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Social physique anxiety and physical activity: A self-determination theory perspective

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ABSTRACT

Objective: Using self-determination theory [Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York, NY: Plenum Press; Ryan, R. M., & Deci, E. L. (2002). An overview of self-determination theory: an organismic-dialectical perspective. In E. L. Deci, & R. M. Ryan, (Eds.), *Handbook of self-determination research* (pp. 3–33). Rochester, NY: University of Rochester Press.] as a framework, this study examined the relationships between social physique anxiety (SPA) and physical activity-related psychological needs, motivation, and reported behavior.

Method: Three hundred and eighty one males and females ($M_{age} = 18.69$, SD = 1.15) completed a self-administered questionnaire package.

Results: Results revealed a good measurement model for the total sample ($\chi^2 = 592.52$; df = 238; RMSEA = .063; CFI = .94; SRMR = .05) and multi-group invariance indicated that the male and female measurement models were comparable. The structural model was adequate for the total sample ($\chi^2 = 638.69$; df = 243; RMSEA = .065; CFI = .94; SRMR = .06) and accounted for 36% of the variance in reported physical activity behavior. In addition, the structural model was partially gender invariant.

Conclusions: Findings supported the proposed motivational sequence in which SPA directly influenced need satisfaction, and indirectly influenced physical activity motivation and behavior. From a practical perspective, interventions aimed at decreasing SPA may be helpful in promoting physical activity motivation and behavior.

Physical activity leads to a multitude of physical, psychological, and social benefits (Fox, 1999; Warburton, Nicol, & Bredin, 2006). Despite these benefits, the majority of North Americans fail to participate in sufficient physical activity (Gilmour, 2007). Given the high prevalence of inactivity, research focusing on the factors that will increase people's motivation towards adopting and maintaining an active lifestyle is essential. Self-determination theory (SDT; Deci & Ryan, 1985; Ryan & Deci, 2002) may be a useful framework for understanding correlates of physical activity motivation and behavior.

SDT is a contemporary meta-theory that provides researchers with a greater understanding of peoples' motivation towards volitional behaviors (Ryan & Deci, 2002). The empirical basis of SDT comes in part from the organismic integration theory (OIT), a sub-theory of SDT. According to OIT, motivation is a multidimensional construct that lies on a continuum that includes intrinsic, extrinsic, and amotivated motives (Ryan & Deci, 2002). Researchers often conceptualize motivation as a relative autonomy index, whereby distinct motives are weighted to create a measure of self-determined motivation (Gagné, Ryan, & Bargmann, 2003; Ingledew, Markland, & Sheppard, 2004; Ryan & Connell, 1989). Higher levels of self-determined motivation emanate when a person's perceived locus of causality is internal and engagement in behavior is a result of a sense of volition and choice. In contrast, lower levels of self-determined motivation are seen when a person's perceived locus of causality is external and the behavior is undertaken because they feel pressured or compelled to do so, either by others or by themselves (Ryan & Deci, 2002). Consequently, higher levels of self-determination generate more positive behavioral outcomes, such as physical activity, compared to lower levels of self-determined forms of motivation (Ryan & Deci, 2000).

Another SDT sub-theory that has received growing support is basic needs theory (BNT; Ryan & Deci, 2002). Central to BNT is the assumption that individuals have three basic psychological needs, namely competence (need to interact effectively with one's environment and feel effective in producing desired outcomes), autonomy (need to experience volition and feel that one has ability to make their own decisions without feeling controlled), and

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relatedness (need to feel connected to others), that are innate, universal, and fundamental for their well-being (Deci & Ryan, 1985; Ryan & Deci, 2002). Researchers have specified that BNT and OIT are closely linked since the degree to which an individual is able to satisfy these basic psychological needs will influence the type and extent to which they are motivated to enact a particular behavior (Hagger & Chatzisarantis, 2008; Ryan & Deci, 2000).

