopathology relevant to the restrictive and bulimic eating disorders. In addition, the current thesis extends these findings further by detailing the specific form and function of the self-criticism associated with eating psychopathology. The current finding that the specific form of self-criticism associated with eating psychopathology is characterised by self-criticisms that focus on a failure to live up to internal, personal standards that are high and constantly receding, is in line with the model of clinical perfectionism specific to the eating disorders (Shafran et al., 2002). The current thesis also replicated the link between perfectionism and compulsive exercise (Ackard, Brehm, & Steffen, 2002; Flett & Hewitt, 2005; Shroff et al., 2006). However, it extends these findings by presenting the first published study demonstrating the same relationship described above whereby self-criticism was found to substantially account for the relationship between perfectionistic high standards and compulsive exercise. In addition, the finding that compulsive exercise was associated with self-criticism supported previous descriptions of compulsively exercising eating disorder patients (e.g., Beumont et al., 1994). Taken together, the results of the current thesis add further support to Dunkley, Blankstein et al.'s (2006) conceptual framework delineating self-criticism as the primary

indicator of dysfunctional perfectionism in the eating disorders and are compatible with a model in which the influence of high personal standards on both eating psychopathology and compulsive exercise is mediated by self-criticism.

7.4 Limitations of the present thesis

Although the findings above make an important contribution to eating disorders research, the present thesis has several limitations. The next section will critically consider these limitations under the headings of theoretical limitations and those related to methodology.

7.4.1 Theoretical limitations

As outlined in Chapter 1, much of the literature pertaining to compulsive exercise is difficult to interpret due to the multitude of definitions and terms, and measurement inconsistencies. The proposed maintenance model of compulsive exercise was constructed on the basis of a critical evaluation of the literature considered relevant to the construct of compulsive exercise within the context of the eating disorders. The findings from this review clearly indicated the multidimensionality of the compulsive exercise construct and by extension, its maintenance. However, it was not the aim of the present thesis to determine and examine all possible factors that may operate in the maintenance of compulsive exercise. Therefore, it is possible that factors important to the maintenance of compulsive exercise and by extension the proposed cognitive-behavioural conceptualisation may have been missed or overlooked. Such factors could include socio-cognitive processes implicated in the development and maintenance of eating disorder psychopathology (Corning, Krumm, & Smitham, 2006; Gilbert & Meyer, 2003) but that have never been examined in the context of compulsive exercise. In addition, core-beliefs and personality traits such as narcissism may be relevant, since both have been shown to be related to eating disorder psychopathology in both clinical and non-clinical samples (e.g., Sines, Waller, Meyer, & Wigley, 2008; Waller & Mari, 2008). Moreover, alexithymia

may also be important, as it has similarly been shown to be linked with eating disorder psychopathology in clinical and non-clinical samples (Lawson, Waller, Sines, & Meyer, 2008; Ridout, Thom, & Wallis, 2010) and is further linked with both perfectionism (Lundh, Johnsson, Sundqvist, & Olsson, 2002), narcissism (Lawson et al., 2008) and core beliefs (Lawson, Emanuelli, Sines, & Waller, 2008). Lastly, the influence of potential moderators and mediators on the examined links between the variables of interest was not directly addressed by the present research. It is likely that intra-individual factors such as levels of anxiety and depression, and self-esteem could have an effect on the strength of the relationships between for example, compulsive exercise and affect regulation as they have been shown to mediate or moderate relationships between various factors such as perfectionism and eating psychopathology (Sassaroli, Gallucci, & Ruggiero, 2008), compulsive exercise and eating psychopathology (De Young & Anderson, 2010), and self-criticism and eating psychopathology (Dunkley & Grilo, 2007). It will be important for future research to address these limitations.

7.4.2 Methodological issues

Further limitations of the present thesis stem from the methodology employed. These can be broadly categorised into those stemming from experimental design, the measures used, and the research sample. Each of these limitations will be critically considered in turn.

7.4.2.1 *Experimental design*

A key limitation of the present thesis stems from the use of cross-sectional rather than longitudinal (prospective) designs. Such a design precludes the drawing of any conclusions regarding the temporal and causal relationships between the different variables. For example, even though a relationship between compulsive exercise and perfectionism was found, it is not possible to make a definitive statement about the causal relationship between the two. As a result, the directional relationships between factors

detailed in the proposed model of compulsive exercise remain purely hypothetical. It therefore remains unclear whether, for example, perfectionism predicts compulsive exercise, or vice versa. In addition, it was not possible to determine the relation between the time frame of the variables implicated in the maintenance of compulsive exercise and the occurrence of compulsive exercise behaviour. In future research, it will be necessary to investigate whether processes prior in time, such as cognitions pertaining to perfectionism, predict compulsive exercise later in time, thereby establishing a causal (maintenance) relationship. However, despite these limitations, the present results do provide empirical support for a link between potential risk factors.

7.4.2.2 Measures used

All data presented in this thesis was collected via self-report questionnaires. As a consequence, several limitations apply. First, because self-report measures rely on participants own perceptions of their behaviours, rather than actual behaviours, they are vulnerable to a range of response distortions which may result in unreliable data due to under or over-reporting of behaviours (Furnham & Henderson, 1982; Sallis & Saelens, 2000). Such distortions may be broadly grouped into two categories: response styles, which imply a bias in a particular direction regardless of the content of the test items, and response sets, which reflect a conscious or unconscious attempt to create a certain impression (Lanyon & Goodstein, 1997). The acquiescence response style refers to the tendency of participants to respond positively (“true” or “yes”) regardless of the content of the question. Whilst a potential confound, the questionnaires used in the present research all included positively and negatively scored items as well as conceptual opposites in order to control for both *agreement acquiescence* (the tendency to agree with all types of question) and *acceptance acquiescence* (the tendency to endorse all statements, even when contradictory, as true of oneself).

Of particular relevance to the type of questionnaire used in the present research is the extreme and central tendency response style whereby participants may display a

tendency to respond consistently using particular sections of the rating scale. Whilst this may be true of some participants, inspection of the range of responses obtained for all measures used in the present research suggests a broad range of responses were given. However, it is possible that the requirement to select the most appropriate of a spectrum of pre-coded responses may force some individuals to select a response that doesn't fully represent their true attitude or behaviour (Robinson, 1993). The social desirability bias refers to a response set whereby participants answer questions in such a way as to deliberately or unconsciously represent themselves as more favourable (Edwards, 1953). However, recent findings relating to the completion of measures of eating pathology suggest that given a high perceived anonymity for participants in completing the measures, the potential confound of such a bias is minimised (Anderson, Simmons, Milnes, & Earleywine, 2007; Lavender & Anderson, 2009).

Second, self-report questionnaires have been shown to consistently yield higher rates of eating pathology than interview assessments (e.g., Keel, Crow, Davis, & Mitchell, 2002; Perry, Morgan, Reid, Brunton, O'Brien et al., 2002). This implies that participants in the present studies may have over-reported the level of their psychopathology or behaviours. Indeed, that is why no claims were made re 'diagnosis' or 'cut-offs' in the studies that make up this thesis. Yet whilst Fairburn and Beglin (1990; 1994) suggest that such over-reporting may stem from more frequent endorsements of particularly complex or ill-defined questions, more recent research has suggested that self-report questionnaires may in fact yield more candid responding from participants and therefore greater accuracy due to the anonymity such assessment affords them (Lavender & Anderson, 2009). Furthermore, it is certainly true that the validity of self-report questionnaires is dependent upon the respondents understanding item wording. Given the finding that starvation and disruptive eating patterns are associated with reduced cognitive abilities such as attention and concentration (Laessle, Platte, Schweiger & Pirke, 1996) it is possible that this assumption is not met by those individuals with greater levels of eating

pathology. However, in order to minimise any such potential effect, BMI was considered throughout the studies that make up this thesis.

