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## Do Autonomous Exercise Regulations Underpin Different Types of Exercise Imagery?

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The purpose of this study was to examine the relationship between exercise regulations varying in self-determination and exercise imagery. Female Canadian university exercise participants ( $N = 165$ ) completed measures of exercise regulations and exercise imagery following an exercise class. Descriptive statistics indicated participants held more self-determined reasons for exercise participation in the form of greater endorsement of both identified and intrinsic exercise regulations, as well as reporting more frequent use of appearance related exercise imagery. Canonical correlation analysis revealed two significant canonical functions ( $R_{c1} = .47$ ,  $R_{c2} = .30$ ). The first function suggested that more self-determined exercise regulations were associated with both appearance and technique imagery, while the second function revealed that introjected regulation was most strongly associated with appearance-related imagery. Collectively, these data suggest that the content of exercise imagery can be understood within a theoretical framework that clarifies the functional role played by different images in exercise promotion based upon their motivational foundations.

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Received 11 July 2002; accepted 20 January 2003.

Funding for this study was provided through a grant awarded to Dr. Wendy M. Rodgers and Dr. Craig Hall by the Social Sciences and Humanities Research Council of Canada. The first author would like to gratefully acknowledge the funding support provided by the University of Alberta through both the Izaak Walton Killam and Andrew Stewart Memorial Scholarships. Our appreciation is extended to the exercise participants that gave freely of their time to participate in this study and the exercise class instructors who facilitated access to their classes.

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Previous research and commentary suggests that imagery plays a salient role in a number of important life domains including exercise and sport (Annett, 1996; Hall, 1995; Martin, Moritz, & Hall, 1999; Paivio, 1986). In the context of competitive sport, the merit of mental rehearsal is recognized by both coaches and athletes (Hall, Rodgers, & Barr, 1990), and a growing body of research points to the value of imagery as a potential performance enhancement technique (Hall, Mack, Paivio, & Hausenblas, 1998; Hall & Rodgers, 1989).

Hall (1995) was among the first to suggest that exercise participants may use imagery for cognitive and motivational reasons in much the same way as competitive athletes use mental rehearsal to enhance sport performance. Based upon previous imagery research, Hall argued that imagery promotes exercise adherence directly and indirectly through other self-referent cognitions (such as self-efficacy) that have demonstrated links with exercise behavior (see McAuley, Penna, & Jerome, 2001 for a review of the relationship between self-efficacy and exercise). Despite the limited amount of research examining Hall's contentions directly, a small number of studies suggest that imagery is associated with exercise involvement (Gammage, Hall, & Rodgers, 2000; Hausenblas, Hall, Rodgers, & Munroe, 1999; Rodgers, Hall, Blanchard, & Munroe, 2001).

The majority of available research focusing on exercise imagery has relied predominantly on responses to the Exercise Imagery Questionnaire (EIQ; Hausenblas et al., 1999). Hausenblas et al. created the EIQ on the basis of responses from open-ended elicitation questions, and provided initial psychometric support for the 3-factor structure of the EIQ using confirmatory factor analysis procedures. Hausenblas et al. indicated that exercise participants endorsed three specific types of imagery which were subsequently labeled: (a) *appearance* (i.e., imagining how one's physique or fitness looks), (b) *technique* (i.e., imagining using the correct form and body position during exercise), and (c) *energy* (i.e., imagining the feeling of energy and stress relief stemming from exercise). Building upon the work of Hausenblas et al., Gammage et al. (2000) found that active exercise participants reported using more appearance-related imagery than either technique or energy imagery irrespective of gender, frequency, or type of exercise. More importantly, both Gammage et al. and Hausenblas et al. indicated that more frequent exercisers (those participating > 3 times per week) reported more imagery experiences than less frequent exercisers (participating < 2 times per week). In line with Hall's (1995) contentions, these studies suggest a tentative link between imagery use and exercise involvement. However, the motivational functions of imagery overall, as well as the motivational implications associated with different types of exercise imagery assessed by the EIQ have yet to be clearly established.

