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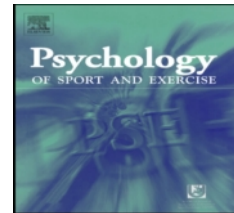
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1 Running Head: Social Physique Anxiety and Physical Activity

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

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ACCEPTED MANUSCRIPT

Abstract

1
2 *Objective:* Using self-determination theory (SDT; Deci & Ryan, 1985; Ryan & Deci, 2002) as a
3 framework, this study examined the relationships between social physique anxiety (SPA) and
4 physical activity-related psychological needs, motivation, and reported behavior. *Method:* Three
5 hundred and eighty one males and females ($M_{age} = 18.69$, $SD = 1.15$) completed a self-
6 administered questionnaire package. *Results:* Results revealed a good measurement model for the
7 total sample ($\chi^2 = 592.52$; $df = 238$; $RMSEA = .063$; $CFI = .94$; $SRMR = .05$) and multi-group
8 invariance indicated that the male and female measurement models were comparable. The
9 structural model was adequate for the total sample ($\chi^2 = 638.69$; $df = 243$; $RMSEA = .065$; $CFI =$
10 $.94$; $SRMR = .06$) and accounted for 36% of the variance in reported physical activity behavior.
11 In addition, the structural model was partially gender invariant. *Conclusions:* Findings supported
12 the proposed motivational sequence in which SPA directly influenced need satisfaction, and
13 indirectly influenced physical activity motivation and behavior. From a practical perspective,
14 interventions aimed at decreasing SPA may be helpful in promoting physical activity motivation
15 and behavior.
16 **Keywords:** competence, autonomy, relatedness, motivation, self-presentation, health

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

2 Physical activity leads to a multitude of physical, psychological, and social benefits (Fox,
3 1999; Warburton, Nicol, & Bredin, 2006). Despite these benefits, the majority of North
4 Americans fail to participate in sufficient physical activity (Gilmour, 2007). Given the high
5 prevalence of inactivity, research focusing on the factors that will increase people's motivation
6 towards adopting and maintaining an active lifestyle is essential. Self-determination theory
7 (SDT; Deci & Ryan, 1985; Ryan & Deci, 2002) may be a useful framework for understanding
8 correlates of physical activity motivation and behavior.

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

1 Another SDT sub-theory that has received growing support is basic needs theory (BNT;
2 Ryan & Deci, 2002). Central to BNT is the assumption that individuals have three basic
3 psychological needs, namely competence (need to interact effectively with one's environment
4 and feel effective in producing desired outcomes), autonomy (need to experience volition and
5 feel that one has ability to make their own decisions without feeling controlled), and relatedness
6 (need to feel connected to others) that are innate, universal, and fundamental for their well-being
7 (Deci & Ryan, 1985; Ryan & Deci, 2002). Researchers have specified that BNT and OIT are
8 closely linked since the degree to which an individual is able to satisfy these basic psychological
9 needs will influence the type and extent to which they are motivated to enact a particular
10 behavior (Hagger & Chatzisarantis, 2008; Ryan & Deci, 2000).

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

21 Causality orientations theory (COT; Deci & Ryan, 1985), a third SDT sub-theory, is a
22 framework that may help identify facilitating or impeding factors associated with psychological
23 need satisfaction and motivation. According to COT, individuals interpret social cues differently

1 and this interpretation affects the initiation and regulation of behavior. A controlled orientation is
2 central to the COT such that social contexts that are appraised as controlling or pressuring hinder
3 the satisfaction of the basic psychological needs, and in turn, are associated with lower self-
4 determined motivation (Deci & Ryan, 2002). The pressures placed on young men and woman to
5 portray an ideal physique are predominant social forces in today's society (Smolak, 2004). A
6 failure to live up to these standards, whether real or imagined, may induce thoughts and feelings
7 that individuals are negatively evaluating one's physique. In this case, social physique anxiety
8 may be experienced (SPA; Hart, Leary, & Rejeski, 1989). Subsequently, individuals who are
9 concerned that others are or may be judging their physiques negatively (i.e., SPA) may feel
10 pressured by society's ideals to engage in physical activity to enhance their physique and
11 decrease the chances of negative evaluations. In support of this contention, Ryan and Connell
12 (1989) suggested that engaging in a behavior to avoid negative feelings about oneself or because
13 one is concerned about others' approval is a common form of internal control. From this
14 perspective, SPA may be an internal source of controlling influence that likely undermines
15 physical activity motivation via its impact on the basic psychological needs.

