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Images of exercising: Exploring the links between exercise imagery use, autonomous and controlled motivation to exercise, and exercise intention and behavior

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ABSTRACT

Objectives: In the present study, we tested a model examining the relationships between exercise imagery use, motivational regulations for exercise engagement, intention to exercise, and self-reported exercise behavior. This work represents an initial attempt to examine relationships between a new type of exercise imagery (enjoyment imagery) and motivational regulations for exercise.
Design: Cross-sectional.
Method: Exercisers with a mean age of 40.29 years (SD = 13.29; 177 female, 141 male) completed measures of the targeted variables.
Results: Structural equation modeling analyses revealed direct and indirect (via motivational regulations) links between imagery and exercise-related outcomes. Technique and enjoyment imagery were positively related to autonomous motivation. Conversely, appearance imagery was positively associated with controlled motivation. Direct relationships were evidenced between energy imagery and self-reported exercise behavior, and between appearance imagery and intention to exercise.
Conclusions: The potential motivational functions served by different exercise imagery types are discussed, and the inclusion of enjoyment imagery in future exercise imagery research is recommended.
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Although it is widely recommended that individuals should aim to engage in at least 30 min of moderate exercise on at least 5 days of the week to improve their health (e.g., Great Britain Department of Health [DH], 2005), survey data reveals that only 37% of men and 24% of women in England are meeting these guidelines, with over a third of adults being inactive (i.e., participating in less than one session of 30 min activity per week; see DH, 2005). Even those who do heed advice to become more physically active are not always successful in the desired behavioral changes. It is commonly estimated that 50% of individuals who commence an exercise program will drop out within the first 6 months (e.g., Dishman, 1988); a statistic which has been supported across diverse demographic profiles including college students, middle-aged and elderly adults, as well as varied settings (e.g., health promotion, worksites) (Robison & Rogers, 1994). Noteworthy, however, is that adherers and dropouts can be differentiated in terms of their self-motivation, with those reporting intrinsic reasons for exercising (e.g., enjoyment) being more likely to maintain exercise behavior (Ingledew, Markland, & Medley, 1998). Collectively, these findings highlight not only a need for raising general levels of physical activity in the population, but also the importance of gaining a better understanding of individuals' motivation to exercise.

One motivational framework that is applicable to the process of behavior adoption and maintenance is self-determination theory (SDT; Ryan & Deci, 2000). Within SDT it is posited that the motives, or regulations, governing behavior vary along a continuum of self-determination ranging from behaviors that are externally controlled to those which are fully autonomous in nature. At the extremes of the continuum are amotivation, a state reflecting a lack of intention to engage in an activity; the opposite of which is intrinsic motivation, a behavioral regulation representing engagement in an activity for the sheer pleasure and satisfaction that may be derived from it (Ryan & Deci). Between these extremes lie four kinds of extrinsic motivation (external regulation, introjected regulation, identified regulation, and integrated regulation).

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With regard to one's motivation to partake in an activity, Deci and Ryan (2008) argue that the central distinction made within contemporary SDT work is that of autonomous versus controlled motivation. Autonomous behaviors are those represented by the behavioral regulations which encompass a sense of personal volition in behavior (i.e., intrinsic motivation, integrated regulation and identified regulation). Deci and Ryan summarize that autonomous motivation "comprises both intrinsic motivation and the types of extrinsic motivation in which people have identified with an activity's value and ideally will have integrated it into their sense of self" (p. 182).[1] When individuals are motivated for autonomous reasons, their behaviors are initiated and sustained by their own true self, and involve doing what they find important or interesting (Moller, Deci, & Ryan, 2006). In contrast, Deci and Ryan state that controlled motivation "consists of both external regulation, in which one's behavior is a function of external contingencies of reward or punishment, and introjected regulation, in which the regulation of action has been partially internalized and is energized by factors such as an approval motive, avoidance of shame, contingent self-esteem, and ego-involvements" (p. 182). Thus, controlled motivation represents behavior that emanates from feelings of pressure or coercion, which can come from either internal or external sources (Moller et al.). Aligned with Ryan and Deci's (2000) argument that this represents the central distinction of motivation within SDT, a number of recent exercise studies have grouped participant responses into autonomous versus controlled regulations within their analyses (e.g., Barbeau, Sweet, & Fortier, 2009; Standage, Sebire, & Loney, 2008; Wilson, Blanchard, Nehl, & Baker, 2006).

Across many contexts such as clinical, health, and academic settings (see Deci & Ryan, 2008; Ryan & Deci, 2000), it has consistently been shown that behaviors engaged in for autonomous reasons (as opposed to controlled), result in more adaptive outcomes (e.g., greater behavioral persistence, and increased well-being). The tenets of SDT have been increasingly supported in exercise settings where it has been found that autonomous forms of motivation (consisting of intrinsic motivation and identified regulation) positively predict higher levels of self-reported exercise behavior (e.g., Wilson et al., 2006), as well as predicting greater engagement in objectively-assessed bouts of moderate intensity exercise behavior (Standage et al., 2008).

Research findings pertaining to more controlled behavioral regulations (consisting of external regulation and introjected regulation) within SDT have shown a fairly inconsistent pattern of associations with respect to both intention to exercise and exercise behavior. With regard to exercise behavior, while Wilson, Rodgers, and Fraser (2002) found a significant negative association between external regulation and self-reported moderate exercise behavior, other research has found a nonsignificant association between these variables (e.g., Edmunds, Ntoumanis, & Duda, 2006). Further, some research has supported a positive relationship between introjected regulation and total self-reported exercise behavior (e.g., Edmunds et al.). In contrast, past work has also evidenced nonsignificant relationships between both external and introjected regulations and total self-reported exercise behavior (e.g., Wilson, Rodgers, Blanchard, & Gessell, 2003). Importantly, when using an objective assessment of exercise behavior, Standage et al. (2008) reported no relationship between controlled motivation toward exercise (i.e., a composite score of external and introjected regulations) and engagement in bouts of moderate intensity exercise behavior.

