



Exercise identity as a risk factor for exercise dependence

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Objectives. The aim of the study was to explore the relationship between exercise identity and exercise dependence. We hypothesized that stronger exercise identities would be associated with greater odds of experiencing exercise dependence symptoms.

Design. Logistic regression was used to assess the extent of association between exercise identity and the risk of experiencing exercise dependence symptoms.

Method. Participants (101) were recruited online via sports clubs and social networking sites and were asked to complete online measures of exercise identity and exercise dependence.

Results. The overall model fit was a significant improvement on the baseline model, but only the exercise beliefs factor was significantly associated with the odds of dependence symptoms, with higher scores on the belief scale predicting greater odds of experiencing dependence symptoms. Exercise role identity, in contrast, was not significantly associated with odds of experiencing dependence symptoms. Per cent correct classification was 55.9% for asymptomatic and 88.2% for symptomatic individuals and the overall per cent correct classification was 77.5%.

Conclusions. The relation between identity and dependence could represent both a fruitful research avenue and a potential therapeutic target for those experiencing dependence symptoms; although our findings only showed a relationship between one of the two factors of the exercise identity measure and dependence. Longitudinal research is required to examine the relationship between identity and dependence in the context of other variables to better understand why some individuals become exercise dependent whereas others do not.

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Statement of contribution

What is already known on this subject?

- Exercise identity has been identified as an important determinant of exercise behaviour and studies within the exercise identity framework have proven elucidative with respect to the psychological processes that may underpin commitment to exercise.
- It has separately been established that some individuals may become dependent on exercise and exhibit symptoms indicative of a behavioural addiction to exercise according in line with clinical definitions.

What does this study add?

- Psychological explanation for exercise dependence based on escalation of normal exercise identity processes.
- Empirical investigation of identity-dependence link using a sample of physically active individuals.
- Comparison of two alternative structures for the exercise identity construct.

Exercise dependence

Exercise, although associated with numerous physical and psychological benefits (e.g., Biddle & Mutrie, 2008; Warburton, Nicol, & Bredin, 2006), can be detrimental to health if excessive. Potential physical consequences of over-exercise include menstrual disturbances in women (Beckvid Henriksson, Schnell, & Linden Hirschb erg, 2000) skeletal muscle damage (Collins *et al.*, 2003), increased susceptibility to injury (Almeida, Williams, Shaffer, & Brodine, 1999) and illness (Smith, 2003). People who identify as dependent on exercise have a higher risk of experiencing the mal effects of excessive participation in exercise (Kjelsas, Augestad, & Gotestam, 2003; Symons Downs & Hausenblas, 2004). Characterized as ‘an obsessive and unhealthy preoccupation with exercise’ (Hamer & Karageorghis, 2007; p. 477), exercise dependence can also prove highly disruptive to functioning because of the mal effects of being dependent *per se*. For example, by definition, the state of being exercise dependent is associated with a large amount of time spent pursuing exercise at the expense of time spent in other activities, withdrawal symptoms, a constant need to increase participation levels, a lack of control over exercise behaviour and the failure to cease exercising when medically contraindicated (Hausenblas & Symons Downs, 2002a). Empirical investigations have found self-reported exercise dependence to be associated with a higher risk of illness and injury (Symons Downs & Hausenblas, 2004), quantifiable mood disturbances on abstaining from exercise (Aidman & Woollard, 2003; but see Hausenblas, Gauvin, Symons Downs, & Duley, 2008) and large amounts of time spent in exercising (Kjelsas *et al.*, 2003).

The potentially serious consequences of exercise dependence for physical and psychological health suggest a need to identify possible interventions. The design of effective interventions, however, depends upon first clearly characterizing the state of exercise dependence, its causes and perpetuating factors.

The earliest attempts at capturing the nature of exercise dependence led to a proliferation of definitions and terminology, resulting in conceptual confusion as to the meaning of the construct (Allegre, Souville, Therme, & Griffiths, 2006). This confusion has now been largely resolved by defining the construct with explicit reference to the DSM-IV criteria for addiction (American Psychiatric Association, 1994) and in this respect exercise dependence differs from related constructs such as ‘obligatory exercise’ (e.g., Elbourne &

Chen, 2007), 'exercise commitment' (McLaren, Gauvin, & White, 2001) and 'compulsive exercise' (Guidi *et al.*, 2009). A distinction can also be made between primary exercise dependence, where the exercise is an end in itself, and secondary exercise dependence where the behaviour serves the purpose of weight management within an eating disorder (Allegre *et al.*, 2006). In the present study we were interested in this primary form of exercise dependence which is characterized by seven dimensions which are assumed, in clinical practice, to form the basis of addiction: tolerance, withdrawal, lack of control, intention effects, reduction in other activities, time and continuance, which reflect both its addictive character and psychosocial consequences. This definition is reflected in the measurement of the construct. The Exercise Dependence Scale (EDS) and its revisions (EDS, EDS-R, EDS-21; Hausenblas & Symons Downs, 2002b; Symons Downs, Hausenblas, & Nigg, 2004) are structured with respect to these seven dimensions.

