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Divine, Alison; Roberts, Ross; Hall, Craig

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Alison Divine, Ross Roberts, Craig Hall

Author Note

Alison Divine, School of Kinesiology, Western University; Ross Roberts, Institute for the Psychology of Elite Performance, School of Sport, Health and Exercise Sciences, Bangor University; Craig Hall, School of Kinesiology, Western University

Correspondence concerning this article should be addressed to Alison Divine, School of Kinesiology, Western University. N6A 3K7. Email: adivine@uwo.ca

Abstract

The present study examined the relationship between exercise imagery and exercise dependence, building on the limitations of previous work that has considered exercise dependence as a single factor construct. Examining the relationship between imagery and separate exercise dependence symptoms is vital to expand what is known about exercise dependence, but also to inform interventions to address exercise dependence. A total of 339 male (n = 99) and female (n = 240) adults completed measures of exercise dependence and imagery. Structural Equation Modeling revealed that different types of imagery were related to different exercise dependence symptoms. Appearance and health imagery were positively associated with tolerance, reduction in other activities, and lack of control symptoms. Routines imagery was positively associated with intention effects, whereas technique imagery was negatively associated with intention effects. Feelings imagery was positively associated with withdrawal symptoms of exercise dependence. These differential effects highlight the importance of considering exercise dependence multidimensionally; in particular, patterns of exercise imagery use may have important implications for interventions aimed at reducing/preventing exercise dependence.

Keywords: imagery, exercise dependence, exercise, excessive

Revisiting the Exercise Imagery and Exercise Dependence Relationship

Over recent years compelling evidence has supported the psychological and physical benefits of engaging in regular exercise (Warburton, Nicol, & Bredin, 2006). While many exercisers have a strong commitment to habitual exercise and engage in appropriate levels of exercise behavior, in more extreme cases exercise can become compulsive and exercisers feel compelled to continue despite physical injuries or psychological harm (Hausenblas & Symons-Downs, 2002a). Such a negative compulsion to exercise can have harmful effects on an individual's lifestyle, including physical, social, medical and financial problems stemming from compulsive exercise behavior (Terry, Szabo, & Griffiths, 2004). This resulting maladaptive pattern of exercise behavior is most commonly referred to as exercise dependence (Hausenblas & Symons-Downs, 2002a). Exercise dependence is a craving for exercise that leads to uncontrollable excessive exercise behavior resulting in physiological and/or psychological symptoms (Hausenblas & Symon-Downs, 2002a). These symptoms are: (a) *tolerance:* the need to increase amounts of exercise to achieve the same effect, or diminishing effects with the same amount of exercise; (b) *withdrawal:* results in withdrawal symptoms such as anxiety and exercise is used to relieve/avoid withdrawal symptoms; (c) *intention effects:* exercise occurs in larger amounts than intended; (d) *loss of control*: unsuccessful efforts to reduce exercise or a persistent desire to do so; (e) *time:* a great deal of time is spent participating in exercise; (f) *reduction in other activities:* social, occupational or recreational activities are reduced or given up in order to exercise; (g) *continuance:* continue to exercise despite a known physical (e.g., injury) or psychological problem that

is caused by exercise or made worse (Hausenblas & Symons Downs, 2002a). Studies have indicated that the prevalence rate of exercise dependence among undergraduate age exercisers is as high as 45.9% (Zmijewski & Howard, 2003), but reduces to approximately 25% for older exercisers with an average age of 40 years (Weik & Hale, 2008). Exercise dependence symptoms are associated with higher psychological morbidity and addictiveness (Bamber, Cockerill, & Carroll, 2000), as well as low self-esteem, body dissatisfaction, and compulsiveness (Bamber et al., 2000; Hall, Hill, Appleton, & Kozub, 2009).

