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Student Motivation in High School Physical Education: A Latent Profile Analysis Approach

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Guided by the principles of self-determination theory, the purpose of this study was to identify latent profiles representing high school students' motivational regulations for physical education (PE) and to model putative predictors and outcomes of profile membership. A sample of 532 Australian high school students, age 12–16 years ($M = 13.83$, $SD = 1.13$), reported their motivation for PE, perceptions of need satisfaction in PE, and effort expended in PE. Latent profile analysis revealed evidence of 3 distinct profiles that were consistent with continuum expectations outlined in self-determination theory (i.e., the moderately autonomous, moderately controlled, and highly autonomous profiles), alongside 2 profiles characterized by levels of introjected regulation that aligned with autonomous motives (i.e., the mixed motivation and amotivated profiles). Analyses also revealed that, on the whole, greater need satisfaction predicted membership of more autonomous profiles and that membership of such profiles was predictive of greater self-reported effort in PE. Analyses revealed evidence of qualitatively distinct motivation profiles that were differentially predicted by students' psychological need satisfaction and predictive of in-class effort. This study is not only the first to use latent profile analysis to explore the role of psychological need satisfaction in predicting PE motivation profiles. It also provides practical information regarding the prevalence and potential outcomes of students' motivation profiles.

Keywords: cluster, motivation profiles, person centered, psychological needs

School-based physical education (PE) classes, which are standard components of school curricula in many countries, provide numerous benefits to students. Research has shown that students' experiences in PE may predict their leisure-time physical activity outcomes (e.g., Hagger, Chatzisarantis, Culverhouse, & Biddle, 2003), academic performance outside of PE (Bailey, Armour, Kirk, Jess, Pickup, & Sandford, 2009), development of movement skills (Kalaja, Jaakkola, Liukkonen, & Digelidis, 2012), and various social and self-concept dimensions (Bailey, 2006). For these reasons, researchers have devoted considerable attention to understanding the factors that characterize (and predict) positive PE experiences (e.g., Mouratidis, Barkoukis, & Tsorbatzoudis, 2015; Ntoumanis & Standage, 2009; Rutten, Boen, Vissers, & Seghers, 2015), and with particular relevance for the present investigation, a significant proportion of this study has been directed toward studying the predictors, nature, and consequences of students' PE motivation (e.g., Owen, Smith, Lubans, Ng, & Londsdale, 2014).

According to proponents of self-determination theory (SDT; Deci & Ryan, 1985), motivation for an activity (e.g., PE) can be studied in terms of both its quality (i.e., one's motives for participation) and quantity (i.e., the strength of those motives). With respect to the notion of motivation quality, types of motivation are described in SDT along a continuum reflecting the degree to which the motive, or regulation, is "self-determined" (i.e., volitional or self-endorsed) in nature. At the most self-determined (or autonomous) end of the continuum is intrinsic motivation, which reflects involvement in an activity for its own sake, and due to the pleasure and enjoyment that it provides. Adjacent to intrinsic motivation on the continuum is integrated regulation, representing engagement in an activity because it aligns with one's sense of self and identity. Identified regulation, also regarded as autonomous in nature (albeit less so than intrinsic motivation and integrated regulation), is characterized by the pursuit of an activity because of the importance or "valuing" of the outcomes of that activity. Two remaining forms of regulation on the continuum—introjected regulation and external regulation—reflect the pursuit of an activity due to pressures imposed internally (e.g., guilt) and externally (e.g., to avoid punishment), respectively, and are (most often) regarded as controlled in nature. Finally, *amotivation* reflects an absence of intention or energy for an activity (Deci & Ryan, 1985).

