

**Emotion regulation styles as longitudinal predictors of compulsive exercise:  
A twelve month prospective study**

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**Abstract**

Exercise can be used as a mood regulator but, in the eating disorder literature, exercise has sometimes been found to be compulsive, detrimental to physical health, and regarded as one maladaptive strategy used to regulate emotions. This study examined longitudinal associations between emotion regulation styles and this compulsive exercise in 572 adolescents who completed measures of compulsive exercise and emotion regulation. Twelve months later they completed measures of compulsive exercise. Compulsive exercise was predicted by Internal Dysfunctional emotion regulation in girls and boys, even after controlling for initial levels of compulsive exercise. Adolescents displaying compulsivity to exercise may require intervention programmes to alter their emotion regulation strategies.

**Key words:** Emotion Regulation, Adolescents, Health promotion, Eating Disorders, Risk Factors, Internal Dysfunctional emotion regulation

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Exercise is a positive behaviour for all ages, which can provide many positive benefits, such as mood enhancement and alleviation of anxiety (e.g. Salmon, 2001). However, for a small percentage of people, exercise can be performed compulsively. Specifically, compulsive exercise is commonly seen in clinical eating disorder patients, and is characterised by a driven urge to exercise, often despite physical injury or illness, and usually performed in a routine-like fashion (Meyer, Taranis, Goodwin, & Haycraft, 2011). Further to this description, compulsive exercise has been associated with affect regulation in clinical samples (Bratland-Sanda et al., 2010), which is in line with the generally accepted view of exercise as a functional emotion regulation strategy (e.g., Thayer, Newman, & McLain, 1994). Indeed, exercise is largely a positive behaviour with widely known psychological and physical benefits, and such exercising within the eating disorder population could also be regarded as functional, as it could potentially alleviate stress (Hausenblas, Cook & Chittester, 2008). However, exercise behaviour seen in individuals with eating disorders can often become compulsively motivated (Davis et al., 1997) and, as such, it poses a significant physical and psychological risk (Meyer et al., 2011).

Meyer and colleagues (2011) developed a cognitive behavioural model of compulsive exercise, stipulating several psychological maintaining factors, including eating disorder psychopathology, rigidity, obsessive-compulsiveness, and emotion regulation. The emotion regulation maintenance factor was further separated out into positive and negative reinforcement. Meyer and colleagues noted that an individual who is exercising regularly may continue to do so through the positive reinforcement that they receive from performing exercise (i.e., the positive reinforcement may result

from a sense of achievement, a sense of well-being, or the social aspects of exercising, amongst other things). This positive motivator is a common factor in continuing exercise behaviour in the general population (Biddle, Fox, & Boutcher, 2000). In addition, the model suggested that compulsive exercise may be maintained by a process of negative reinforcement, whereby the individual continues to exercise as a result of the removal of aversive stimuli, such as negative emotions. This suggestion is supported by the extant literature highlighting the anxiolytic properties of exercise (e.g., Biddle et al., 2000).

This process of positive and negative reinforcement motivating the individual to exercise is not on its own problematic, as it is a mechanism that would apply to any behaviour (e.g., Ferster & Skinner, 1957). However, it is arguably a problem when the individual anticipates the negative reinforcement prior to performing the exercise and, as such, begins to use it as an avoidant coping strategy; in other words, they begin to exercise as a way of avoiding the aversive stimuli (e.g., anxiety) prior to the stimuli even being present. This experiential avoidance of a negative emotion has been regarded as a dysfunctional emotion regulating strategy, which paradoxically could actually lead to a subsequent increase in the negative emotions that are trying to be avoided, as it prevents the individual from learning that the emotion will dissipate gradually by itself (e.g., Kashdan, Barrios, Forsyth, & Steger, 2006). This process then leads the individual to maintain a compulsive drive to exercise because they fear what may happen if they were to stop exercising (Meyer et al., 2011).