There is a growing body of research in sport and exercise psychology that has provided strong evidence supporting SDT's sub-theories (i.e., BNT, OIT) and has highlighted the value of SDT as a comprehensive motivational framework for understanding physical activity behavior. Specifically, the basic psychological needs have been linked to physical activity self-determined motivation (Edmunds, Ntoumanis, & Duda, 2006; Standage, Gillison, & Treasure, 2007; Wilson & Rodgers, 2004), and self-determined motivation has been linked to higher levels of physical activity participation (Edmunds et al., 2006; Mullen & Markland, 1997; Wilson, Rodgers, Fraser, & Murray, 2004). While these studies support the main tenets of SDT, there is a need to identify the underlying factors that influence the satisfaction of the basic psychological needs and self-determined motivation for physical activity.

Causality orientations theory (COT; Deci & Ryan, 1985), a third SDT sub-theory, is a framework that may help identify facilitating or impeding factors associated with psychological need satisfaction and motivation. According to COT, individuals interpret social cues differently and this interpretation affects the initiation and regulation of behavior. A controlled orientation is central to the COT such that social contexts that are appraised as controlling or pressuring hinder the satisfaction of the basic psychological needs, and in turn, are associated with lower self-determined motivation (Deci & Ryan, 2002). The pressures placed on young men and women to portray an ideal physique are predominant social forces in today's society (Smolak, 2004). A failure to live up to these standards, whether real or imagined, may induce thoughts and feelings that others are negatively evaluating one's physique. In this case, social physique anxiety may be experienced (SPA; Hart, Leary, & Rejeski, 1989). Subsequently, individuals who are concerned that others are or may be judging their physiques negatively (i.e., SPA) may feel pressured by society's ideals to engage in physical activity to enhance their physique and decrease the chances of negative evaluations. In support of this contention, Ryan and Connell (1989) suggested that engaging in a behavior to avoid negative feelings about oneself or because one is concerned about others' approval is a common form of internal control. From this perspective, SPA may be an internal source of controlling influence that likely undermines physical activity motivation via its impact on the basic psychological needs.

Though a tenable hypothesis, past research on the relationship between SPA and physical activity motivation and behavior has been limited in scope. Research has failed to address the underlying psychological processes that may explain the equivocal relationships observed between SPA and physical activity motivation and behavior (see Hausenblas, Brewer, & Van Raalte, 2004). Nonetheless, there has been preliminary work grounded in SDT by Thogersen-Ntoumani and Ntoumanis (2006, 2007) that has demonstrated negative links between SPA and perceptions of competence, autonomy, relatedness, and self-determined motivation. While these studies examined SPA as an outcome, the cross-sectional design and statistical analyses employed do not exclude the possibility that SPA may influence motivation. In fact, the authors suggested that SPA may be a correlate of non-self-determined forms of motivation. In line with this proposition, Gillison, Standage, and Skevington (2006) reported that SPA was a positive correlate of extrinsic goals, which in turn negatively predicted self-determined motivation. However, Gillison et al. (2006) did not test whether the psychological needs mediate the relationship between SPA and motivation. Research exploring the indirect influence of SPA on motivation through the basic psychological needs would therefore expand on the current literature and extend Deci and Ryan's (2000) proposition that controlling factors indirectly influence motivation.

Thus, the main purpose of this study was to examine the motivational sequence proposed by SDT by exploring the relationships between SPA, the basic psychological needs, motivation, and behavior within the physical activity domain. Since the current study included males and females, a secondary aim was to test the measurement and structural invariance of this model across gender. This was deemed important given Ryan and Deci's (2002) universality hypothesis which suggests that the constructs embedded in SDT should hold the same meaning and the processes should not differ across gender. Between-group gender differences in latent means were also examined given the known mean-level gender differences on several of the variables under study (e.g., Hart et al., 1989; Ntoumanis, 2005).

Based on theoretical assumptions (Deci & Ryan, 2000; Ryan & Deci, 2002) and empirical findings (e.g., Ntoumanis, 2005; Thogersen-Ntoumani & Ntoumanis, 2007; Wilson & Rodgers, 2004) various hypotheses were put forward. First, it was hypothesized that a negative relationship would emerge between SPA and the basic psychological needs. Second, it was anticipated that perceptions of competence, autonomy, and relatedness would be positively linked to self-determined motivation. Third, it was hypothesized that a positive relationship would be observed between self-determined motivation and physical activity. Lastly, it was predicted that the measurement and structural models would be invariant, but that there would be mean-level differences for males and females. Specifically, that males would report lower levels of SPA and relatedness, and higher levels of competence, autonomy, self-determined motivation and physical activity behavior than females.