Research focusing on intention to exercise has found introjected regulation to be positively associated with exercise intentions in adults (e.g., Wilson & Rodgers, 2004) and young people (Hagger, Chatzisarantis, Culverhouse, & Biddle, 2003). However, a nonsignificant relationship between external regulation and exercise intention in both of these studies was reported. Other research (e.g., Chatzisarantis, Biddle, & Meek, 1997) suggests external regulation can be important in young people developing strong intentions to exercise outside of school.

Based on such work, the issue of importance therefore becomes how to create conditions that will foster the internalization of exercise behavior. According to SDT (Ryan & Deci, 2000), individuals are active agents driven by a natural tendency to internalize the regulation of their behavior. That is, if provided with appropriate social environs (e.g., autonomy-supportive context), they will seek to transform originally external reasons for performing an activity, and assimilate and integrate these reasons with the self over time. Green-Demers, Pelletier, Stewart, and Gushue (1998) suggest that the use of psychological strategies can contribute to the internalization of target behaviors. In support of this proposal, they found that figure skaters' use of interest-enhancing strategies (e.g., setting long-term goals, adding variety to training) positively predicted interest in training tasks, with interest levels in turn positively predicting self-determined motivation. Their findings suggest that the employment of psychological strategies plays a role in the internalization process. Contemporary research highlights the need to establish psychological strategies and interventions which are effective in this regard in terms of exercise behavior (e.g., see Edmunds et al., 2006).

Imagery has long been considered to be an effective performance enhancement tool for athletes. It has also been recognized as a potential self-regulatory strategy for exercisers to enhance motivation and self-efficacy (e.g., Giacobbi, Hausenblas, & Penfield, 2005). The growth of research in exercise imagery has occurred largely in response to Hall's (1995) assertion that imagery could have a positive influence on the cognitions and motivation of exercisers. Hall suggested that exercisers might imagine participating in their favorite forms of exercise, and achieving their exercise goals. In the subsequent development of the Exercise Imagery Questionnaire (EIQ), Hausenblas, Hall, Rodgers, and Munroe (1999) identified three main types of imagery utilized by exercisers: (a) appearance imagery (i.e., imagining oneself becoming healthier and improving one's physical appearance), (b) energy imagery (i.e., imagining oneself being energized and ready to exercise); and (c) technique imagery (i.e., imagining the correct execution of exercise form/technique). Research employing the EIQ has found specific patterns of imagery use among exercisers. High frequency exercisers tend to use imagery more than low frequency exercisers, and appearance imagery is the most frequently used imagery type (Gammage, Hall, & Rodgers, 2000). Gender differences have also been reported, with males reporting significantly higher use of technique imagery than females, and females reporting significantly higher use of appearance imagery than males (Gammage et al.). Moreover, the EIQ has revealed that frequency of exercise imagery use positively predicts greater exercise behavior and intention to exercise (for a review see Munroe-Chandler & Gammage, 2005).

The EIQ has previously been used in an exercise imagery study guided by the theoretical tenets of SDT (Wilson, Rodgers, Hall, & Gammage, 2003). All three types of exercise imagery were positively associated with both controlled and autonomous forms of exercise regulation in a sample of 165 female exercisers. Via results from a canonical correlation analysis, these authors concluded that

[1] Integrated regulation is also suggested as a type of extrinsic regulation in the SDT continuum, reflecting a state in which an individual has integrated motivation toward an activity into their sense of self, aligned with their other needs and values (Deci & Ryan, 2008; Ryan & Deci, 2000). Most questionnaires assessing motivation from a SDT perspective in exercise do not include an integrated regulation subscale (including the BREQ-2 employed in this study). Consequently this behavioral regulation does not receive detailed description in this manuscript.

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exercise imagery use is tied to reasons for exercise engagement in a manner consistent with SDT. The inclusion of exercise-related outcomes, such as intention to exercise and exercise behavior, would extend their findings. Wilson and colleagues also proposed that future research should further consider the direction of causality between the behavioral regulations of SDT and other exercise-related cognitions. Based on Hall's (1995) suggestion that imagery use may serve a motivational function for exercisers, Gammage et al. (2000) proposed that by encouraging exercisers to use different types of imagery it may be possible to enhance the quality of their motivation, which in turn may lead to increased exercise behavior; a prediction which informed our hypothesized model.

Another issue to consider is the measurement of exercise imagery. The most established questionnaire to date, the EIQ, has been shown to demonstrate adequate psychometric properties (Hausenblas et al., 1999). However, it may fall short of capturing the full range of images experienced by exercisers due to its provision for only three types of exercise imagery. In particular, the EIQ is limited with respect to tapping the motivational function that imagery might have for exercisers (Munroe-Chandler & Gammage, 2005). To this end, the EIQ has recently been expanded to capture a motivational function of imagery in a manner that is consistent with the way in which intrinsic motivation is conceptualized in SDT (i.e., by adding items describing enjoying the process of exercise) (Stanley & Cumming, 2010a). Prior research supports the inclusion of these items since qualitative studies have shown that exercisers image themselves having fun in association with exercise (e.g., Short, Hall, Engel, & Nigg, 2004).