This suggestion of compulsive exercise being regarded as a maladaptive coping strategy is arguably but one thread in a complex chain of maladaptive behaviours that some adolescents might manifest. The suggestion that compulsive exercise occurs in response to negative affect has been proposed by other research in

clinical (e.g. Penas Lledo, Vaz Leal, & Waller, 2002) and non-clinical samples (e.g., De Young & Anderson, 2010). Compulsive exercise has also been directly associated with an avoidance of negative affect (Meyer & Taranis, 2007), and such avoidance is widely linked with psychological distress, health problems and psychiatric symptomatology (Endler & Parker, 1990), including eating disorder psychopathology (e.g., Ghaderi & Scott, 2000).

A recent cross-sectional study of compulsive exercise in adolescents found that compulsive exercise was associated with emotion regulation styles (Goodwin, Haycraft, & Meyer, 2012). However, it is unknown whether these particular styles can actually lead to the future development of compulsive exercise. Therefore, prospective designs are required to inform prevention strategies for compulsive exercise, which is particularly relevant in this adolescent age group, given that the typical age of onset of eating disorders is in adolescence (Striegel-Moore & Bulik, 2007).

In summary, emotion regulation has been previously associated with exercise behaviour. However, exercise behaviour can become compulsive in nature, particularly if it is being primarily motivated by a dysfunctional emotion regulation strategy (e.g., avoidance). It remains unclear whether emotion regulation styles predict compulsive exercise over time and therefore, whether or not they play a role in the development of compulsive exercise. Therefore, this study aims to build upon the initial work of Goodwin and colleagues (2012) and to identify whether there is a specific longitudinal association between emotion regulation styles and compulsive exercise. It is hypothesised that dysfunctional emotion regulation styles will be positively related to compulsive exercise, even after controlling for initial levels of compulsive exercise.

## Methods

### Participants and Procedure

An initial 813 adolescents were recruited from five schools, and assessed at baseline (T1). After dropouts from baseline to the 12-month follow-up (T2; dropout  $n = 241$ ), a final sample of 572 adolescents aged 12-14 years old (mean = 13.16 years,  $SD = .73$ ) at T1 was used for this study. The sample comprised boys and girls (boys  $n = 252$ ; girls  $n = 320$ ) and it was predominantly British (98.6% of sample), as well as being ethnically homogenous ("White British" = 95.4%). Self reported height and weight information was converted to Body Mass Index (BMI) values, which were age- and gender-adjusted into BMI  $z$  scores (Child Growth Foundation, 1996). At T1, the BMI  $z$  score mean for boys was 0.38 ( $SD = 1.51$ ) and for girls it was 0.10 ( $SD = 1.25$ ). At T2, boys' mean BMI  $z$  score mean was 0.27 ( $SD = 1.37$ ) and was 0.04 ( $SD = 1.06$ ) for girls.

Following institutional ethical approval, five schools across the United Kingdom were sent questionnaire packs (including consent forms and parent letters), which were given to all pupils aged within the required age range of the study (12-14 years old at T1). Questionnaires were completed during a regular timetabled class period. All returned questionnaires were assigned a specific identification code in order for them to be matched to the longitudinal follow-up. A follow-up assessment was conducted approximately 12-months later (T2), using the same procedure as at T1.

### Measures

For the purposes of this study, background information was collected at T1 on age, gender, nationality, ethnicity and self-reported height and weight, followed by the subsequent validated measures. At T2, similar background information was

collected (in order to aid identification of follow-up participants), plus the Compulsive Exercise Test (Taranis, Touyz, & Meyer, 2011).