Identifying the underlying mechanisms of exercise dependence represents another important challenge in making progress towards intervention. In this study we propose that a potential mechanism of dependence may be the development of, and need to maintain, an exercise identity. According to identity theory, identities involve classifying oneself as being in a particular role and internalizing the meanings associated with this role (Stets & Burke, 2000). Anderson and Cychosz (1994) have applied this theory to exercise, proposing that exercise identities can represent core aspects of the self-concept, which play a part in both giving meaning to past behaviour and in guiding future behaviour (Anderson & Cychosz, 1995). This relation with behaviour is assumed to be bidirectional. As such, the activation of an identity promotes behaviours which are consistent with this identity, although feedback regarding the behaviour modifies the identity to bring it in line with the person's actions (Anderson, Cychosz, & Franke, 2001). The theory predicts that when individuals perceive themselves as having acted in a manner consistent with their identity, they experience positive affect, self-esteem, and self-efficacy (Stets & Burke, 2000, 2003). Those who do not perceive themselves as having acted in a manner consistent with their identity, however, experience negative affect (Stets & Burke, 2003; Stryker & Burke, 2000) and are therefore motivated to avoid this distress and 'act to counteract the disturbance' (Stets & Burke, 2000; p. 233), although persistent failure to achieve congruence between behaviour and identity may result in a modification to one's identity (Burke, 1991). The strength of these affective responses is assumed to be a function of the extent to which a role identity is endorsed (Stets & Burke, 2003). This assumption was observed empirically in a study in which those with stronger exercise identities displayed stronger affective responses to perceptions of both identity-inconsistent and identity-consistent recent behaviour (Strachan, Brawley, Spink, & Jung, 2009).

We suggest then that exercise dependence may result from this positive feedback loop. The individual at risk of dependence feels compelled to exercise to avoid the negative feelings associated with acting in a manner inconsistent with his or her identity and/or to experience the increases in self-esteem, self-efficacy and positive affect associated with performing the perceived role of an exerciser well. This behaviour, in turn, may strengthen the exercise identity. These motivations may, in part, explain the reluctance of the dependent individual to discontinue exercise in the event of medical contraindication (Symons Downs & Hausenblas, 2004) and the negative affect experienced when discontinuation does occur (Aidman & Woollard, 2003).

The relevance of exercise identity to exercise behaviour has already been demonstrated. Positive correlations between exercise identity scores and exercise behaviour in

terms of self-reported time spent exercising, perceived exertion during exercise, muscular endurance, percentage body fat and fitness levels have been observed (Anderson & Cychosz, 1995; Anderson, Cychosz, & Franke, 1998; Cooke, Liardi, & Hall, 2011) and a reciprocal influence of behaviour is supported by the finding that identity strength increases over the course of an exercise programme (Cardinal & Cardinal, 1997). It was thus our aim in this study to expand on these previous findings by determining the relationship between exercise identity and exercise dependence symptoms, as consistent with the dimensions of dependence specified in DSM-IV. We hypothesized that stronger exercise identities would be associated with a greater likelihood of experiencing exercise dependence symptoms.

Materials and Methods

Participants and procedures

After receiving ethical approval from the first author's educational institution, participants were recruited via websites for sports clubs and sport and exercise networking sites (two sports clubs, a university sports union, two swimming clubs, two athletics clubs and four sport, and exercise networking sites). This recruitment method was consistent with our aim of obtaining a sample with high levels of physical activity, that is, comprising those most likely to be at risk of exercise dependence. A covering email, describing the study and providing a link to the online survey was either sent to the website moderator, with a request that it be posted on the site, forwarded to the website members or was posted directly to the site. The online survey asked participants to complete measures of exercise identity, exercise dependence and exercise behaviour. All measures were administered online and all responses were anonymous. Inclusion criteria were as follows: adults (aged over 18 years) who were able to give informed consent. Consent was assumed if participants completed the online survey. The sample comprised 39 men and 62 women with a mean age of 32 ($SD = 12.1$). Self-reported exercise levels ranged from sedentary (~2%) to elite athlete (~2%), but most participants rated themselves as active (43%), very active (26%) or athlete (28%). As the number of website users who saw or were forwarded the invitation to participate was not known, it is not possible to determine a response rate.

Measures

Participants were administered measures of exercise identity and exercise dependence and asked to provide demographic information.

Exercise identity

Exercise identity was measured using the 'Exercise Identity Scale' (EIS; Anderson & Cychosz, 1994). The scale was originally developed to measure the extent to which exercise contributes to an individual's role identity. Although initial evidence supported the unidimensionality of the scale (Anderson & Cychosz, 1994; Anderson *et al.*, 1998), subsequent analyses have shown a better fit for a two-factor measurement model (Vlachopoulos, Kaperoni, & Moustaka, 2011; Wilson & Muon, 2008) comprising the factors 'exercise beliefs' and 'exercise identity role'. The exercise beliefs factor is measured by six items such as 'I have numerous goals relating

to exercising' and is concerned with a person's reflections on exercise behaviour. The exercise role identity factor is measured by three items such as 'I consider myself an exerciser' and is assumed to reflect the extent to which exercise has become a part of a person's identity. All items are rated on a 7-point scale from *Strongly Disagree* to *Strongly Agree*. Vlachopoulos *et al.* (2011) found Cronbach's alpha values of 0.87 and 0.90 for the exercise role identity and exercise beliefs scale respectively. In the present sample, Cronbach's alpha values were 0.87 for the exercise role identity scale and 0.88 for the exercise beliefs scale. In this study, the two scales were also highly correlated ($r = 0.77$, $p < .01$ based on scale scores).