The main aim of the present study was to test a model (Fig. 1) drawing from the findings of Wilson, Rodgers, Hall, et al. (2003) to examine relationships between exercise imagery types and the motivational regulations that underpin exercise behavior. The three imagery types measured by the EIQ were included in the study along with additional items to represent images of exercise enjoyment (Stanley & Cumming, 2010a). In a sample of predominantly young female exercisers, Wilson, Rodgers, Hall et al. found positive relationships between all three EIQ imagery types (i.e., appearance, technique, and energy imagery) and the autonomous and controlled behavioral regulations for exercise. However, some of these relationships were acknowledged as inconsistent with the tenets of SDT (e.g., appearance imagery linked to autonomous forms of behavioral regulation, and technique imagery associated with controlled forms of regulation). When considering their findings for technique imagery, Wilson, Rodgers, Hall et al. speculated this type of imagery may reflect an outcome of exercise participation (i.e., it is reflective of individuals' personal exercise ability). Our initial model considers the possible motivational potential of imagery, rather than the use of this psychological strategy being an exercise outcome. Consistent with the posits of SDT it was hypothesized that since exercising for body-related reasons represents an extrinsic focus for exercising (Vansteenkiste, Simons, Lens, Sheldon, & Deci, 2004), use of appearance imagery would be positively associated with controlled motivation. Conversely it was expected that the remaining three imagery types (i.e., enjoyment, technique, and energy imagery) would be positively related with autonomous motivation as they represent a more intrinsic task focus and target outcomes integral to, rather than separable from, exercise.

Based on the literature summarized previously, it was predicted that autonomous motivation would be positively related to both intention to exercise (e.g., Wilson & Rodgers, 2004) and self-reported exercise behavior (e.g., Edmunds et al., 2006; Wilson, Rodgers, Blanchard, et al., 2003). Although departing from the theoretical tenets of SDT, but reflecting the findings from cross-sectional work that both introjected (e.g., Wilson & Rodgers, 2004) and external regulations (e.g., Chatzisarantis et al., 1997) have been linked with the intention to exercise, our initial model explored a positive pathway from the controlled motivation composite to intention to exercise. Finally, a positive relationship was also hypothesized between intention to exercise and self-reported exercise behavior (e.g., Hagger et al., 2003).

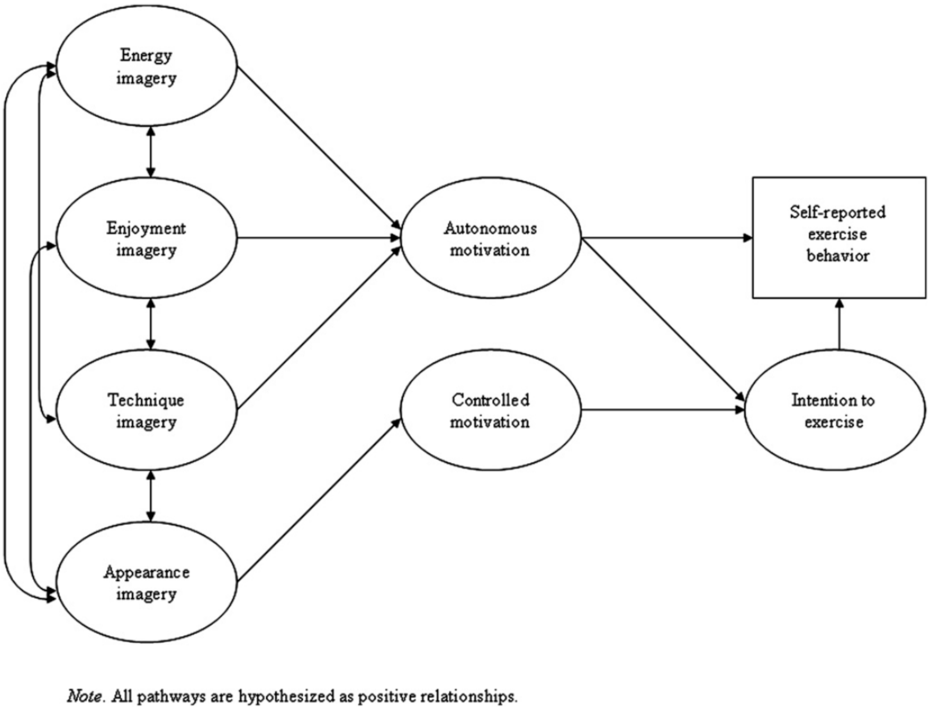

Fig. 1. Hypothesized model of relationships between exercise imagery use, motivational regulations, and cognitive and behavioral outcomes.

Method

Participants

Three hundred and fifty participants were recruited to take part in the study, of whom 193 were female (55%) and 157 were male (45%). The age range of the sample was 18–65 years ($M = 40.29$; SD = 13.29). The participants reported engaging in a variety of exercise activities including aerobics classes ($n = 14$), weight training ($n = 17$), cardio machines ($n = 17$), running outdoors ($n = 36$), swimming ($n = 12$), cycling outdoors ($n = 6$), martial arts ($n = 10$), yoga/pilates ($n = 6$), racquet sports ($n = 14$), team sports ($n = 11$), walking outdoors ($n = 12$), circuits classes ($n = 9$), multiple exercise types ($n = 174$), or not specified ($n = 12$).

Measures

Participants were asked to provide basic demographic and personal information such as their age, gender, and main exercise activity in which they participated.