**Compulsive Exercise Test (CET; Taranis et al., 2011).** The CET assesses compulsive exercise cognitions across five dimensions of: Avoidance and Rule-Driven Behaviour (“I feel extremely guilty if I miss an exercise session”); Weight Control Exercise (“I exercise to burn calories and lose weight”); Mood Improvement (“I feel less anxious after I exercise”); Lack of Exercise Enjoyment (“I find exercise a chore”); and Exercise Rigidity (“I follow a set routine for my exercise”). Responses are provided on a six-point Likert scale ranging from “0 – Never true” to “5 – Always true”. A total CET score is calculated by summing the mean item score for each of the five subscales, with higher scores representing greater compulsivity towards exercise. Only the total CET score was used for this study. The CET has been psychometrically tested within an adolescent age group, using a cross-sectional sample recruited as a wider part of this programme of research (Goodwin, Haycraft, Taranis, & Meyer, 2011), and was found to demonstrate satisfactory concurrent and discriminant validity with the Commitment to Exercise Scale (CES; Davis, Brewer, & Ratusny, 1993) and the Eating Disorder Inventory-2 (EDI-2; Garner, 1991), respectively. The CET was administered at T1 and at T2 and, with the current sample, the CET Total had a Cronbach’s alpha of .89 at T1 and .87 at T2.

**Regulation of Emotions Questionnaire (REQ; Phillips & Power, 2007).**

The REQ assesses a person’s emotion regulation tendencies. The REQ comprises four subscales: *Internal Dysfunctional*, *Internal Functional*, *External Dysfunctional* and *External Functional*. *Internal Dysfunctional* emotion regulation style describes the extent to which an individual deals with a situation by themselves (internal), incorporating such dysfunctional behaviours as self-harm, rumination, and repression

(e.g. “I harm or punish myself in some way”). The *Internal Functional* emotion refers to adaptive internal emotion regulation, such as positive re-appraisal, planning, and putting the situation into perspective (e.g. “I review/rethink my thoughts or beliefs”). *External Dysfunctional* emotion regulation refers to maladaptive interaction behaviours such as bullying others physically or verbally, making others feel bad, or lashing out at objects (e.g. “I take my feelings out on other people physically, e.g. fighting, lashing out”). Finally, regulating emotion through interacting with others can be additionally described by the *External Functional* style subscale, which measures positive behaviours such as advice seeking, physical contact, or doing something nice with friends and family (e.g. “I talk to someone about how I feel”). Higher scores on each of the subscales relates to a greater tendency to use that particular style of emotion regulation. Phillips and Power (2007) were able to demonstrate good factor structure for the REQ among adolescents, and found sufficient validity for the measure, with dysfunctional emotion regulation being positively correlated with parent reports of emotional and behavioural problems, and functional emotion regulation being positively correlated with quality of life. The Cronbach’s alpha coefficients in the current sample were .71 (Internal Dysfunctional), .73 (Internal Functional), .77 (External Dysfunctional), and .74 (External Functional). The REQ was measured at T1 only.

### **Data Analysis**

Attrition analysis (multiple t tests) compared dropouts ( $n = 241$ ) and the final retained sample ( $n = 572$ ) on all study variables, including BMI z scores. Dropouts scored significantly higher than the retained sample on REQ External Dysfunctional ( $t = 3.51, p < .01$ ) and significantly lower than the retained sample on REQ Internal Functional ( $t = -2.83, p < .01$ ). This suggests some possible sample bias, although the



former was only significant for one school, and so was not biased for the majority of the recruitment sites. Importantly, most dropouts occurred due to specific classes not being able to be assessed at follow-up, rather than at the individual level. There were no significant differences between dropouts and the retained sample on all other variables.

The study aimed to create gender-specific risk factor models, building on the work of Goodwin et al. (2012), who examined boys and girls separately. All analyses were therefore conducted separately for boys and girls in the current sample (which was further supported by the gender differences found on the T2 CET Total, and two of the four REQ subscales; see Table 1). Kolmogorov-Smirnov tests demonstrated non-normal distribution of the majority of the study variables. Therefore, non-parametric tests were used where appropriate. However, residuals on the regression analyses showed normal distribution, and so no transformations of the variables were made before performing the subsequent regression analyses (Field, 2005). Initial investigations found that T1 BMI  $z$  score and the study variables were not significantly correlated (Spearman's  $\rho$ ,  $p > .05$ ). Therefore, T1 BMI  $z$  score was not entered into the regression models as a control variable.

