

Examining Combinations of Social Physique Anxiety and Motivation Regulations Using Latent Profile Analysis

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ABSTRACT

Previous research has used cluster analysis to examine how social physique anxiety (SPA) combines with motivation in physical education. This study utilized a more advanced analytic approach, latent profile analysis (LPA), to identify profiles of SPA and motivation regulations. Students in grades 9–12 ($N = 298$) completed questionnaires at two time points assessing SPA and motivation regulations, psychological needs, enjoyment, effort, and characteristics of physical education peers. LPA identified four profiles representing *Autonomous* (13.4%), *Average* (39.3%), *Low Autonomous* (25.2%), and *Autonomous and Introjected* (22.1%). Profiles were replicated at a second time point, and evidence of profile measurement invariance across gender was found. A multivariate analysis of variance (MANOVA) showed profile differences. The model-based analytic approach to identify profiles of SPA and motivation regulations differed from cluster analysis profiles. The profiles were not driven by SPA, rather autonomous motivation is the dominant factor associated with physical education motivational experiences.

KEYWORDS

adolescence; physical education; self-determination theory; social anxiety

Social physique anxiety (SPA) is feeling distressed or apprehensive about others' potential negative evaluation of one's own physical appearance (Hart, Leary, & Rejeski, 1989). The conceptualization of SPA emerged from body image and body esteem literature as well as interpersonal literature on self-presentational concern (Hart et al., 1989). Adolescents are at risk for experiencing such concerns, particularly in social settings that emphasize one's physique and abilities, such as physical education (Carlson, 1995; Crombie, Brunet, & Sabiston, 2011). SPA is of concern because it has been typically linked to a variety of negative consequences such as lower perceptions of competence and enjoyment, disordered eating, and avoidance of situations where the body might be on display (see Sabiston, Pila, Pinsonnault-Bilodeau, & Cox, 2014). However, what has been less clear is how these feelings of apprehension over the perceived negative evaluation of one's body impact physical activity experiences in contexts like physical education. Both exercising and exercise avoidance have been identified as strategies that individuals use to cope with the unpleasant feelings associated with SPA (Kowalski, Mack, Crocker, Niefer, & Fleming, 2006; Sabiston, Sedgwick, Crocker, Kowalski, & Mack, 2007). These findings help explain why SPA has demonstrated different relationship patterns with levels

of physical activity across samples (see Sabiston et al., 2014). Therefore, an examination of factors that might moderate the effects of SPA on physical activity variables in specific contexts is warranted.

Recently, the role of motivation regulations as conceptualized by self-determination theory (SDT) has been investigated as a potential moderator in the relationship between SPA and physical activity behavior—that is, past research has examined how physical activity-related indicators varied for individuals with different combinations of SPA and motivation regulations (Cox, Ullrich-French, & Sabiston, 2013). Motivation was conceptualized as the different reasons why individuals engage in physical education using an SDT framework (Ryan & Deci, 2007). SDT conceptualizes motivation as multi-dimensional and the organismic integration mini-theory outlines different reasons for engagement that fall along a continuum of self-determination ranging from purely intrinsic to increasing levels of controlling or extrinsic regulation. More controlling reasons include participating in physical education in order to gain an external reward or meet an external contingency (i.e., external regulation) or participating in order to feel better about oneself or avoid feeling shame (i.e., introjected regulation). These controlling types of motivation tend to associate with less

positive outcomes such as lower effort, enjoyment, and physical activity behavior (Ryan & Deci, 2007; Teixeira, Carraça, Markland, Silva, & Ryan, 2012). On the other hand, autonomous forms of motivation are likely to support positive physical education experiences (e.g., Cox, Smith, & Williams, 2008; Ntoumanis, 2001; Ullrich-French & Cox, 2009) and are reflected in participation for the enjoyment and satisfaction of the activity (i.e., intrinsic motivation) or because one values the activity (i.e., identified regulation).

An early investigation of SPA in a high school physical education setting using a person-centered approach (i.e., cluster analysis) showed that the relationship between SPA and different outcomes (i.e., enjoyment, behavior) depended on how it combined with motivation regulations (Cox et al., 2013). Results revealed four distinct clusters: one with relatively high levels of all motivation regulations and average SPA, one with average autonomous motivation (i.e., intrinsic motivation and identified regulation combined) and lower controlling motivation and SPA, and two clusters with students higher in SPA. One of these clusters with relatively high SPA had moderate levels of all motivation regulations whereas the other had higher external regulation and lower autonomous motivation and introjected regulation. Only students in this latter group suffered in terms of lower levels of enjoyment and effort in physical education as well as leisure-time physical activity. Therefore, understanding how SPA combines with specific motivation regulations may allow us to more accurately predict levels of engagement in physical education for those with higher SPA.

Despite the promise of the initial findings using a cluster analysis approach, there are a number of methodological limitations in the use of cluster analysis. First, the techniques used to decide on the number of clusters present within a dataset are somewhat arbitrary and inherently limited (Magidson & Vermunt, 2002; Vermunt & Magidson, 2002). Second, cluster analysis does not account for measurement error in cluster membership despite the fact that characteristics of the cluster do not align perfectly with individual participants' responses within that cluster. This is a problem because researchers often form conclusions about the individuals within a cluster without properly acknowledging and modeling the uncertainty in cluster membership (Magidson & Vermunt, 2002; Vermunt & Magidson, 2002).