7.4.2.3 Research sample and recruitment

There are a number of limitations related to the sample and the method of recruitment used in the present thesis. First, whilst not all participants were university students, most were (97.2%), and all participants were recruited from university campuses. Therefore, the relative homogeneity of the sample makes it difficult to know whether the current results are generalisable to non-student populations. In addition, the data presented in the present thesis was gathered from Universities in the UK and Australia that are renowned for sport and exercise, therefore, this may further limit generalisation of the findings to different samples. Second, all participants were recruited via some form of convenience sampling (i.e., non-probability sampling) whereby they were approached either directly (i.e., in person) or indirectly such as via email. It is therefore possible that as a result of being a self-selected sample, participants who completed the measures may have differed from those who chose not to participate (i.e., sampling bias). For example, participants may have been more likely to have psychological distress than those who chose not to participate, or may have been more interested in eating related issues such as dieting, or have been motivated to share their attitudes and opinions. It is possible this may have led to a slight polarisation of responses thereby skewing the data and further limiting the generalisability of the results. However, as no data is available regarding those who chose not to participate, it is not possible to characterise those who chose to participate and those who did not. Lastly, the respondents were all non-clinical. It is therefore possible that the findings may differ in clinical samples. However, participants were not screened for a past or present diagnosis of an eating disorder in order to allow a wide range of eating-related attitudes and behaviours to be included in the analyses. Indeed, the range of eating pathology (i.e., cognitions and behaviours) displayed in the

results reported in this thesis supports the current sample consisting of a wide range of eating pathology.

7.5 Future directions for research

The current thesis has proposed a new theoretically coherent and empirically derived cognitive-behavioural conceptualisation of compulsive exercise and provided further empirical support for some of the links. The proposed model further provides a framework upon which a cognitive-behavioural intervention for compulsive exercise could be based (see Section 1.6). However, due to the inherent equivocality of much of the existing literature on which the model is based, it is best considered a tentative proposition with only preliminary validation for some of the suggested links. Furthermore, many of the proposed links in the new model of the maintenance of compulsive exercise are based on correlational research and therefore do not indicate directional causality. In addition, research into compulsive exercise in the context of the eating disorders is essentially still in its infancy, due largely to the definition and measurement problems that beset much of the existing literature. Therefore, several directions for future investigations can be suggested.

7.5.1 Longitudinal links between the proposed maintaining factors and compulsive exercise

As outlined above, a limitation of the present thesis was an inability to determine the causal relationships between the proposed links between variables in the new model of compulsive exercise. Therefore, there are several future directions for longitudinal studies. These are outlined below.

7.5.1.1 Longitudinal links between compulsive exercise eating and pathology

In a prospective study of eating disorder development, compulsive exercise was found to have almost no predictive power for the development of an eating disorder after

initial eating psychopathology had been controlled for (Wichstrom, 2000). However, in this study compulsive exercise was defined in terms of frequency (i.e., quantitative criteria). It therefore remains to be ascertained what effect compulsive exercise defined in terms of qualitative (i.e., compulsivity) criteria would have on the prediction of subsequent eating disorder development. Given the current thesis findings, it could be hypothesised that only certain components of compulsive exercise are a risk factor for subsequent development of an eating disorder, such as weight control exercise and exercising to avoid negative affect (negative reinforcement), whereas others in isolation are less likely to be, such as exercise rigidity and positive reinforcement. Future research should therefore seek to ascertain the predictive power of compulsive exercise on the development of eating pathology utilising a multidimensional measure of compulsive exercise such as the CET in a prospective study.

7.5.1.2 Longitudinal links between difficulties regulating affect and compulsive exercise

It has been suggested that exercise behaviour comes to be relied upon for its affect regulatory function (i.e., compulsive) only after a period of time (Hsiao & Thayer, 1998). However, it is unknown whether a difficulty regulating affect is a predisposing factor for compulsive exercise, or if a high level of exercise is in some way causal in the development of affect regulatory difficulties, perhaps by becoming the only means by which an individual regulates their affect (Fairburn, Cooper, & Shafran, 2003). It would therefore be useful to study the prospective links between exercise behaviour and affect regulation, particularly in terms of teasing out the causal relations between compulsive exercise and affect regulation difficulties. Furthermore, the prospective role of eating pathology in such a relationship could also be studied. It could be hypothesised that affect regulatory difficulties are causally linked with development of both compulsive exercise and eating pathology, the temporal occurrence of each being dependent only upon the individual's pre-morbid exercise behaviour.

7.5.1.3 Longitudinal links between perfectionism and compulsive exercise

Given that the self-criticism dimension of perfectionism was found to account for the relationship between the high personal standards dimension of perfectionism and compulsive exercise, it is plausible that self-criticism is prospectively linked with the development of compulsive exercise. Furthermore, the findings of the current thesis support the notion that a similar link may exist in relation to the development of eating pathology. Therefore, future studies should seek to determine the predictive impact of self-criticism on the subsequent development of both compulsive exercise and eating pathology prospectively.

7.5.2 Confirmation within clinical populations

Given the aim of developing an intervention to tackle compulsive exercise in the eating disorders, it will be important to determine whether the current findings can be replicated and extended in clinical eating disordered samples. Preliminary research has already done this for affect regulation and compulsive exercise (e.g., Penas-Lledo, Vaz Leal, & Waller, 2002; Vansteelandt et al., 2007). However, further research is clearly warranted to delineate the precise nature of the relationships suggested by the proposed new model of compulsive exercise in eating disordered samples. In addition, the validity of the model could be further enhanced by future research utilising samples of eating disordered patients for whom exercise is a central feature of their presentation. This would then provide an empirically supported foundation upon which a cognitive-behavioural intervention could potentially be based and may further inform prevention programs and screening assessments for use among non-clinical populations.

7.5.3 Validating maintenance relationships: Predictors of outcome from the treatment of compulsive exercise

The proposed cognitive-behavioural conceptualisation of the maintenance of compulsive exercise makes specific predictions about which factors may be linked with

poorer outcome from the treatment of compulsive exercise. For example, the results of this thesis provide preliminary support for the suggestion that both high levels of self-critical perfectionism and/or difficulties regulating emotions may be associated with the maintenance of compulsive exercise behaviour. Whilst there is as yet no formal protocol for the treatment of compulsive exercise, it would still be possible to study whether any of the proposed maintaining factors, such as compulsivity, affect regulation and perfectionism, are indeed associated with a poorer outcome from interventions aimed at addressing compulsive exercise, thereby validating their role as maintaining factors. Even in the absence of targeted interventions for compulsive exercise, it would be possible to determine whether any of the proposed maintaining factors of compulsive exercise are indeed associated with its maintenance by examining, in patients treated for an eating disorder for whom compulsive exercise was a feature, the difference between those patients whose exercise behaviour self-corrected and those for whom it did not, in terms of the proposed maintenance factors. Future research into the treatment of eating disordered patients should therefore consider including a measure of compulsive exercise (i.e., the CET) as well as measures of the proposed maintenance factors.