Given the negative consequences associated with exercise dependence, understanding the psychological and cognitive antecedents that underpin this construct is important. A relevant cognition associated with exercise dependence, also predicting exercise participation, is exercise imagery (Gammage, Hall, & Rodgers, 2000; Hausenblas, Hall, Rodgers, & Munroe, 1999). Imagery is the process of recreating an experience in the mind utilizing different sensory modalities to mimic real experience (White & Hardy, 1998). Hall (1995) was the first to suggest that imagery may be related to exercise dependence given there is a motivational component to both constructs. Moreover, it has been well documented that imagery is effective for changing thoughts, beliefs, and behaviors in a variety of domains (Hall, 2001; Johnson & Lutgendorf, 2002; Paivio, 1986; Taylor, Pham, Rivkin, & Armor 1998). Additionally, imagery may be a self-regulatory strategy for exercisers to enhance motivation and self-efficacy (Giaccobbi, Hausenblas, & Penfeild, 2005). A number of studies have confirmed that imagery is used frequently by exercisers and is related to exercise cognitions such as exercise intentions (Rodgers, Munroe, & Hall, 2001), self-efficacy (Cumming, 2008), the drive for

muscularity (Munroe-Chandler, Gammage & Hall, 2006), and exercise motivation (Hall, Rodgers, Wilson & Norman, 2010). Specifically, images associated with exercise technique and feeling energized were related to the drive for muscularity (Munroe-Chandler et al., 2006). Additionally, images of appearance were related to controlling forms of exercise motivation (Hall et al., 2010). Furthermore, exercise dependence is predicted by the drive for muscularity (Hale, Roth, DeLong, & Briggs, 2010), and motivational regulations (Parastatidou, Doganis, Theodorakis, & Vlachopoulos, 2014). Specifically, Parastatidou and colleagues (2014) found that exercise motivation related to feelings of self-worth or guilt for not exercising was related to all exercise dependence symptoms, except tolerance (Parastidou et al., 2014). The similarities between exercise dependence and imagery with exercise motivation highlighted in the above mentioned studies suggest that exercise imagery may play a role in the development or continuation of exercise dependence. However, despite the obvious theoretical links between imagery and exercise dependence (Edmunds, Ntoumanis, & Duda, 2006; Hall, 1995) only three studies have examined relationships between these two variables. Rodgers, Hall, Blanchard, and Munroe (2001) found that two types of imagery, namely technique (e.g., " I imagine form and body position") and energy (e.g., "To get me energized, I imagine exercising") positively predicted a total score of exercise dependence. These findings were partially replicated and extended by Hausenblas and Symons-Downs (2002b) who found that energy imagery predicted exercise dependence in both men and women, and appearance imagery (e.g.," I Imagine a leaner me from exercising") predicted exercise dependence in women only. Additionally, in a third study, energy imagery was the

strongest predictor of weightlifting dependence followed by appearance and technique imagery (Munroe-Chandler & Gammage, 2004).

Hausenblas and Symons-Downs (2002b) emphasized the importance of assessing exercise dependence as a multidimensional construct consisting of seven dimensions or factors encompassing the seven symptoms of exercise dependence. This multidimensional approach is necessary to fully understand how cognitions and behaviors might be differentially related to various components of exercise dependence. Thus, the findings of the aforementioned imagery studies were limited as they only considered exercise dependence as a single factor. More specifically, although Hausenblas and Symons-Downs (2002b) measured exercise dependence using the seven factor scale the statistical approach expressed exercise dependence as a single factor. As such, how exercise imagery influences the seven aspects of exercise dependence outlined earlier is unknown. Additionally, given recent developments in the measurement of exercise imagery, researchers have argued that five functions of exercise imagery should be considered as opposed to the three functions of technique, appearance and energy imagery that have typified much of the extant exercise imagery research (Giacobbi, Tuccitto, Buman, & Munroe-Chandler, 2010). These five functions include images about one's exercise routine (i.e., routine imagery), form and body position (i.e., technique imagery), physical appearance and health (i.e., appearance/health imagery), successfully completing a workout (i.e., self-efficacy imagery), and images about feeling relaxed and reducing stress (i.e., exercise feelings imagery). Research has indicated that these five functions of exercise imagery are differentially related to exercise behavior (Giacobbi et al., 2010).