In SDT, it is argued that autonomous forms of motivation are catalyzed in environments (and through social interactions) in which three psychological needs—for autonomy (i.e., the need to be the source of one's behavior and experience actions as originating from the self), competence (i.e., the need to feel effective in one's actions), and relatedness (i.e., the need to feel supported and connected to significant others)—are satisfied (Deci & Ryan, 2000). In practice, this theoretical principle indicates that "need-supportive" teaching (i.e., teacher behaviors that satisfy students' needs; e.g., Reeve & Jang, 2006) can encourage more adaptive motivational responses from those under their guidance. Research within PE contexts has substantiated these claims, showing that students' autonomous motivation for PE is fostered when they report high levels of need satisfaction (e.g., Van den Berghe, Vansteenkiste, Cardon, Kirk, & Haerens, 2014). In turn, it has also been demonstrated that stronger autonomous (relative to controlled) motivation for PE is predictive of positive outcomes both inside (e.g., objectively measured physical effort, achievement, prosocial behavior; Haerens, Aelterman, Vansteenkiste, Soenens, & Van Petegem, 2015; Mayorga-Vega, Martínez-Baena, & Viciana, 2018; Soenens, Sierens, Vansteenkiste, Dochy, & Goossens, 2012; Wang & Liu, 2007) and outside the

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classroom (e.g., greater physical self-worth, physical activity intentions; Haerens, Kirk, Cardon, De Bourdeaudhuij, & Vansteenkiste, 2010; Standage, Duda, & Ntoumanis, 2006).

Existing PE research framed by SDT has demonstrated the conceptual and practical significance of studying students' motivation. However, there are important ways through which our understanding of motivational processes in PE may be advanced. To elaborate, much of the existing work on student motivation in PE has operationalized motivation in the form of a single index (commonly referred to as a relative autonomy index [RAI] or self-determination index [SDI]), which—despite the qualitatively different properties of SDT motivational regulations—provides a single estimate of individuals' autonomous (relative to controlled) motivation (e.g., Haerens et al., 2010; Jackson, Whipp, Chua, Dimmock, & Hagger, 2013). Motivation scores derived using the RAI or SDI are then typically used to understand the variables that predict, and/or are predicted by, students' motivation for PE. Although this composite approach offers an intuitive and "user-friendly" method for operationalizing what is a complex network of constructs (i.e., motivational regulations), some researchers have recently commented that creating a single index is somewhat reductionist in nature and may obscure important information associated with the individual regulations/motives (see Chemolli & Gagné, 2014; Litalien, Morin, & McInerney, 2017). Accordingly, those researchers have presented, and encouraged other investigators to adopt, alternative methods for modeling motivational regulation data (see Chemolli & Gagné, 2014; Gagné et al., 2015; Wilson, Sabiston, Mack, & Blanchard, 2012).

One recommended modeling alternative—to this and other "variable-centered" approaches—is to consider all motivational regulations simultaneously within a "person-centered" approach. Person-centered analyses enable researchers to identify homogenous groups (or profiles) of participants according to patterns that they display across variables of interest and examine how theorized antecedents and outcomes may align with membership of those different profiles. This approach resolves a number of concerns arising within variable-centered approaches including the loss of information associated with simplified operationalization (i.e., the RAI; Litalien et al., 2017), multicollinearity when using multiple regulation subscales simultaneously (e.g., Standage, Sebire, & Loney, 2008), and the neglect of potential synergistic effects (either positive or negative) between regulations. Importantly, whereas variable-centered approaches assume that participants are drawn from a single homogeneous population, person-centered approaches recognize the existence of distinct subpopulations characterized by differences on key variables (e.g., motivation). Therefore, with respect to the study of PE motivation such an approach would enable researchers to examine the naturally occurring profiles that are apparent *across* motivational regulations outlined in SDT (rather than collapsing those regulations into a single index or examining them in isolation).