Method

Participants and procedures

Following appropriate behavioral ethics approvals, school directors and teachers from schools in Montreal, Canada were approached for their support. Male and female students were briefed during class on the study and provided with a letter of information for their parents and appropriate consent forms. Approximately one week later, the main researcher returned to the classrooms to hand out the survey to all interested participants who provided consent. The survey was completed once during regular class time.

The final sample consisted of 381 individuals ($n = 220$ females, $n = 161$ males) ranging in age from 17 to 23 years ($M_{age} = 18.69$, $SD = 1.15$). Participants described themselves as Caucasian (70.1%, $n = 267$), Chinese (9.4%, $n = 36$), Black (8.4%, $n = 32$), West Asian (5.2%, $n = 20$), South Asian (3.7%, $n = 14$), South East Asian (2.9%, $n = 11$), Japanese (0.8%, $n = 3$), Aboriginal (0.5%, $n = 2$), Filipino (0.5%, $n = 2$), and other (9.7%, $n = 37$). Mean body mass index (BMI) suggested the sample was healthy ($BMI_{males} = 23.58\ kg/m^2$, $SD = 3.71$; $BMI_{females} = 21.84\ kg/m^2$, $SD = 3.60$; World Health Organization, 1997).

Measures

The questionnaire package contained measures assessing demographic information (i.e., gender, age, weight, height, ethnicity) and relevant valid and reliable instruments.

Social physique anxiety

The truncated 9-item Social Physique Anxiety Scale (SPAS; Martin, Rejeski, Leary, McAuley, & Bane, 1997) measures the degree of anxiety that an individual experiences when he/she perceives that others are or may be negatively evaluating his/her physique. Participants responded to items such as "It would make me uncomfortable to know others were evaluating my figure" on a 5-point Likert scale anchored at the extremes by *not at all* to *extremely* characteristic of me. Evidence for adequate internal consistency ($\alpha \geq .84$) and factorial and construct validity of the 9-item version has been demonstrated in previous studies (Martin et al., 1997; Motl & Conroy, 2000; Smith, 2004). For the main analyses, the nine items of the SPAS were parceled to create three indicators. Parceling is a common procedure that can be used with unidimensional constructs to reduce bias in estimation of structural parameters (Bandalos, 2002).

Psychological need satisfaction

The Psychological Need Satisfaction in Exercise (PNSE; Wilson, Rogers, Rodgers, & Wild, 2006) scale consists of 18 items assessing perceived competence, autonomy, and relatedness. Sample items include: "I feel that I am able to complete exercises that are personally challenging" (competence), "I feel free to exercise in my own way" (autonomy), and "I feel close to my exercise companions who appreciate how difficult exercise can be" (relatedness). Items are assessed on a 6-point Likert scale from 1 = *false* to 6 = *true*. The PNSE scale has demonstrated good construct validity and internal reliability ($\alpha \geq .90$; Wilson, Longley, Muon, Rodgers, & Murray, 2006; Wilson, Rogers, et al., 2006). For the current study, the respective items were indicators of latent variables for competence (6 items), autonomy (6 items), and relatedness (6 items) beliefs.

Motivation

The Behavioral Regulation in Exercise Questionnaire-2 (BREQ-2; Markland & Tobin, 2004) is a 19-item inventory that assesses amotivation and external, introjected, identified, and intrinsic motivation. Responses are reported on a 5-point scale anchored at the extremes by *not true for me* to *very true for me*. Researchers have supported the reliability ($\alpha \geq .75$) and validity (i.e., factorial, construct) of the BREQ-2 (Markland & Tobin, 2004; Wilson & Rodgers, 2004). The BREQ-2 was scored by computing a unidimensional index of the degree of self-determination, called the Relative Autonomy Index (RAI; Ryan & Connell, 1989). The RAI is a single score representing the overall degree of self-determination and is obtained by weighting each behavioral subscale [i.e., amotivation $\times (-3)$, external regulation $\times (-2)$, introjected regulation $\times (-1)$, identified regulation $\times (+2)$, intrinsic regulation $\times (+3)$] followed by the summing of these weighted scores. Higher scores represent higher levels of self-determined motivation. For the current study, the RAI was a manifest variable (scores were an indicator of a latent variable for motivation, the factor loading was fixed to 1.00, and the error variance was set to zero) in the model.