Leisure Time Exercise Questionnaire (LTEQ; Godin & Shephard, 1985)

The LTEQ was used to assess patterns of self-reported exercise behavior. It consists of three questions that examine how many times in a current typical week an individual has engaged in mild, moderate, and strenuous exercise for more than 20 min in their free time. Each individual item was weighted by metabolic equivalents (i.e., units representing the metabolic cost of physical activity in multiples of resting oxygen consumption) and then summed to form an overall weekly exercise behavior score. Scores were weighted and summed via the following equation: [Strenuous × 9] + [Moderate × 5] + [Mild × 3]. In addition to Godin and Shephard's study providing support for the reliability and validity of the measure, the evaluation of questionnaires assessing self-reported physical activity conducted by Jacobs, Ainsworth, Hartman, and Leon (1993) also supported the LTEQ as a valid and reliable measure of exercise behavior.

Behavioral intention to exercise (BI; Courneya & McAuley, 1993)

Three items (e.g., "I intend to exercise three times per week over the next 4 weeks") assessed an individual's intention to exercise in the subsequent 4 weeks on a 7-point Likert-type rating scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). A score for behavioral intention was calculated by averaging the three items. Satisfactory psychometric properties have previously been demonstrated for this instrument (e.g., Courneya & McAuley; Wilson & Rodgers, 2004). In the present study the internal consistency of these items was $\alpha = .80$.

Behavioral Regulation in Exercise Questionnaire-2 (BREQ-2; Markland & Tobin, 2004)

The BREQ-2 was used to assess individuals' levels of amotivation,[2] external, introjected, identified, and intrinsic regulations. Participants responded to items using a 5-point scale from 0 (*not true for me*) to 4 (*very true for me*). Example items are "I don't see why I should have to exercise" (amotivation, $\alpha = .74$), "I take part in exercise because my friends/family/partner say I should" (external, $\alpha = .74$), "I feel guilty when I don't exercise" (introjected, $\alpha = .74$), "I value the benefits of exercise" (identified, $\alpha = .71$), and "I get pleasure and satisfaction from participating in exercise" (intrinsic, $\alpha = .93$). Alongside our internal consistency values provided above, other studies have supported the psychometric properties of the BREQ-2 (e.g., Barbeau et al., 2009; Wilson & Rodgers, 2004).

It is expected that adjacent behavioral regulations along the SDT continuum, such as identified and intrinsic motivation, will be more positively correlated than more distal behavioral regulations, such as external regulation and intrinsic motivation (see Standage et al., 2008; Wilson et al., 2006). The correlations displayed in Table 1 indicate that our data conforms to this hypothesis. Therefore, consonant with contemporary research contrasting autonomous and controlled motivation in the exercise context (e.g., Standage et al.; Wilson et al.), we averaged the intrinsic motivation and identified regulation subscales to form a composite score for autonomous motivation ($\alpha = .90$). A composite score for controlled motivation ($\alpha = .75$) was created by averaging the responses provided to the introjected regulation and external regulation subscales.[3] This involved randomly creating parcels of items to form four and three indicators for the autonomous and controlled motivation latent factors respectively. With regard to the controlled motivation composite, because the BREQ-2 contains four external regulation items but only three introjected regulation items, following a CFA we excluded the external regulation item with the lowest β value (i.e., "I exercise because other people say I should": $\beta = .59$). This permitted us to create three indicators to the latent factor "controlled motivation". Such an approach can be considered acceptable as it preserves the general structure of the originally hypothesized model but with only the best indicators (Hoffmann, 1995).

The Exercise Imagery Questionnaire (EIQ; Gammage et al., 2000; Hausenblas et al., 1999)

The EIQ measures exercisers' use of appearance (e.g., "I imagine a firmer me from exercising"), technique (e.g., "When I think about exercising, I imagine perfecting my technique"), and energy imagery (e.g., "To get me energized, I imagine exercising") on a 9-point rating scale from 1 (*never*) to 9 (*always*). Each subscale is represented by three items, which are averaged to indicate the frequency with which each type of imagery is used. Past research supports the multidimensional factor structure of the EIQ, and reveals Cronbach's α reliability levels higher than .70 for the three EIQ subscales (e.g., Gammage et al., 2000; Wilson, Rodgers, Hall et al., 2003).

Three additional items recently developed as part of a study by Stanley and Cumming (2010a) were included to tap into a motivational function of imagery not measured by existing exercise imagery questionnaires (i.e., enjoyment imagery): "I imagine enjoying my exercise session", "I imagine exercise being a pleasurable activity", and "When I think about exercise, I imagine myself

[2] Two anonymous reviewers enquired about the omission of amotivation from our structural models. Amotivation refers to a lack of intention to act, and constitutes an important regulation in the SDT continuum (Deci & Ryan, 2008). It was measured in this study via the BREQ-2, but was not significantly correlated with any of the imagery types, intention to exercise, or self-reported exercise behavior. Our sample of regular exercisers cannot be characterized as exhibiting a lack of intention to act, reporting very low levels of amotivation ($M = .12$ on a 0–4 scale), and a mean intention to exercise of 5.96 on a 1–7 scale. Since amotivation would contribute no significant findings to the manuscript it was omitted from the main analyses.

[3] Two anonymous reviewers commented that it would be interesting to examine the differential relationships between the varied motivational regulations of SDT and intention to exercise and self-reported exercise behavior. For the purposes of the present study the decision to use composite scores was taken for two reasons. It permitted the testing of a complex model with an acceptable participant to estimated parameter ratio. Secondly, we chose to align our analyses with the important distinction made by Deci and Ryan (2008) in SDT between autonomous and controlled motivation, which also makes our manuscript congruent with other recent studies in the research area of SDT and physical activity (e.g., Standage et al., 2008; Wilson et al., 2006).

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Table 1
Reliability analyses, descriptive statistics, and correlations for all study variables.