Traditionally, person-centered phenomena have been investigated using cluster analytic techniques (e.g., Aelterman, Vansteenkiste, Soenens, & Haerens, 2016; Haerens et al., 2010; Jackson, Gucciardi, & Dimmock, 2011; Wang & Biddle, 2001). However, model-based methods—such as the use of latent profile analysis (LPA)—allow for a more sophisticated approach to person-centered analysis (see Magdison & Vermunt, 2002; Meyer & Morin, 2016; Wang, Morin, Ryan, & Liu, 2016). The use of cluster analyses has been criticized for a range of reasons, including that it is too sensitive to the clustering algorithm, lacks clear guidelines for the selection of an optimal number of profiles, and relies on rigid assumptions that do not always hold with real-life data (i.e., exact assignment of individuals to a single profile, conditional independence, equality of the indicators' variances across clusters), all of which reduce the likelihood of extracting the correct number of profiles (e.g., Meyer & Morin, 2016; Morin et al., 2011; Vermunt & Magidson, 2002). The benefits of LPA over cluster analysis have been demonstrated in simulation studies in which it has been shown that latent class models outperform cluster analyses on a range of criteria, most important of which is the identification of the correct number of profiles (Magidson & Vermunt, 2002). An additional benefit of model-based approaches such as LPA is the estimation of probability-based classification, which provides an empirical estimate of classification accuracy and results in reduced misclassification in the final model. Accordingly, although previous studies applying cluster analysis provide a foundation through which investigators can study motivation profiles, the application of LPA now represents a more accurate and robust method for addressing person-centered issues.

Importantly, the application of LPA to the study of motivation in PE enables researchers to retain the defining characteristics unique to each of the motivational regulations and therefore retain more information than composite scoring approaches. Moreover, the identification of motivational profiles in PE promises to provide valuable practical insight into (a) the different motivational patterns that are observed in real-world contexts, (b) the factors that predict students' membership of a given profile, and (c) how membership of different profiles may distinguish students on outcomes of interest. With these opportunities in mind, and guided by SDT principles, our goal in this study was to use LPA to identify motivation profiles for high school students in PE and to examine predictors and outcomes of those profiles.

Recently, Wang et al. (2016) sought to establish latent profiles among Singaporean high school students using four SDT-based motivation constructs (i.e., intrinsic motivation, identified regulation, introjected regulation, and external regulation), as well as examine possible profile predictors (i.e., age, gender, and perception of PE teachers' autonomy support) and outcomes (i.e., perceived competence and physical activity intentions). Wang et al.'s analyses revealed five distinct latent motivation profiles, reflecting "moderate controlled motivation" (i.e., above sample average external regulation, average introjected regulation, below average identified regulation and intrinsic motivation); "strong controlled motivation" (i.e., above sample average external regulation, very low levels of introjected regulation and intrinsic motivation, and low levels of identified regulation); "autonomous motivation" (i.e., below average external and introjected regulation, above average identified regulation and intrinsic motivation); an "internalized regulation" profile (i.e., above average across all constructs); and a "moderate motivation" profile (i.e., average scores across all constructs).

To identify emergent profiles, Wang et al.'s analyses indicated that stronger perceptions of autonomy support from one's teacher predicted (likely) membership of relatively autonomous profiles, and in turn, that membership of these "desirable" profiles predicted greater intentions for physical activity (relative to membership in more "controlled" motivation profiles). These findings reinforced the utility of person-centered (and specifically, LPA) methods in this context, and, by successfully distinguishing students on important outcomes (e.g., physical activity intentions), demonstrate the value of investigating motivational profiles in PE.