Longitudinal predictors of compulsive exercise were investigated using a hierarchical regression, with T2 CET Total as the outcome variable. Emotion regulation styles of Internal Dysfunctional, Internal Functional, External Dysfunctional and External Functional were entered as the predictor variables in Step 1. It has been reported that baseline levels of the outcome variable must also be controlled for, to ensure that true change in the outcome is being predicted (e.g., Presnell, Bearman, & Stice, 2004). Therefore, the T1 CET Total was entered in Step 2 to identify whether any significant relationships found in Step1 remained after

controlling for the baseline levels of the outcome variable. Significance was set at  $p < .05$ .

## Results

### Descriptive Statistics of the Sample

Table 1 shows the means and standard deviations for the study variables for boys and girls, as well as a test of difference between boys and girls on all study variables (Mann Whitney U). The means for T1 CET Total and T2 CET Total for boys and girls equate to low to mid-point scoring ("sometimes true of me"). Overall, for all boys, the T1 CET Total recorded a significant positive correlation (one-tailed) with T2 CET Total (Spearman's  $\rho = .52, p < .001$ ), and for the girls, the same correlation was also significant (Spearman's  $\rho = .55, p < .001$ ). Boys and girls did not report significantly different CET Total scores at T1, but at T2 girls reported a significantly greater CET Total than boys.

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INSERT TABLE 1 ABOUT HERE

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The means for the REQ subscales were all lower than in a previous study of adolescents using the same measure (Phillips & Power, 2007). The pattern of scores for the boys was identical to the previous study of Phillips and Power (2007), with Internal Functional recording the highest mean, followed by External Functional, then Internal Dysfunctional and the least reported emotion regulation style being External Dysfunctional. Among the girls, the pattern was the same except for External Functional recording a greater mean than Internal Functional.

### Emotion Regulation and Compulsive Exercise

**Boys.** The hierarchical regression predicting T2 CET Total outcome can be seen in Table 2. The hierarchical regression model found that collectively the REQ predictors significantly predicted T2 CET Total and accounted for 11% ( $R^2$ ) of the T2 CET Total variance. After controlling for T1 CET Total, the total variance of T2 CET Total accounted for was 31%. In the final step of the model, T1 CET Total and REQ Internal Dysfunctional were significant unique predictors of T2 CET Total. There were no other significant predictors of T2 CET Total.

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INSERT TABLE 2 ABOUT HERE

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**Girls.** Table 2 also shows the results of the hierarchical regression predicting T2 CET Total outcome. The model found that the REQ subscales collectively significantly predicted T2 CET Total and accounted for 13% ( $R^2$ ) of the T2 CET Total variance. After entering the T1 CET Total, the final step of the model was also significant and accounted for 36% ( $R^2$ ) of the variance of T2 CET Total. In the final step of the model, T1 CET Total and Internal Dysfunctional were the only two significant unique predictors. There were no other significant predictors of T2 CET Total.

### Discussion

The current study examined the longitudinal effects of emotion regulation styles on compulsive exercise, to assess whether they could be implicated in the development of this eating disorder symptom among adolescents. The results demonstrated that emotion regulation styles did longitudinally predict compulsive exercise in boys and girls, even after controlling for the initial levels of the outcome

(i.e. compulsive exercise). This association supports previous studies that have suggested that compulsive exercise is a dysfunctional emotion regulation strategy (Penas-Lledo et al., 2002), and the maintenance model of compulsive exercise that postulates that dysfunctional emotion regulation can act upon compulsive exercise (Meyer et al., 2011). However, the current findings extend this association using a prospective design and implicate emotion regulation styles in the development of compulsive exercise in both boys and girls.