7.5.4 Objective assessment of the temporal relations between compulsive exercise and the proposed maintenance factors

In light of the limitations of retrospective self-report investigations as outlined above, future studies should seek to use a daily process design that utilises ‘real-time’ data gathering methods such as ecological momentary assessment (EMA) (Anestis, Selby, Crosby, Wonderlich, Engel et al., 2010; Engel, Wonderlich, & Crosby, 2005; Smyth, Wonderlich, Crosby, Miltenberger, Mitchell et al., 2001). Such a method has number of distinct advantages. First, the momentary aspect of the assessments in a daily process design such as EMA reduces the bias introduced by recall and retrieval processes associated with self-report measures (Shiffman & Stone, 1998). Second, because assessment via EMA occurs in the naturalistic environment of the participant, it has high

ecological validity (Shiffman & Stone, 1998). Third and perhaps most importantly, as EMA assesses different participants repeatedly over time, it is possible to simultaneously study *between* as well as *within* subject relations between variables like compulsive exercise, eating pathology and affect regulation (Vansteelandt et al., 2007). The use of EMA could therefore enable a better understanding of the temporal relations between for example, the frequency of compulsive exercise and levels of negative affect or eating disordered behaviours such as bingeing and compulsive exercising. It could certainly be hypothesised from the proposed cognitive-behavioural conceptualisation of compulsive exercise that as a compensatory strategy, the frequency of compulsive exercise may be linked to the frequency of bingeing behaviour. It could also be hypothesised that in terms of affect regulation, compulsive exercise is preceded by an elevation in negative affect and results in a reduction of negative affect, akin to purging (Fairburn, Cooper, & Shafran, 2003; Meyer, Waller, & Waters, 1998).

7.6 Clinical implications of the present results

The current research aimed to inform clinical practice and has several clinical implications. The following section will suggest several ways in which the present findings could be used to inform assessment and treatment approaches for compulsive exercise in the eating disorders.

7.6.1 Identifying high-risk individuals

As detailed in Chapter 1, compulsive exercise is implicated as a significant factor in the aetiology and development of the eating disorders (e.g., Beumont et al., 1994; Davis, Katzman, & Kirsch, 1999). Therefore, it is imperative that individuals who are at high-risk of developing compulsive exercise, and by extension an eating disorder, are identified as early as possible. This would then allow for intervention to possibly prevent the progression from compulsive exercise into an eating disorder and thereby minimize physical and psychological damage. Indeed, recent research specifically highlights the

importance of targeting known risk factors in an effort to prevent the development of eating disorders and the high efficacy of targeted prevention programs (Stice, Ng, & Shaw, 2010). To this end, the current results provide preliminary support for the notion that exercising to avoid negative affect as well as a self-critical personality style in the presence of exercising could be regarded as early warning signs for the later onset of an eating disorder and may warrant preventative intervention. In addition, the CET may be a useful clinical tool in assessing and potentially screening for the presence of compulsive exercise behaviour.

7.6.2 Addressing compulsive exercise in the eating disorders

The proposed cognitive-behavioural conceptualisation of compulsive exercise provides a preliminary model of the factors implicated in the maintenance of compulsive exercise. This may provide a useful assessment and intervention framework for clinicians working with eating disordered patients for whom compulsive exercise is a prominent feature of their presentation. Specifically, the proposed model highlights the areas of importance in terms of assessment and further provides a conceptual framework for formulating compulsive exercise from a cognitive-behavioural perspective. The results of the present thesis also suggested specific features of compulsive exercise that could potentially be used to inform a cognitive-behavioural intervention for compulsive exercise in the eating disorders. These are presented below.

7.6.2.1 Difficulties regulating emotions

The results of the present thesis suggest that for those patients where compulsive exercise is a component of their eating disorder, treatment efficacy may be enhanced if therapists are made aware of the functional utility of compulsive exercise in terms of affect regulation. Indeed, although preliminary, the finding of a link between compulsive exercise and specific difficulties (i.e., deficits) in regulating emotions suggests a particular target for intervention. Clinicians could address this deficit in therapy. One therapeutic approach

would be to equip patients with alternative, more adaptive ways of regulating their emotions. For example, this could be achieved by utilising the emotion regulation components of Dialectical Behaviour Therapy (DBT; Linehan, 1993), specifically in terms of distress tolerance, whereby patients are taught to calmly recognise negative emotions and their impact, rather than becoming overwhelmed or hiding from them. The adaption and use of DBT in this way is supported by the promising results of a recent randomised-controlled trial that specifically adapted DBT for use in binge eating disorder (Safer, Robinson, & Booil, 2010). However, it is important to note that the present finding is preliminary and further research is needed to validate the proposed links.

7.6.2.2 Avoidance of affect

The finding of a link between compulsive exercise and an avoidant coping style in Chapter 4 may, if supported through further research, have additional implications for potential interventions for compulsive exercise. Whilst having some therapeutic overlap with the treatment of emotion regulation difficulties as outlined above, avoidance of negative affect, particularly in terms of anxiety, is also a central feature of the anxiety disorders and obsessive-compulsive disorder in particular (Beck, Emery, & Greenberg, 1985; Wells, 1997). It may therefore be useful for clinicians to conceptualise the avoidance in compulsive exercise as a type of safety behaviour. Such a conceptualisation is certainly not new (e.g., Beumont et al., 1994; Davis & Kaptein, 2006). Given this conceptualisation, it follows that it may be therapeutically efficacious to adapt techniques used in the treatment of obsessive-compulsive disorder such as response-prevention to help compulsive exercisers overcome their tendency to avoid the negative affect associated with not exercising by engaging in more exercise. Alternatively, clinicians could utilise more generic cognitive-behavioural techniques such as behavioural experiments to challenge the predictions compulsive exercisers may make about the perceived negative consequences of stopping or reducing their exercise behaviour that is contributing to the anxiety they are driven to avoid via exercise. However, such avoidance is best addressed,

the findings of Chapter 4 highlight the importance of raising both clinician's and patient's awareness of the potential 'use' of exercise to mitigate anxiety, and the possible influence of avoidance in the maintenance of the compulsive exercise behaviour.

7.6.2.3 Self-criticism

The results of the present thesis further suggest that when perfectionism is identified as a significant maintenance factor in an individual's presentation, whether in terms of compulsive exercise or the eating disorders in general, such individuals may require therapeutic interventions that specifically address their self-critical tendencies. Although only a preliminary finding, this is in line with the suggestion of Dunkley, Blankstein et al. (2006) that the focus of therapeutic intervention in addressing perfectionism may be better aimed at the self-critical component as opposed to the high personal standards. It is therefore important that clinicians are made aware of not solely focussing on the high personal standards that typify a perfectionistic presentation. Indeed, the current results support the notion that in the absence of self-criticism, high personal standards do not constitute a clinically significant maintenance factor for either compulsive exercise or the eating disorders. In addition, in terms of eating psychopathology, the findings of the present thesis provide preliminary support for the idea that therapeutic efficacy may be further enhanced if therapists are aware of the specific cognitive content and functional utility of the self-critical tendencies. However, as previously stated these findings require further empirical validation and testing.

7.6.3 Tailoring treatment approaches to maximise effectiveness

The CET was developed to measure a broad range of factors implicated in the maintenance of compulsive exercise. For this reason, the CET is potentially a useful clinical assessment tool when striving to formulate the maintenance of an individual's exercise behaviour. For example, by providing a clearer picture of those factors that are operating in the maintenance of an individual's compulsive exercise behaviour the CET

could be used to tailor treatment, thereby optimising efficacy. In addition, the CET could be used as an outcome tool providing feedback on the relative efficacy of alternative therapeutic interventions/approaches for compulsive exercise. Such data could be used to further tailor and optimise the therapeutic efficacy of future interventions.