Previous research examining imagery in the exercise domain has focused almost exclusively on the association between the degree of imagery use and the frequency of exercise participation (Gammage et al., 2000; Hausenblas et al., 1999). Although this line of research links imagery with exercise behavior, the mechanisms responsible for the generation of different forms of exercise imagery have yet to be thoroughly examined or placed within a comprehensive theoretical framework. Towards this end, a number of researchers have called for more theoretically driven research that may explain both the use and function of imagery in exercise contexts (Hall, 1995; Rodgers et al., 2001). One theoretical framework that has proven useful in other domains for understanding relationships between cognition and behavior is self-determination theory (SDT; Deci & Ryan, 1985, 2000, 2002; Ryan & Deci, 2000, 2001).

SDT contends that regulations responsible for motivated behavior and psychological well-being vary along a continuum of self-determination from completely controlled to fully autonomous in nature (Deci & Ryan, 1985, 2000, 2002; Ryan & Deci, 2000, 2001). *Autonomous regulations* (identified and intrinsic regulations) emanate from an integrated sense of self, reflect personal volition, and are associated with a perceived internal locus of causality (Deci &

Ryan, 1985; deCharms, 1968). *Identified regulation* involves participating because one values the important outcomes associated with the behavior, and conceptually is considered to be a self-determined form of extrinsic motivation (Deci & Ryan, 1985; Ryan & Deci, 2000, 2001). *Intrinsic regulation* refers to participation that is undertaken volitionally for the pleasure, satisfaction, and interest derived solely from the behavior itself (Deci & Ryan, 1985; Ryan & Deci, 2000; 2001). From an SDT perspective, all behaviors regulated via intrinsic motives are self-determined, and therefore intrinsic regulation conceptually represents the “upper boundary” of autonomous motivation.<sup>1</sup>

In contrast to autonomous regulations, SDT contends that behavior can be motivated by contingencies which develop under conditions where people feel forced to behave in accordance with interpersonal obligations or intrapsychic pressures (Deci & Ryan, 1985, 2002; Ryan & Deci, 2000, 2001). *Controlling regulations* (external and introjected regulations) stem from an external perceived locus of causality (deCharms, 1968) and reflect a fragmented or incoherent sense of self (Deci & Ryan, 1995; Kernis, Paradise, Whitaker, Wheatman, & Goldman, 2000). *External regulation* represents the most controlling motive, and involves regulating behavior to satisfy interpersonal demands or appease external contingencies (Ryan & Deci, 2000, 2001). Conversely, *introjected regulation* refers to intrapersonal pressures or contingencies that motivate behavior by inducing a desire to avoid feeling guilty, anxious, or shameful regarding behavioral disengagement (Ryan & Deci, 2000, 2001).

The practical importance of distinguishing between these motivational qualities is that a growing body of research indicates more beneficial consequences accrue from autonomous regulations as opposed to their controlling counterparts. For example, research across a variety of domains now links more autonomous regulations not only with behavioral persistence (Williams, Freedman, & Deci, 1998; Williams, Gagné, Ryan, & Deci, 2002; Williams, Grow, Freedman, Ryan & Deci, 1996), but also with enhanced psychological well-being (Kernis et al., 2000; Kowal & Fortier, 2000; Ryan & Deci, 2001; Wilson & Rodgers, 2002). Furthermore, research conducted within the framework of SDT on life goals (or aspirations) by Kasser and Ryan (1993, 1996) suggests that aspiring towards improved physical appearance (an extrinsic life goal) is associated with controlling forms of extrinsic motivation and psychological maladjustment (Kasser & Ryan, 1993, 1996). Extrapolating from this line of research to the exercise imagery literature, it seems reasonable to suggest that SDT may provide a comprehensive framework from which to examine the potential motivational foundations of different types of exercise imagery.