However, further work is needed to extend the literature in this area. First, LPA studies that build on the work of Wang et al. (2016) are important for providing evidence regarding the consistency (or lack thereof) of students' PE motivation profiles across different geographical and cultural contexts. In the case of this study, we are using an Australian, as opposed to Singaporean cohort. More important than geographical considerations, although amotivation has been included in previous cluster analytic examinations of motivation (e.g., Haerens et al., 2010; Ntoumanis, 2002; Wang & Biddle, 2001), Wang et al. did not include amotivation in their profile assessment, and it remains to be seen how latent profiles, and profile characteristics, may (or may not) differ when also accounting for amotivation. Indeed, recent meta-analytic examination of the continuum structure of motivation has provided evidence to support the inclusion of amotivation within SDT (Howard, Gagné, & Bureau, 2017). Moreover, research in workplace settings has also shown that amotivation may undermine vitality and commitment, and contribute to burnout and turnover intentions (e.g., Gagné et al., 2015; Tremblay, Blanchard, Taylor, Pelletier, & Villeneuve, 2009). Finally, it is also important that we broaden our knowledge of the predictors and outcomes of latent motivation profiles, particularly with regard to psychological need satisfaction as this is a central feature of SDT that has yet to be explored in this manner. Accordingly, in this investigation, we sought to chart predictor (i.e., perceived need satisfaction) and outcome (i.e., effort expended in PE) variables that were not assessed within Wang et al.'s study, with the goal of determining how these concepts may predict (in the case of need satisfaction), or be predicted by (in the case of effort), profile membership.

Latent profile analysis is exploratory (i.e., data driven) in nature, and as a result, it is difficult to provide explicit a priori hypotheses regarding the number and nature (and consequently, correlates) of students' latent PE motivation profiles. Nonetheless, drawing from sport, education, and workplace research in which SDT-based motivational profiles have been examined (e.g., Matosic & Cox, 2014; Ullrich-French & Cox, 2009; Van den Broeck, Lens, De Witte, & Van Coillie, 2013; Vansteenkiste, Sierens, Soenens, Luyckx, & Lens, 2009), we anticipated that (a) four to six distinct latent profiles may emerge, (b) some emergent profiles would be characterized by endorsement of relatively more autonomous (with relatively low controlled) motives, (c) some emergent profiles would be characterized by relatively more controlled (with relatively low autonomous) motives, and (d) some profiles would be relatively neutral and/or mixed in nature. Consistent with previous reports (e.g., Gagné, Forest, Gilbert, Aubé, Morin, & Malorni, 2010; Vansteenkiste et al., 2009; Wang et al., 2016), we also anticipated that relatively strong perceptions of need satisfaction would predict increased likelihood of membership in "autonomous" profiles and that membership of such profiles would, in turn, predict greater self-reported effort directed toward one's PE pursuits. In contrast, we predicted that (more likely) membership of "controlled" profiles would be predicted by relatively low perceptions of need support and be predictive of relatively low levels of effort.

Methods

Participants

A total of 532 high school students (238 boys and 294 girls), aged 12–16 years ($M = 13.83$, $SD = 1.13$), were recruited from rural and metropolitan schools in Western Australia. Students were recruited from 21 classes across 17 different government and independent high schools. Class sizes ranged from 12 to 32 and were drawn from Grades 7 to 10. The average age of PE teachers was 33.76 years ($SD = 9.15$, range = 23–62).

Procedure

After we received ethical approval from the human research ethics office at the University of Western Australia (as well as from relevant educational authorities), principals of 75 government and 80 independent high schools were informed about the study through e-mail (and a follow-up phone call). If they were willing to allow their PE teachers to participate, principals were asked to share the details of the study with their relevant staff members and to invite any interested teachers to notify the lead author. In response, 21 teachers from 17 different schools agreed to participate in the study, and in-person data collection visits were organized with each school. During these visits, conducted by the lead investigator in a normally scheduled PE lesson, students were informed (in writing) about the nature of the research project and about their participant rights, before being asked to provide their informed consent and complete instruments assessing variables of interest during the last 10 min of the lesson. Prior to the visits, information sheets and passive consent forms were delivered to the parents by their sons/daughters, and parents were asked to respond if they wished to have their son/daughter excluded from the study.