Latent profile analysis (LPA) is a latent variable mixture modeling technique and although not a new analytic approach, has recently gained attention as a superior person-centered method for identifying profiles (Magidson & Vermunt, 2002; Vermunt &

Magidson, 2002). LPA has been successfully applied in other fields to examine the multi-dimensional nature of health-related constructs such as eating disorders (Mitchell et al., 2007), stress and coping (Aldridge & Roesch, 2008), and academic self-concept (Marsh, Lüdtke, Trautwein, & Morin, 2009). The two major methodological weaknesses of cluster analysis are addressed in an LPA approach (Magidson & Vermunt, 2002; Vermunt & Magidson, 2002). LPA is a model-based approach, which models the measurement error related to the uncertainty in profile membership. It assumes that underlying latent subgroups exist in a specified population and that membership can be inferred based on individual responses to a set of observed variables. Because LPA is a model-based approach, there are also several fit statistics (e.g., Bayesian information criteria [BIC]) which can help researchers determine the number of profiles that best represent the data, and compare the relative and overall fit of the model to the data. See Muthen (2001) for a more detailed overview of the LPA model. Given the importance of better understanding how different combinations of SPA and motivation regulations in physical education predict relevant outcomes, further research using the most methodologically rigorous approach is needed. Using a more sophisticated modeling approach to identify profiles may allow a better understanding of potential precipitating factors of the various combinations. Identifying specific antecedents that may associate with the different combinations is important to inform practical strategies for reducing negative physical education experiences. In this study, we examined two types of theoretically relevant antecedents: psychological need satisfaction and social contextual variables, neither of which has been previously examined using a person-centered profile approach.

Drawing from SDT, psychological need satisfaction has shown to be instrumental in predicting more autonomous forms of motivation (Ryan & Deci, 2007). In a physical education context, these include the need to feel competent or effective at different activities, the need to feel socially connected to one's teachers and peers, and the need to feel autonomous or that one has volition in deciding how to act. Though robust data support the relationship between psychological need satisfaction and more autonomous motivation (e.g., Standage, Duda, & Ntoumanis, 2006; Ullrich-French & Cox, 2009), we do not know how the satisfaction of specific needs may link to different combinations of SPA and motivation regulations.

The second set of potential antecedents was derived from the social evaluative aspect of SPA. By definition, individuals must perceive the potential for social

evaluation by others for SPA to manifest (Hart et al., 1989), thus the characteristics of the people within a particular setting may be relevant to the degree of SPA experienced. Several studies have found that characteristics of others (e.g., presence of men versus women) or the nature of social relationships with others who are present (e.g., parents versus peers, being around a best friend or close friends) associate with SPA. For example, young adults report greater SPA in the presence of their peers compared to their parents (Brunet & Sabiston, 2011). In another study, participants reported that they would experience less SPA when in the presence of a best friend or in the company of several friends (i.e., three or more) compared to being alone (Carron & Prapavessis, 1997). Finally, women in an exercise setting reported higher SPA in a mixed gender setting compared to an all-female setting and even higher SPA in an all-male exercise setting (Kruisselbrink, Dodge, Swanburg, & MacLeod, 2004). The same was not found for men. Thus, fluctuations in SPA associate with the characteristics of others within a particular setting. A key limitation of the current literature is that participants are often asked to imagine what they would feel in a hypothetical scenario rather than in a real-world setting they are currently experiencing. This limitation will be addressed in the present study.

In the physical education setting, limited research has explored the characteristics of others in relation to SPA. In one study, the number of close friends or presence of a best friend in one's physical education class did not predict SPA in that setting (Cox, Ullrich-French, Madonia, & Witty, 2011). The only significant social variable was peer acceptance in physical education class. The more students felt they were accepted by their peers, the less SPA they experienced. In line with exercise research, identifying characteristics of the peers one interacts with during physical education class may elucidate key correlates of SPA within this setting. Some peer characteristics that have not been explored previously, but may be relevant to the social evaluative potential of the physical education setting include gender, skill, age, as well as the familiarity of other students one is participating with during activities in physical education.

We had four specific aims in this study. First, we used latent profile analysis to identify unique combinations of SPA and motivation regulations (autonomous motivation, introjected regulation, external regulation) in physical education in order to directly compare the results with a previous investigation in which cluster analysis was used (Cox et al. 2013). Second, we extended the previous investigation by replicating the

emergent profiles identified in the first wave of data collection with data from the same students 4 months later and tested gender invariance of the profiles to provide stronger evidence of profile validity. Third, we used a classify-analyze approach to assign individuals to profiles and to examine differences on theoretically relevant variables. We examined profile differences in the outcomes of enjoyment and effort in physical education, similar to Cox et al. (2013). We extended the previous investigation by also examining differences in motivation antecedent variables including characteristics of the social group students were participating with (i.e., number of close friends, degree of familiarity of classmates, relative age, gender, skill of other students) and psychological needs (perceived competence, autonomy, and relatedness) in physical education.