Therefore, the purpose of the current study was to revisit the relationships between exercise dependence and exercise imagery employing more comprehensive measures to assess both these constructs than have been previously employed. Given that exercise imagery and dependence have motivational components, we expected that the motivational types of exercise imagery (appearance/health imagery, feelings imagery and self-efficacy imagery) would predict exercise dependence symptoms. Additionally, given the lack of previous empirical evidence into the relationships between the motivational imagery variables and the seven exercise dependence symptoms examined in this study, we included pathways in our SEM model to each exercise dependence symptom. With respect to the cognitive functions of imagery (routines imagery and technique imagery), we included pathways from each of these to the symptoms of intention and time effects in the model. We included these pathways in order to examine the influence of specific exercise imagery components, such as the influence of exercise technique imagery on the time one intends to exercise and the actual time that exercise lasts. Imagining specific components of a workout and exercise technique may influence the how long one intends to exercise and the time the exercise bout takes.

Methods

Participants

Participants were 339 male (n = 99) and female (n = 240) exercisers with a mean age of 24.42 years (SD = 7.56). We recruited participants from university undergraduate classes (n = 188) and from the general community (n = 151).

Measures

***Exercise Imagery*.** We used the Exercise Imagery Inventory Revised (EII-R; Giacobbi et al., 2010) to assess participants' use of exercise imagery. The EII-R assesses five types of imagery including: technique imagery (e.g., "I imagine the perfect exercise technique"), routines imagery (e.g., I imagine the order I perform my exercise activities"), appearance/health imagery (e.g., "I imagine losing weight from exercise"), self-efficacy imagery (e.g., " I imagine having the confidence to complete my workout"), and exercise feelings imagery (e.g., "I imagine being more relaxed from exercising"). Items are scored on a 7-point Likert Scale ranging from 1 (*never*) to 7 (*often*). The EII-R demonstrates good reliability, as well as, content, factorial and discriminant validity (Giacobbi et al., 2010).

Exercise Dependence. We assessed exercise dependence levels with the 21-item multidimensional Exercise Dependence Scale (Hausenblas & Symons-Downs, 2002c). The Exercise Dependence Scale measures exercise dependence symptoms including: withdrawal (e.g., "I exercise to avoid feeling irritable"), tolerance (e.g., "I continually increase my exercise duration to achieve the desired effects/benefits"), continuance (e.g., "I exercise when injured"), lack of control (e.g., I am unable to reduce how often I exercise"), reduction in other activities (e.g., "I would rather exercise than spend time with family/friends"), time (e.g., I spend most of my free time exercising"), and intention (e.g., "I exercise longer than I intend"). Each item is scored on a 6-point Likert Scale, anchored at 1 (*never)* and 6 (*always*). The Exercise Dependence Scale has demonstrated internal consistency, factorial validity, and test-retest reliability (Hausenblas & Symons-Downs, 2002c).

Procedure

Following ethical approval from the host university, we recruited participants from a large undergraduate class as well as in the general community, through postings on community electronic newsletters. Participants completed an online questionnaire containing the measures, which took approximately 15 minutes to complete.

Analysis

Previous imagery and exercise dependence research has utilized a series of regressions (Hausenblas & Symons-Downs, 2002b; Rodgers et al., 2001). While the predictive nature of this approach is informative it does not allow for a simultaneous assessment of the impact of each independent variable on the dependent variable, while taking into account intercorrelations and error variance (Kline, 2011). Thus we used SEM to overcome these issues. The use of SEM is advantageous as exercisers use multiple types of imagery (Hausenblas et al., 1999), and those who are exercise dependent score highly on at least three of the symptoms (American Psychiatric Association, 1994). As such, following the examination of a measurement model, we used SEM with Maximum Likelihood Estimation, using AMOS 22.0 (Arbuckle, 2014) to examine whether exercise imagery predicted exercise dependence. Observed variable residuals were allowed to correlate with their respective construct subscales.