Measures

Basic Psychological Need Satisfaction. Students were asked to report their basic psychological need satisfaction (in their PE class at that time) using a 15-item instrument. Perceptions of autonomy need satisfaction were measured using five items employed by Standage, Duda, and Ntoumanis (2005), following the stem "When I am in this PE class. . . " (e.g., "I feel a certain freedom in choosing what I do"). Competence need satisfaction was measured using five items from the perceived competence subscale in the intrinsic motivation inventory (Ryan, 1982; e.g., "I am satisfied with my performance in this PE class"), adapted for sport contexts by McAuley, Duncan, and Tammen (1989). Finally, relatedness need satisfaction was measured using a contextually modified version of the five-item acceptance subscale (e.g., "I feel like a valued member of the class") from the perceived relatedness scale (Richer & Vallerand, 1998). All responses were made on a 7-point scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Scores derived from these measures have demonstrated evidence of internal consistency in previous PE-based studies (e.g., Taylor, Ntoumanis, Standage, & Spray, 2010). As Cronbach's alpha has been called into question on multiple occasions (Revelle & Zinbarg, 2009; Sijtsma, 2009), we computed omega total for congeneric reliability with "*R*": .79 for autonomy, .85 for competence, and .85 for relatedness.

Motivation. Students' motivation for PE was measured using the Perceived Locus of Causality (PLOC) questionnaire (Goudas, Biddle, & Fox, 1994). The PLOC questionnaire contains five subscales—each consisting of four items—and we used the common stem, "At the moment, I take part in this PE class." Subscales represent intrinsic motivation (e.g., ". . . because it is fun"); identified regulation (e.g., ". . . because I want to learn sport skills"); introjected regulation (e.g., ". . . because it bothers me if I don't"); external regulation (e.g., ". . . because that's the rule"); and amotivation (e.g., ". . . but I can't see what I am getting out of PE"). The PLOC questionnaire does not include a subscale for assessing integrated regulation. All responses were made on a 7-point scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Previous PE-based research has demonstrated support for the validity and reliability of scores derived from the PLOC questionnaire

(Lonsdale, Sabiston, Taylor, & Ntoumanis, 2011). Omega total scores derived from these subscales in this study were .91 (intrinsic motivation), .87 (identified regulation), .79 (introjected regulation), .68 (external regulation), and .81 (amotivation).

Effort. Four items from the effort importance subscale of the intrinsic motivation inventory (IMI; Ryan, 1982) were used to measure students' perceptions of the effort that they expend in PE. Responses to items such as "I try very hard in this PE class" were scored on a 7-point scale anchored at 1 (*strongly disagree*) and 7 (*strongly agree*). Although perceptions of effort are often operationalized with five items when using this IMI subscale, our use of the four-item version was consistent with recommendations (for measurement parsimony) outlined by McAuley et al. (1989). There is well-established evidence to support the validity and reliability of IMI subscale scores (e.g., McAuley et al., 1989), and in this study, omega total derived from this four-item subscale displayed a congeneric reliability of .84.

Data Analysis

Descriptive statistics were computed using IBM Statistical Package for Social Science (SPSS), version 24 (IBM, Armonk, NY). Missing data (which comprised 0.5% of all cases) were missing completely at random; a Little chi-square test was nonsignificant, $\chi^2(1,246) = 1,320.35$, $p = .07$, and missing data were subsequently replaced using the program's single imputation function. Subsequently, standard confirmatory factor analysis measurement models were estimated for all subscales to examine the appropriateness of factor structures and generate latent variables. The parameters of these latent variables were then saved as factor scores (specified to have a mean of 0 and a *SD* of 1) and subsequently used in the LPA models. This process is necessary as current software does not allow for measurement models and LPA models to be run simultaneously. In comparison with scale scores (i.e., averages of items on a subscale), factor scores have the advantage of providing a partial control for measurement error by giving more weight to items presenting lower levels of measurement error (Kam, Morin, Meyer & Topolnytsky, 2016; Morin & Marsh, 2015; Skrondal & Laake, 2001). All measurement models and LPA models were estimated in Mplus, version 8 (Los Angeles, CA; Muthén & Muthén, 2017). These analyses also accounted for the nesting of students within classroom (i.e., under separate teachers; 17 different schools; four schools with two participating teachers) through the "type = complex" specification (Asparouhov, 2005).