16 Though a tenable hypothesis, past research on the relationship between SPA and physical
17 activity motivation and behavior has been limited in scope. Subsequently, research has failed to
18 address the underlying psychological processes that may explain the equivocal relationships
19 observed between SPA and physical activity motivation and behavior (see Hausenblas, Brewer,
20 & Van Raalte, 2004). Nonetheless, there has been preliminary work grounded in SDT by
21 Thogersen-Ntoumani and Ntoumanis (2006, 2007) that has demonstrated negative links between
22 SPA and perceptions of competence, autonomy, relatedness, and self-determined motivation.
23 While these studies examined SPA as an outcome, the cross-sectional design and statistical

1 analyses employed do not exclude the possibility that SPA may influence motivation. In fact, the
2 authors suggested that SPA may be a correlate of non-self-determined forms of motivation. In
3 line with this proposition, Gillison, Standage, and Skevington (2006) reported that SPA was a
4 positive correlate of extrinsic goals, which in turn negatively predicted self-determined
5 motivation. However, Gillison et al. (2006) did not test whether the psychological needs mediate
6 the relationship between SPA and motivation. Research exploring the indirect influence of SPA
7 on motivation through the basic psychological needs would therefore expand on the current
8 literature and extend Deci and Ryan's (2000) proposition that controlling factors indirectly
9 influence motivation.

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

19 Based on theoretical assumptions (Deci & Ryan, 2000; Ryan & Deci, 2002) and
20 empirical findings (e.g., Ntoumanis, 2005; Thøgersen-Ntoumani & Ntoumanis, 2007; Wilson &
21 Rodgers, 2004) various hypotheses were put forward. First, it was hypothesized that a negative
22 relationship would emerge between SPA and the basic psychological needs. Second, it was
23 anticipated that perceptions of competence, autonomy, and relatedness would be positively

1 linked to self-determined motivation. Third, it was hypothesized that a positive relationship
2 would be observed between self-determined motivation and physical activity. Lastly, it was
3 predicted that the measurement and structural models would be invariant, but that there would be
4 mean-level differences for males and females. Specifically, that males would report lower levels
5 of SPA and relatedness, and higher levels of competence, autonomy, self-determined motivation
6 and physical activity behavior than females.

7 Methods

8 *Participants and Procedures*

9 Following appropriate behavioral ethics approvals, school directors and teachers from
10 schools in [large Canadian city, withheld for review] were approached for their support. Male
11 and female students were briefed during class on the study and provided with a letter of
12 information for their parents and appropriate consent forms. Approximately one week later, the
13 main researcher returned to the classrooms to hand out the survey to all interested participants
14 who provided consent. The survey was completed once during regular class time.

15 The final sample consisted of 381 individuals ($n = 220$ females, $n = 161$ males) ranging
16 in age from 17 to 23 years ($M_{age} = 18.69$, $SD = 1.15$). Participants described themselves as
17 Caucasian (70.1%, $n = 267$), Chinese (9.4%, $n = 36$), Black (8.4%, $n = 32$), West Asian (5.2%, n
18 = 20), South Asian (3.7%, $n = 14$), South East Asian (2.9%, $n = 11$), Japanese (0.8%, $n = 3$),
19 Aboriginal (0.5%, $n = 2$), Filipino (0.5%, $n = 2$), and other (9.7%, $n = 37$). Mean-level body mass
20 index (BMI) suggested the sample was healthy ($BMI_{males} = 23.58 \text{ kg/m}^2$, $SD = 3.71$; $BMI_{females} =$
21 21.84 kg/m^2 , $SD = 3.60$; World Health Organization, 1997).

22 *Measures*

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

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

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

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

15 *Physical Activity Behavior.* The Leisure Time Exercise Questionnaire (LTEQ; Godin &
16 Shephard, 1985) is a two-item questionnaire that assesses reported leisure physical activity
17 behavior, which refers to “any volitional activity that results in energy expenditure undertaken
18 during one’s free time” (Sylvia-Bobiak & Caldwell, 2006, p. 75). The first item (LTEQ1)
19 measures the amount of weekly (7-day) strenuous, moderate, and light activity engaged in
20 excluding physical education as these activities are considered mandatory (Gillison et al., 2006)
21 and do not occur during one’s free time. A total score is calculated by multiplying the weekly
22 frequencies of strenuous, moderate, and light activities by 9, 5, and 3 respectively, which
23 provides a total metabolic equivalent intensity level. The second item (LTEQ2) is a frequency

1 score of regular activity during a typical 7-day period that results in a fast heartbeat and
2 sweating, and is responded on a 3-point Likert scale ranging from *often* to *never*. The test-retest
3 reliability and concurrent validity of the LTEQ using objective measures has been documented
4 (Kowalski, Crocker, & Kowalski, 1997; Scerpella, Tuladhar, & Kanaley, 2002). Both items from
5 the LTEQ were indicators of a latent physical activity variable.