7.7 Conclusions

In summary, the present thesis offers a significant contribution to our understanding of compulsive exercise in the eating disorders and the factors implicated in its maintenance. A new measure of compulsive exercise was developed based on a theoretically coherent and empirically supported model of compulsive exercise, and demonstrated to have good psychometric properties. Compulsive exercise was demonstrated to be a multidimensional and multifunctional construct. Not only is compulsive exercise associated with increased levels of eating psychopathology, but it is also associated with increased frequency of eating disordered behaviours such as bingeing and purging. In addition, compulsive exercise was shown to be associated with a maladaptive emotional coping style and a difficulty in regulating emotions, thereby supporting a functional role of emotion regulation in the maintenance of compulsive exercise. Compulsive exercise was further shown to be associated with the dysfunctional, self-critical dimension of perfectionism suggesting a potential role in the maintenance of compulsive exercise.

Taken together, these findings make a valuable contribution to both future clinical developments and future research in the field of compulsive exercise in the eating disorders. Indeed, the proposed maintenance model of compulsive exercise has already led to the development of the first manualised cognitive-behavioural intervention for compulsive exercise in the eating disorders, Loughborough Eating-disordered Activity therAPy (LEAP). In addition, preliminary research has supported the efficacy of LEAP in addressing compulsive exercise in an eating disordered population (La Puma, Taranis, Touyz, & Meyer, 2008; Taranis, Meyer, & Arcelus, 2010; Taranis, Meyer, & Touyz, 2009)

and a large multi-site international randomised controlled trial is now underway to further examine it.

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Appendix A

Letters of research ethics approval



The University of Sydney

NSW 2006 Australia

Human Research Ethics Committee

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19 June 2006

Professor S Touyz
School of Psychology
Transient Building – F12
The University of Sydney

Dear Professor Touyz

I am pleased to inform you that the Human Research Ethics Committee at its meeting on 6 June 2006 approved your protocol entitled **“Won't Stop or Can't Stop? An Investigation into Trait Perseverance and Mood Intolerance as Potential Risk and/or Maintenance Factors for Excessive Exercise in the Eating Disorders”**

Details of the approval are as follows:

Ref No.:	06-2006/2/9244
Approval Period:	June 2006 – June 2007
Authorised Personnel:	Professor S Touyz Mr L Taranis

The approval of this project is **conditional** upon your continuing compliance with the *National Statement on Ethical Conduct in Research Involving Humans*. We draw to your attention the requirement that a report on this research must be submitted every 12 months from the date of the approval or on completion of the project, whichever occurs first. Failure to submit reports will result in withdrawal of consent for the project to proceed.

The project is approved for an initial period of 12 months with approval for up to four (4) years following receipt of the appropriate report. **Your report will be due on 30 June 2007.**

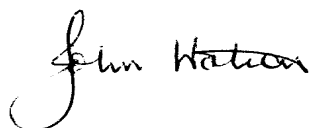
Conditions of Approval Applicable to all Projects

(1) **Reporting of Serious Adverse Events**

Researchers should immediately report anything to the Human Research Ethics Committee which might warrant review of ethical approval of the protocol, including:

- Serious or unexpected adverse effects on participants;
 - Proposed changes in the protocol or any other material given to the participants in the study must be known prior to being actioned, including participant information and consent forms; and
 - Unforeseen events that might affect continued ethical acceptability of the project.
- (2) Modifications to the protocol cannot proceed until such approval is obtained in writing. (Refer to the website www.usyd.edu.au/ethics/human under 'Forms and Guides' for a Modification Form).
- (3) The confidentiality and anonymity of all research subjects is maintained at all times, except as required by law.
- (4) All research subjects are provided with a Participant Information Sheet and Consent Form, unless otherwise agreed by the Committee.
- (5) The Participant Information Sheet and Consent Form are to be on University of Sydney letterhead and include the full title of the research project and telephone contacts for the researchers, unless otherwise agreed by the Committee.
- (6) The following statement must appear on the bottom of the Participant Information Sheet. ***Any person with concerns or complaints about the conduct of a research study can contact the Senior Ethics Officer, University of Sydney, on (02) 9351 4811.***
- (7) The standard University policy concerning storage of data and tapes should be followed. While temporary storage of data or tapes at the researcher's home or an off-campus site is acceptable during the active transcription phase of the project, permanent storage should be at a secure, University controlled site for a minimum of seven years.
- (8) A report and a copy of any published material should be provided at the completion of the Project.

Yours sincerely



**Associate Professor J D Watson
Chairman
Human Research Ethics Committee**

Cc: Mr Lorin Taranis, 3/44 Vine Street, Chippendale NSW 2008

**LOUGHBOROUGH UNIVERSITY
ETHICAL ADVISORY COMMITTEE**

**RESEARCH PROPOSAL
INVOLVING HUMAN PARTICIPANTS**

Title: Mood intolerance and excessive exercise in the eating disorders

Applicant: Dr C Meyer, L Taranis

Department: Human Sciences

Date of clearance: 29 June 2006

Comments of the Committee:

The Committee agreed to issue clearance to proceed subject to the following conditions:

- i) That confirmation of Head of Department approval was provided (an email would suffice).
- ii) That the participant information sheet was amended to include a telephone contact number for the investigator.

**LOUGHBOROUGH UNIVERSITY
ETHICAL ADVISORY COMMITTEE**

**RESEARCH PROPOSAL
INVOLVING HUMAN PARTICIPANTS**

Title: Perseverance: Maintaining excessive exercise in the eating disorders

Applicant: Dr C Meyer, L Taranis

Department: Human Sciences

Date of clearance: 29 June 2006

Comments of the Committee:

The Committee agreed to issue clearance to proceed subject to the following conditions:

- i) That confirmation of Head of Department approval was provided (an email would suffice).
- ii) That the participant information sheet was amended to include a telephone contact number for the investigator.

LOUGHBOROUGH UNIVERSITY
ETHICAL ADVISORY SUB-COMMITTEE

RESEARCH PROPOSAL
INVOLVING HUMAN PARTICIPANTS

Title: Personality, exercise and eating-related attitudes and behaviours

Applicants: Dr C Meyer, L Taranis

Department: Human Sciences

Date of clearance: 12 October 2006

Comments of the Sub-Committee:

The Sub-Committee agreed to issue clearance to proceed.

Appendix B

Compulsive Exercise Test (CET)

CET

Instructions

Listed below are a series of statements regarding exercise. Please read each statement carefully and circle the number that best indicates how true each statement is of you. Please answer all the questions as honestly as you can.

Never true	Rarely true	Sometimes true	Often true	Usually true	Always true	
0	1	2	3	4	5	
1) I feel happier and/or more positive after I exercise.	0	1	2	3	4	5
2) I exercise to improve my appearance.	0	1	2	3	4	5
3) I like my days to be organised and structured of which exercise is just one part.	0	1	2	3	4	5
4) I feel less anxious after I exercise.	0	1	2	3	4	5
5) I find exercise a chore.	0	1	2	3	4	5
6) If I feel I have eaten too much, I will do more exercise.	0	1	2	3	4	5
7) My weekly pattern of exercise is repetitive.	0	1	2	3	4	5
8) I do not exercise to be slim.	0	1	2	3	4	5
9) If I cannot exercise I feel low or depressed.	0	1	2	3	4	5
10) I feel extremely guilty if I miss an exercise session.	0	1	2	3	4	5
11) I usually continue to exercise despite injury or illness, unless I am very ill or too injured.	0	1	2	3	4	5
12) I enjoy exercising.	0	1	2	3	4	5
13) I exercise to burn calories and lose weight.	0	1	2	3	4	5
14) I feel less stressed and/or tense after I exercise.	0	1	2	3	4	5
15) If I miss an exercise session, I will try and make up for it when I next exercise.	0	1	2	3	4	5
16) If I cannot exercise I feel agitated and/or irritable.	0	1	2	3	4	5
17) Exercise improves my mood.	0	1	2	3	4	5
18) If I cannot exercise, I worry that I will gain weight.	0	1	2	3	4	5
19) I follow a set routine for my exercise sessions e.g., walk or run the same route, particular exercises, same amount of time, and so on.	0	1	2	3	4	5
20) If I cannot exercise I feel angry and/or frustrated.	0	1	2	3	4	5
21) I do not enjoy exercising.	0	1	2	3	4	5
22) I feel like I've let myself down if I miss an exercise session.	0	1	2	3	4	5
23) If I cannot exercise I feel anxious.	0	1	2	3	4	5
24) I feel less depressed or low after I exercise.	0	1	2	3	4	5

Appendix C

Commitment to Exercise Scale (CES)

CES

Instructions

Listed below are a series of statements regarding exercise. Please read each statement and circle the number that best indicates your level of agreement with the statement in question.