Based on our expectation that four to six latent profiles would be identified, models including one through seven profiles were specified using robust maximum likelihood estimation. The means and variances of the five motivation factors were freely estimated in all profiles (Morin et al., 2011), using 10,000 random sets of start values, 300 iterations for each random start, and the 300 best solutions retained for final stage optimization (Hipp & Bauer, 2006). All models converged on well-replicated solutions. Simulation studies have found that the consistent Akaike information criterion (CAIC), the Bayesian information criterion (BIC), the sample-adjusted BIC (ABIC), and the Bootstrap Likelihood Ratio Test (BLRT) are most effective in choosing a model that best recovers the sample's true parameters (e.g., McLachlan & Peel, 2000; Morgan, 2015; Nylund, Asparouhov, & Muthén, 2007). Information criteria such as the Akaike information criterion (AIC), CAIC, BIC, and ABIC cannot be compared with any general guideline of "good fit" as these statistics vary greatly depending on the complexity of the model. Instead, these criteria are compared between otherwise equal models with lower values indicating a better-fitting model. Both the adjusted Lo–Mendell–Rubin likelihood ratio test (aLMR) and the BLRT compare a "k" profile model with a "k-1" profile model. A significant *p* value associated with these tests indicates that the "k-1" profile model should be rejected in favor of a "k" profile model.

Having identified the most appropriate profile solution, we conducted logistic regressions to include theorized antecedents in the model. Specifically, we modeled separate perceptions of need satisfaction (autonomy, competence, and relatedness), as well as participant age and gender (for consistency with Wang et al., 2016), as predictors of profile membership. In logistic regression, categorical dependent variables (in this case, latent profiles) are regressed onto continuous independent variables. Therefore, the regression coefficients reflect the increase that can be expected in the log odds of the outcome (i.e., the probability of membership in one profile vs. another), for each unit increase in the predictor. For simplicity, we report odds ratios (*OR*s), reflecting the change in likelihood of membership in a target profile versus a comparison profile. For example, an *OR* less than one indicates a reduced probability of membership in the target profile compared with a comparison, whereas an *OR* of two would indicate membership in the target profile is two times more likely than in the comparison profile for each one unit increase in the predictor variable. Finally, we tested the relation between profile membership and the outcome variable effort through the direct inclusion of the outcome variable in the model as additional profile indicator (Morin & Wang, 2016). The "model constraint" command was used to systematically test mean-level differences across all specific pairs of profiles (using the multivariate delta method; e.g., Raykov & Marcoulides, 2004).

Results

Descriptive Statistics

An overview of the means and *SD*s for primary variables, and zero-order correlations between variables of interest, is presented in the Supplementary Material (see Supplemental Table S1 [available online]). In general, scores for intrinsic motivation and identified regulation indicated that students strongly endorsed these autonomous motives. Mean scores for controlled forms of motivation were approximately at the midpoint, and average scores for competence, relatedness, and autonomy need satisfaction were above the midpoint on the scales used to measure these constructs.