Research has also supported the stability and validity of the EIS scores. Anderson and Cychosz (1994) reported a 1 week test-retest reliability of 0.93 as well as significant correlations with exercise behaviour. Additional research has shown that exercise identity predicts exercise behaviour both in a cross-sectional (Anderson *et al.*, 1998) and prospective design (Cardinal & Cardinal, 1997).

Exercise dependence

Exercise dependence was measured using the 'Exercise Dependence Scale-21' (EDS-21; Hausenblas & Symons Downs, 2002b). The scale has 21 items grouped into seven subscales (Summarized in Table 1) which correspond to different aspects of dependence derived from the DSM-IV criteria for addiction (American Psychiatric Association, 1994). In this study, Cronbach's alpha values exceeded 0.80 for all scales except the

Table 1. Exercise dependence-21 subscales

Scale	Description	Example item	Cronbach's alpha
Withdrawal	Symptoms such as anxiety or fatigue associated with abstinence	'I exercise to avoid feeling irritable'	0.86
Continuance	Continuing to exercise despite physical or psychological contraindication	'I exercise when injured'	0.86
Tolerance	Need to increase exercise to achieve desired effect or the diminishing effects of the same amount of exercise with continued use	'I continually increase my exercise frequency to achieve the desired effects/benefits'	0.88
Lack of control	Inability to reduce amount of exercise	'I am unable to reduce how intense I exercise'	0.86
Reduction in other activities	Other activities are reduced at the expense of engaging in exercise	'I would rather exercise than spend time with my friends/family'	0.59
Time	Spending a large amount of time engaged in activities necessary to obtain exercise	'A great deal of my time is spent exercising'	0.90
Intention effects	Exercising for longer or in a larger amount than intended	'I exercise longer than I intend'	0.85

'reduction in other activities' scale (See Table 1). Participants rate items on a 6 point scale from *Never* to *Always* and are categorized as 'at risk', 'non-dependent symptomatic' or 'non-dependent asymptomatic' based on their pattern of responses. 'At risk' implies possible exercise dependence whereas 'nondependent symptomatic' and 'non-dependent asymptomatic' imply a lack of dependence but with some symptoms of dependence in the case of the former. To meet the criteria for 'at risk' a participant must score in the dependent range (i.e., 4 and above on the Likert scale) on at least three criteria. To qualify for the non-dependent-symptomatic category, a participant must score at the non-dependent symptomatic level (i.e., 3 on the Likert scale) on at least three criteria. They may also score in the dependent range on one or two criteria, in combination with scoring in the non-dependent symptomatic range on others, to meet the requirements for this category. Participants who do not meet the criteria for either 'at risk' or 'non-dependent-symptomatic' are categorized as 'non-dependent-asymptomatic'.

Demographics

Participants were also asked to select their gender as either male or female, record their age, and rate their level of activity from the following options: 'sedentary', 'active', 'very active', 'athlete', and 'elite athlete'.

Statistical procedure

Confirmatory factor analysis of exercise identity scale

To test the factorial validity of the measurement model of the exercise identity scale in the present sample we compared the absolute fit of both the one factor model suggested by initial studies (Anderson & Cychosz, 1994) and the two-factor model, which has recently superseded the original model (Vlachopoulos *et al.*, 2011; Wilson & Muon, 2008). After performing a multivariate normality test in AMOS 17.0 (Arbuckle, 2008), models were implemented in MPlus 6.11 software (Muthen & Muthen, 2010) using maximum likelihood estimation. Scaling and identification were achieved by fixing latent variances to 1.0. In the one factor model, all items load on a general exercise identity factor. In the two-factor model there are two correlated latent factors: items 1, 2, and 6 load on an exercise role identity factor and the remaining items load on an exercise beliefs factor. We assessed the goodness of fit of the model using the Chi-square, Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), Standardized Root Mean Square Residual (SRMR), Aikake's Information Criterion (AIC) and Bayesian Information Criterion (BIC). The Chi-square value is a measure of the discrepancy between the sample covariance matrix and the population covariance matrix implied by the model, however, its sensitivity to sample size undermines its practical utility (Byrne, 2009). Judgements of fit were, therefore, based mainly on the remaining fit indexes, which can assess the extent to which a model is practically well-fitting (Byrne, 2009). CFI and TLI values of greater than 0.95 and RMSEA values of less than 0.05 are indicative of good model fit (Byrne, 2009; Hu & Bentler, 1999). TLI, RMSEA, AIC and BIC are also useful for comparing models because they into account model complexity. The model with the smaller AIC and BIC magnitudes is the better fitting model.