Specifically, an internal dysfunctional emotion regulation style was the only significant unique predictor of compulsive exercise. This regulation style describes the management of emotions using such behaviours as rumination, repression and self-harm, and essentially emotion regulation that is conducted without social support, in a rather avoidant fashion. Huon and colleagues (1999) showed that an avoidance of social forms of coping were associated with greater maladaptive eating attitudes, whilst the general eating disorders literature also demonstrates that individuals with eating disorders often isolate themselves and tend to have interpersonal difficulties (Hartmann, Zeeck, & Barrett, 2009). Therefore, the finding in the current study suggests that the eating disorder symptom of compulsive exercise may develop out of an individual's underlying preference to deal with emotions on their own, but in a dysfunctional manner that does not address the problem. This has also been shown by research which found that compulsive exercise was cross-sectionally linked to an avoidance of affect (Meyer & Taranis, 2007). Certainly, eating disorder patients may attempt to reduce or control negative emotions by limiting food intake, but this in turn exacerbates the disorder's symptomatology. This same dysfunctional way of managing negative emotions could be true of compulsive exercise (Loumidis & Roxborough, 1995). In other words, it becomes a short term distraction, which may

develop into long term compulsive behaviour if there are no other coping strategies (Adams, Miller, & Kraus, 2003). This is particularly worrying given that compulsive exercise was associated here with dysfunctional emotion regulation in this non-clinical sample of adolescents.

The results have several practical implications. Although the benefits of exercise are well-established, and exercise should still be advocated among adolescents and adults alike, the small percentage of adolescents reporting *compulsive exercise* attitudes should be encouraged to deal with their emotions in more functional ways, preferably via the use of social support and interaction with others, which in itself could lead to psychological and physical health benefits (Blechman, 1998). Prevention programmes, for example, could look to reduce the risk of developing compulsive exercise by encouraging more varied coping skills, to avoid a reliance on exercise. Further research into emotion regulation, anxiety, compulsive exercise and the eating disorders is warranted to more fully examine the complex interplay between these constructs. Furthermore, these complex relationships would be useful to measure in elite sport training environments among adolescents. For these young athletes, a 'standard' training plan might be interpreted as 'obsessive', but there are few suggestions that these athletes are negatively impacted by their training, suggesting that risk for compulsive exercise is not likely to be simply a function of exercise volume alone.

It must be noted that there were several limitations of this study. The use of a self-report measure of BMI is not always reliable and, as such, should be measured objectively in future studies. Likewise, emotion regulation in adolescents may be problematic (Phillips & Power, 2007), although the REQ does provide a useful and validated measure to help our understanding of adolescents' emotion regulation

strategies. The use of the REQ at T1 only also makes the assumption that emotion regulation styles have remained constant during the follow-up period, which may not be the case. Contrastingly, for compulsive exercise, the follow-up period of 12-months may not have been sufficient to identify its true development. Indeed, the T1 and T2 compulsive exercise scores were significantly related, suggesting a high degree of temporal stability of this measure. Therefore, future studies should look to extend the time period for follow-ups, as well as including more follow-up assessments to examine the trajectory of compulsive exercise development. It was also not assessed whether the different styles of emotion regulation and the use of compulsive exercise actually differed in their efficacy at reducing negative emotions. Therefore, future research should look to see whether Internal Dysfunctional emotion regulation and the use of compulsive exercise actually lead to any short and/or long term reduction in negative emotions, such as anxiety, and what effect this has on a person's physical and psychological health. Finally, the sample was ethnically homogenous, and therefore findings cannot be generalised to other ethnic groups. This lack of ethnic diversity is something that needs addressing in further research, to identify whether or not the concept of compulsive exercise is culture-specific and/or whether or not the proposed risk factors are similar across cultures.