Latent Profile Analysis

The fit statistics for the profile enumeration process are reported in the Supplementary Material (see Supplemental Table S2 [available online]). Given that the information criteria (AIC, CAIC, BIC, and ABIC) continued to improve with the addition of more profiles and that there was an absence of a noticeable inflexion point in the scree plot (see Supplemental Figure S1 [available online]), we primarily relied on the likelihood ratio tests (i.e., aLMR and BLRT) as well as on the profile meaning to establish the optimal number of profiles to extract. Specifically, although the BLRT did not indicate a single solution, the aLMR indicated that both five and six profile solutions were adequate. Close examination of profiles in each enumeration indicated that, relative to the four-profile solution, the five-profile solution did add a well-defined, qualitatively distinct, and potentially meaningful profile. However, the six-profile solution did not; this solution merely split an existing profile resulting in two profiles that were the same shape (and differed only quantitatively). As such, the six-profile solution did not make a theoretically meaningful contribution and did not warrant the additional complexity. Furthermore, the five-profile solution showed a high level of classification accuracy as demonstrated by the entropy value of .928. This model was further supported by the average posterior probabilities of class membership in the dominant profile, which were consistently higher than .951, indicating a high degree of confidence in profile classification.

Profile Description

The retained five-profile solution is displayed in Figure 1, with unstandardized mean scores presented in the Supplementary Material (see Supplemental Table S3 [available online]). Throughout this section, descriptions of high, average, and/or low scores on a given variable refer to students' scores relative to the average level observed (for that variable) across the entire sample. Profile 1, labeled the *amotivated* profile, was most probable for 14.6% of the sample (classification probability .961), and represented students with a high level of amotivation (relative to levels observed in the entire sample), slightly above average external regulation, and low or very low levels of introjected regulation, identified regulation, and intrinsic motivation. The second profile (most probable for 20% of the sample; classification probability .95), referred to as the *moderately autonomous* profile, represented students with moderately low amotivation, slightly below average external regulation, and moderately low introjected regulation, combined with above average levels of identified regulation and intrinsic motivation. The third profile was labeled *mixed motivation* and was most probable for 23.9% of the sample (.96 classification probability). Students in this profile presented average levels of amotivation, slightly above average levels of external regulation, and relatively high levels of introjected regulation, identified regulation, and intrinsic motivation. The fourth profile represented the largest proportion of students (i.e., was most probable for 27.2% of students; classification probability .95) and was labeled the *moderately controlled* profile. Students in this profile reported moderately high amotivation, close to average levels of external regulation and introjected regulation, and moderately low levels of identified regulation and intrinsic motivation. The fifth, and *highly autonomous* profile, was the smallest and was most probable for 14.3% of the sample (classification probability .99). Students in this profile displayed low amotivation, slightly below average levels of external regulation, close to average introjected regulation, and very high levels of identified regulation and intrinsic motivation.

Predictors of Profile Membership

When examining predictors of profile membership through logistic regressions, we observed no significant effects for participant age and/or gender. However, basic need satisfaction was related to profile membership in several cases (see Table 1). Competence satisfaction appeared to represent the most consistent of these predictors, with increases in competence need satisfaction significantly predicting membership in profiles characterized by higher levels of identified regulation and intrinsic motivation (*mixed motivation*, Profile 3; *highly autonomous*, Profile 5). For example, a 1-point increase in perceived competence need satisfaction increased the probability of membership in the *moderately autonomous* profile by 185% compared with the *moderately controlled* profile, despite relatively similar levels of overall motivation