Relation of exercise identity to exercise dependence

To test the hypothesis that stronger exercise identities are associated with a higher risk of experiencing exercise dependence symptoms, we used logistic regression to examine the relation between exercise role identity, exercise beliefs and the odds of experiencing exercise dependence symptoms. We chose to decompose the exercise identity scale into these two factors as confirmatory factor analysis has supported this two-factor measurement model over the unidimensional model on which the scale was originally constructed (Vlachopoulos *et al.*, 2011; Wilson & Muon, 2008) and this two-factor structure was supported in our sample. The outcome variable, exercise dependence, was the person's dependence category according to the EDS-21 scoring system. We had only five participants in the 'at risk' category and, thus, combined this category with the 'non-dependent symptomatic' category such that we then had two possible outcomes: symptomatic versus asymptomatic.

In addition, we assessed our measured covariates age, gender, and level of exercise participation as potential confounders, defined as being correlated with the outcome that is, exercise dependence symptoms and putative cause of the outcome that is, exercise identity without itself being affected by the putative cause of the outcome that is, exercise identity. Any variables meeting this criterion were included in the main analysis as covariates to account for their potential confounding effects.

Results

CFA of EIS factor structure

Two-factor model

A critical ratio value of 4.50 suggested that data did not deviate substantially from multivariate normality (Byrne, 2009). Fit statistics are given in Table 2. All fit statistics, including those which are sensitive to model parsimony (TLI, RMSEA, AIC, BIC) supported the better fit of the two-factor model and only the two-factor model had a CFI value which exceeded consensus criteria for good fit. Based on a chi-square difference test on one degree of freedom (the number of additional constraints in the one factor model), the addition of a second factor improved fit by a statistically significant amount [$\chi^2(1) = 21.48, p < .01$]. Given these results, we adopted the two-factor measurement model of the EIS for subsequent analyses. In this two-factor model, all parameters were statistically significant with factor loadings tending to be above .70 (minimum = .53, maximum = .88). The role identity and beliefs factors were also very highly correlated ($r = .88$).

Relating exercise identity and exercise dependence

A logistic regression model tested the hypothesis that stronger exercise identity is associated with a greater risk of experiencing the symptoms of exercise dependence. Univariate analyses suggested that of the potential confounders measured (age, gender, level of exercise participation), only level of exercise participation met the criteria for a potential confounder in being correlated with both putative cause and outcome. This covariate was not included in the model, however, because it was believed that the behaviour of athletes and elite athletes may be qualitatively different from others who are physically active that is, the exercise participation variable was likely not on an ordinal or

Table 2. Fit statistics for 1 and 2 factor EIS measurement models

χ^2 (p)	CFI	TLI	RMSEA	SRMR	AIC	BIC
1 Factor model (Free parameters = 27)						
76.65 (<.001)	.92	.89	.13	.06	3440.55	3512.47
2 Factor model (Free parameters = 28)						
55.17 (.001)	.95	.93	.10	.05	3421.07	3495.65

Table 3. Summary of logistic regression model testing the relationship between exercise identity and the symptoms of exercise dependence

Predictor (Outcome = Exercise dependence)	B	SE(B)	Wald	p	95% CI for Odds Ratio		
					Lower	OR	Upper
Exercise role identity	0.01	0.08	0.01	.92	0.87	1.01	1.17
Exercise beliefs	0.16	0.05	11.03	<.01	1.01	1.17	1.29

interval scale. The final model is summarized in Table 3. Results showed that the overall model fit was a significant improvement on the baseline model ($\chi^2(5) = 33.01, p < .01$; $R^2_N = 0.38$), but only the exercise beliefs factor was significantly associated with the odds of dependence symptoms, with higher scores on the belief scale predicting greater odds of experiencing dependence symptoms ($OR = 1.17, p < .01$). Exercise role identity was not significantly associated with odds of experiencing dependence symptoms ($OR = 1.01, p = 0.92$). Per cent correct classification was 55.9% for asymptomatic and 88.2% for symptomatic individuals and the overall per cent correct classification was 77.5%.

Generalizability of the model was supported by the fact that there was no significant interaction between the predictors and their log, suggesting that the assumption of linearity of the logit held (Hosmer & Lemeshow, 1989). Furthermore, tolerance values of 0.41 suggested that there was no significant multicollinearity (Menard, 1995).

Discussion

Summary of results

In this study, we hypothesized that exercise dependence symptoms were more likely to present in people with strong exercise identities. This hypothesis was based on the assumption that exercise identity promotes behaviour consistent with the perceived role of the exerciser through the experience of negative affect when failing to act in line with identity, and positive affect and increased self-efficacy and self-esteem when succeeding. Previous research has demonstrated the importance of affective responses and appraisals in motivating exercise behaviour in both dependent and non-dependent individuals (Hamer & Karageorghis, 2007; Kwan & Bryan, 2010; Lowe, Eves, & Carroll, 2002; Mohiyeddini, Pauli, & Bauer, 2009) and has shown that exercising is generally associated with increases in positive affect which is likely to be reinforcing (Reed, 2005). For people who identify strongly with the role of an exerciser, this positive response may be augmented by the fact that it provides affirmation of their identity (Strachan *et al.*, 2009). Conversely, increased negative affect in response to failing to act in a manner consistent

with one's identity (Stets & Burke, 2003) may resemble the negative affect experienced by individuals who are dependent on exercise, but are prevented from exercising (Aidman & Woollard, 2003).