- 1) How important do you think it is to your general well-being not to miss your exercise sessions?

Not at all important	0	1	2	3	4	5	6	7	8	9	10	Very Important
----------------------	---	---	---	---	---	---	---	---	---	---	----	----------------

- 2) Does it upset you if, for one reason or another, you are unable to exercise?

Never upset	0	1	2	3	4	5	6	7	8	9	10	Always upset
-------------	---	---	---	---	---	---	---	---	---	---	----	--------------

- 3) If you miss an exercise session, or several sessions, do you try to make them up by putting in more time when you get back?

Never	0	1	2	3	4	5	6	7	8	9	10	Always
-------	---	---	---	---	---	---	---	---	---	---	----	--------

- 4) Do you have a set routine for your exercise sessions, e.g., the same time of day, the same location, the same number of laps, particular exercises, and so on?

No routine	0	1	2	3	4	5	6	7	8	9	10	Strict routine
------------	---	---	---	---	---	---	---	---	---	---	----	----------------

- 5) Do you continue to exercise at times when you feel unwell or tired?

Never	0	1	2	3	4	5	6	7	8	9	10	Always
-------	---	---	---	---	---	---	---	---	---	---	----	--------

- 6) Do you continue to exercise even when you sustained an exercise-related injury?

Never	0	1	2	3	4	5	6	7	8	9	10	Always
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- 7) Do you feel 'guilty' that you have 'let yourself down' when you miss an exercise session?

Not at all	0	1	2	3	4	5	6	7	8	9	10	A great deal
------------	---	---	---	---	---	---	---	---	---	---	----	--------------

- 8) Are there times when you turn down an invitation to an interesting social event because it interferes with your exercise schedule?

Never	0	1	2	3	4	5	6	7	8	9	10	Always
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Appendix D

Eating Disorders Inventory (EDI)

EDI

Instructions

The items ask about your current attitudes, feelings and behaviour. Some of the items relate to food or eating. Other items ask about your feelings about yourself.

For each item, decide if the item is true about you ALWAYS (A), USUALLY (U), OFTEN (O), SOMETIMES (S), RARELY (R), or NEVER (N). Circle the letter that corresponds to your rating. For example, if your rating for the item is OFTEN, you would circle the (O) for that item. Respond to all of the items, making sure that you circle the letter for the rating that is true about you. If you need to change an answer, make an 'X' through the incorrect letter and then circle the correct one.

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

Appendix E

Obligatory Exercise Questionnaire (OEQ)

OEQ

Instructions

Listed below are a series of statements about people’s exercise habits. Please circle the number that reflects how often you could make the following statements:

1 = NEVER 2 = SOMETIMES 3 = USUALLY 4 = ALWAYS

1	I engage in physical exercise on a daily basis.	1	2	3	4
2	I engage in one/more of the following forms of exercise: walking, jogging/running or weightlifting.	1	2	3	4
3	I exercise more than three days per week.	1	2	3	4
4	When I don’t exercise I feel guilty.	1	2	3	4
5	I sometimes feel like I don’t want to exercise, but I go ahead and push myself anyway.	1	2	3	4
6	My best friend likes to exercise.	1	2	3	4
7	When I miss an exercise session, I feel concerned about my body possibly getting out of shape.	1	2	3	4
8	If I have planned to exercise at a particular time and something unexpected comes up (like an old friend comes to visit or I have some work to do that needs immediate attention) I will usually skip my exercise for that day.	1	2	3	4
9	If I miss a planned workout, I attempt to make up for it the next day.	1	2	3	4
10	I may miss a day of exercise for no good reason.	1	2	3	4
11	Sometimes, I feel a need to exercise twice in one day, even though I may feel a little tired.	1	2	3	4
12	If I feel I have overeaten, I will try to make up for it by increasing the amount I exercise.	1	2	3	4
13	When I miss a scheduled exercise session I may feel tense, irritable or depressed.	1	2	3	4
14	Sometimes, I find that my mind wanders to thoughts about exercising.	1	2	3	4
15	I have had daydreams about exercising.	1	2	3	4
16	I keep a record of my exercise performance, such as how long I work out, how far or fast I run.	1	2	3	4
17	I have experienced a feeling of euphoria or a “high” during or after an exercise session.	1	2	3	4
18	I frequently “push myself to the limits.”	1	2	3	4
19	I have exercised when advised against such activity (i.e. by a doctor, friend, etc.).	1	2	3	4
20	I will engage in other forms of exercise if I am unable to engage in my usual form of exercise.	1	2	3	4

Appendix F

Eating Disorders Examination Questionnaire (EDE-Q)

EDE-Q

Instructions

The following questions are concerned with the PAST FOUR WEEKS ONLY (28 days). Please read each question carefully and circle the appropriate number on the right. Please answer all the questions.

ON HOW MANY DAYS OUT OF THE PAST 28 DAYS		No days	1-5 days	6-12 days	13-15 days	16-22 days	23-27 days	Every day
1.	Have you been deliberately <u>trying</u> to limit the amount of food you eat to influence your shape or weight?	0	1	2	3	4	5	6
2.	Have you gone for long periods of time (8 hours or more) without eating anything in order to influence your shape or weight?	0	1	2	3	4	5	6
3.	Have you <u>tried</u> to avoid eating any foods which you like in order to influence your shape or weight?	0	1	2	3	4	5	6
4.	Have you <u>tried</u> to follow definite rules regarding your eating in order to influence your shape or weight; for example, a calorie limit, a set amount of food, or rules about what or when you should eat?	0	1	2	3	4	5	6
5.	Have you wanted your stomach to be empty?	0	1	2	3	4	5	6
6.	Has thinking about food or its calorie content made it much more difficult to concentrate on things you are interested in; for example, read, watch TV, or follow a conversation?	0	1	2	3	4	5	6
7.	Have you been afraid of losing control over eating?	0	1	2	3	4	5	6
8.	Have you had episodes of binge eating?	0	1	2	3	4	5	6
9.	Have you eaten in secret? (Do not count binges.)	0	1	2	3	4	5	6
10.	Have you definitely wanted your stomach to be flat?	0	1	2	3	4	5	6
11.	Has thinking about shape or weight made it more difficult to concentrate on things you are interested in; for example, read, watch TV or follow a conversation?	0	1	2	3	4	5	6
12.	Have you had a definite fear that you might gain weight or become fat?	0	1	2	3	4	5	6
13.	Have you felt fat?	0	1	2	3	4	5	6
14.	Have you had a strong desire to lose weight?	0	1	2	3	4	5	6