Based on SDT's notion of a regulatory continuum (Deci & Ryan, 1985; Ryan & Deci, 2000, 2001), and research examining correlates of life goals (Kasser, 2002; Kasser & Ryan, 1993, 1996), the types of imagery expressed in the EIQ (Hausenblas et al., 1999) can be construed as a function of the motivational foundations underpinning their expression. More specifically, appearance imagery focuses largely on the physical improvements anticipated from exercise participation, and therefore is likely to be positively associated with more controlling motives such as external and introjected regulations as suggested by previous research (Kasser & Ryan, 1993, 1996). Alternatively, technique imagery focuses on the performance of exercise itself, and as such should be associated with more autonomous regulations (identified and intrinsic

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1. In the broader context of self-determination theory (Deci & Ryan, 1985; Ryan & Deci, 2000, 2001), there is another form of extrinsic motivation termed integrated regulation. Integrated regulation occurs “when identified regulations have been fully assimilated to the self” (Ryan & Deci, 2000, p. 62) and conceptually represents a point along the motivational continuum between identified and intrinsic regulation.

regulations). Although energy imagery reflects an expected outcome of exercise behavior per se, it is conceivable that this type of imagery reflects a sense of enthusiasm and inherent enjoyment implicit to the activity itself, a state analogous to feelings of subjective vitality (Ryan & Deci, 2001; Ryan & Frederick, 1997). In this regard, it seems plausible that energy imagery will be more closely associated with autonomous than controlling regulations.

On the basis of previous commentary calling for more theoretically grounded research in the exercise imagery domain (Hall, 1995; Rodgers et al., 2001), the purpose of this study was to examine the relationships between SDT's regulatory continuum and exercise-related imagery. Accordingly, on the basis of arguments put forth by SDT (Deci & Ryan, 1985; Ryan & Deci, 2000, 2001), and previous research examining imagery in the exercise domain (Gammage et al., 2000; Hausenblas et al., 1999; Rodgers et al., 2001), it was hypothesized that exercisers endorsing more self-determined or autonomous regulations would report higher use of energy and technique imagery while more controlling regulations would be positively associated with greater endorsement of appearance imagery.

## METHOD

### Participants

The participants in this study consisted of 165 female students and staff enrolled in various aerobic exercise classes ( $n = 20$ ) at a large Canadian university. Our sample was exclusively female due to the gender composition of the classes in which our study took place. Participants were predominantly young (75.9% of the sample were aged between 18 and 21) and ranged in age from 18 to 39 ( $M_{age} = 20.71$ ,  $SD = 2.69$ ). Self-reported anthropometric and physical activity data revealed that participants were quite healthy at the time of data collection. Body Mass Index (BMI) values ( $M = 21.71$  Kg/M<sup>2</sup>,  $SD = 2.77$  Kg/M<sup>2</sup>) fell within the healthy range (i.e., 18.00 to 24.99 Kg/M<sup>2</sup>) for this age cohort (American College of Sports Medicine, 1995). Also, participants indicated engaging in weekly physical activity ( $M_{mets} = 59.67$ ,  $SD = 24.01$  based upon responses to the Godin Leisure Time Exercise Questionnaire; Godin & Shepherd, 1985) at a level comparable with previous research using college-aged samples (Hayes, Crocker, & Kowalski, 1999).<sup>2</sup> At the time of data collection, all participants were in the second week of a 12 week exercise class offered through the university during the winter term.<sup>3</sup>

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2. A MET value is way of expressing the rate of energy expenditure associated with a particular physical activity (Godin & Shepherd, 1986). The GLTEQ (Godin & Shepherd, 1985) comprises 3 self-report items assessing frequency of participation in mild, moderate, and strenuous exercise done for at least 20 min per session during a typical week. Consistent with the exercise categorizations suggested by Rodgers and Gavin (1998) used in previous exercise imagery research (Gammage et al., 2000), the majority of participants in this study (77.4 %) would be considered frequent (exercising 3 or more times per week) than infrequent (exercising only 1–2 times per week) exercisers based on their participation in self-reported strenuous weekly exercise.