We found partial support for our hypothesis, as the exercise beliefs component of the exercise identity measure, but not the exercise role identity factor, was significantly associated with the odds of experiencing exercise dependence symptoms, whereby higher scores on this factor were related to a greater likelihood of exercise dependence symptoms. However, given that both the exercise beliefs and exercise role identity factors are assumed to reflect exercise identity, theoretically we would expect both factors to predict dependence, so this finding requires further consideration. One possibility is that measurement issues accounted for the result. Confirmatory factor analysis supported the two-factor model over the unidimensional model in the present sample, but the fit of the former was judged to be only mediocre based on the RMSEA. Furthermore, the two factors were strongly correlated, suggesting a high level of redundancy with one another. It is possible, given the high correlation between the two factors, that the construct is in fact truly unidimensional; however, two factors were indicated due to item format effects. Item format effects can result in substantively meaningless factors being indicated due to the item covariation arising out of format effects (Brown, 2006). We suggest that this issue may signal a need to revisit the factor structure of the EIS, first establishing the potential role of format effects in its factorial structure and, if truly two-dimensional, modifying items to optimize its performance as a two-factor scale.

An alternative approach to understanding our result is to examine more closely the items that make up the two factors of the EIS: exercise beliefs and exercise role identity. On the face of it, the label 'exercise role identity' is arguably more closely related to identity than the label 'exercise beliefs', and indeed the three items that form this first factor do focus on perceptions by oneself and others of being an exerciser (e.g., 'I consider myself an exerciser'). Therefore, if exercise identity is related to dependence, one might expect the exercise role identity to have emerged as the significant predictor of dependence symptomatology. However, although the exercise beliefs factor does include items that appear to be less concerned with exercise as central to one's self-concept (e.g., 'I have numerous goals related to exercise'), other items do more clearly focus on this theme (e.g., 'physical exercise is a central factor to my self-concept'). Therefore, it is difficult to state categorically that the exercise role identity factor is a stronger measure of identity than exercise beliefs. In looking at the items more closely, it should also be acknowledged that one of the items on the exercise beliefs factor ('I would feel a real loss if I were forced to give up exercising') has some conceptual overlap with exercise dependence, which is not ideal when trying to establish the relationship between the two concepts.

If the findings of the present study are taken as supportive of a relationship between exercise identity and dependence, this has several possible implications. One argument is that the centrality of exercise to a person's self-concept should be decreased to reduce maladaptive exercise behaviour. However, an alternative suggestion, bearing in mind the health benefits of exercise and that the strength of exercise identity has been found to be positively linked with exercise participation and commitment (Anderson & Cychosz, 1995), is that the importance of exercise identity for promoting self-esteem and positive affect is reduced, but that one's identity as an exerciser is maintained. Indeed the fact that only a small number of participants met the full criteria for exercise dependence, but over half had some symptoms of it, may reflect the fact that some of the factors which are included in the diagnosis of exercise dependence, may actually be

adaptive, in certain combinations, in terms of promoting engagement in and adherence to exercise.

Work by Vlachopoulos *et al.* (2011) may be informative here. The authors explored the extent to which motivation regulatory mechanisms and basic psychological needs proposed by self-determination theory (SDT; Deci & Ryan, 1985) correlated with exercise identity and beliefs. SDT posits that the extent to which an individual incorporates a particular identity is related to the nature of the regulatory mechanisms that motivate the activities underpinning the particular identity. Vlachopoulos *et al.* (2011) found that 'identified regulation', where the motivation to engage in an activity arises out of a personal belief in the importance of the action, and need for competence were significant correlates of both exercise role identity and exercise beliefs, while 'introjected regulation', where the motivation for engaging in an activity is to avoid guilt or increase sense of self-worth, was also significantly correlated with the latter. Although introjected regulation can act as a valuable initial step in motivating individuals to undertake exercise (e.g., Gillison, Osborn, Standage, & Skevington, 2009), interventions that attempt to promote more self-determined motivation to exercise in the longer term, may help prevent exercise dependence symptoms.

Vallerand and colleagues have also utilized SDT as a framework, applying the distinction between harmonious and obsessive passion to various activities including gambling (Ratelle, Vallerand, Mageau, Rousseau, & Provencher, 2004), music (Mageau *et al.*, 2009) and sport (Vallerand, Mageau, Elliot, Dumais, Demers, & Rousseau, 2008). They argue that the process by which an activity is internalized, or becomes part of the person's identity, determines whether harmonious or obsessive passion develops (Vallerand *et al.*, 2003). In the case of harmonious passion, the activity is internalized autonomously, that is, it has no contingency attached to it, and the individual has a free rather than compelled desire to engage in it, and experiences positive affect while taking part in the activity. In contrast, obsessive passion develops from controlled internalization of the activity as a result of a contingency being attached to the activity, such as increased self-esteem. Obsessive passion is characterized by a sense of compulsion to undertake the activity and persistence, even in the face of negative outcomes, (i.e., the person is controlled by the behaviour rather than *vice versa*), a lack of positive affect when engaging in the behaviour and negative affect when not able to engage in it (Mageau *et al.*, 2009). In this framework, exercise dependence shows a marked similarity with obsessive passion. Furthermore, consistent with our proposal, Vallerand *et al.* (2003) found that obsessive passion was more strongly associated with identification with the activity than was harmonious passion. This theory may then provide a useful framework for better understanding the longitudinal development of exercise dependence versus non-dependent exercise, whether or not it is possible to change from one to the other, and the role of identity and affect and self-esteem within these processes.