Since LPA has not previously been conducted with these variables we did not know what differences might emerge when using a different analytic approach. We therefore took an exploratory approach by not starting with a pre-determined number of profiles. Based on SDT and past findings, we did however hypothesize that profiles characterized by greater autonomous motivation regardless of levels of SPA or controlling forms of motivation would predict greater effort and enjoyment in physical education. We also expected that when students experienced greater psychological need fulfillment and were more similar to (i.e., age, gender, skill level) and familiar with the students they were participating with, they would belong to a profile characterized by greater autonomous motivation and less SPA relative to other profiles.

Method

Participants and procedure

Students in grades 9–12 at a public high school were sent home with a letter detailing the study and parental consent forms after study approval was received from the Institutional Review Board. Then, those students who returned signed parent consent forms were invited to take a survey administered by one of the study authors and several research assistants that included measures of all study variables during a regularly scheduled physical education class in November. They were informed of study risks, their rights as participants, and that completing the survey indicated their assent. Students completed the same survey a second time in March of the same school year. During each quarter of the school year, students were given the opportunity to choose which activity they wanted to participate in.

Thus, at the second data collection point, students were participating in a different activity than during the first data collection and potentially with a different group of peers. Further, students were not divided by age, grade, or gender so there was great potential for the degree of homogeneity within groups to vary considerably. For this study, only those students who completed surveys at both data collection points were included in the analyses to aid in the ability to compare the solutions obtained at different time points. The sample included 298 students with an average age of 15.72 ($SD = 1.23$), 60% girls, and 86.7% White. Approximately 20% of the students were in 9th, 11th, and 12th grade, and 42% were in 10th grade.

Measures used in latent profiles

SPA. Concern and worry about others evaluating their appearance negatively within the context of physical education was assessed with a modified nine-item version of the SPA Scale (Hart et al., 1989; Martin, Rejeski, Leary, McAuley, & Bane, 1997). The item that refers to being in a bathing suit was excluded because it was not relevant in this physical education setting. The scale was modified by instructing students to respond to how true each statement was for them while participating in their current activity in physical education. An example item is “Unattractive features of my physique/figure make me nervous during this activity in physical education class.” Possible responses ranged from 1 (*not at all characteristic of me*) to 5 (*extremely characteristic of me*). Convergent and factorial validity as well as internal consistency reliability of scale scores have been supported in studies using contextualized versions of this instrument (Brunet & Sabiston, 2009; Cox et al., 2011).

Motivation regulations. Four motivation regulations (intrinsic motivation, identified regulation, introjected regulation and external regulation) or the reasons why students participated in physical education were measured with the Perceived Locus of Causality Scale (Goudas, Biddle, & Fox, 1994). The scale includes four items tapping into each regulation and students respond after the stem, “I take part in physical education class...” Responses range from 1 (*strongly disagree*) to 7 (*strongly agree*). Many physical education studies support the validity and internal consistency reliability of subscale scores (e.g., Standage et al., 2006; Ullrich-French & Cox, 2009). Consistent with our previous study (Cox et al., 2013) and due to high correlations (.84 and .77), subscale scores for intrinsic

motivation and identified regulation were averaged to create an autonomous motivation variable for the main analyses.

Profile antecedent and outcome measures

Enjoyment. The amount of fun students experienced during their current activity in physical education was measured with two items modified from the work of Scanlan, Carpenter, Schmidt, Simons, and Keeler (1993) on the sport enjoyment scale. The items were “How much do you enjoy the current activity you are doing in physical education?” and “How much fun do you have participating in your current activity in physical education?” Support for the validity and internal consistency reliability from similarly modified items has been found with a physical education sample (Ullrich-French & Cox, 2009). Correlation between these items was .71 in the current sample.

Psychological need satisfaction. Competence was assessed using a modified version of the sports competence scale (Amorose, 2003). Three items addressed how good, how much ability, and how skilled each student felt they were in their current activity in physical education. An example item is “How good do you think you are at the sport/activity you are currently doing in your physical education class?” Responses ranged from 1 (*not at all good/not much ability/not skilled*) to 5 (*very good/whole lot of ability/very skilled*). Reliability and validity evidence has been provided in college age samples (Amorose, 2003; Hollembeak & Amorose, 2005).

Autonomy was assessed with six items developed by Hollembeak and Amorose (2005) to tap into perceptions of choice and volition in the context of sport. We modified these items slightly for students’ current activity (e.g., “I have a say in what I do when participating in this sport/activity.” Responses fall on a scale ranging from 1 (*not at all true for me*) to 5 (*completely true for me*). Relatedness was measured using the 10 items from the Need for Relatedness Scale (Richer & Vallerand, 1998). Items followed the prompt of “In my relationships with my teacher and classmates in this sport/activity, I feel ...” followed by items, such as “supported,” “close to them,” “understood.” Responses fall on a 7-point scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). There is reliability and validity evidence for these measures of perceived autonomy and relatedness in a similar sample (Ullrich-French & Cox, 2009).