3. Consistent with the university mandate, all exercise classes were offered through the Non-credit Instructional program housed with the university's Campus Recreation Department. The exercise classes met twice per week for 12 weeks in duration under the leadership of a qualified exercise instructor. Each class lasted for approximately 55 minutes, and was comprised of a warm-up and cool down period separated by bouts of exercise conducted at a self-selected intensity. None of the participants involved in this study were enrolled in classes that emphasized resistance training or flexibility exercises as the primary form of class-based physical activity.

## Measures

### *Behavioral Regulation in Exercise Questionnaire (BREQ)*

Participants completed the BREQ (Mullan, Markland, & Ingledew, 1997), a 15-item self-report measure assessing the reasons why people exercise. The BREQ operationalizes exercise motivation along a graded self-determination continuum, and includes scales assessing external, introjected, identified, and intrinsic regulations.<sup>4</sup> Sample items characterizing each BREQ subscale were as follows: "I exercise because other people say I should" (external regulation; 4 items), "I feel guilty when I don't exercise" (introjected regulation; 3 items), "I value the benefits of exercise" (identified regulation; 4 items), "I enjoy my exercise sessions" (intrinsic regulation; 4 items). Following the stem, "Why do you exercise?" participants responded to each item on a 5-point Likert-type scale ranging from 1 (*Not true for me*) to 5 (*Very true for me*). Previous research reports internal consistency (Cronbach's  $\alpha$ ) reliability coefficients for each BREQ subscale that range from .76 to .90 (Mullan et al., 1997) and indicates that BREQ scores are useful in predicting current stage of exercise adoption (Mullan & Markland, 1997). Additional research has demonstrated some support for a simplex pattern of relationships between the BREQ subscales, as well as relationships with exercise behavior that are consistent with theoretical propositions (Wilson, Rodgers, & Fraser, 2002). Subscale scores were calculated by taking the average of the relevant items for each BREQ construct.

### *Exercise Imagery Questionnaire (EIQ)*

The EIQ (Gammage et al., 2000; Hausenblas et al., 1999) is a 9-item self-report measure that taps thoughts associated with technique, appearance, and energy related imagery. Sample items characterizing each EIQ subscale were as follows: "When I think about exercising, I imagine my form and body position" (EIQ-technique; 3 items), "I imagine a 'leaner-me' from exercising" (EIQ-appearance; 3 items), "To get me energized, I imagine exercising" (EIQ-energy; 3 items). Participants rate the frequency of their imagery use on a 9-point Likert-type scale ranging from 1 (*None*) to 9 (*Always*). Previous research using confirmatory factor analysis procedures suggests some support for the EIQ's multidimensional factor structure (Rodgers et al., 1999), and reports internal consistency (Cronbach's  $\alpha$ ) reliability estimates for each EIQ subscale that exceeded .80 in university samples participating in group based exercise classes (Rodgers et al., 1999). Subscale scores for EIQ-appearance, EIQ-technique, and EIQ-energy were calculated by averaging the appropriate items.

## Procedures and Analyses

Following a regularly scheduled class, all participants were approached by one of the investigators and invited to participate in a study examining reasons for exercise participation. Participants were given the opportunity to ask questions regarding the research project prior to providing written informed consent and completing a questionnaire. Data analyses proceeded in four stages. First, the data were screened for discrepant responses and examined for confor-

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4. The construct of intrinsic regulation has been conceptualized within the BREQ in a manner consistent with Deci and Ryan's (1985) theorizing. Recent research (Li, 1999) and commentary (Vallerand, 2001) have forwarded the idea of multidimensional intrinsic motivation. While this notion is appealing, these contentions have yet to be systematically evaluated in the physical domain and represent an extension of SDT's multidimensional extrinsic motivation continuum. The interested reader is referred to Vallerand (2001) for a conceptual discussion, and Li and Harmer (1996) for empirical evidence that questions the measurement of multidimensional forms of intrinsic motivation in the physical activity domain.



mity with relevant statistical assumptions. Second, internal consistency estimates (Coefficient  $\alpha$ ; Cronbach, 1951) and descriptive statistics were calculated for all study variables. Third, Pearson ( $r_s$ ) correlations were computed between the subscales of the BREQ and EIQ to examine their bivariate relationships. Third, a canonical correlation ( $R_c$ ) analysis was conducted to examine the linear relationships between exercise regulations (as measured by the subscales of the BREQ) and exercise imagery (as measured by the subscales of the EIQ).