Additional research would, however, be required to firstly establish the role of affect, self-efficacy and self-esteem in the proposed mechanism of exercise dependence as, although our hypothesis was based on this premise, we did not measure these factors in response to exercise (or lack thereof) in our sample. Therefore, it would be pertinent for future research to address which variables moderate or mediate the relationship between identity and exercise dependence and identify the processes underpinning the formation of strong exercise identities. These future lines of enquiry may increase our understanding of why some individuals become exercise dependent whereas others maintain healthy levels of the behaviour, and allow interventions to be developed which focus on

encouraging more self-determined regulatory motivational mechanisms and promoting autonomy, competence, and relatedness in relation to exercise (e.g., Moustaka, Vlachopoulos, Kabitsis, & Theodorakis, 2012).

This work, which can increase our understanding of how exercise identities are formed and contribute to exercise dependence, may also inform interventions aimed at increasing exercise participation among those who do not currently meet the minimum exercise requirements for health. The repetitiveness and regularity of exercise behaviour in dependence resembles the behaviour of a person with a strong habit, and habit strength is an important predictor of exercise behaviour (Rhodes, Bruijn, & Matheson, 2010). By distinguishing the maladaptive and adaptive aspects of identity in exercise dependence, for example, by determining whether it is the positive affect associated with exercising or the negative affect associated with not exercising which is most instrumental in developing a compulsion to exercise, it may be possible to arrive at a recipe for exercise identity that promotes only adaptive exercise behaviour.

A final implication of the present study is that exercise dependence may be quite rare. In our sample of 101 individuals, which targeted people who were engaged in high levels of physical activity, only five individuals met the full criteria for exercise dependence. There was, however, a large number of individuals ($n = 68$) who reported experiencing some symptoms of dependence. In previous studies using physically active samples, estimates of exercise dependence prevalence have ranged from 3.1% to 13.4% (Hausenblas & Symons Downs, 2002a) and in a college sample, Edmunds, Ntoumanis, and Duda (2006) reported a prevalence of 3.4%.

To assess the generalizability of our results, it is important to consider some of the salient strengths and weaknesses of this study. In successfully targeting people who were physically active, we achieved the aim of obtaining a sample of individuals who were likely to be most at risk of exercise dependence. Very few participants met the full criteria, however, despite a large number showing at least some symptoms, which limits our conclusions to the experience of exercise dependence symptoms rather than exercise dependence *per se*. It would be useful for future research to examine the relationship between identity, affect, self-esteem and self-efficacy in a group of individuals who meet the criteria for exercise dependence. Future research should also aim to model the subtypes of those with primary and secondary exercise dependence separately. The latter refers to individuals with an eating disorder who use exercise as a weight management strategy (Allegre *et al.*, 2006) and it might be expected that their identity would differ from those with primary exercise dependence. The study also failed to take account of individual differences in exercise identity roles. Strachan *et al.* (2009) note that people will vary in their perception of how much exercise participation constitutes being an exerciser. Considering these variations in future research may help increase the precision with which identity can be related to both dependence symptoms and actual exercise behaviour.

A further limitation is that the cross-sectional design of the study did not allow us to establish the direction of causality in the relation between dependence and identity. Although we interpret the correlation as being indicative of stronger exercise identities promoting dependence, stronger identities could also develop as a result of first becoming dependent on exercise or, alternatively, both could arise as a result of engaging in a high level of exercise for other reasons such as professional obligation, performance goals or health or body image considerations. A further source of exercise identity reinforcement, in addition to one's own self-perception of identity-behaviour consistency, is assumed to be the feedback received in social interaction.

Conclusions

In this study, we hypothesized that strong exercise identities may promote exercise dependence through the affective processes, which regulate adherence to behaviours perceived to be consistent with an identity. Our results showed that stronger exercise beliefs, but not exercise role identity, were associated with a higher risk of experiencing exercise dependence symptoms. This conclusion suggests that the relation between identity and dependence could represent both a fruitful research avenue and a potential therapeutic target for those experiencing dependence symptoms, but future research is needed to establish the longitudinal relationships between identity, affect, self-esteem, self-efficacy, and exercise dependence.