Social variables. Five items were developed for this study to assess students' perceptions of the characteristics of the peers in their activity group in physical education. First, "How many of your close friends are participating in your current sport/activity with you?" was asked with a response set ranging from 0 to 5 or more friends. Four items were asked about the relative composition of the other students in the current class: "Generally, the students in my group are" with the response options of 1 (*completely unknown/strangers*) to 7 (*well known to me*), "Generally the students in my group are" with response options of 1 (*much younger than me*) to 7 (*much older than me*), "With regard to how good/skilled my classmates are at this activity, generally, the students in my group are" with response options of 1 (*much worse than me*) to 7 (*much better than me*), "Generally, the students in my group are" with response options of 1 (*mostly opposite gender*) to 7 (*mostly my gender*).

Data analysis

We used LPA (Gibson, 1959; Moustaki, 1996; Vermunt & Magidson, 2002) as a person-centered analytic technique to identify profiles of students based on SPA and motivation regulations. We used this approach because LPA is a model-based approach that accounts for measurement error in the profiles and uses fit statistics to aid the selection of the profile solution that best fits the data. The observed indicators included autonomous motivation, introjected regulation, external regulation, and SPA.

We fit a series of LPA models with 1 through 6 classes, or profiles. Model identification was assessed using 1,000 sets of starting values. For model selection, we used information criteria (BIC, Akaike information criterion [AIC], and adjusted BIC) to compare models, with lower values indicating better relative fit. We also examined entropy, which ranges from 0 to 1 with numbers closer to 1 indicating improved accuracy for classifying individuals into the "correct" profile, and Lo-Mendell-Rubin likelihood ratio test (LMR-LRT; Lo, Mendell, & Rubin, 2001), which provides a test statistic to show whether a lower versus higher number profile solution is a better fit. All models were fit using MPLUS 7.11. To validate the structure of the solution we conducted the LPA with the second time point in order to compare the final solution from time one to the same sample at a second time point.

A classify-analyze approach was taken to examine whether individuals classified into profiles, based on each individual's highest probably of profile

membership, would differ on outcome and antecedent variables. Three separate multivariate analyses of variance (MANOVAs) were conducted, all using profile membership as the fixed factor and included gender and grade as covariates to examine profile differences on three sets of dependent variables of (a) psychological needs (competence, autonomy, relatedness), (b) enjoyment and effort in physical education, and (c) social contextual variables representing the activity group makeup of number of close friends, age, gender, skill, and familiarity.

Results

There were no missing data on the variables used to create profiles. There were missing data on one variable (effort), but Little's MCAR test was not significant ($\chi^2(75) = 69.24, p > .05$) therefore expectation maximization was used to impute missing data on this variable. All variables were normally distributed and the only outliers ($n = 4$) were detected on the variable effort. Analyses run with and without the outliers were nearly identical, therefore all cases were retained. There were no multivariate outliers (p mahalanobis's distance $< .001$). Internal consistency reliability ranged from $\alpha = .77-.95$ for all calculated scales (see Table 1).

The whole sample ($N = 298$) scored above the mid-point on all motivation regulation measures and roughly at the mid-point on the SPA measure (see Table 1). Students also reported moderate scores on the psychological needs and enjoyment, and relatively high on effort in physical education. For the social contextual indices, students reported having almost three close friends in their current physical education activity and scored above the midpoint on the degree to which students in their group were well known to them. The indices representing social context indicated that on average, students reported classmates were relatively similar to them in age and skill, and that students in their group tended to be more of their own gender (more similar to themselves). Correlations appear in Table 1. SPA was not related to autonomous motivation, but had small positive relationships with introjected and external regulations. SPA also was negatively correlated with psychological needs (although the correlation with autonomy was not significant) and effort in physical education, but not correlated with enjoyment. SPA also was positively correlated with relative age and skill in that those with high SPA reported classmates as older and more skilled than themselves. Those who reported that more students in their group were their own gender also reported classmates were more well known.

Table 1. Descriptive statistics, $N = 298$.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Autonomous														
2. Introjected	.61**													
3. External	-.10	.32*												
4. SPA	-.08	.13*	.22**											
5. Competence	.51**	.29**	-.10	-.27**										
6. Autonomy	.42**	.17**	-.23**	-.09	.19**									
7. Relatedness	.57**	.37**	-.07	-.12*	.39**	.36**								
8. Enjoy current	.60**	.30**	-.19**	-.03	.35**	.39**	.41**							
9. Effort	.42**	.26**	-.09	-.13*	.35**	.21**	.28**	.30**						
10. Close friends	.24**	.14*	.03	-.04	.26**	.17**	.41**	.22**	.23**					
11. Known classmates	.33**	.23**	-.01	.02	.33**	.18**	.52**	.23**	.18**	.46**				
12. Relative age	.11	.09	.09	.12*	-.10	.14*	.03	.09	.07	.11	.05			
13. Relative skill	-.07	-.10	-.01	.18**	-.36**	.01	-.11	-.01	-.11	-.01	-.02	.31**		
14. Relative gender	.33**	.14*	-.12*	-.04	.17**	.09	.21**	.19**	.17**	.06	.21**	.03	.05	
Scale	1-7	1-7	1-7	1-5	1-5	1-5	1-7	1-5	1-4	1-6	1-7	1-7	1-7	1-7
Mean (SD)	4.15 (1.57)	3.55 (1.48)	3.86 (1.57)	2.57 (.91)	3.57 (.87)	3.00 (.74)	4.22 (1.37)	3.10 (1.03)	3.39 (.72)	2.78 (1.69)	4.80 (1.55)	4.23 (1.12)	4.02 (1.20)	5.43 (1.80)
Alpha	.93	.77	.78	.86	.89	.82	.95	—	—	—	—	—	—	—