Variable	α	M	SD	2	3	4	5	6	7	8	9
Imagery types											
Appearance imagery (1)	.93	6.36	2.38	.45**	.43**	.56**	−.04	.27**	.08	.18**	.08
Technique imagery (2)	.90	4.95	2.47	–	.60**	.55**	.01	.16**	.26**	.11*	.24**
Energy imagery (3)	.79	2.99	1.83		–	.66**	−.00	.22**	.27**	.16**	.24**
Enjoyment imagery (4)	.87	4.66	2.32			–	−.03	.21**	.30**	.16**	.19**
Motivational regulations											
Amotivation (5)	.74	.12	.35				–	.18**	−.32**	−.08	−.07
Controlled motivation (6)	.75	1.05	.35					–	.02	.04	.01
Autonomous motivation (7)	.90	3.18	.35						–	.33**	.29**
Intention to exercise (8)	.80	5.96	1.38							–	.25**
Self-reported exercise behavior (9)	N/A	41.51	25.48								–

*$p < .05$, **$p < .01$.

having fun while exercising". These items were mixed in with the other EIQ items and rated on the same 9-point scale.

Procedure

Following approval by the ethics committee of a British University, the background to the study and the procedure involved were explained to the managers/head trainers of a variety of gyms/fitness clubs (e.g., martial arts, weight training, swimming clubs, and running clubs), and after securing their permission to collect data, questionnaires were then distributed among exercisers at these venues. Participants were either approached in a group setting (e.g., an exercise class) or approached individually by the first author as they were entering or leaving the gym. The study was briefly introduced to potential participants and they were offered an information letter, and the opportunity to ask any questions pertaining to the study before signing a consent form. All participants were reassured that their participation in the study would be anonymous and their responses kept confidential.

Results

Preliminary analyses

Data screening and cleaning

Multivariate outliers were determined by analyzing Mahalanobis distance values. Following the recommendations of Tabachnick and Fidell (2007) these values were evaluated as the χ^2 with degrees of freedom equal to the number of variables in the full data set. Any cases (in this instance, 24) with Mahalanobis distance values greater than the critical value shown in a chi-square critical value table were removed from further analyses. Eight further cases were deleted due to missing data in a specific non-random pattern (e.g., entirely missing sections on exercise behavior or intention to exercise). Since our data set then only had 49 values missing (.15% of values in the data set), it was deemed acceptable to replace these isolated values with the series mean (Hair, Black, Babin, Anderson, & Tatham, 2006) because having a complete data set was integral to the structural equation modeling analysis. A final sample of 318 was used in the subsequent analyses.

Descriptive statistics

The means, standard deviations and Cronbach's α values for all study variables are displayed in Table 1. The internal reliability for all of the subscales was satisfactory, with alpha coefficients above .70.

Main analyses

Structural equation modeling (SEM) procedures were used to test the hypothesized model with the AMOS 6.0 program (Arbuckle, 2005). Normality of data is assumed when using maximum likelihood analysis. Mardia's multivariate coefficient (73.74; critical ratio > 1.96) revealed that the present data were not normally distributed. Since the bootstrapping sampling distribution is not linked to assumptions of normality, this procedure was used in the subsequent analyses; 1000 bootstrap samples with replacement were employed so as to provide a more accurate indication of parameter stability (i.e., via bootstrap-generated standard errors) (cf. Byrne, 2001).

Within the hypothesized model (Fig. 1), the independent variables (i.e., the imagery types) are hypothesized as being correlated (cf. Byrne, 2001). Accordingly, we allowed these factors to covary. Such a decision is in keeping with the finding that higher frequency exercisers report using more of all imagery types than lower frequency exercisers (e.g., Gammage et al., 2000; Hausenblas et al., 1999), and research demonstrating positive relationships between use of the different exercise imagery types (e.g., Wilson, Rodgers, Hall, et al., 2003).

To assess model fit, the two index presentation strategy recommended by Hu and Bentler (1999) was followed. Hu and Bentler recommend supplementing the χ^2 test with other fit indices, which can be further categorized into absolute and incremental fit indices. Hu and Bentler explain that while an absolute fit index assesses how well an a priori model reproduces the sample data, an incremental fit index measures the proportionate improvement in model fit demonstrated by comparing a target model to a more restricted null model (i.e., where all the observed variables are typically uncorrelated). Consequently the maximum likelihood (ML) based standardized root mean squared residual (SRMR) and the root mean square error of approximation (RMSEA) were used as measures of absolute fit (values less than .08 for the SRMR and less than .06 for the RMSEA are suggested by Hu and Bentler as indicative of good model fit), along with two supplementary incremental fit indices; in this case the comparative fit index (CFI) and the incremental fit index (IFI) were used (values close to or exceeding .95 are suggested by Hu and Bentler as indicative of good model fit). In addition to the indices of fit, we also examined the proportion of variance that was explained by the independent variable(s) (IV) for the dependent variable of interest by examining the squared multiple correlation (SMC) values. The SMC values indicated that in terms of the composite motivational regulation scores, the predictors (or IVs) explained 11.7% of the variance in autonomous motivation, whereas 9% was explained in controlled motivation responses. In terms of the outcome variables, the predictors explained 17.5% of the variance in intention to exercise