Physical activity behavior

The Leisure Time Exercise Questionnaire (LTEQ; Godin & Shephard, 1985) is a two-item questionnaire that assesses reported leisure physical activity behavior, which refers to "any volitional activity that results in energy expenditure undertaken during one's free time" (Sylvia-Bobiak & Caldwell, 2006, p. 75). The first item (LTEQ1) measures the amount of weekly (7-day) strenuous, moderate, and light activity engaged in excluding physical education as these activities are considered mandatory (Gillison et al., 2006) and do not occur during one's free time. A total score is calculated by multiplying the weekly frequencies of strenuous, moderate, and light activities by 9, 5, and 3 respectively, which provides a total metabolic equivalent intensity level. The second item (LTEQ2) is a frequency score of regular activity during a typical 7-day period that results in a fast heartbeat and sweating, and is responded on a 3-point Likert scale ranging from *often* to *never*. The test–retest reliability and concurrent validity of the LTEQ using objective measures has been documented (Kowalski, Crocker, & Kowalski, 1997; Scerpella, Tuladhar, & Kanaley, 2002). Both items from the LTEQ were indicators of a latent physical activity variable.

Data analysis

Following preliminary psychometrics and descriptive analyses, the proposed motivational sequence was tested using maximum likelihood structural equation modeling (LISREL, 8.50; Jöreskog & Sörbom, 2004). In line with the study hypotheses, a series of models were explored: (a) confirmatory analysis of the measurement model; (b) sequential analyses to test measurement invariance and latent mean differences for males and females; (c) structural modeling of the relationships among SPA, basic psychological needs, motivation, and physical activity behavior factors; and (d) structural invariance to test if the path coefficients were similar for males and females.

Following Hu and Bentler's (1999) recommendations regarding values for global model fit, the root mean square error of approximation (RMSEA; cutoff values close to .06), comparative fit index (CFI; cutoff values close to .95), and the standardized room mean squared residual (SRMR; cutoff values close to .08) were used to judge overall model fit since chi-square (χ^2) values are sensitive to sample size and often inflate Type I error (Marsh, Balla, & McDonald, 1988). Although χ^2 values were not used to assess overall model fit, the χ^2 difference test was used to evaluate whether nested models were better fitting models compared with baseline models for invariance testing since sample size is held constant. In addition, Cheung and Rensvold's (2002) criteria regarding the difference in CFI ($\triangle$CFI) between nested models was used to evaluate the invariance hypothesis ($\triangle \text{CFI} \leq |.01|$ indicates invariance).

Results

Data screening and descriptive statistics

The data were examined for patterns of missing data, potential outliers and for violations of the assumptions of multivariate analysis following the procedures outlined by Tabachnick and Fidell (2007). Given that less than 1.0% of the data were missing and no apparent pattern was evident amongst the missing data, median imputation was invoked to replace missing data for each individual case (Tabachnick & Fidell, 2007). The distributional properties of each variable suggested that the assumptions of normality, homoscedasicity, and linearity required by multivariate analyses were met. Cronbach alpha coefficients for the SPAS, PNSE, and BREQ-2 indicated that all scales had suitable internal consistency ($\alpha \geq .76$; see Table 1).

Means and standard deviations for all study variables are reported in Table 1. Participants reported low to moderate levels of SPA, moderate to high levels of psychological need satisfaction, and moderate levels of reported physical activity behavior and are consistent with previous research (Edmunds et al., 2006; Kowalski et al., 1997; Strong, Martin Ginis, Mack, & Wilson, 2006; Wilson, Longley, et al., 2006). In addition, the mean relative autonomy index (RAI) score indicated that participants tended to be moderately self-determined, which is similar than that reported previously (Gillison et al., 2006).

Main analyses

Confirmatory factor analysis (CFA) was used to verify the measurement model. Bivariate correlations among latent variables

Table 1
Scale reliability coefficients, means and standard deviations (SD) for females and males.