Notes. * $p < .05$, ** $p < .01$. Autonomous = autonomous motivation; Introjected = introjected regulation; External = external regulation; Effort = physical education effort; Known classmates = relative familiarity with classmates.

LPA

Models 1–6 were well identified. The AIC and adjusted BIC were lowest for the 6-profile solution suggesting this model fit the data best, but the BIC was lowest for the 4-profile solution which also supports good model fit for the 4-profile model (see Table 2 for all model fit statistics). In addition, the LMR-LRT indicates the 4-profile solution is better than 3-profile ($p < .05$) while the 5- and 6-profile solutions do not provide improved fit ($p > .05$). Although entropy was highest for the 6-profile solution (.76), the 4-profile solution was similar (.73) and was the second highest value. As a result, we carefully examined the 3-, 4-, 5-, and 6-profile models for conceptual clarity. In determining the most appropriate profile solution, it is important to balance both the statistical fit criteria with the conceptual and practical understanding of the profiles (Collins & Lanza, 2010). The additional profiles added in the 5-profile and 6-profile models did not contribute to our conceptual understanding (i.e., the added profiles were highly similar and essentially duplicated an existing profile) and because only a small proportion (less than 10%) of

the sample fell into those added profiles, we focused our model selection on the more parsimonious 3- and 4-profile models. The 4-profile model was very similar to the 3-profile model, but added an average profile that provided unique representation of both introjected and external regulations, which we believe better captured the nuances of potential motivation regulation profiles. The 4-profile solution was selected based on these conceptual reasons and overall support from the model fit statistics. To validate the structure of the selected 4-profile model, we replicated the 4-profile model with the same sample at a second time-point, four months later. All defining characteristics of the profiles were replicated, further supporting our selection of the 4-profile model.¹ The remaining analyses used the time one data.

The 4-profile model at time one is presented in Table 3 with the estimated means and standard error for each indicator for each profile based on the LPA results. The total sample estimated means are also provided to aid in interpretation of profiles. The first profile represented 13.4% of the sample and was labeled

Table 2. Model fit statistics for the LPA profile selection process.

	Number of profiles					
	1	2	3	4	5	6
HO LL	-2,046.374	-1,985.968	-1,955.996	-1,929.329	-1,916.928	-1,916.604
LL corrected	.836	1.082	1.051	1.082	1.169	1.163
AIC	4,108.748	3,997.937	3,947.991	3,904.659	3,889.855	3,879.208
BIC	4,138.325	4,045.999	4,014.539	3,989.692	3,993.374	4,001.212
n -Adjusting BIC	4,112.954	4,004.771	3,957.454	3,916.750	3,904.576	3,896.557
Max LL H1	-1,925.558	-1,925.558	-1,925.558	-1,925.558	-1,925.558	-1,925.558
Entropy	na	.665	.700	.734	.734	.761
LMR-LRT	na	116.714	57.913	51.524	23.962	19.947
p	na	.003	.002	.012	.351	.355

Note. HO LL = null log likelihood; LL corrected = log likelihood corrected.

Table 3. Latent profile means, standard error, and full sample estimated means.

	Latent profiles								Full sample (N = 298) M
	Autonomous (N = 40)		Average (N = 117)		Low Autonomous (N = 75)		Autonomous and Introjected (N = 66)		
	M	SE	M	SE	M	SE	M	SE	
Autonomous motivation	4.90	.30	4.13	.21	2.16	.16	5.78	.17	4.16
Introjected regulation	2.54	.29	3.89	.16	1.93	.16	5.37	.19	3.56
External regulation	2.13	.32	4.33	.24	3.80	.27	4.31	.21	3.86
SPA	1.94	.13	2.74	.14	2.61	.13	2.68	.12	2.57

Autonomous. This profile was characterized by higher than average autonomous motivation in combination with lower than average introjected and external regulation, and SPA. The second profile represented 39.3% of the sample and was labeled *Average* because they reported average levels of all four indicators. The third profile represented 25.2% of the sample and was labeled *Low Autonomous* because they reported lower than average levels of autonomous motivation and introjected regulation in combination with average external regulation and SPA. Finally, the fourth profile represented 22.1% of the sample and was labeled *Autonomous and Introjected*. This profile was characterized by higher than average autonomous motivation and introjected regulation in combination with relatively average levels of external regulation and SPA.