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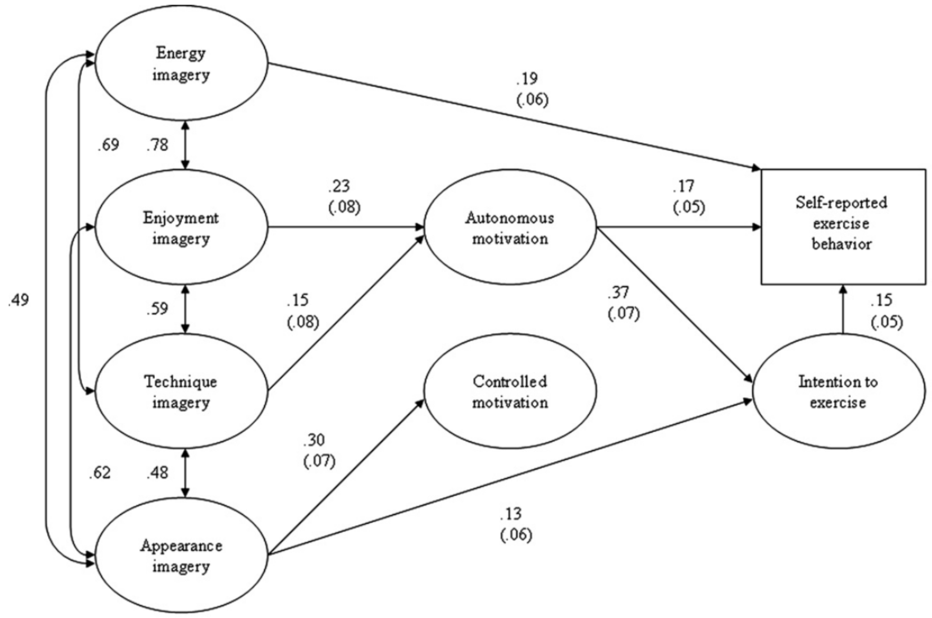

Note. All pathways represent significant standardized parameter estimates ($p < .05$). The bootstrap 95% confidence interval estimate of the standard error for each parameter is shown in parentheses.

Fig. 2. Revised model of relationships between exercise imagery use, motivational regulations, and cognitive and behavioral outcomes.

responses. Lastly, 13.8% of the variance in self-reported exercise behavior responses was explained by the set of predictors.

Before testing the hypothesized model, a confirmatory factor analysis supported our revised four factor EIQ (i.e., including enjoyment imagery items): χ^2 (48) = 119.02, $p < .01$; χ^2/d.f. = 2.48; CFI = .97; IFI = .97; RMSEA = .07; SRMR = .04. A confirmatory factor analysis of the full measurement model for the study was then performed with all latent factors allowed to correlate freely (i.e., consistent with the model building approach recommended by Anderson & Gerbing, 1988). The measurement model provided a good fit to the data: χ^2 (203) = 360.93, $p < .01$; χ^2/d.f. = 1.77; CFI = .96; IFI = .96; RMSEA = .05; SRMR = .04. The second step of this model building approach analyzed the relationships between the exercise imagery types, the motivational regulations, intention to exercise, and self-reported exercise behavior.

The results of the SEM analysis indicated the hypothesized model fit the data very well: χ^2 (217) = 394.82, $p < .01$; χ^2/d.f. = 1.82; CFI = .96; IFI = .96; RMSEA = .05; SRMR = .04. The path linking energy imagery with autonomous motivation was removed because it was nonsignificant, as too was the path from controlled motivation to intention to exercise. Modification indices were examined and considered from a theoretical perspective, resulting in a path being added between appearance imagery and intention to exercise (Rodgers, Munroe, & Hall, 2002), and one linking energy imagery to exercise behavior (Rodgers, Hall, Blanchard, & Munroe, 2001). The fit for the revised model was then determined: χ^2 (217) = 380.15, $p < .01$; χ^2/d.f. = 1.75; CFI = .96; IFI = .96; RMSEA = .05; SRMR = .05. The results for this model are shown in Fig. 2. The standardized indirect effects in the revised model are as follows, with the bootstrap estimate of the standard error in parentheses: Enjoyment imagery to exercise behavior, .05 (.02); enjoyment imagery to intention to exercise, .09 (.04); technique imagery to exercise behavior, .04 (.02); technique imagery to intention to exercise, .06 (.03); appearance imagery to exercise behavior, .02 (.01); autonomous motivation to exercise behavior, .06 (.02).

Testing for gender invariance

Gender invariance for the hypothesized causal structure of the model was examined via multigroup SEM analyses. Specifically, based on a procedure outlined by Byrne (2001) we compared increasingly constrained models in which the measurement and structural parameters were constrained to be equal. First, our final model was tested in each group independently. Results showed good model fit for the male ($n = 141$): χ^2 (217) = 320.85, $p < .01$; χ^2/d.f. = 1.48; CFI = .94; IFI = .94; RMSEA = .06; SRMR = .07; and female samples ($n = 177$): χ^2 (217) = 320.35, $p < .01$; χ^2/d.f. = 1.48; CFI = .96; IFI = .96; RMSEA = .05; SRMR = .05. Subsequently, an unconstrained model was examined via multisample analysis, indicating the causal model to provide a good fit to the data across the male and female samples: χ^2 (458) = 673.71; χ^2/d.f. = 1.47; CFI = .95; IFI = .95; RMSEA = .04; SRMR = .08. Next, the measurement weights were constrained to be equal, with results showing a good fit to the data to be maintained: χ^2 (461) = 677.25, $p < .01$; χ^2/d.f. = 1.47; CFI = .95; IFI = .95; RMSEA = .04; SRMR = .08. The structural weights were then fixed to be equal across samples with the results again showing the model to retain a good fit to the data: χ^2 (466) = 681.28, $p < .01$; χ^2/d.f. = 1.46; CFI = .95; IFI = .95; RMSEA = .04; SRMR = .09. The testing of the invariance of error variances and covariances is considered overly restrictive (Byrne, 2001), and as such we did not pursue this line of inquiry. In addition to fit indices remaining good, based on the recommendation that a value of ΔCFI smaller than or equal to .01 indicates a non-substantial decrease in model fit (Cheung & Rensvold, 2002), our results (ΔCFI = .00) provide support for factorial invariance across gender for the causal model.