References

- Aidman, E. V., & Woollard, S. (2003). The influence of self-reported exercise addiction on acute emotional and physiological responses to brief exercise deprivation. *Psychology of Sport and Exercise*, 4, 225–236. doi:10.1016/S1469-0292(02)00003-1
- Allegre, B., Souville, M., Therme, P., & Griffiths, M. (2006). Definitions and measures of exercise dependence. *Addiction Research and Theory*, 14, 631–646. doi:10.1080/16066350600903302
- Almeida, S. A., Williams, K. M., Shaffer, R. A., & Brodine, S. K. (1999). Epidemiological patterns of musculoskeletal injuries and physical training. *Medicine & Science in Sports Exercise*, 31, 1176–1182.
- American Psychiatric Association (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington DC: American Psychiatric Association.
- Anderson, D. F., & Cychosz, C. M. (1994). Development of an exercise identity scale. *Perceptual & Motor Skills*, 78, 747–751.
- Anderson, D. F., & Cychosz, C. M. (1995). Exploration of the relationship between exercise behaviour and exercise identity. *Journal of Sport Behavior*, 18, 159–166.
- Anderson, D. F., Cychosz, C. M., & Franke, W. D. (1998). Association of exercise identity with measures of exercise commitment and physiological indicators of fitness in a law enforcement cohort. *Journal of Sport Behavior*, 21, 233–241.
- Anderson, D. F., Cychosz, C. M., & Franke, W. D. (2001). Preliminary exercise identity scale (EIS) norms for three adult samples. *Journal of Sport Behavior*, 24, 1–9.
- Arbuckle, J. L. (2008). *AMOS 17.0.1*. Springhouse, PA: Amos Development Corporation.
- Beckvid Henriksson, G., Schnell, C., & Linden Hirschb erg, A. (2000). Women endurance runners with menstrual dysfunction have prolonged interruption of training due to injury. *Gynecologic and Obstetric Investigation*, 49, 41–46.
- Biddle, S., & Mutrie, N. (2008). *Psychology of physical activity: Determinants, well-being and interventions* (2nd ed.). New York: Routledge.
- Brown, T. A. (2006). *Confirmatory factor analysis for applied research*. New York: The Guilford Press.
- Burke, P. J. (1991). Identity processes and social stress. *American Sociological Review*, 56, 836–849.
- Byrne, B. M. (2009). *Structural equation modeling with AMOS: Basic concepts, programming, and applications*. Mahwah, NJ: Erlbaum
- Cardinal, B. J., & Cardinal, M. K. (1997). Changes in exercise behavior and exercise identity associated with a 14-week aerobic exercise class. *Journal of Sport Behavior*, 20, 377–386.
- Collins, M., Renault, V., Grobler, L. A., St Clair Gibson, A., Lambert, M. I., Wayne Derman, E., ... Mouly, V. (2003). Athletes with exercise-associated fatigue have abnormally short muscle DNA telomeres. *Medicine in Sports and Exercise*, 35, 1524–1528.
- Cooke, L. M., Liardi, V. L., & Hall, C. R. (2011). Does the shoe FIT? An examination of the relationship of exercise identity with exercise frequency, intensity, and duration. *Journal of Sport & Exercise Psychology*, 33, S138–S138.

- Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York: Plenum.
- Edmunds, J., Ntoumanis, N., & Duda, J. L. (2006). Examining exercise dependence symptomatology from a self-determination perspective. *Journal of Health Psychology, 11*, 887–903. doi:10.1177/1359105306069091
- Elbourne, K. E., & Chen, J. (2007). The continuum model of obligatory exercise: A preliminary investigation. *Journal of Psychosomatic Research, 62*, 73–80. doi:10.1016/j.jpsychores.2004.12.003
- Gillison, F., Osborn, M., Standage, M., & Skevington, S. (2009). Exploring the experience of introjected regulation for exercise across gender in adolescence. *Psychology of Sport and Exercise, 10*, 309–319. doi:10.1016/j.psychsport.2008.10.004
- Guidi, J., Pender, M., Hollon, S. D., Zisook, S., Schwartz, F. H., Pedrelli, P., & Petersen, T. J. (2009). The prevalence of compulsive eating and exercise among college students: An exploratory study. *Psychiatry Research, 165*, 154–162. doi:10.1016/j.psychres.2007.10.005
- Hamer, I., & Karageorghis, C. I. (2007). Psychobiological mechanisms of exercise dependence. *Sports Medicine, 37*, 477–484. doi:http://bura.brunel.ac.uk/handle/2438/3121
- Hausenblas, H. A., Gauvin, L., Symons Downs, D., & Duley, A. R. (2008). Effects of abstinence from habitual involvement in regular exercise on feeling states: an ecological momentary assessment study. *British Journal of Health Psychology, 13*, 237–255. doi:10.1348/135910707X180378
- Hausenblas, H. A., & Symons Downs, D. (2002a). Exercise dependence: A systematic review. *Psychology of Sport and Exercise, 3*, 89–123. doi:10.1016/S1469-0292(00)00015-7
- Hausenblas, H. A., & Symons Downs, D. (2002b). How much is too much? The development and validation of the exercise dependence scale. *Psychology and Health, 17*, 387–404. doi:10.1080/0887044022000004894
- Hosmer, D. W., & Lemeshow, S. (1989). *Applied logistic regression*. New York: Wiley.
- Hu, L. T., & Bentler, P. M. (1999). Cut-off criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*, 1–55.
- Kjelsas, E., Augestad, L. B., & Gotestam, K. G. (2003). Exercise dependence in physically active women. *European Journal of Psychiatry, 17*, 145–155.
- Kwan, B. M., & Bryan, A. D. (2010). Affective response to exercise as a component of exercise motivation: Attitudes, norms, self-efficacy and temporal stability of intentions. *Psychology of Sport and Exercise, 11*, 71–79. doi:10.1016/j.psychsport.2009.05.010
- Lowe, R., Eves, F., & Carroll, D. (2002). The influence of affective and instrumental beliefs on exercise intentions and behavior: A longitudinal analysis. *Journal of Applied Social Psychology, 32*, 1241–1252. doi:10.1111/j.1559-1816.2002.tb01434.x
- Mageau, G. A., Vallerand, R. J., Charest, J., Salvy, S.-J., Lacaille, N., Bouffard, T., & Koestner, R. (2009). On the development of harmonious and obsessive passion: The role of autonomy support, activity specialization, and identification with the activity. *Journal of Personality, 77*, 601–645. doi:10.1111/j.1467-6494.2009.00559.x
- McLaren, L., Gauvin, L., & White, D. (2001). The role of perfectionism and excessive commitment to exercise in explaining dietary restraint: Replication and extension. *International Journal of Eating Disorders, 29*, 307–313. doi:10.1002/eat.1023
- Menard, S. (1995). *Applied logistic regression analysis*. Sage University paper series on quantitative applications in the social sciences, 07-106. Thousand Oaks, CA: Sage.
- Mohiyeddini, C., Pauli, R., & Bauer, S. (2009). The role of emotion in bridging the intention-behaviour gap: The case of sports participation. *Psychology of Sport and Exercise, 10*, 226–234. doi:10.1016/j.psychsport.2008.08.005
- Moustaka, F. C., Vlachopoulos, S. P., Kabitsis, C., & Theodorakis, Y. (2012). Effects of an autonomy-supportive exercise instructing style on exercise motivation, psychological well-being, and exercise attendance in middle-age women. *Journal of Physical Activity and Health, 9*, 138–150.
- Muthen, L. K., & Muthen, B. O. (2010). *Mplus user's guide* (6th Ed.) Los Angeles, CA: Muthen & Muthen.