When assessing model fit we used the following fit indices: the Santorra-Bentler chi-square statistic (Santorra & Bentler, 1994), the Comparative Fit Index (CFI; Bentler, 1990), the Tucker-Lewis Index (TLI; Tucker & Lewis, 1973), the Root Mean Square Error of Approximation (RMSEA; Stieger & Lind, 1980) and the Standardized Root Mean Square Residual (SRMR; Bentler, 1995). Models are deemed to have an acceptable fit with cut off values for the CFI and TLI above .900, the SRMR and RMSEA equal to

or below .080 (McDonald & Ho, 2002). With respect to the Santorra-Bentler chi-square, although a non-significant chi square ($p > .05$) indicates good model fit, recommendations suggest that the chi-square should be evaluated more subjectively as an index of fit. As such, large chi- square values relative to degrees of freedom indicate poor model fit, whereas small values indicate good model fit (Jöreskog & Sorbom, 1989).

Results

Descriptive statistics, including means, standard deviations, and scale reliabilities are presented in Table 1. Prior to evaluating the structural model, we examined a measurement model using confirmatory analytic procedures to examine the fit of the items (indicators) of the EII-R and the EDS to their hypothesized constructs (latent). All latent variables were allowed to correlate with each other and their variances were fixed to one. The measurement model (Figure 1) demonstrated a reasonable fit ($\chi^2_{(794)} =$ 1634.97, p =.000 ; CFI = .926; TLI = .916; and RMSEA = .056 and SRMR = .051). All items loaded significantly on their intended factors (.506-.963) supporting the seven factor EDS and five factor EII-R.

Given that the measurement model was validated the structural model was examined. This model with latent variables and significant pathways shown can be found in Figure 2. The model demonstrated an acceptable fit ($\chi^2_{(808)} =$1681.421, p =.000 ; CFI = .923; TLI = .914; and RMSEA = .057 and SRMR = .060).

Analysis of the standardized parameter estimates revealed that technique imagery was inversely related tp intention effects (β = -.105, p = .041) indicating that higher levels of technique imagery were associated with fewer intentions to over-exercise. Routines imager was positively related to intention effects (β = .259, p =.001) indicating that using

routines imagery is associated with more intentions to over- exercise. Feelings imagery was positively related to withdrawal symptoms (β =.487, p =.001) suggesting that images of the feelings experienced with exercise were associated with higher withdrawal symptoms. Appearance/Health imagery significantly predicted tolerance (β =.288, p =.001), lack of control (β = .148, p =.027), and reduction in other activities (β =.130, p =.052). These findings indicate that images about becoming fitter, healthier, and looing weight through exercise were associated with increased tolerance symptoms as well as reduced sense of control of exercise and participating less in other activities, such as being with family and friends. Lastly, exercise self-efficacy imagery failed to associate with exercise dependence.

Discussion

The objective of the current study was to extend previous research (Hausenblas, & Symons-Downs, 2002b; Rodgers et al., 2001) by re-examining the relationships between exercise imagery and exercise dependence employing more comprehensive measures. By examining the relationship between exercise imagery and the seven symptoms of exercise dependence the current study supported previous research but also provided unique insight into this relationship. Consistent with previous research, feelings imagery was positively related to exercise dependence (Hausenblas & Symons-Downs, 2002b; Rodgers et al., 2001). Specifically, feelings imagery was positively related to withdrawal symptoms. In fact, feelings imagery and withdrawal symptoms had the strongest relationship. This finding was intuitive, in so far as feelings imagery and withdrawal symptoms refers to the feelings associated with exercising.