Discussion

The purpose of this study was to test a structural model based on past findings applying SDT (Ryan & Deci, 2000) in the exercise domain, drawing from the findings of Wilson, Rodgers, Hall, et al. (2003), to examine the relationships between different types of exercise imagery and autonomous and controlled motivation, and to determine whether these relationships were linked to intention to exercise and self-reported exercise behavior. Based on past research findings in the area (e.g., Wilson, Rodgers, Hall, et al.) and Gammage et al.'s (2000) suggestion that different imagery types may influence exercisers' motivation to exercise, it was hypothesized that use of appearance imagery would be associated with controlled motivation, while technique, energy and enjoyment imagery would all be associated with autonomous motivation. The relationships hypothesized in our initial model were largely supported, with appearance imagery found to be positively related to controlled motivation. As hypothesized, technique imagery was positively related to autonomous motivation, with the hypothesized positive pathway between enjoyment imagery and autonomous motivation also supported. However the pathway between energy imagery and autonomous motivation was nonsignificant. Concerning the behavioral regulations of SDT, autonomous motivation was linked to both intention to exercise and exercise behavior, whereas the positive hypothesized pathway between controlled motivation and intention to exercise was not supported in this sample.

Controlled motivation reflects carrying out a given behavior to attain an external reward (i.e., external regulation) or to avoid internal sanctions such as feelings of shame or guilt (i.e., introjected regulation) (Ryan & Deci, 2000). That appearance imagery was positively related to controlled motivation in the present study is consistent with the idea that such imagery content focuses primarily on the physical improvements attached to exercise and is therefore expected to be linked with more controlling motives for exercise behavior (i.e., external and introjected regulations) (see Wilson, Rodgers, Hall, et al., 2003). Linked to this is the relationship included in our revised model between appearance imagery use and the intention to exercise; a finding consistent with Rodgers et al. (2002) and their statement that while appearance imagery and appearance-related motives are important in inspiring the intention to exercise, they may be insufficient in terms of determining high levels of exercise engagement, or sustained exercise behavior. Thus, while Gammage et al. (2000) suggest that appearance-based images serve a motivational function for exercisers, our data indicates that the quality of that motivation may be quite controlled.

The finding that technique imagery was positively related to autonomous motivation is consistent with the idea that using imagery with content focused on the correct performance of exercise techniques serves to achieve an outcome integral to, rather than independent of, the exercise activity; reflecting an intrinsic focus for the use of technique imagery as a psychological strategy (see Vansteenkiste et al., 2004). Wilson, Rodgers, Hall, et al. (2003) found associations between technique imagery use and both controlled and autonomous motivational regulations, although it must also be noted that Wilson and colleagues explained that finding a link between technique imagery and controlled behavioral regulations had been unexpected in their study, given that such imagery content focuses on the performance of exercise itself and is therefore expected to be related to autonomous motivation. An avenue for future research might be to reexamine the individual links between technique imagery and different types of behavioral regulation within SDT to further explicate their relationships, as the present work involved composite scores and, as such, did not focus on these individual relationships.

Wilson, Rodgers, Hall, et al. (2003) described finding relationships between energy imagery use and both autonomous and controlled behavioral regulations. Again, a relationship with controlled regulations was unexpected, leading the authors to speculate that energy imagery use can target an outcome of exercising but might also reflect a state of vitality inherent to the activity itself, and in that sense could potentially be linked with both controlled and autonomous behavioral regulations. In the present study we hypothesized only a relationship between energy imagery use and autonomous regulation. Although our final model did not support this relationship, the pathway between energy imagery and autonomous motivation almost reached significance ($p = .07$). Hence, we would still endorse Wilson and colleagues' comment that energy imagery use is more closely associated with autonomous motivation than with controlled motivation. A direct pathway was introduced to our revised model between energy imagery and self-reported exercise behavior, consistent with Rodgers et al.'s (2001) finding that use of this imagery type was associated with exercise behavior in a sample of avid exercisers. Yet despite exercisers using energy imagery to either augment or sustain their exercise behavior, with energy imagery being described as serving a motivational function (e.g., Munroe-Chandler & Gammage, 2005), our data suggests that energy imagery is not positively linked with autonomous motivation to the extent that enjoyment imagery might be. Nonetheless, a relationship between energy imagery use and exercise behavior is apparent, as therefore is the possibility of a different motivational mechanism by which energy imagery might lead to increased exercise behavior. Rather than impacting autonomous motivation per se, the motivational role of energy imagery in altering exercise-related affect is a possibility worth considering. Munroe-Chandler and Gammage posited that the nature of imagery used by exercisers varies across different settings, suggesting that while exercisers might use imagery content focused on outcomes (e.g., appearance) to initially build the intention to exercise, they might then switch their focus to using energy imagery more during exercise to maintain their energy and arousal levels during a workout. Relevant implications regarding the respective motivational functions served by enjoyment and energy imagery can be drawn from the recent experiment conducted by Stanley and Cumming (2010b). Use of energy imagery was associated with improvements in exercise-related arousal and revitalization. Hence it may be that energy imagery does not exert a large influence on making exercise seem more intrinsically rewarding over the long-term, but it might help exercisers to develop levels of exercise arousal sufficient to persist with their exercise behavior. Considering the link between positive exercise-related affect and exercise behavior (e.g., Williams et al., 2008), if energy imagery can help to boost levels of energy for exercising, and enhance postexercise affect, this in turn might encourage increased exercise behavior. While our model does not explore this possibility, the effects of energy imagery use on both exercise affect and behavior certainly merit further research attention.