Ultimately, the current study represents the first longitudinal investigation in adolescents of emotion regulation and compulsive exercise, as measured using the CET. Although exercise is beneficial for the majority of adolescents, the findings suggest that an internal dysfunctional emotion regulation style may be a specific risk factor for the development of compulsive exercise in adolescent boys and girls, and so early intervention programmes aimed at reducing compulsive exercise may benefit from improving adolescents' emotion regulation style to a more functional and

interactive style. More work is needed to fully examine the complex interplay between emotion regulation, anxiety, compulsive exercise and eating disorder psychopathology.

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TABLE 1: Means and standard deviations for study variables for boys and girls, and Mann Whitney U test of difference between boys and girls on study variables

| <i>Variable</i>        | <i>Boys Mean (SD)</i> | <i>Girls Mean (SD)</i> | <i>Z</i> |
|------------------------|-----------------------|------------------------|----------|
| Internal Dysfunctional | 1.10 (0.75)           | 1.28 (0.80)            | 2.83**   |
| Internal Functional    | 1.86 (0.78)           | 1.77 (0.72)            | 1.08     |
| External Dysfunctional | 0.83 (0.67)           | 0.81 (0.71)            | 0.84     |
| External Functional    | 1.84 (0.77)           | 2.26 (0.82)            | 6.10***  |
| T1 CET Total           | 9.76 (4.14)           | 10.08 (3.62)           | 0.92     |
| T2 CET Total           | 8.33 (3.67)           | 9.43 (3.43)            | 3.62***  |

Note: \*\*\* $p < .001$ , \*\* $p < .01$ ; CET = Compulsive Exercise Test; EDI-2 = Eating

Disorder Inventory; T1 / T2 = Time 1 / Time 2

TABLE 2:

*Hierarchical multiple regression predicting T2 CET Total score (outcome) for boys and girls*

| <i>Model</i>           | <i>F (df)</i>                 | <i>R<sup>2</sup></i> | <i>Adj R<sup>2</sup></i> | <i>Beta</i> | <i>t</i> |
|------------------------|-------------------------------|----------------------|--------------------------|-------------|----------|
| Boys 1.                | 6.50 <sub>(4, 208)</sub> ***  | .11                  | .09                      |             |          |
| Internal Dysfunctional |                               |                      |                          | .25         | 3.46**   |
| Internal Functional    |                               |                      |                          | .13         | 1.68     |
| External Dysfunctional |                               |                      |                          | .08         | 1.07     |
| External Functional    |                               |                      |                          | .03         | 0.37     |
| Boys 2.                | 18.34 <sub>(5, 207)</sub> *** | .31                  | .29                      |             |          |
| T1 CET Total           |                               |                      |                          | .48         | 7.65***  |
| Internal Dysfunctional |                               |                      |                          | .14         | 2.24*    |
| Internal Functional    |                               |                      |                          | .08         | 1.12     |
| External Dysfunctional |                               |                      |                          | .02         | 0.25     |
| External Functional    |                               |                      |                          | -.03        | -0.48    |
| Girls 1.               | 10.04 <sub>(4, 261)</sub> *** | .13                  | .12                      |             |          |
| Internal Dysfunctional |                               |                      |                          | .32         | 4.96***  |
| Internal Functional    |                               |                      |                          | .13         | 1.84     |
| External Dysfunctional |                               |                      |                          | .06         | 0.85     |
| External Functional    |                               |                      |                          | -.03        | -0.41    |
| Girls 2.               | 28.73 <sub>(5, 260)</sub> *** | .36                  | .34                      |             |          |
| T1 CET Total           |                               |                      |                          | .51         | 9.48***  |
| Internal Dysfunctional |                               |                      |                          | .15         | 2.57**   |
| Internal Functional    |                               |                      |                          | .04         | 0.69     |
| External Dysfunctional |                               |                      |                          | .03         | 0.56     |
| External Functional    |                               |                      |                          | -.04        | -0.61    |

Note: Adj = Adjusted; T1 / T2 = Time 1 / Time 2; CET = Compulsive Exercise Test

\*\*\* p <.001; \*\* p <.01; \* p <.05