## RESULTS

### Preliminary Data Screening

Prior to conducting any statistical analyses associated with our study hypotheses, the data were screened to determine their conformity with relevant statistical assumptions (i.e., normality, linearity, and homoscedasticity). The distributional properties of each variable and a histogram of the standardized residuals indicated that only the external regulation and EIQ-appearance variables deviated marginally from normality. Both variables were normalized using the square-root transformation procedures suggested by Tabachnik and Fidell (2001). The scatterplot of residuals suggested that both linearity and homoscedasticity assumptions were tenable.

### Descriptive Statistics and Internal Consistency Reliability Estimates

The internal consistency estimates for each BREQ and EIQ subscale are presented in Table 1 (all  $\alpha$ s  $> .70$ ). The descriptive statistics (see Table 1) were similar to previous research for both EIQ-appearance and EIQ-technique, but both EIQ-energy and BREQ subscale scores were slightly higher than reported in previous research (Gammage et al., 2000; Mullen & Markland, 1997; Rodgers et al., 2001). Notwithstanding this observation, the pattern of imagery use and motives regulating exercise behavior reported by the participants in this study were consistent with previous research (Gammage et al., 2000; Rodgers et al., 2001; Wilson & Rodgers, 2002; Wilson et al., 2002). Specifically, participants in this study reported greater endorsement of autonomous (identified and intrinsic exercise regulations) as opposed to controlling motives for exercise involvement, as well as more frequent use of appearance imagery in comparison to either technique or energy imagery.

### Bivariate Relationships Between Exercise Regulations and Exercise Imagery

Pearson correlations (see Table 1) were computed to examine the relationships between exercise regulations and the content of exercise imagery using the subscales of the BREQ and EIQ, respectively. A number of interesting observations emerged from these analyses. First, the interrelationships between exercise regulations measured by the BREQ displayed a graded pattern of associations with proximal subscales (external-introjected, introjected-identified, identified-intrinsic) being more positively correlated with one another than distal subscales. Second, introjected regulation was positively correlated with all three EIQ subscales, but most strongly associated with EIQ-appearance. Third, autonomous regulations (both identified and intrinsic) were weak-to-moderately correlated with both EIQ-technique and EIQ-energy. Finally, all EIQ-subscales were positively interrelated, with the relationship between EIQ-technique and EIQ-energy being quite strong ( $r = .65$ ).

### Canonical Correlation Between Exercise Regulations and Exercise Imagery

Canonical correlation ( $R_c$ ) analysis was conducted to examine the multivariate relationships between exercise regulations and exercise imagery.  $R_c$  coefficients provide an index of the asso-

**Table 1**  
**Pearson Correlations Between BREQ and EIQ Subscales**

Variable	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7
1. BREQ – External Regulation	1.62	0.24	a = .81						
2. BREQ – Introjected Regulation	2.88	0.96	.21**	a = .75					
3. BREQ – Identified Regulation	4.47	0.56	-.30**	.32**	a = .71				
4. BREQ – Intrinsic Regulation	4.26	0.68	-.32**	.09	.54**	a = .89			
5. EIQ – Appearance	7.31	1.62	.11	.40**	.17 <sup>†</sup>	.04	a = .88		
6. EIQ – Technique	5.82	1.88	.07	.28**	.25**	.33**	.35**	a = .85	
7. EIQ - Energy	5.09	2.16	.11	.21**	.13	.21**	.38**	.65**	a = .87

*Note:* BREQ = Behavioral Regulation in Exercise Questionnaire; EIQ = Exercise Imagery Questionnaire. Pearson correlations are placed in the lower triangle of the matrix. Internal consistency estimates (Cronbach's Coefficient  $\alpha$ ) are placed along the principal diagonal. Correlation matrix is based upon pairwise comparisons and sample size is consistent across each element in the matrix. <sup>†</sup>  $p < .05$ . \*\*  $p < .01$ , two-tailed significance.