This study is the third to provide support for the inclusion of enjoyment imagery in exercise imagery research (see also Stanley & Cumming, 2010a, 2010b). The enjoyment imagery items included in this study were internally consistent ($\alpha = .87$), and enjoyment imagery showed a positive association with autonomous motivation in the present findings. In turn, autonomous motivation was positively related to both intention to exercise and self-reported exercise behavior. Munroe-Chandler and Gammage (2005) have suggested that exercisers might use imagery to alter their exercise-related feeling states, giving the example that if one images having fun during exercise it may increase exercise enjoyment. Stanley and Cumming (2010b) recently found that participants who used imagery while exercising in a laboratory setting enjoyed the exercise more than those using no psychological strategy at all, with enjoyment imagery showing the largest effect. To our knowledge, the present study is the first cross-sectional work to confirm that in naturalistic gym settings, a heterogeneous sample of exercisers report using enjoyment imagery and it is linked to more self-determined reasons for exercising. Further research is needed to verify Stanley and Cumming's initial finding that using this imagery type impacts individuals' enjoyment of exercise. The finding that exercisers are using enjoyment imagery also has important implications for exercise imagery measurement, by demonstrating that there is still scope for improvement and refinement of the existing EIQ items.

Our findings also highlight the relevance of considering how psychological strategies impact differentially on the controlled and autonomous regulations underpinning exercise engagement, and in turn, how these varied types of motivation have differential influences on exercise-related outcomes. In line with previous research, autonomous motivation was positively related to both intention to exercise (e.g., Wilson & Rodgers, 2004) and self-reported exercise behavior (e.g., Edmunds et al., 2006; Wilson, Rodgers, Blanchard, et al., 2003), reiterating the argument advanced within SDT that autonomous motivation is most likely to be associated with adaptive exercise outcomes. Conversely, and in contrast to one of our hypotheses, a positive relationship was not evidenced between controlled motivation and intention to exercise. As noted previously however, studies examining links between controlled behavioral regulations and the intention to exercise, or to be physically active, have not produced a consistent pattern of findings. Taken together, our results support considerable previous research examining the behavioral regulations of SDT in exercise behavior, indicating that efforts aimed at increasing exercise behavior should endeavor to aid individuals in feeling more autonomous and to internalize the target behavior, rather than experiencing feelings of being controlled in their exercise participation. To facilitate the internalization of regular exercise behavior, our findings suggest that those who frequently use or experience images with content focused on their appearance might be advised to focus more on the imagery content which was found to be associated with autonomous motivation (i.e., technique and enjoyment imagery). Future research might consider exploring the relationships we describe here with sedentary individuals, or with exercise initiates to verify whether they apply equally across other samples. For instance, our sample was comprised of current regular exercisers. Consistent with our expectations their responses yielded a positive link between intention to exercise and self-reported exercise behavior, but this finding may not necessarily apply in a sample of individuals who are unaccustomed, or new, to exercise.

It is important to note that the present study also has limitations that can both inform, and be addressed, by future research. First, the participants' exercise behavior was assessed via self-report. To avoid any potential measurement inaccuracy due to retrospective recall, future research may consider more objective measures of exercise behavior (cf. Standage et al., 2008). Second, the nature of the study was cross-sectional and although causality is being implied between imagery, behavioral regulations, intention to exercise and self-reported exercise behavior, this has not been tested. Nonetheless, the present study lends support to the suggestion that the use of psychological strategies might contribute to the internalization of target behaviors (Green-Demers et al., 1998). Future research could consider testing the effects of exercise imagery use on motivation to verify the findings of this study as well as examining the dynamic interplay between imagery and motivation-related variables. For instance, longitudinal or experimental designs could establish whether imagery can be used as a strategy to self-regulate exercise behavior, or to alter exercise-related cognitions such as self-efficacy, enjoyment, affect, and physical self-worth. Finally, research addressing the role of the psychological needs as posited within SDT would be particularly interesting as we attempt to better understand how different types of imagery may impact on one's motivation to engage in exercise behavior.

Prior research has indicated that the regulations of SDT independently predict exercise behavior (e.g., Edmunds et al., 2006). Using composite scores in this study may be viewed as a limitation, for example in terms of not examining relationships between imagery types and each individual regulation of SDT. Nonetheless the findings of the present study remain consistent with theory in that imagery with content reflecting outcomes integral to the activity (i.e., technique and enjoyment imagery) were related to autonomous motivation while appearance imagery was linked with controlled motivation; as expected the more self-determined regulations were positively associated with exercise behavior. Given this limitation subsequent research, especially intervention work, could consider the effects of imagery use on the individual behavioral regulations and their relative effects on exercise outcomes. Novel findings in this study suggest a timely possibility: testing whether enjoyment imagery can be used to beneficially impact autonomous reasons for exercising, and augment exercise behavior.

In summary, the results indicate that enjoyment and technique imagery are related to autonomous motivation as conceptualized within SDT, and appearance imagery is related more to controlled motivation. Imagery use was related to quality of motivation, which at the autonomous end of the SDT continuum, linked positively to intention to exercise and self-reported exercise behavior. The pattern of results show that encouraging the use of imagery with content relating to the enjoyment of exercise and the correct performance of exercise technique are promising as strategies that might encourage the internalization of exercise behavior. This study also provides further support for the inclusion of enjoyment imagery in future exercise imagery research.

Appendix. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.psychsport.2011.10.002.

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