Scale	Range	Females ($n = 220$)			Males ($n = 161$)		
		α[a]	Mean	SD	α[a]	Mean	SD
Social physique anxiety	1–5	.89	2.94	.82	.87	2.37	.75
Basic psychological needs							
Competence	1–6	.93	4.45	1.14	.93	5.05	.92
Autonomy	1–6	.91	5.08	.96	.91	5.23	.89
Relatedness	1–6	.89	4.24	1.16	.87	4.59	1.02
RAI[b]	−15 to +15	–	6.94	4.54	–	8.13	3.98
Physical activity							
LTEQ1[c]	0–227	–	42.40	25.34	–	57.0	34.99
LTEQ2[d]	1–3	–	1.99	.73	–	2.40	.66

[a] Scale reliabilities are Cronbach's alpha coefficients.
[b] RAI is a composite score of self-determined motivation.
[c] LTEQ1 is the physical activity measure in METS.
[d] LTEQ2 is the frequency physical activity measure.

were low to moderate (see Table 2) and were generally consistent with the main hypotheses. For the total sample, and sub-samples of females and males, results indicated that all factor loadings were relatively high (>.60) and significant, with low standard errors (<.05). Fit statistics reveal good-fitting measurement models (see Table 3, Model 1a–1c for the total sample, females, and males).

Results of the multi-group analyses are displayed in Table 3 (Models 2a–2e) and indicated that the factor structure was invariant across genders, establishing measurement invariance. The test of invariant item intercepts demonstrated that female and male latent mean scores could be compared (see Table 3, Model 3). Differences in latent factor means were identified by examining the *t*-values in the Kappa matrix from the LISREL output. In addition, the standardized effect sizes for these mean-level differences were computed (Hancock, 2001) and were interpreted as small (.20), medium (.50), and large (.80). Females had significantly higher SPA ($t = 7.04$, $p < .05$, $d = .65$), and lower perceptions of competence ($t = -5.60$, $p < .05$, $d = .52$), relatedness ($t = -2.98$, $p < .05$, $d = .27$), motivation ($t = -2.71$, $p < .05$, $d = .25$) and physical activity levels ($t = -4.99$, $p < .05$, $d = .46$) compared to males.

Table 2
Correlations among social physique anxiety, the basic psychological needs, motivation, and physical activity behavior latent and manifest variables for the total sample, females and males.

Variables	1	2	3	4	5
Total sample ($N = 381$)					
1. Social physique anxiety	–				
2. Competence	−.37*	–			
3. Autonomy	−.22*	.46*	–		
4. Relatedness	−.20*	.43*	.28*	–	
5. Relative autonomy index	−.23*	.58*	.33*	.29*	–
6. Physical activity	−.21*	.60*	.27*	.30*	.58*
Female sample ($n = 220$)					
1. Social physique anxiety	–				
2. Competence	−.32*	–			
3. Autonomy	−.26*	.43*	–		
4. Relatedness	−.18*	.35*	.31*	–	
5. Relative autonomy index	−.25*	.58*	.34*	.15*	–
6. Physical activity	−.14	.60*	.23*	.22*	.59*
Male sample ($n = 161$)					
1. Social physique anxiety	–				
2. Competence	−.26*	–			
3. Autonomy	−.11	.52*	–		
4. Relatedness	−.11	.50*	.18*	–	
5. Relative autonomy index	−.11	.55*	.28*	.49*	–
6. Physical activity	−.08	.51*	.32*	.36*	.57*

*$p < .05$.

Table 3
Goodness-of-fit statistics for measurement, group invariance, and structural models for the total sample ($N = 381$), females ($n = 220$) and males ($n = 161$).

Models	χ^2	df	RMSEA	CFI	SRMR
Model 1 – Measurement model					
1a. Total sample	592.52	238	.063	.94	.05
1b. Females	526.27	238	.074	.92	.06
1c. Males	375.71	238	.060	.93	.06
Model 2 – Group invariance					
2a. Baseline	901.98	476	.069	.92	.06
2b. FL	916.61	494	.067	.92	.06
2c. FL + FV	928.04	500	.067	.92	.08
2d. FL + FV + FC	957.04	515	.067	.92	.08
2e. FL + FV + FC + U	1068.87	538	.072	.90	.09
Model 3 – Latent means					
3. FL + II + LM	945.86	512	.067	.92	.06
Model 4 – Path models					
4a. Total samples	638.69	243	.065	.94	.06
4b. Females	551.74	243	.076	.91	.07
4c. Males	384.48	243	.060	.93	.07

Note. χ^2 = Chi-square; df = degrees of freedom; RMSEA = room mean square error of approximation; CFI = confirmatory fit index; NNFI = non-normed fit index; SRMR = standardized room mean squared residual; FL = Factor loadings; FV = factor variances; FC = factor covariances; U = uniqueness; II = item intercepts: LM = latent means.