- Ratelle, C. F., Vallerand, R. J., Mageau, G. A., Rousseau, F. L., & Provencher, P. (2004). When passion leads to problematic outcomes: A look at gambling. *Journal of Gambling Studies*, 20, 105–119. doi:10.1023/B:JOGS.0000022304.96042.e6
- Reed, J. (2005). Acute physical activity and self-reported affect: A review. In A. V. Clark (Ed.), *Causes, role and influence of mood states* (pp. 91–113). Chicago: Nova Science Publishers, Inc.
- Rhodes, R. E., de Bruijn, G.-J., & Matheson, D. H. (2010). Habit in the physical activity domain: integration with intention temporal stability and action control. *Journal of Sport and Exercise Psychology*, 32, 84–98.
- Smith, L. L. (2003). Overtraining, excessive exercise and altered immunity: Is this a T helper-1 versus T helper-2 lymphocyte response? *Sports Medicine*, 33, 347–364.
- Stets, J. E., & Burke, P. J. (2000). Identity theory and social identity theory. *Social Psychology Quarterly*, 63, 224–237.
- Stets, J. E., & Burke, P. J. (2003). A sociological approach to self and identity. In M. R. Leary & J. P. Tangney (Eds.), *Handbook of self and identity* (pp. 128–152). New York: Guilford Press.
- Strachan, S. M., Brawley, L. R., Spink, K. S., & Jung, M. E. (2009). Strength of exercise identity and identity-exercise consistency affective and social cognitive relationships. *Journal of Health Psychology*, 14, 1196–1206. doi:10.1177/1359105309346340
- Stryker, S., & Burke, P. J. (2000). The past, present, and future of an identity theory. *Social Psychology Quarterly*, 63, 284–297. doi:10.2307/2695840
- Symons Downs, D., & Hausenblas, H. A. (2004). I can't stop: The relationship among exercise dependence symptoms, injury and illness behaviors and motives for exercise continuance. *Journal of Human Movement Studies*, 45, 359–375.
- Symons Downs, D., Hausenblas, H. A., & Nigg, C. A. (2004). Factorial validity and psychometric examination of the exercise dependence scale- revised. *Measurement in Physical Education and Exercise Science*, 8, 183–201. doi:10.1207/s15327841mpee0804_1
- Vallerand, R. J., Blanchard, C., Mageau, G. A., Koestner, R., Ratelle, C. F., Léonard, M., ... Marsolais, J. (2003). Les passion de l'âme: on obsessive and harmonious passion. *Journal of Personality and Social Psychology*, 4, 756–767. doi:10.1037/0022-3514.85.4.756
- Vallerand, R. J., Mageau, G. A., Elliot, A. J., Dumais, A., Demers, M.-A., & Rousseau, F. (2008). Passion and performance attainment in sport. *Psychology of Sport and Exercise*, 9, 373–392. doi:10.1016/j.psychsport.2007.05.003
- Vlachopoulos, S. P., Kaperoni, M., & Moustaka, F. C. (2011). The relationship of self-determination theory variables to exercise identity. *Psychology of Sport and Exercise*, 12, 265–272. doi:10.1016/j.psychsport.2010.11.006
- Warburton, D. E. R., Nicol, C. W., & Bredin, S. S. D. (2006). Health benefits of physical activity: The evidence. *Canadian Medical Association Journal*, 174, 801–809. doi:10.1503/cmaj.051351
- Wilson, P. M., & Muon, S. (2008). Psychometric properties of the exercise identity scale in a university sample. *International Journal of Sport and Exercise Psychology*, 6, 115–131.

Received 21 December 2011; revised version received 15 June 2012

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