**Table 2**  
**Canonical Loadings of Exercise Imagery and Exercise Regulation Dimensions**

Variables	Canonical Loadings	
	Function 1	Function 2
Exercise Imagery		
EIQ-Appearance	.749	.651
EIQ-Technique	.882	-.469
EIQ-Energy	.629	-.276
$R_d$	12.77	2.19
Exercise Regulations		
BREQ-External	.229	.104
BREQ-Introjected	.844	.520
BREQ-Identified	.555	-.107
BREQ-Intrinsic	.543	-.757
$R_d$	7.01	1.94

*Note.* EIQ = Exercise Imagery Questionnaire. BREQ = Behavioral Regulation in Exercise Questionnaire.  $R_d$  = Redundancy Coefficient (Pedhazur, 1997).

ciation between two composite sets of variables (Tabachnick & Fidell, 2001; Thompson, 1984). The appearance, technique, and energy subscales of the EIQ formed the criterion set while the subscales of the BREQ (external, introjected, identified, and intrinsic) served as the predictor set in the  $R_c$  analysis. The overall multivariate test indicated that two significant canonical functions emerged representing a moderate degree of association between forms of imagery and exercise regulations ( $R_{c1} = .47$ ; Wilks's  $\Lambda = .706$ ,  $F(12, 391) = 4.585$ ,  $p < .01$ ;  $R_{c2} = .30$ ; Wilks's  $\Lambda = .907$ ,  $F(6, 298) = 2.469$ ,  $p < .05$ ). Consistent with previous recommendations (Cohen, 1992; Tabachnick & Fidell, 2001; Thompson, 1984), both canonical correlations emerging from this analysis exceeded the minimum acceptable value ( $R_c = |.30|$ ) for the purposes of interpretation.

Table 2 presents the canonical loadings for both canonical functions retained from the analysis. Canonical loadings represent the correlation between the original variables and their canonical variates and conceptually define the canonical variate upon which they load by providing the relative contribution of each variable to the canonical function (Tabachnick & Fidell, 2001; Thompson, 1984). Consistent with Pedhazur's (1997) recommendations, only canonical loadings exceeding  $|.30|$  were interpreted. An inspection of the first canonical function suggests that EIQ-appearance, EIQ-technique, and EIQ-energy made moderate to strong contributions to the multivariate relationship along with introjected, identified, and intrinsic exercise regulations. The observed relationship in the first canonical function suggests that more self-determined exercise regulations are associated with each type of exercise imagery given that external regulation (the least self-determined and most controlling form of extrinsic motivation) was not significantly related to this canonical function. In the second canonical function, EIQ-appearance and BREQ-introjected regulation made moderate positive contributions to the multivariate relationship in conjunction with negative contributions from both EIQ-technique and BREQ-intrinsic that were moderate in nature. The observed relationship in this second canonical function indicates that exercisers who reported higher levels of appearance imagery tend to be

motivated to exercise by more controlling motives in the form of introjected regulation and less reliant on intrinsic regulation. Redundancy coefficients (see Table 2) reflecting the amount of shared variance between the set of predictor and criterion variables indicates that both canonical functions combine to account for 14.96% of the exercise imagery variance.