The theoretically-derived path model was tested in which SPA was a hypothesized negative correlate of the basic psychological needs, the basic psychological needs were expected to be positive correlates of motivation, and motivation was a hypothesized positive correlate of physical activity behavior. In this model, the basic psychological needs were allowed to correlate based on their complimentary and non-orthogonal nature (Hagger & Chatzisarantis, 2008; Ryan & Deci, 2002). Goodness-of-fit statistics revealed that the model reflected the data well for the total sample and gender sub-samples (see Table 3, Models 4a–4c). The standardized estimates are depicted in Fig. 1.

As further support for the hypothesized relationships, the direct and indirect effects were examined in the LISREL output. There were no significant direct effects of SPA on motivation ($\gamma = -.01$, $p > .05$) or on physical activity behavior ($\gamma = .02$, $p > .05$). The indirect effects of SPA on motivation ($\gamma = -.22$) and physical activity behavior ($\gamma = -.23$) were significant ($p < .01$). Additionally, there were no significant effects of perceptions of autonomy and relatedness on physical activity behavior ($\beta = .01$–$.07$, $p > .05$). Perceived competence had significant direct ($\beta = .39$, $p < .01$) and indirect ($\beta = .19$, $p < .01$) effects on physical activity behavior.

Gender invariance in the pattern of relationships was explored using a stepwise procedure described by Byrne (1998). A baseline model where all paths were free to be estimated for both groups was compared with a fully constrained model where all paths were set equal. Based on the χ^2 difference ($\Delta\chi^2 = 17.17$, df = 7, $p < .05$) and ΔCFI statistics (ΔCFI = .02), structural invariance was not tenable. To identify which parameters were non-invariant, constrained structural paths were freed one at a time while all remaining parameters were constrained to be invariant and the resulting χ^2 difference test was used to determine whether the relationship differed between males and females. Results of this post hoc analysis indicated that only the path from perceived relatedness to motivation ($\Delta\chi^2 = 12.88$, df = 1, $p < .001$) was significantly different for males and females, supporting partial invariance.

Discussion

Using SDT (Deci & Ryan, 1985; Ryan & Deci, 2002) as a guiding framework, the main purpose of this study was to examine

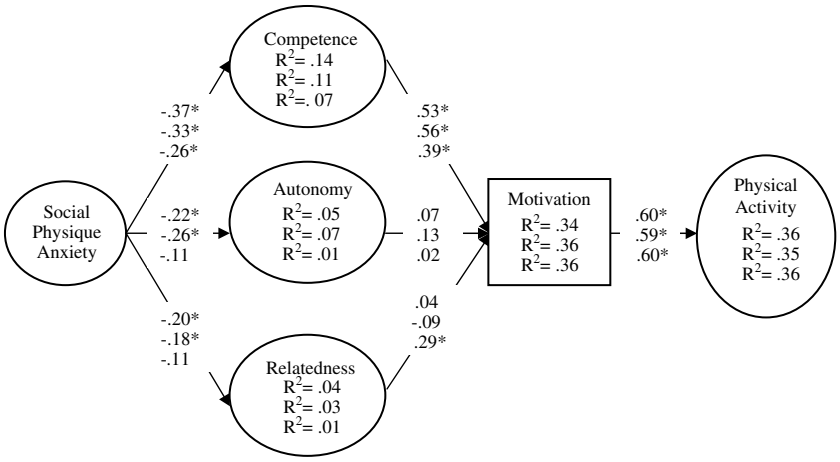

Fig. 1. Structural equation model representing the relationships between social physique anxiety, competence, autonomy, relatedness, motivation, and physical activity. Standardized coefficients are indicated for the total (top), female (middle) and male (bottom) samples. For simplicity, measurement terms are not included and the correlation between competence and autonomy ($r = .43–.52$), competence and relatedness ($r = .35–.50$), and autonomy and relatedness ($r = .18–.31$) are not shown.