OVER THE PAST FOUR WEEKS (28 DAYS)

15.	On what proportion of times that you have eaten have you felt guilty because of the effect on your shape or weight? (Do not count binges.) (Circle the number which applies.)	0 – None of the times 1 – A few of the times 2 – Less than half the times 3 – Half the times 4 – More than half the times 5 – Most of the times 6 – Every time
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16.	Over the past four weeks (28 days), have there been any times when you have felt that you have eaten what other people would regard as an unusually large amount of food given the circumstances? (Please circle YES or NO and put appropriate number in box.)	YES NO
17.	How many such episodes have you had over the past four weeks?	()
18.	During how many of these episodes of overeating did you have a sense of having lost control over your eating?	()
19.	Have you had other episodes of eating in which you have had a sense of having lost control and eaten too much, but have <u>not</u> eaten an unusually large amount of food given the circumstances?	YES NO
20.	How many such episodes have you had over the past four weeks?	()
21.	Over the past four weeks have you made yourself sick (vomit) as a means of controlling your shape or weight?	YES NO
22.	How many times have you done this over the past four weeks?	()
23.	Have you taken laxatives as a means of controlling your shape or weight?	YES NO
24.	How many times have you done this over the past four weeks?	()
25.	Have you taken diuretics (water tablets) as a means of controlling your shape or weight?	YES NO
26.	How many times have you done this over the past four weeks?	()
27.	Have you exercised <u>hard</u> as a means of controlling your shape or weight?	YES NO
28.	How many times have you done this over the past four weeks?	()

	OVER THE PAST FOUR WEEKS (28 DAYS) (PLEASE CIRCLE THE NUMBER WHICH BEST DESCRIBES YOUR BEHAVIOUR.)	NOT AT ALL	1	SLIGHTLY	2	3	MODERATELY	4	5	MARKEDLY	6
29.	Has your weight influenced how you think about (judge) yourself as a person?	0	1	2	3	4	5	6	7	8	9
30.	Has your shape influenced how you think about (judge) yourself as a person?	0	1	2	3	4	5	6	7	8	9
31.	How much would it upset you if you had to weigh yourself once a week for the next four weeks?	0	1	2	3	4	5	6	7	8	9

32.	How dissatisfied have you felt about your weight?	0	1	2	3	4	5	6
33.	How dissatisfied have you felt about your shape?	0	1	2	3	4	5	6
34.	How concerned have you been about other people seeing you eat?	0	1	2	3	4	5	6
35.	How uncomfortable have you felt seeing your body; for example, in the mirror, in shop window reflections, while undressing or taking a bath or shower?	0	1	2	3	4	5	6
36.	How uncomfortable have you felt about others seeing your body: for example, in communal changing rooms, when swimming or wearing tight clothes?	0	1	2	3	4	5	6

Appendix G

Distress Tolerance Scale (DTS)

DTS

Instructions

Think of times that you feel distressed or upset. Read each statement below and circle the number that best describes your beliefs about feeling distressed or upset. Please answer all the questions as honestly as you can.

	Never	Rarely	Sometimes	Most of the	All the time
1) If I am concerned that I am going to feel anxious, I make sure that I have planned lots of things to do to keep my mind occupied.....	0	1	2	3	4
2) I avoid situations in which I know I will become over excited.....	0	1	2	3	4
3) If I think that I might feel lonely, I will make sure that I am surrounded by people.....	0	1	2	3	4
4) If I am feeling anxious, I will do something practical to steady my nerves (e.g., clean the house).....	0	1	2	3	4
5) When I am really angry, I do something mentally to calm myself (e.g., count to 100).....	0	1	2	3	4
6) If I know I am going to be alone for any length of time I will make sure that I have lots of things to do to make the time pass quickly...	0	1	2	3	4
7) I avoid situations that I know will make me nervous.....	0	1	2	3	4
8) I tend to avoid situations and people that I know will make me feel sad.	0	1	2	3	4
9) I won't engage in activities/relationships about which I know I will become too enthusiastic.....	0	1	2	3	4
10) If I find I am getting too anxious, I will do something to soothe myself (e.g., listen to music, read a book, watch TV).....	0	1	2	3	4
11) When I get angry, I have to leave the situation in order to control my temper.....	0	1	2	3	4
12) I don't let myself think about things that would depress me.....	0	1	2	3	4
13) If I feel myself enjoying something too much, I will stop it before I get carried away.....	0	1	2	3	4
14) I cope with feeling lonely, I do something to remind myself that there are other people there for me (e.g., read letters, look at photographs)	0	1	2	3	4

Appendix H

Difficulties in Emotion Regulation Scale (DERS)

DERS

Please indicate how often the following statements apply to you by writing the appropriate number from the scale below on the line beside each item:

1-----	2-----	3-----	4-----	5-----
almost never (0-10%)	sometimes (11-35%)	about half the time (36-65%)	most of the time (66-90%)	almost always (91-100%)

- _____ 1) I am clear about my feelings.
- _____ 2) I pay attention to how I feel.
- _____ 3) I experience my emotions as overwhelming and out of control.
- _____ 4) I have no idea how I am feeling.
- _____ 5) I have difficulty making sense out of my feelings.
- _____ 6) I am attentive to my feelings.
- _____ 7) I know exactly how I am feeling.
- _____ 8) I care about what I am feeling.
- _____ 9) I am confused about how I feel.
- _____ 10) When I'm upset, I acknowledge my emotions.
- _____ 11) When I'm upset, I become angry with myself for feeling that way.
- _____ 12) When I'm upset, I become embarrassed for feeling that way.
- _____ 13) When I'm upset, I have difficulty getting work done.
- _____ 14) When I'm upset, I become out of control.
- _____ 15) When I'm upset, I believe that I will remain that way for a long time.
- _____ 16) When I'm upset, I believe that I'll end up feeling very depressed.
- _____ 17) When I'm upset, I believe that my feelings are valid and important.
- _____ 18) When I'm upset, I have difficulty focusing on other things.
- _____ 19) When I'm upset, I feel out of control.
- _____ 20) When I'm upset, I can still get things done.
- _____ 21) When I'm upset, I feel ashamed with myself for feeling that way.

1-----2-----3-----4-----5					
<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 20%; text-align: center;">almost never (0-10%)</td> <td style="width: 20%; text-align: center;">sometimes (11-35%)</td> <td style="width: 20%; text-align: center;">about half the time (36-65%)</td> <td style="width: 20%; text-align: center;">most of the time (66-90%)</td> <td style="width: 20%; text-align: center;">almost always (91-100%)</td> </tr> </table>	almost never (0-10%)	sometimes (11-35%)	about half the time (36-65%)	most of the time (66-90%)	almost always (91-100%)
almost never (0-10%)	sometimes (11-35%)	about half the time (36-65%)	most of the time (66-90%)	almost always (91-100%)	

- _____ 22) When I'm upset, I know that I can find a way to eventually feel better.
- _____ 23) When I'm upset, I feel like I am weak.
- _____ 24) When I'm upset, I feel like I can remain in control of my behaviors.
- _____ 25) When I'm upset, I feel guilty for feeling that way.
- _____ 26) When I'm upset, I have difficulty concentrating.
- _____ 27) When I'm upset, I have difficulty controlling my behaviors.
- _____ 28) When I'm upset, I believe that there is nothing I can do to make myself feel better.
- _____ 29) When I'm upset, I become irritated with myself for feeling that way.
- _____ 30) When I'm upset, I start to feel very bad about myself.
- _____ 31) When I'm upset, I believe that wallowing in it is all I can do.
- _____ 32) When I'm upset, I lose control over my behaviors.
- _____ 33) When I'm upset, I have difficulty thinking about anything else.
- _____ 34) When I'm upset, I take time to figure out what I'm really feeling.
- _____ 35) When I'm upset, it takes me a long time to feel better.
- _____ 36) When I'm upset, my emotions feel overwhelming.