Although in previous research technique imagery was found to be a positively related to of exercise dependence (Hausenblas & Symons-Downs, 2002b; Rodger et al., 2001) the present study found technique imagery to be negatively associated with intention effects. This is interesting, as it suggests that focusing on images of the specific technique may reduce the intention to over-exercise and may be a good candidate for interventions aimed at reducing exercise dependence.

In partial support of our hypothesis, routines imagery was positively related to intention effects but not time effects. It may be reasonable to expect that imagery about going through one's routine may include a time component, however, exercisers may only imagine the components of their routine, or their routine as a whole, without a sense of the overall time taken to complete the exercise session (Giacobbi, Hausenblas, Fallon, & Hall, 2003).

Previous research on the relationship between appearance imagery and exercise dependence has found equivocal results (Hausenblas & Symons-Downs, 2002b; Rodgers et al., 2001). The current study found that appearance/health imagery was significantly related to exercise dependence. Specifically, we found that appearance/health imagery positively predicted tolerance, lack of control, and reduction in other activities. This inconsistency demonstrated by previous studies may simply be because these studies considered exercise dependence as single factor resulting from the summation of the seven individual factors, thereby precluding an assessment of the subtle differences that may exist in the relationships between types of imagery and symptoms of dependence.

Lastly, self-efficacy imagery was not significantly associated with any exercise dependence symptoms. This is surprising given that self-efficacy is a strong determinant

of exercise behavior (Bauman, Reis, Sallis, Wells, Loos, & Martin, 2012). Exercisers that use self-efficacy imagery stated that the content of their images included persisting through a workout and physical discomfort (Giacobbi et al., 2003). As such we expected that self-efficacy imagery would be associated with intention effects in that exercisers who have intention symptoms persist in their workout and tend to exercise for longer than intended. However, this was not the case. Perhaps self-efficacy imagery is less relevant to exercise dependence than previously thought. The role that self-efficacy imagery plays in exercise dependence requires further investigation.

The results of the current study highlight that the relationship between imagery and exercise dependence is more complex than was thought at first. Although the majority of findings indicate that different types of imagery were positively associated with exercise dependence, technique imagery had a negative relationship with intention effects. Additionally, exercise imagery was not associated with all of the exercise dependence symptoms. These findings are important for interventions as certain types of imagery have differential roles on exercise dependence symptoms. Given the number of null findings between exercise imagery and exercise dependence, it is likely that other variables may be important, potentially moderating the relationship between exercise imagery and dependence. One potential avenue is that of motivation. Previous research has found that perceptions of motivational climate, in particular an ego–involving orientation climate (Gonzalez-Cutre & Sicilia, 2012), and more controlling (i.e., external, introjected and integrated) forms of exercise regulation positively predict exercise dependence (Gonzalez-Cutre & Sicilia, 2012). Similar relationships have also been found in imagery research. Athletes higher in ego-orientation tended to use more motivational

types of imagery (Cumming, Hall, Harwood, & Gammage, 2002). Additionally, introjected regulation was most strongly associated with appearance and energy imagery, while, technique and energy imagery were associated with intrinsic motivation (Wilson, 2003). Furthermore, the seven exercise dependence symptoms, except tolerance are positively related to introjected regulation (Parastatidou et al., 2014). As such, future research should examine the potential moderating effect of motivation between exercise imagery and exercise dependence.