a motivational model that links SPA, psychological need satisfaction, motivation, and physical activity behavior. Overall, this study provided adequate support for the proposed motivational sequence in which SPA directly influenced need satisfaction, and indirectly influenced physical activity motivation and behavior, as demonstrated by the findings of good-fitting structural model. Additionally, mean differences on the main study constructs were generally consistent with projections and gender invariance tests suggested that the male and female measurement models were similar. Finally, results provided partial support for gender invariance of the structural model.

It was hypothesized that SPA would be a negative correlate of perceived competence, autonomy, and relatedness. This first hypothesis was tenable, and supports previous research grounded in SDT (Thogersen-Ntoumani & Ntoumanis, 2007) and other theories (Kowalski, Crocker, & Kowalski, 2001; Mack, Strong, Kowalski, & Crocker, 2007). The observation of the significant direct effects of SPA on the basic psychological needs supports the notion that SPA is a controlling factor and the theoretical proposition that controlling factors hinder need satisfaction (Deci & Ryan, 2000). Also, the finding of a significant indirect effect of SPA on motivation further substantiates Ryan and Deci's (2000) proposition that an individual's motivation would not be directly influenced by controlling factors. Rather sources of controlling influence (in this case SPA) are likely to thwart need satisfaction, which would result in lower levels of self-determined motivation. While these findings highlight SPA as a salient factor that influences perceptions of competence, autonomy, and relatedness within the physical activity domain, the current findings are based on a cross-sectional design and therefore no causal inferences can be made. Given Thogersen-Ntoumani and Ntoumanis' (2006, 2007) findings that non-self-determined motivation was a positive correlate of SPA, there might be a circular process in which SPA and physical activity motivation yield a reciprocal effect over time. These possible reciprocal relationships should be examined using longitudinal studies.

In line with the second hypothesis and theoretical perspectives (Ryan & Deci, 2000), perceived competence was a significant positive correlate of self-determined motivation for physical activity. This result compares favorably with previous findings of strong links between perceptions of competence and physical activity motivation (Ferrer-Caja & Weiss, 2000; Ntoumanis, 2005; Standage, Duda, & Ntoumanis, 2006). Perceived competence was also significantly directly related to physical activity behavior. Whereas this latter finding is inconsistent with the main SDT premise, empirical findings (Sabiston & Crocker, 2008; Sallis, Prochaska, & Taylor, 2000) suggest that competence and efficacy beliefs directly influence behavior. Furthermore, SDT-based work has also shown that perceptions of competence are linked directly and indirectly to physical activity behavior (Edmunds et al., 2006). In view of the direct and indirect effects observed in the current study and in Edmunds et al.'s (2006), it appears that the physical activity domain may be a unique context where linking perceptions of competence to motivation as well as to behavior may be a better reflection of the relationships embedded in SDT.

Departing from theoretical postulation and the second hypothesis, perceived autonomy and relatedness were not significant correlates of motivation. Ryan and Deci (2002) suggest that the relative impact of perceptions of competence, autonomy, and relatedness on motivation may vary depending on the task. In particular, they believe that perceived relatedness plays a more distal role in promoting self-determined motivation. As such, some individuals are able to maintain intrinsic motivation to participate in individual-based physical activities (e.g., jogging) even though they are performed without feeling connected with others (Deci & Ryan, 2002). In support of this proposition, most findings of a positive relatedness-motivation relationship have been conducted within sport or physical education settings (Kowal & Fortier, 2000; Standage et al., 2006). These environments share common features, such that individuals are likely to have recurrent social interactions with the same people over time, they provide opportunities to learn new skills in groups, and the environments focus on individual and collective group goals (Ntoumanis, 2001). In contrast, findings of a non-significant link between relatedness and motivation, similar to the current study, have focused on exercise contexts (Edmunds et al., 2006; Wilson, Rodgers, Blanchard, & Gessell, 2003). In leisure physical activity, there are likely limited opportunities for interaction among participants and therefore little reason to expect perceptions of relatedness to influence motivation. Furthermore, the reasons underlying participation in physical education, sport, exercise, and/or leisure physical activity more generally may be regulated differently and may also partially explain the association (or lack thereof) between autonomy and motivation. Future research should focus on various physical activity contexts to determine if the relative importance of perceptions of autonomy and relatedness vary as a function of the context, and to better understand the mechanisms underlying the relationships to self-determined motivation.