Gender invariance. To determine if the structure of the 4-profile model remained consistent across male and female students, we conducted a measurement invariance test by incorporating gender as a grouping variable. We estimated one model with profiles restricted to be equal across gender and compared the difference in log likelihood values and degrees of freedom to a freely estimated model (log likelihood difference: 3.22, *df* difference: 4). Using the *G*-squared difference test, we found evidence for measurement invariance (i.e., the structure of the 4-profile model is the same for male and female students [*G*-squared: 3.22 < 11.14, $\alpha = .05$, *df* = 4]). Although the profile structure was the same, the proportions of male and female students within each profile were different ($\chi^2(3) = 10.40$, $p < .05$) with nearly half of the girls in the *Average* profile as compared to 12% of boys. The remaining students were distributed more evenly across the *Autonomous* (17% girls, 29.5% boys), *Low Autonomous* (20% girls, 28.5% boys), and *Autonomous and Introjected* (21% girls, 30% boys) profiles, although males had generally higher representation across all profiles, except for the *Average* profile.

Profile classification. In order to examine the associations between profile membership and the variables of interest, we used a classify-analyze approach to assign participants to the profile in which he/she has the highest posterior probability (see Clogg, 1995). Posterior probabilities are produced based on the LPA model to indicate the likelihood that each individual belongs in each profile. The average posterior probabilities of membership in this study were high, ranging from .83 to .87, indicating relatively low classification error. This four-level categorical variable was used to represent profile membership in the remaining analyses.

Profile differences in psychological needs, enjoyment/effort, and social context

The MANOVA with the psychological needs of competence, autonomy, and relatedness as dependent variables was significant (Pillai's trace = .405; $F(9, 867) = 15.04$, $p < .01$, $\eta_p^2 = .14$). Grade was a significant ($p < .01$) covariate. Follow-up analyses of variance (ANOVAs) support significant differences between profiles for competence ($F(3, 289) = 28.08$, $p < .01$, $\eta_p^2 = .23$), autonomy ($F(3, 289) = 14.67$, $p < .01$, $\eta_p^2 = .13$), and relatedness ($F(3, 289) = 37.41$, $p < .01$, $\eta_p^2 = .28$). Examination of pairwise comparisons of the estimated marginal means controlling for gender and grade are reported in Table 4 with significant profile differences indicated by different superscripts. The *Autonomous* and *Autonomous and Introjected* profiles do not differ on any psychological need variable representing similarly high scores. The *Low Autonomous* profile is significantly lower than all other profiles across all psychological needs. The *Average* profile fell in-between the most adaptive and least adaptive profiles, though it did not differ from the *Autonomous and Introjected* profile on autonomy.

The MANOVA with enjoyment of current activity and effort in physical education as dependent variables was significant (Pillai's trace = .37; $F(6, 578) = 21.70$, $p < .01$, $\eta_p^2 = .18$). Gender and grade were not significant ($p > .05$). Follow-up ANOVAs support significant

Table 4. Profile estimated marginal means, standard errors, and differences based on MANOVA controlling for gender and grade.

Outcomes		Assigned profiles								Full sample (N = 295)
		Autonomous (N = 39)		Average (N = 115)		Low Autonomous (N = 75)		Autonomous and Introjected (N = 66)		
		M	SE	M	SE	M	SE	M	SE	
Psychological needs	Competence	3.99 ^a	.12	3.57 ^b	.07	2.99 ^c	.09	1.04 ^a	.09	3.58
	Autonomy	3.40 ^a	.11	2.98 ^b	.07	2.60 ^c	.08	3.23 ^{ab}	.09	2.99
	Relatedness	4.88 ^a	.19	4.29 ^b	.11	3.13 ^c	.13	5.01 ^a	.14	4.23
Physical education enjoyment and effort	Enjoy current activity	3.79 ^a	.14	3.09 ^b	.08	2.23 ^c	.10	3.65 ^a	.11	3.09
	Effort	3.60 ^a	.10	3.46 ^a	.06	2.94 ^b	.08	3.68 ^a	.08	3.39
Class social context	Close friends in class	2.96 ^{ab}	.26	2.70 ^b	.16	2.24 ^b	.19	3.46 ^a	.20	2.79
	Known classmates	5.12 ^{ab}	.24	4.46 ^b	.14	4.15 ^c	.17	5.43 ^a	.18	4.80
	Relative age	4.01 ^a	.15	4.35 ^a	.09	3.99 ^a	.11	4.39 ^a	.11	4.22
	Relative skill	4.15 ^a	.18	3.91 ^a	.10	4.23 ^a	.13	3.90 ^a	.14	4.02
	Relative gender	6.33 ^a	.28	5.36 ^{bc}	.16	4.69 ^c	.20	5.93 ^{ab}	.21	5.44

Notes. Different superscripts indicate significant differences between profiles controlling for grade and gender (three cases did not report gender and were excluded); estimated marginal means are adjusted for gender and grade.

differences between profiles for enjoyment of current activity ($F(3, 289) = 45.58, p < .01, \eta_p^2 = .31$) and effort ($F(3, 289) = 18.29, p < .01, \eta_p^2 = .16$). Examination of pairwise comparisons of the estimated marginal means controlling for gender and grade are reported in Table 4 with significant profile differences indicated by different superscripts. The *Autonomous* and *Autonomous and Introjected* profiles did not differ and were higher than other profiles on all variables, except for the *Average* profile on effort in physical education. The *Low Autonomous* profile had significantly lower scores on enjoyment and effort variables compared to all other profiles. The *Average* profile had scores in-between the most adaptive and least adaptive profiles on all variables, except effort in physical education.