6 *Data Analysis*

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

15 Following Hu and Bentler (1999) recommendations regarding values for global model fit,
16 the root mean square error of approximation (RMSEA; cutoff values close to .06), comparative
17 fit index (CFI; cutoff values close to .95), and the standardized root mean squared residual
18 (SRMR; cutoff values close to .08) were used to judge overall model fit since chi-square (χ^2)
19 values are sensitive to sample size and often inflate Type I error (Marsh, Balla, & McDonald,
20 1988). Although χ^2 values were not used to assess overall model fit, χ^2 difference test was used to
21 evaluate whether nested models were better fitting models compared with baseline models for
22 invariance testing since sample size is held constant. In addition, Cheung and Rensvold's (2002)

1 criteria regarding the difference in CFI (ΔCFI) between nested models was used to evaluate the
2 invariance hypothesis ($\Delta\text{CFI} \leq .01$ indicates invariance).

3 Results

4 *Data Screening and Descriptive Statistics*

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

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

20 *Main Analyses*

21 Confirmatory factor analysis (CFA) was used to verify the measurement model. Bivariate
22 correlations among latent variables were low to moderate (see Table 2) and were generally
23 consistent with the main hypotheses. For the total sample, and sub-samples of females and

1 males, results indicated that all factor loadings were relatively high ($> .60$) and significant, with
2 low standard errors ($< .05$). Fit statistics reveal good fitting measurement models (see Table 3,
3 Model 1a - 1c for the total sample, females, and males).

4 Results of the multi-group analyses are displayed in Table 3 (Models 2a - 2e) and
5 indicated that the factor structure was invariant across genders, establishing measurement
6 invariance. The test of invariant item intercepts demonstrated that female and male latent mean
7 scores could be compared (see Table 3, Model 3). Differences in latent factor means were
8 identified by examining the t -values in the Kappa matrix from the LISREL output. In addition
9 the standardized effect sizes for these mean level differences were computed (Hancock, 2001)
10 and were interpreted as small (.20), medium (.50), and large (.80). Females had significantly
11 higher SPA ($t = 7.04, p < .05, d = .65$), and lower perceptions of competence ($t = -5.60, p < .05,$
12 $d = .52$), relatedness ($t = -2.98, p < .05, d = .27$), motivation ($t = -2.71, p < .05, d = .25$) and
13 physical activity levels ($t = -4.99, p < .05, d = .46$) compared to males.

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

22 As further support for the hypothesized relationships, the direct and indirect effects were
23 examined in the LISREL output. There were no significant direct effects of SPA on motivation

1 ($\gamma = -.01, p > .05$) or on physical activity behavior ($\gamma = .02, p > .05$). The indirect effects of SPA
2 on motivation ($\gamma = -.22$) and physical activity behavior ($\gamma = -.23$) were significant ($p < .01$).
3 Additionally, there were no significant effects of perceptions of autonomy and relatedness on
4 physical activity behavior ($\beta = .01$ to $.07, p > .05$). Perceived competence had significant direct
5 ($\beta = .39, p < .01$) and indirect ($\beta = .19, p < .01$) effects on physical activity behavior.

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

16 Discussion

17 Using SDT (Deci & Ryan, 1985; Ryan & Deci, 2002) as a guiding framework, the main
18 purpose of this study was to examine a motivational model that links SPA, psychological need
19 satisfaction, motivation, and physical activity behavior. Overall, this study provided adequate
20 support for the proposed motivational sequence in which SPA directly influenced need
21 satisfaction, and indirectly influenced physical activity motivation and behavior, as demonstrated
22 by the findings of good-fitting structural model. Additionally, mean differences on the main
23 study constructs were generally consistent with projections and gender invariance tests suggested

1 that the male and female measurement models were similar. Finally, results provided partial
2 support for gender invariance of the structural model.