In line with the third hypothesis, motivation was a significant positive correlate of leisure physical activity behavior. This finding suggests that individuals who exhibit more self-determined motivation are likely to engage in higher levels of physical activity. Previous research has consistently shown a positive link between self-determined motivation and physical activity (Edmunds et al., 2006; Mullen & Markland, 1997; Wilson & Rodgers, 2004). This finding is particularly encouraging since engaging in physical activity for intrinsic reasons (e.g., positive health benefits, enjoyment and fun), rather than extrinsic reasons (e.g., guilt, pressure, pleasing others), has been shown to be a better predictor of long-term physical activity (Mullen & Markland, 1997).

Providing support to the final hypothesis and previous studies (Hart et al., 1989; Ntoumanis, 2005), males reported significantly lower SPA and higher perceptions of competence, motivation and physical activity compared to females. In addition, the proposed motivational sequence was partially invariant, which partly substantiates the current hypothesis and Ryan and Deci's (2002) contention that the relationships between the constructs embedded within SDT should not differ across populations. However, contrary to hypothesized and existing work (Ntoumanis, 2001; Standage, Duda, & Ntoumanis, 2005), males reported significantly higher perceptions of relatedness than females, and the link between perceived relatedness and motivation was significantly different for males and females. These findings warrant more attention since relatedness is generally considered to be important for females (Smith, 1998) and prior work with females has supported relatedness as a key correlate of motivation (Kowal & Fortier, 2000). In speculation, it may be that males in the current study engaged in group-based leisure physical activities more often than their female counterparts, which is likely to increase their perceptions of connectedness to others, and, in turn, their motivation. Some evidence suggests that males are more involved in team sports that entail high levels of interdependency in their free time, while females participate in individual sports and exercises (Sallis, Zakarian, Hovell, & Hofstetter, 1996). This may be reflected in the current study, however, general activity levels were assessed rather than types of physical activity and this contention cannot be tested with the existing sample. Therefore, future work should consider the specific modes of activity (i.e., individual, group-based) to which individuals are drawn.

Additionally, it is interesting to note that while the results of the invariance analysis indicated that no other relationship significantly differed for males and females, the link between SPA and perceptions of autonomy and relatedness reached significance for females but not for males. Given that males tend to place lesser importance on perceptions of appearance than females (Muth & Cash, 1997), it is possible that the debilitating effect of SPA may be less pervasive for males, in which case they would not experience SPA as a controlling factor that undermines their perceptions of autonomy and relatedness. Unfortunately, little understanding of the relationship between SPA and psychological need satisfaction currently exists. Future research is warranted to help explain such gender differences on the relationships between SPA and psychological need satisfaction.

In spite of the novel findings presented in this study, there are limitations associated with this work. First, the use of a convenience sample of volunteer young adults may limit the generalizability of the study findings. Future research should replicate these results with different age groups. Second, given the cross-sectional design of this study, the direction of effects cannot be inferred. Longitudinal studies should be employed to help explain the temporal relationship patterns between SPA, the basic psychological needs, motivation, and physical activity behavior. Finally, the use of the physical activity self-report may have inherent limitations (e.g., inability to recall, social desirability). To obtain accurate estimates of energy expenditure, a combination of self-report questionnaires and objective assessments would be ideal.

Despite these limitations, this study advanced theoretical propositions and suggests that SPA is a controlling factor that has a pervasive effect on perceptions of competence, autonomy, and relatedness, potentially hindering physical activity motivation and behavior. This finding is unique in providing an understanding of SPA as it related to health behaviors, since little is known about the sources influencing the relationship between SPA and motivation in the physical activity domain. Thus, SDT provides a viable framework to examine the relationships among SPA and constructs related to physical activity. Considering the current findings, it appears that intervention strategies to decrease SPA, as well as increase perceived competence and self-determined motivation, seem particularly suited to increase physical activity behavior.

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