The MANOVA with the social contextual variables (number of close friends, how well-known classmates were, relative age, skill, and gender) as dependent variables was significant (Pillai's trace = .23; $F(15, 861) = 4.78, p < .01, \eta_p^2 = .08$). Gender and grade were significant ($p < .05$) covariates. Follow up ANOVAs support significant differences between profiles for number of close friends ($F(3, 289) = 6.82, p < .05, \eta_p^2 = .07$), how well-known classmates were ($F(3, 289) = 9.69, p < .01, \eta_p^2 = .09$), relative age ($F(3, 289) = 3.71, p < .01, \eta_p^2 = .04$), and relative gender ($F(3, 289) = 9.79, p < .01, \eta_p^2 = .09$), but not for relative skill ($F(3, 289) = 1.71, p > .05, \eta_p^2 = .02$). Examination of pairwise comparisons of the estimated marginal means controlling for gender and grade are reported in Table 4 with significant profile differences indicated by different superscripts. The *Autonomous* and *Autonomous and Introjected* profiles did not differ and represented more familiar and similar social contextual perceptions. Those in the *Low Autonomous* profile had more opposite gender classmates and

students were less well known in their activity group compared to all other profiles. There were no profile differences for relative skill and although univariate F test indicated a difference for relative age, no profiles emerged as significantly different in the comparison of estimated marginal means.

Discussion

The purpose of this study was to use LPA to identify unique combinations of SPA and motivation regulations in physical education. In addition, the authors examined the validity of the solution by comparing LPA solutions across two time points, tested for gender invariance, and examined profile differences on theoretically relevant outcome variables. The four profiles identified were supported at two time points and represented *Autonomous*, *Average*, *Low Autonomous*, and *Autonomous and Introjected* groups. Average SPA was similar across the groups with the exception of the *Autonomous* profile, where SPA was notably low in both absolute terms and relative to the sample mean. The *Autonomous* profile represents the most theoretically adaptive combination of motivation and SPA, yet it did not differ from the *Autonomous and Introjected* profile on key motivational outcomes or need satisfaction. Students in these two profiles reported the most positive motivational experiences in their physical education class. These findings are similar to past motivation profile research that suggests that higher controlling forms of motivation do not seem to harm motivational outcomes as long as autonomous motivation is high (Ullrich-French & Cox, 2009). Similarly, the relatively higher levels of SPA and introjected regulation in the *Autonomous and Introjected* profile did not appear to relate to negative outcomes, perhaps due to the high level of autonomous motivation. Therefore,

consistent with an earlier study (Cox et al., 2013), results suggest that autonomous motivation associates with positive outcomes in physical education irrespective of SPA levels.

Aside from the *Autonomous* profile, the three remaining profiles had similar levels of SPA yet differed across many of the outcome variables. The *Autonomous and Introjected* profile reported the most positive outcomes, followed by the *Average* profile and then the *Low Autonomous* profile. Notably, there were significant differences between all three groups on enjoyment and need satisfaction. Therefore, students who were most at-risk for negative experiences in physical education were in the *Low Autonomous* profile which was characterized by relatively low autonomous motivation and average external regulation and SPA, but scores that fall above the scale's midpoint. These findings suggest that level of autonomous motivation is a better predictor of students' experiences in physical education compared to SPA level.

The *Autonomous* profile appeared to be a rather elite profile due to representing the smallest proportion of students and a higher proportion of male students. First, the small number of students in this profile suggests that it is difficult for students to obtain such a theoretically adaptive motivation pattern that includes low levels of both forms of controlling motivation and SPA. The higher proportion of male students in this profile is consistent with research showing that boys report experiencing lower SPA (Brunet & Sabiston, 2009; Kowalski et al., 2006; Smith, 2004) and higher autonomous motivation (Brunet & Sabiston, 2009). Although the gender distribution within profiles varied, we found a similar profile structure across gender through measurement invariance testing. This indicates that these variables may combine similarly for male and female students. The research on SPA has focused more on female samples than male samples; however, there is increasing evidence to suggest that this construct is meaningful for male populations.