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

20 In line with the second hypothesis and theoretical perspectives (Ryan & Deci, 2000),
21 perceptions of competence was a significant positive correlate of self-determined motivation for
22 physical activity. This result compares favorably with previous research, which found strong
23 links between perceptions of competence and physical activity motivation (Ferrer-Caja & Weiss,

1 2000; Ntoumanis, 2005; Standage, Duda, & Ntoumanis, 2006). Perceived competence was also
2 significantly directly related to physical activity behavior. While this latter finding is inconsistent
3 with the main SDT premise, empirical findings (Sabiston & Crocker, 2008; Sallis, Prochaska, &
4 Taylor, 2000) suggest that competence and efficacy beliefs directly influence behavior.
5 Furthermore, SDT-based work has also shown that perceptions of competence are linked directly
6 and indirectly to physical activity behavior (Edmunds et al., 2006). In view of the direct and
7 indirect effects observed in the current study and in Edmunds et al.'s (2006), it appears that the
8 physical activity domain may be a unique context where linking perceptions of competence to
9 motivation as well as to behavior may be a better reflection of the relationships embedded in
10 SDT.

11 Departing from theoretical postulation and the second hypothesis, perceived autonomy
12 and relatedness were not significant correlates of motivation. Ryan and Deci (2002) suggest that
13 the relative impact of perceptions of competence, autonomy, and relatedness on motivation may
14 vary depending on the task. In particular, they believe that perceived relatedness plays a more
15 distal role in promoting self-determined motivation. As such, some individuals are able to
16 maintain intrinsic motivation to participate in individual-based physical activities (e.g., jogging)
17 even though they are performed without feeling connected with others (Deci & Ryan, 2002). In
18 support of this proposition, most findings of a positive relatedness-motivation relationship have
19 been conducted within sport or physical education settings (Kowal & Fortier, 2000; Standage et
20 al., 2006). These environments share common features, such that individuals are likely to have
21 recurrent social interactions with the same people over time, they provide opportunities to learn
22 new skills in groups, and the environments focus on individual and collective group goals
23 (Ntoumanis, 2001). In contrast, findings of a non-significant link between relatedness and

1 motivation, similar to the current study, have focused on exercise contexts (Edmunds et al.,
2 2006; Wilson, Rodgers, Blanchard, & Gessell, 2003). In leisure physical activity, there are likely
3 limited opportunities for interaction among participants and therefore little reason to expect
4 perceptions of relatedness to influence motivation. Furthermore, the reasons underlying
5 participation in physical education, sport, exercise, and/or leisure physical activity more
6 generally may be regulated differently and may also partially explain the association (or lack
7 thereof) between autonomy and motivation. Future research should focus on various physical
8 activity contexts to determine if the relative importance of perceptions of autonomy and
9 relatedness vary as a function of the context, and to better understand the mechanisms underlying
10 the relationships to self-determined motivation.

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

20 Providing support to the final hypothesis and previous studies (Hart et al., 1989;
21 Ntoumanis, 2005), males reported significantly lower SPA and higher perceptions of
22 competence, motivation and physical activity compared to females. In addition, the proposed
23 motivational sequence was partially invariant, which partly substantiates the current hypothesis

1 and Ryan and Deci's (2002) contention that the relationships between the constructs embedded
2 within SDT should not differ across populations. However, contrary to hypothesized and existing
3 work (Ntoumanis, 2001; Standage, Duda, & Ntoumanis, 2005), males reported significantly
4 higher perceptions of relatedness than females, and the link between perceived relatedness and
5 motivation was significantly different for males and females. Specifically, the path from
6 relatedness to motivation was non-significant for females, but significant for males. These
7 findings warrant more attention since relatedness is generally considered to be important for
8 females (Smith, 1998) and prior work with females has supported relatedness as a key correlate
9 of motivation (Kowal & Fortier, 2000). In speculation, it may be that males in the current study
10 engaged in group-based leisure physical activities more often than their female counterparts,
11 which is likely to increase their perceptions of connectedness to others, and, in turn, their
12 motivation. Some evidence suggests that males are more involved in team sports that entail high
13 levels of interdependency in their free time, while females participate in individual sports and
14 exercises (Sallis, Zakarian, Hovell, & Hofstetter, 1996). This may be reflected in the current
15 study, however, general activity levels were assessed rather than types of physical activity and
16 this contention cannot be tested with the existing sample. Therefore, future work should consider
17 the specific modes of activity (i.e., individual, group-based) to which individuals are drawn.