An additional, and often over looked, potential moderator is personality (Roberts & Woodman, 2015). Research has demonstrated that a number of personality variables are associated with exercise dependence including: extraversion, neuroticism, agreeableness (Hausenblas & Giaccobi, 2004) and perfectionistic tendencies (Hall et al., 2009). Given the individual differences in the symptomatology of exercise dependence and in imagery use, personality may be a promising moderator in the relationship between imagery and exercise dependence. For example, certain types of imagery might be related to some types of exercise dependence only for those individuals high in perfectionism. This line of enquiry warrants further investigation. Additionally, an individual's type of passion may be an important moderator between exercise imagery and exercise dependence. Indeed research has shown that obsessive passion (i.e., an internal compulsion to engage in an activity) was positively related to all seven symptoms of exercise dependence (Paradis, Cooke, Martin, & Hall, 2013). Furthermore, Parastatidou and colleagues (2014) demonstrated that the relationship between exercise motivation and exercise dependence is mediated by passion. Specifically, obsessive passion mediated the relationship between interjected regulation and all exercise

dependence symptoms. Therefore, it is possible that an individual's type of passion may impact how the use of exercise imagery influences exercise dependence symptoms.

It is important to note limitations of the current study. The study was cross sectional in nature. Future directions should consider utilizing different methodological procedures, including longitudinal studies. Additionally, intervention studies are required to test whether certain types of imagery help to reduce exercise dependence. The current findings examined which functions of imagery predicted which exercise dependence symptoms. As such, it is possible that interventions can target the specific type of imagery associated with the specific symptoms that an exercise dependent experiences. Individuals are considered to be exercise dependent if they score a five or above on three or more symptoms. As such, each exercise dependent may have different symptoms. For instance, if individuals who are exercise dependent and score highly on symptoms of tolerance, lack of control and reductions in other activities, targeting on their use of appearance imagery may be effective. Additionally, it would be interesting to compare imagery use between those high in exercise dependence ("dependents", scoring 5 or above of 3 or more symptoms), those having moderate levels of exercise dependence ("at risk", scoring 3-4 on 3 or more symptoms) and non-exercise dependents. Differences found may inform interventions that target the at risk asymptomatic exerciser to reduce the likelihood of them becoming exercise dependent. This may be an affordable and relatively simple intervention to administer and tailor to individual exercisers experiences. Intervention possibilities are important considerations, given the potential harmful effects of exercise dependence. Additionally, assessing the content of exercise dependents imagery would be informative for interventions. If the content of appearance

images are negative images about one's body, adjusting the images to portray positive appearance images may have a beneficial impact on exercise dependence.

In the present study, the motivational functions of imagery, such as feelings and appearance imagery had a positive impact on exercise dependence symptoms. The cognitive functions demonstrated that routines imagery are associated with more intentions symptoms, however, technique imagery is associated with less intentions symptoms of exercise dependence. The patterns of exercise imagery used by exercisers may have important impact of exercise dependence symptoms.