## DISCUSSION

The purpose of this study was to examine the relationship between exercise regulations varying in their degree of self-determination and the type of exercise imagery reported by female exercise participants. On the basis of propositions put forth by SDT (Deci & Ryan, 1985, 2002; Ryan & Deci, 2000, 2001), it was hypothesized that controlling regulations would be associated with greater use of appearance imagery. Alternatively, more autonomous regulations in the form of identified and intrinsic reasons for exercise participation would be associated with the endorsement of greater technique and energy-related imagery. The results of this study provide mixed support for our original hypothesis. Although somewhat exploratory in nature, the results of the present study make it apparent that introjected and intrinsic regulations appear to be the most prominent exercise regulations associated with different forms of exercise imagery. Consistent with previous research in other domains (Black & Deci, 2000; Ryan & Deci, 2001), our findings suggest SDT appears to be a useful theoretical framework for examining the motivational foundations of context specific cognitions that were represented in this study by the various forms of exercise imagery expressed in the EIQ.

Consistent with previous SDT research in the physical activity domain (Kowal & Fortier, 2000; Li, 1999; Wilson et al., 2002), the results of the present investigation provide some support for the presence of a motivational continuum of exercise regulations proposed by SDT (Deci & Ryan, 1985; Ryan & Deci, 2000, 2001). The direction and magnitude of the correlations presented in Table 1 indicate that adjacent regulations along SDT's motivational continuum (e.g., identified and intrinsic) were more positively associated with one another than distal regulations (e.g., intrinsic and external). These data provide limited support for the notion that motivation is best represented by a continuum proposed within SDT as opposed to either a dichotomy or a unitary motivational index (Deci & Ryan, 1985, 2002; Koestner & Losier, 2002; Ryan & Deci, 2000, 2001). From a practical perspective, this finding is important given that various points along the continuum have been differentially associated with a broad array of motivational consequences including stage of exercise adoption (Mullen & Markland, 1997) and current exercise behavior (Wilson et al., 2002). In this regard, it seems prudent to suggest that future research interested in examining motivational issues from the perspective of SDT inspect the contributions made by each exercise regulation construct spanning the motivational continuum to the motivational consequence under study (see Koestner & Losier, 2002, for a more detailed discussion of this issue).

Results of the bivariate correlation analyses and multivariate canonical correlation analysis suggest that exercise regulations varying in the degree of perceived self-determination associated with them were differentially associated with exercise imagery. Consistent with our original hypothesis, and previous research examining cognitive and affective correlates of motivational regulations from the perspective of SDT (Deci & Ryan, 2002), the results of this study make it apparent that increasingly self-determined forms of exercise regulation were more positively associated with each type of exercise imagery expressed within the EIQ. Interestingly, an examination of the results of the univariate and multivariate analyses (see Tables 1 and 2) suggest that external regulation was not significantly associated with any form of exercise imagery. One possible practical implication stemming from these findings is that the use of imagery as an intervention tool for the promotion of exercise participation may be of limited utility

in people who only engage in exercise solely to appease socially imposed demands or alleviate external contingencies. Future research may wish to examine this proposition further and determine the cognitive and affective correlates of people who are motivated to exercise simply for externally regulated reasons.

In conjunction with the results concerning external regulation and exercise imagery, the present findings also make it apparent that introjected regulation is most strongly associated with appearance imagery. According to SDT (Deci & Ryan, 1985; Ryan & Deci, 2000, 2001), introjection represents the partial internalization of reasons regulating behavioral and psychological consequences in a given context. Previous research has shown that participatory behavior based predominantly on introjected motives is less stable over time compared with more autonomous regulations and is associated with negative thoughts and feelings while engaging in the target behavior (Ryan & Deci, 2000, 2001; Vallerand, 2001). Furthermore, research has demonstrated that persistence behavior in the exercise domain is not predicted by appearance imagery, despite the consistent finding that appearance related thoughts are the most frequently endorsed form of imagery reported by regular exercisers (Rodgers et al., 1999). It appears that one possible explanation for appearance imagery failing to predict enduring exercise behavior may be that the motivational basis underpinning such cognitions is a highly controlling form of introjected regulation.