18 Additionally, it is interesting to note that while the results of the invariance analysis
19 indicated that no other relationship significantly differed for males and females, the link between
20 SPA and perceptions of autonomy and relatedness reached significance for females but not for
21 males. Given that males tend to place lesser importance on perceptions of appearance than
22 females (Harter, 1999), it is possible that the debilitating effect of SPA may be less pervasive for
23 males, in which case they would not experience SPA as a controlling factor that undermines their

1 perceptions of autonomy and relatedness. Unfortunately, little understanding of the relationship
2 between SPA and psychological need satisfaction currently exists. Future research is warranted
3 to help explain such gender differences on the relationships between SPA and psychological
4 need satisfaction.

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

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

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1 Table 1

2 *Scale Reliability Coefficients, Means and Standard Deviations (SD) for Females and Males.*

Scale	Range	Females (<i>n</i> = 220)			Males (<i>n</i> = 161)		
		α^a	Mean	<i>SD</i>	α^a	Mean	<i>SD</i>
Social Physique Anxiety	9-45	.89	26.46	7.37	.87	21.32	6.73
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	-	-	-	-	-	-

3 *Note.* ^aScale reliabilities are Cronbach's alpha coefficients. ^bRAI is a composite score of self-
4 determined motivation. ^dLTEQ1 is the physical activity measure in METS. ^cLTEQ2 is the
5 frequency physical activity measure.

- 1 Table 2
- 2 *Correlations among Social Physique Anxiety, the Basic Psychological Needs, Motivation, and*
- 3 *Physical Activity Behavior Latent 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*

1 * $p < .05$.

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1 Table 3

2 *Goodness of Fit Statistics for Measurement, Group Invariance, and Structural Models for the*3 *Total Sample (N = 381), Females (n = 220) and Males (n = 161).*

Models	χ^2	<i>df</i>	<i>RMSEA</i>	<i>CFI</i>	<i>SRMR</i>
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

4 *Note.* χ^2 = Chi-square; *df* = degrees of freedom; *RMSEA* = root mean square error of5 approximation; *CFI* = confirmatory fit index; *NNFI* = non-normed fit index; *SRMR* =

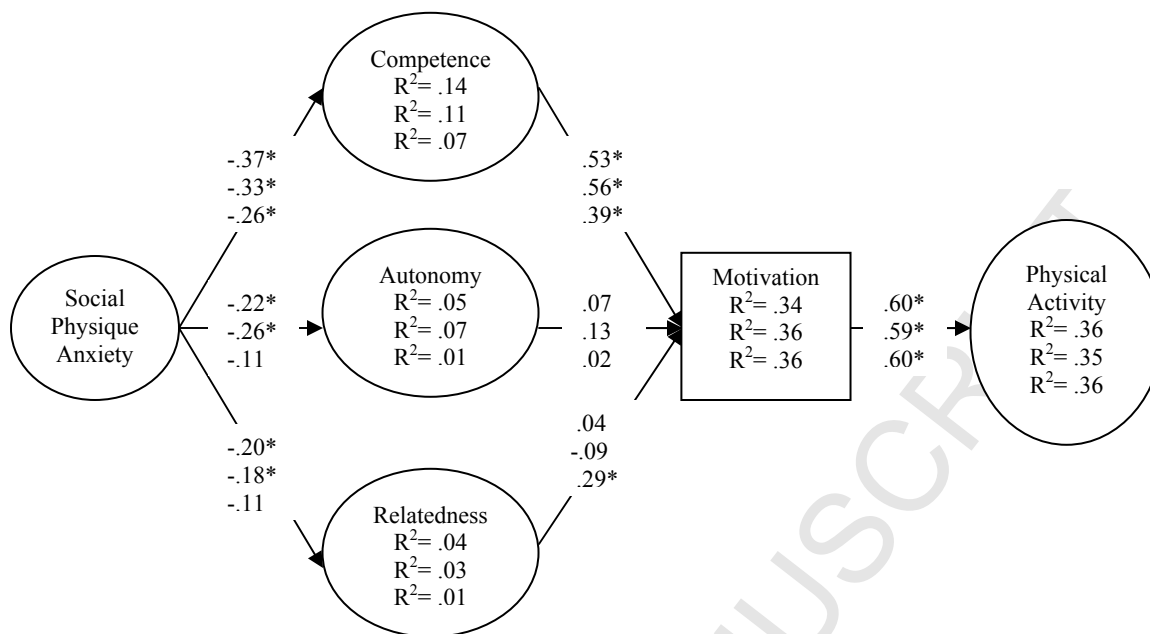
- 1 standardized root mean squared residual; FL = Factor loadings; FV = factor variances; FC =
- 2 factor covariances; U = uniqueness; Π = item intercepts; LM = latent means.

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1 Figure Caption

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

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