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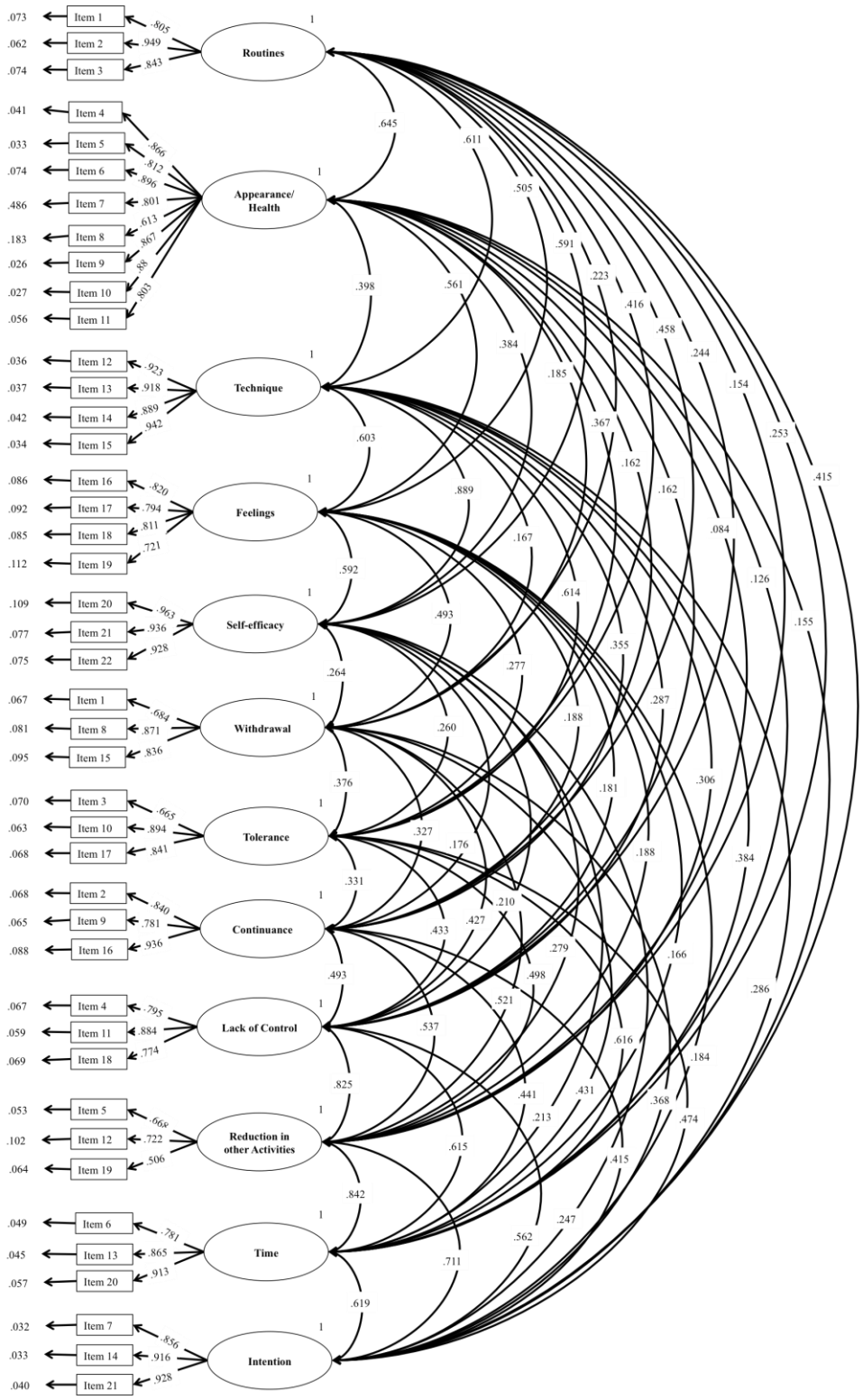
Table 1

Bivariate correlations, means and standard deviations for the exercise dependence and imagery subscales

Variables	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12
1. Withdrawal	1											
2. Continuance	.32**	1										
3. Tolerance	.41**	.65**	1									
4. Lack of Control	.38**	.46**	.47**	1								
5. Reduction in other Activities	.39**	.45**	.48**	.62**	1							
6. Time	.37**	.41**	.58**	.54**	.66**	1						
7. Intention	.31**	.39**	.50**	.51**	.57**	.57**	1					
8. Technique	.18**	.18**	.33**	.17**	.24**	.28**	.17**	1				
9. Routines	.16**	.14**	.24**	.17**	.12**	.19**	.26**	.38**	1			
10. Appearance/Health	.18**	.10	.27**	.13**	.09	.12*	.14*	.38**	.63**	1		
11. Self-efficacy	.28**	.19**	.28**	.17**	.20**	.20**	.23**	.41**	.33**	.40**	1	
12. Feelings	.45**	.17**	.28**	.16**	.15**	.17**	.18**	.39**	.34**	.46**	.61**	1
Mean	3.67	2.94	3.58	2.54	2.34	3.21	2.76	5.09	4.90	5.62	5.08	5.
SD	1.22	1.36	1.11	1.19	0.92	1.20	1.19	1.44	1.43	1.15	1.47	1.
Chronbach's Alpha	.83	.88	.84	.86	.66	.89	.93	.96	.89	.93	.85	.8