Contrary to our original hypothesis, both controlling and autonomous forms of exercise regulation were positively associated with energy and technique imagery, suggesting that the motivational foundations of these forms of exercise imagery are best represented by a diverse array of exercise regulations. An inspection of the data presented in both Tables 1 and 2 suggest that introjected and intrinsic exercise regulations are positively associated with both technique and energy based imagery. Although not completely in line with our original hypothesis, one possible explanation for the link between introjected regulation and technique imagery is that participants may conceive this form of imagery to be an outcome of exercise participation that is reflective of their personal exercise ability. Consequently, given that frequent exercise participation is likely to be accompanied by improvements in technical skills inherent to exercising, it is plausible that people who feel compelled to exercise also feel forced to maintain or improve their technical proficiency to avoid appearing unskilled at the exercise itself. The relationship between intrinsic regulation and technique imagery was more in line with our original hypothesis. People who truly enjoy exercise for its own sake and not for any appreciable reward or instrumental benefit seem likely to think about the technical performance of the exercise itself. Furthermore, the observed relationship between energy-related imagery and both introjected and intrinsic exercise regulations seems consistent with previous research by Rodgers et al. (2001) who reported that energy imagery was a strong predictor of persistent exercise behavior in a sample of avid exercisers. It seems reasonable to contend that the motivational foundations accompanying avid exercise behavior may reside on either a compulsion to exercise in order to avoid guilt or shame, or alternatively, due to their inherent enjoyment of the physical activity itself.

Notwithstanding these findings, this study has several limitations that warrant acknowledgment and future research directions that should be identified. First, the sample providing data for the present investigation was restricted to young, physically active, university-based females. Consequently, the degree to which these findings generalize to other exercise groups (e.g., elderly, males) is unknown and awaits further investigation. Second, while this study assumed that SDT's contentions regarding the influence of regulations on patterns of cognition is correct, we did not test the causal implications of this proposition directly in the present study which was cross-sectional and correlational in nature. Future studies would do well to examine the direction of causality between exercise regulations specified within SDT (Deci & Ryan,

1985; Ryan & Deci, 2000, 2001) and motivational consequences such as exercise relevant cognitions more carefully using longitudinal and experimental designs. Finally, this study focused exclusively on the influence of motivational variables drawn from the regulatory continuum (Deci & Ryan, 1985; Ryan & Deci, 2000, 2001). Given the large amount of unexplained variance evident in the results of the canonical correlation analysis, there is clearly considerable scope for additional research that examines alternative predictors of exercise imagery. Such research may consider the inclusion of additional motivational constructs not included in the present study (e.g., perceived autonomy support, structure, involvement) but which are relevant to SDT in particular and understanding motivational processes in the exercise domain more generally (Deci & Ryan, 1985; Ryan & Deci, 2000; Williams et al., 2002). Alternatively, future research addressing the contributions of demographic considerations (e.g., age, sex, type of exercise) and psychosocial constructs outside the framework of SDT may prove useful in determining the underpinnings of exercise imagery.<sup>5</sup>

In summary, the purpose of the present study was to examine the relationship between exercise regulations that vary in self-determination and the content of exercise imagery. The results of this study suggest that different types of imagery engaged in by exercise participants are regulated by a range of regulations in a manner that is consistent with the SDT literature (Deci & Ryan, 1985; Ryan & Deci, 2000, 2001), as well as with speculations regarding the function of imagery in the exercise domain (Hall, 1995). From a practical perspective, the present findings imply that appearance related imagery, and to a lesser extent technique based imagery, reside upon dubious motivational foundations in the form of controlling introjects. Given that imagery has been demonstrated to be a powerful intervention tool in a variety of life domains (Taylor, Pham, Rivkin, & Armor, 1998), linking the content of exercise imagery to motives that have demonstrated links with behavioral persistence is a promising strategy. Collectively, these findings imply that there may be a motivational basis for the role played by imagery in exercise promotion, and future research examining the consequences of endorsing different regulations proposed by SDT appears warranted.

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5. We acknowledge the comments of a reviewer for bringing this idea to our attention.

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