Appendix I

Frost Multidimensional Perfectionism Scale (FMPS)

FMPS

Instructions

Listed below are a number of statements concerning personal characteristics and traits. Read each item and decide whether you agree or disagree, and to what extent. If you strongly disagree, circle 1; if you strongly agree, circle 5, if you feel somewhere in between circle any one of the numbers between 1 and 5. If you feel neutral or undecided the midpoint is 3.

	Strongly Disagree				Strongly Agree
1. My parents set very high standards for me	1	2	3	4	5
2. Organization is very important to me	1	2	3	4	5
3. As a child I was punished for doing things less than perfect	1	2	3	4	5
4. If I do not set high standards for myself I am likely to end up a second rate person	1	2	3	4	5
5. My parents never tried to understand my mistakes	1	2	3	4	5
6. It is important to me that I be thoroughly competent in everything I do	1	2	3	4	5
7. I am a neat person	1	2	3	4	5
8. I try to be an organized person	1	2	3	4	5
9. If I fail at work/school, I am a failure as a person	1	2	3	4	5
10. I should be upset if I make a mistake	1	2	3	4	5
11. My parents wanted me to be the best at everything	1	2	3	4	5
12. I set higher goals than most people	1	2	3	4	5
13. If someone does a task at work/school better than I, then I feel like I failed the whole task	1	2	3	4	5
14. If I fail partly it's as bad as being a complete failure	1	2	3	4	5
15. Only outstanding performance is good enough in my family	1	2	3	4	5
16. I am very good at focusing my efforts on attaining a goal	1	2	3	4	5
17. Even when I do something very carefully, I often feel that it is not quite right	1	2	3	4	5
18. I hate being less than best at things	1	2	3	4	5

	Strongly Disagree			Strongly Agree	
19. I have extremely high goals	1	2	3	4	5
20. My parents have expected excellence from me	1	2	3	4	5
21. People will probably think less of me if I make a mistake	1	2	3	4	5
22. I never felt like I could meet my parents' expectations	1	2	3	4	5
23. If I do not do as well as other people it means I am an inferior human being	1	2	3	4	5
24. Other people seem to accept lower standards for themselves than I do	1	2	3	4	5
25. If I do not do well all the time, people will not respect me	1	2	3	4	5
26. My parents have always had higher expectations for my future than I have	1	2	3	4	5
27. I try to be a neat person	1	2	3	4	5
28. I usually have doubts about the simple everyday things I do	1	2	3	4	5
29. Neatness is very important to me	1	2	3	4	5
30. I expect higher performance in my daily tasks than most other people do	1	2	3	4	5
31. I am an organized person	1	2	3	4	5
32. I tend to get behind in my work because I repeat things over and over	1	2	3	4	5
33. It takes me a long time to do something right	1	2	3	4	5
34. The fewer mistakes I make, the more people will like me	1	2	3	4	5
35. I never felt I could meet my parents' standards	1	2	3	4	5

Appendix J

Depressive Experiences Questionnaire (DEQ)

DEQ

Instructions

Listed below are a number of statements concerning personal characteristics and traits. Read each item and decide whether you agree or disagree and to what extent. If you strongly agree, circle 7; if you strongly disagree, circle 1; if you feel somewhere in between, circle any one of the numbers between 1 and 7. The midpoint, if you are neutral or undecided, is 4.

		Strongly Disagree						Strongly Agree
		1	2	3	4	5	6	7
1	I set my personal goals and standards as high as possible	1	2	3	4	5	6	7
2	Without support from others who are close to me, I would be helpless	1	2	3	4	5	6	7
3	I tend to be satisfied with my current plans and goals, rather than striving for higher goals	1	2	3	4	5	6	7
4	Sometimes I feel very big, and other times I feel very small	1	2	3	4	5	6	7
5	When I am closely involved with someone, I never feel jealous	1	2	3	4	5	6	7
6	I urgently need things that only other people can provide	1	2	3	4	5	6	7
7	I often find that I don't live up to my own standards or ideals	1	2	3	4	5	6	7
8	I feel I am always making full use of my potential abilities	1	2	3	4	5	6	7
9	The lack of permanence in human relationships doesn't bother me	1	2	3	4	5	6	7
10	If I fail to live up to expectations, I feel unworthy	1	2	3	4	5	6	7
11	Many times I feel helpless	1	2	3	4	5	6	7
12	I seldom worry about being criticized for things I have said or done	1	2	3	4	5	6	7
13	There is a considerable difference between how I am now and how I would like to be	1	2	3	4	5	6	7
14	I enjoy sharp competition with others	1	2	3	4	5	6	7
15	I feel I have many responsibilities I must meet	1	2	3	4	5	6	7
16	There are times when I feel "empty" inside	1	2	3	4	5	6	7
17	I tend not to be satisfied with what I have	1	2	3	4	5	6	7
18	I don't care whether or not I live up to what other people expect of me	1	2	3	4	5	6	7
19	I become frightened when I feel alone	1	2	3	4	5	6	7
20	I would feel like I'd be losing an important part of myself if I lost a very close friend	1	2	3	4	5	6	7
21	People will accept me no matter how many mistakes I have made	1	2	3	4	5	6	7

		Strongly Disagree					Strongly Agree	
		1	2	3	4	5	6	7
22	I have difficulty breaking off a relationship that is making me unhappy	1	2	3	4	5	6	7
23	I often think about the danger of losing someone who is close to me	1	2	3	4	5	6	7
24	Other people have high expectations of me	1	2	3	4	5	6	7
25	When I am with others, I tend to devalue or "undersell" myself	1	2	3	4	5	6	7
26	I am not very concerned with how other people respond to me	1	2	3	4	5	6	7
27	No matter how close a relationship between two people is, there is always a large amount of uncertainty and conflict	1	2	3	4	5	6	7
28	I am very sensitive to others for signs of rejection	1	2	3	4	5	6	7
29	It's important for my family that I succeed	1	2	3	4	5	6	7
30	Often, I feel I have disappointed others	1	2	3	4	5	6	7
31	If someone makes me angry, I let him (her) know how I feel	1	2	3	4	5	6	7
32	I constantly try, and very often go out of my way, to please or help people I am close to	1	2	3	4	5	6	7
33	I have many inner resources (abilities, strengths)	1	2	3	4	5	6	7
34	I find it very difficult to say "No" to the requests of friends	1	2	3	4	5	6	7
35	I never really feel secure in a close relationship	1	2	3	4	5	6	7
36	The way I feel about myself frequently varies: there are times when I feel extremely good about myself and other times when I see only the bad in me and feel like a total failure	1	2	3	4	5	6	7
37	Often, I feel threatened by change	1	2	3	4	5	6	7
38	Even if the person who is closest to me were to leave, I could still "go it alone"	1	2	3	4	5	6	7
39	One must continually work to gain love from another person: that is, love has to be earned	1	2	3	4	5	6	7
40	I am very sensitive to the effects my words or actions have on the feelings of other people	1	2	3	4	5	6	7
41	I often blame myself for things I have done or said to someone	1	2	3	4	5	6	7
42	I am a very independent person	1	2	3	4	5	6	7
43	I often feel guilty	1	2	3	4	5	6	7
44	I think of myself as a very complex person, one who has "many sides"	1	2	3	4	5	6	7
45	I worry a lot about offending or hurting someone who is close to me	1	2	3	4	5	6	7