The LPA approach used in this study identified different profiles compared to those identified using a cluster analysis approach (Cox et al., 2013). We intentionally used the same sample and time point in order to make direct comparisons. In the LPA approach, SPA did not appear to drive profile characteristics as the average level of this variable remained relatively stable across profiles. The standard deviation of SPA for each profile indicated relatively high levels of variability (*SD* range .91–1.03) across the profiles with the exception of the *Autonomous* profile where the standard deviation was notably lower (*SD* = .45). This indicates that levels of SPA vary considerably within three of the profiles. The differences in profiles across the two analytic

approaches could in part be due to the use of fit statistics to inform model selection and the ability to account for measurement error in profile membership, which are the two major advantages to utilizing an LPA approach. This could also be a reflection of the complex and possibly non-linear relationship that SPA may have with motivation and physical activity. However, the use of a second time point to verify the profiles identified using LPA and support for gender invariance provided evidence of the validity and reliability of LPA results.

In this study, we examined the associations between specific characteristics of the peer social context and the emergent profiles. Although there are clearly limitations in the measurement of these indicators of the peer context, we found that the profiles overlapped more on the peer context variables than on psychological needs, enjoyment, or effort. This suggests greater variability in how some of these indicators may relate to the motivation and SPA profiles. The primary difference among profiles on the peer context variables was reflected in the lower level of familiarity with classmates in the *Low Autonomous* profile. Cox et al. (2011) found that in the physical education context the only peer contextual variable that predicted SPA was perceptions of acceptance by peers. The finding that familiarity of peers in the physical education context only distinguished the *Low Autonomous* group suggests a motivational relevance of how familiar and well-known peers are in the physical education setting which could provide a sense of social comfort and belonging. This is supported in the significant and positive bivariate correlations of close friends and familiarity of peers with all psychological needs, particularly with relatedness perceptions. Low to moderate positive correlations with these two peer variables and all motivation regulations, SPA, psychological needs, enjoyment, and effort in physical education further support the important role of the peer context. Interestingly, relative skill and age did not differentiate any of the profiles. Thus, it seemed that friendships and familiarity which could support social belonging were the most important social contextual variables for distinguishing the motivation profiles. To more thoroughly explore these issues stronger measures would be necessary. We created simple one-item indicators to represent relevant aspects of the social context; however, valid and reliable measures would increase the ability to draw conclusions regarding the relevance of the social context to the profiles.

Though they did not distinguish the different profiles, small positive bivariate correlations with SPA were found with relative age and skill. These correlations suggest that those who participate with peers who are

older and more skilled also experience greater SPA in physical education. Interestingly, autonomous motivation was not correlated with SPA in this sample. These findings suggest that autonomous motivation, a powerful driver of the profiles and a reflection of internalized motivation was not systematically related to SPA whereas features of the peer context that may heighten social anxiety and controlling forms of motivation do align with SPA. These findings could reflect that students with lower autonomous motivation and higher controlling motivation are more aware of, or sensitive to the features of the peer context. Whether a less adaptive social context drives low autonomous motivation or vice-versa cannot be established in this study, but deserves further exploration.

Because SPA in the physical education context associates with lower effort, avoidant behaviors, and less physical activity overall (Cox et al., 2013; Cox et al., 2011), it is vital to create a motivationally and socially comfortable environment for physical education students. Interventions in the physical education context that address issues of both motivation and social concerns are likely to be most effective in ameliorating feelings of SPA. Although some of the characteristics of the peer context may be manipulated through appropriate skill and age groupings, it may be more practical to use strategies to enhance a general sense of belonging and autonomous motivation for physical education. Future research may tease out the unique effects of manipulating peer contextual factors compared to fostering autonomous motivation.

A number of limitations should be noted in the interpretation of the current results. First, the data represent minimal diversity and generalizability. The nature of person-centered analyses leads to limited generalizability and replicability of profiles. Although the LPA approach provides a more model-driven approach with more objective criteria for making decisions, it remains an approach that is highly sensitive to the sample. Future LPA research may also be improved by utilizing a more rigorous method for classifying individuals into profiles referred to as an “inclusive approach,” which has recently been shown to improve estimates of the association between profiles and other variables of interest (Bray, Lanza, & Tan, 2014). Finally, the peer contextual items were measured in a limited way by using single item indicators without strong psychometric support. Increased precision in measuring some of the peer features would be useful in future research to bolster our understanding of characteristics of the peer physical education context. Measures with evidence supporting reliability and validity are needed

to more confidently make conclusions about specific aspects of the peer context. Ultimately, research testing manipulations of the social context or motivation will be important to determine effective strategies teachers can use to create the most adaptive physical education experience for students.

Overall, this study provided an example of using the more advanced person-centered LPA to examine SPA and motivation profiles in the physical education context. The authors were able to directly compare the results to the more limited analytic approach of cluster analysis and provide evidence of profile structure stability across time and gender. LPA did not fully replicate profiles identified using cluster analysis (Cox et al., 2013), highlighting that different analytic approaches can lead to different results. Further use of LPA in the sport and exercise psychology literature is encouraged to provide a stronger methodological approach to profile creation. Results suggest that SPA may not explain motivation profile differences in physical education experiences. Rather, the profile differences examined appear to largely reflect sensitivity to levels of autonomous motivation rather than SPA. Future research is needed to further explore the complex relationship of SPA with motivational and behavioral outcomes across samples and contexts.

Note

1. Contact the first author for the full results of the time two LPA results.

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