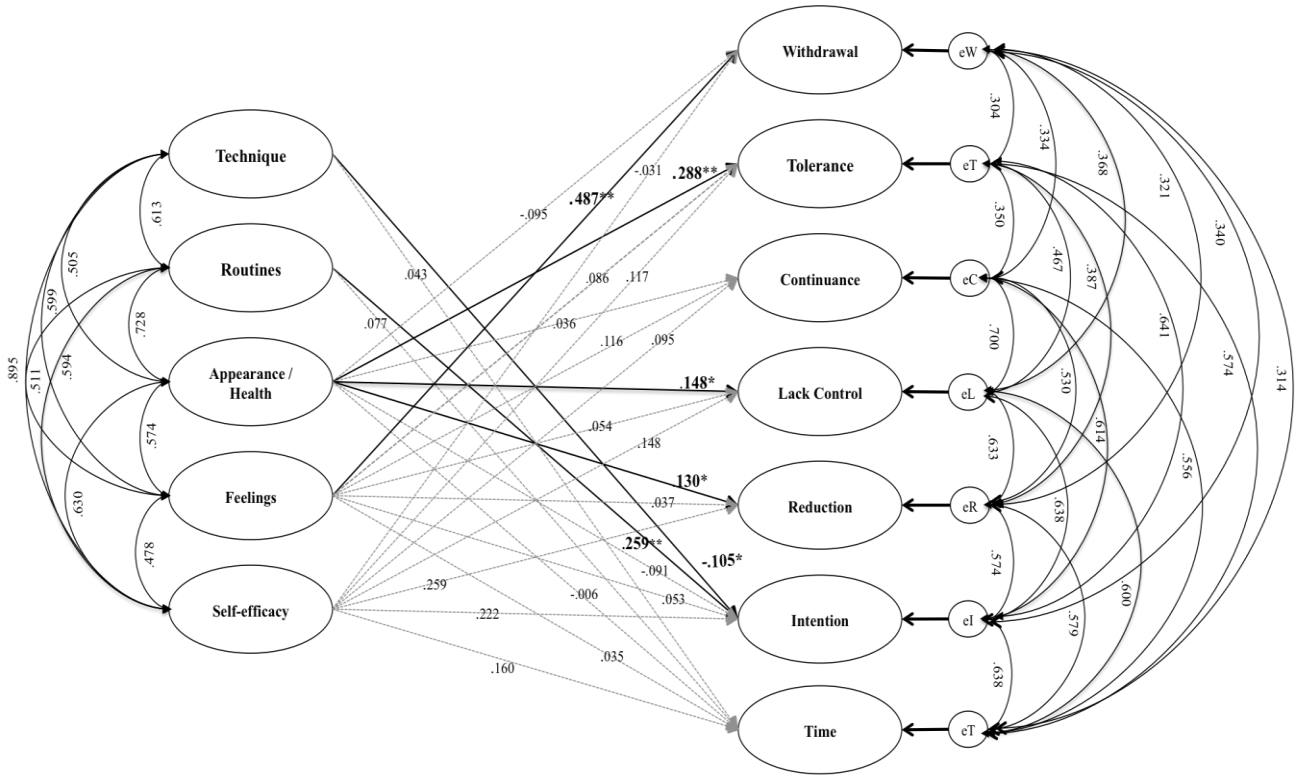
1
2

Figure 1: Measurement Model



Note: All item loadings and covariance's are significant.
Model fit: ($\chi^2_{(794)} = 1634.97$, $p = .000$; CFI = .926; TLI = .916; RMSEA = .056; SRMR = .051)

Figure 2: Structural Model



Note: * $p < 0.05$; ** $p < 0.001$; All covariance's are significant at $p < .001$. Model fit: ($\chi^2_{(808)}$=1681.42, p =.000 ; CFI = .923; TLI = .914; RMSEA = .057; SRMR = .062).