	Strongly Disagree				Strongly Agree			
	1	2	3	4	5	6	7	
46 Anger frightens me	1	2	3	4	5	6	7	
47 It is not "who you are," but "what you have accomplished" that counts	1	2	3	4	5	6	7	
48 I feel good about myself whether I succeed or fail	1	2	3	4	5	6	7	
49 I can easily put my own feelings and problems aside, and devote my complete attention to the feelings and problems of someone else	1	2	3	4	5	6	7	
50 If someone I cared about became angry with me, I would feel threatened that he (she) might leave me	1	2	3	4	5	6	7	
51 I feel comfortable when I am given important responsibilities	1	2	3	4	5	6	7	
52 After a fight with a friend, I must make amends as soon as possible	1	2	3	4	5	6	7	
53 I have a difficult time accepting weaknesses in myself	1	2	3	4	5	6	7	
54 It is more important that I enjoy my work than it is for me to have my work approved	1	2	3	4	5	6	7	
55 After an argument, I feel very lonely	1	2	3	4	5	6	7	
56 In my relationships with others, I am very concerned about what they can give to me	1	2	3	4	5	6	7	
57 I rarely think about my family	1	2	3	4	5	6	7	
58 Very frequently, my feelings toward someone close to me vary: there are times when I feel completely angry and other times when I feel all-loving towards that person	1	2	3	4	5	6	7	
59 What I do and say has a very strong impact on those around me	1	2	3	4	5	6	7	
60 I sometimes feel that I am "special"	1	2	3	4	5	6	7	
61 I grew up in an extremely close family	1	2	3	4	5	6	7	
62 I am very satisfied with myself and my accomplishments	1	2	3	4	5	6	7	
63 I want many things from someone I am close to	1	2	3	4	5	6	7	
64 I tend to be very critical of myself	1	2	3	4	5	6	7	
65 Being alone doesn't bother me at all	1	2	3	4	5	6	7	
66 I very frequently compare myself to standards or goals	1	2	3	4	5	6	7	

Appendix K

Levels of Self-Criticism Scale (LOSC)

LOSC

Listed below are a number of statements. If you strongly agree, circle 7; if you strongly disagree, circle 1; if you feel somewhere in between, circle any of the numbers between 1 and 7. The midpoint, if you are neutral or undecided, is 4.

	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
1. I am very irritable when I have failed	1	2	3	4	5	6	7
2. I have a nagging sense of inferiority	1	2	3	4	5	6	7
3. I am very frustrated with myself when I don't meet the standards I have for myself	1	2	3	4	5	6	7
4. I am usually uncomfortable in social situations where I don't know what to expect	1	2	3	4	5	6	7
5. I often get angry with myself when I fail	1	2	3	4	5	6	7
6. I don't spend much time worrying about what other people will think of me	1	2	3	4	5	6	7
7. I get very upset when I fail	1	2	3	4	5	6	7
8. If you are open with other people about your weaknesses, they are likely to still respect you	1	2	3	4	5	6	7
9. Failure is a very painful experience for me	1	2	3	4	5	6	7
10. I often worry that other people will find out what I'm really like and be upset with me	1	2	3	4	5	6	7
11. I don't often worry about the possibility of failure	1	2	3	4	5	6	7
12. I am confident that most of the people I care about will accept me for who I am	1	2	3	4	5	6	7
13. When I don't succeed, I find myself wondering how worthwhile I am	1	2	3	4	5	6	7
14. If you give people the benefit of the doubt, they are likely to take advantage of you	1	2	3	4	5	6	7
15. I feel like a failure when I don't do as well as I would like	1	2	3	4	5	6	7
16. I am usually comfortable with people asking me about myself	1	2	3	4	5	6	7
17. If I fail in one area, it reflects poorly on me as a person	1	2	3	4	5	6	7

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|-----|---|---|---|---|---|---|---|---|
| 18. | I fear that if people get to know me too well, they will not respect me | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 19. | I frequently compare myself with my goals and ideals | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 20. | I seldom feel ashamed of myself | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 21. | Being open and honest is usually the best way to keep others' respect | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 22. | There are times that it is necessary to be somewhat dishonest in order to get what you want | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Appendix L

Forms of Self-criticising and Self-reassuring Scale (FSCRS)

FSCRS

When things go wrong in our lives or don't work out as we hoped, and we feel we could have done better, we sometimes have *negative and self-critical thoughts and feelings*. These may take the form of feeling worthless, useless or inferior etc. However, people can also try to be supportive of them selves. Below are a series of thoughts and feelings that people sometimes have. Read each statement carefully and circle the number that best describes how much each statement is true for you.

Please use the scale below.

	Not at all like me 0	A little bit like me 1	Moderately like me 2	Quite a bit like me 3	Extremely like me 4
When things go wrong for me:					
1.	I am easily disappointed with myself.				
2.	There is a part of me that puts me down.				
3.	I am able to remind myself of positive things about myself.				
4.	I find it difficult to control my anger and frustration at myself.				
5.	I find it easy to forgive myself.				
6.	There is a part of me that feels I am not good enough.				
7.	I feel beaten down by my own self-critical thoughts.				
8.	I still like being me.				
9.	I have become so angry with myself that I want to hurt or injure myself.				
10.	I have a sense of disgust with myself.				
11.	I can still feel lovable and acceptable.				
12.	I stop caring about myself.				
13.	I find it easy to like myself.				
14.	I remember and dwell on my failings.				
15.	I call myself names.				
16.	I am gentle and supportive with myself.				
17.	I can't accept failures and setbacks without feeling inadequate.				
18.	I think I deserve my self-criticism.				
19.	I am able to care and look after myself.				
20.	There is a part of me that wants to get rid of the bits I don't like.				
21.	I encourage myself for the future.				
22.	I do not like being me.				

Appendix M

Functions of Self-Criticising Scale (FSCS)

FSCS

There can be many reasons why people become critical and angry with themselves. Read each statement carefully and circle the number that best describes how much each statement is true for you.

Use the scale below.

Not at all like me	A little bit like me	Moderately like me	Quite a bit like me	Extremely like me
0	1	2	3	4

I get critical and angry with myself:

1.	To make sure I keep up my standards.	0	1	2	3	4
2.	To stop myself being happy.	0	1	2	3	4
3.	To show I care about my mistakes.	0	1	2	3	4
4.	Because, if I punish myself I feel better.	0	1	2	3	4
5.	To stop me being lazy.	0	1	2	3	4
6.	To harm part of myself.	0	1	2	3	4
7.	To keep myself in check.	0	1	2	3	4
8.	To punish myself for my mistakes.	0	1	2	3	4
9.	To cope with feelings of disgust with myself.	0	1	2	3	4
10.	To take revenge on part of myself.	0	1	2	3	4
11.	To stop me getting overconfident.	0	1	2	3	4
12.	To stop me being angry with others	0	1	2	3	4
13.	To destroy a part of me.	0	1	2	3	4
14.	To make me concentrate.	0	1	2	3	4
15.	To gain reassurance from others.	0	1	2	3	4
16.	To stop me becoming arrogant.	0	1	2	3	4
17.	To prevent future embarrassments.	0	1	2	3	4
18.	To remind me of my past failures	0	1	2	3	4
19.	To keep me from making minor mistakes.	0	1	2	3	4
20.	To remind me of my responsibilities.	0	1	2	3	4
21.	To get at the things I hate in myself.	0	1	2	3	4