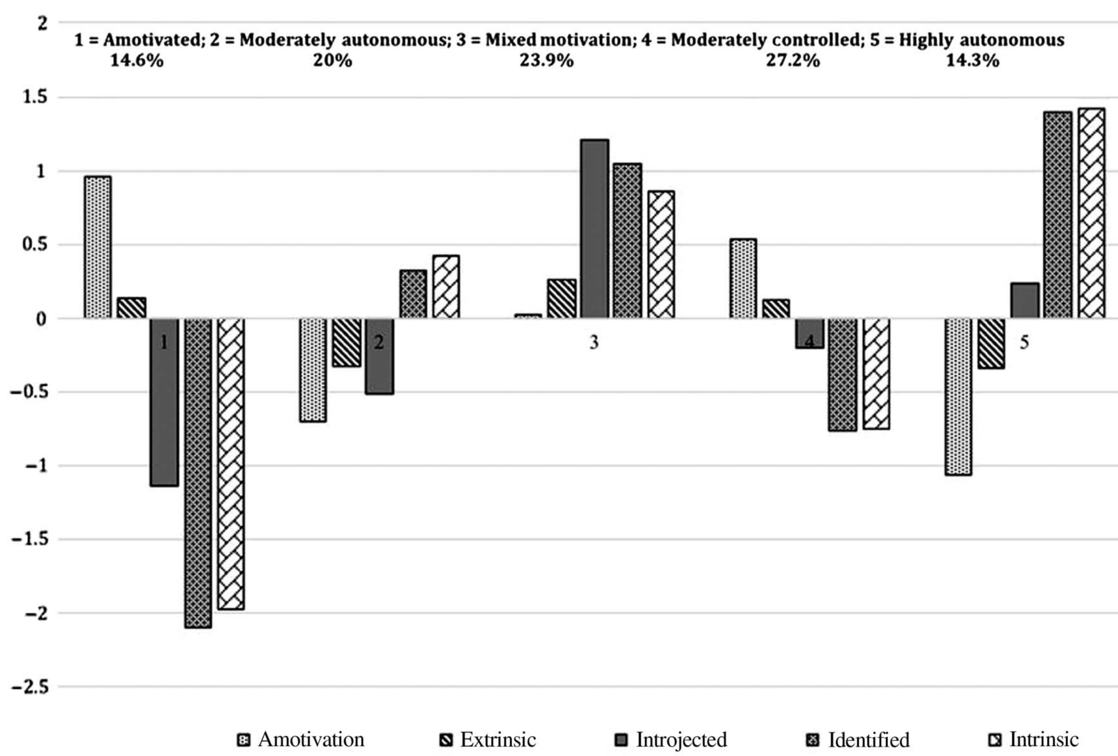

Figure 1 — Graphical representation of profiles based on five motivation types: Profile 1, amotivated; Profile 2, moderately autonomous; Profile 3, mixed motivation; Profile 4, moderately controlled; and Profile 5, highly autonomous.

quantity in these profiles. Likewise, a 1-point increase in perceived competence was associated with a decrease in the probability of belonging in Profile 4 (*moderately controlled*) by a quarter compared with Profile 5 (*highly autonomous*).

Autonomy and relatedness need satisfaction were also significant predictors of profile membership for many of the comparisons. These results demonstrated that higher need satisfaction perceptions predicted greater probability of membership in profiles defined by higher quality motivation (e.g., Profiles 2 and 5) as opposed to profiles representing lower quality motivation (e.g., Profiles 1 and 4). Interestingly, none of the need satisfaction variables predicted difference in membership between the *moderately autonomous* (Profile 2) and *mixed motivation* (Profile 3) profiles, despite these profiles appearing very different (i.e., the *mixed motivation* profile appears to represent much more highly motivated students). However, despite differences in the overall level (i.e., quantity) of motivation between these profiles, the quality of motivation was similar (i.e., amotivation and external regulation were comparatively low compared with identified regulation and intrinsic motivation). As such, the results presented in Table 1 broadly indicated that stronger need satisfaction perceptions predicted membership of profiles characterized by higher quality motivation, but not necessarily by a greater overall amount (i.e., quantity) of motivation. Differences in need satisfaction, for example, did not predict membership differences between either Profiles 2 and 5 or Profiles 3 and 5.

Profile Differences on "Effort" Outcome

Pairwise comparisons (illustrated in Table 2) indicated that each profile significantly predicted different levels of effort, with the exception of Profiles 2 (*moderately autonomous*) and 3 (*mixed motivation*), both of which predicted a similar, slightly above average level of effort. Altogether, these comparisons indicated that membership of Profile 5 (*highly autonomous*) was associated with the highest levels of effort in PE, followed jointly by Profiles 2 (*moderately autonomous)* and 3 (*mixed motivation*). Membership of all of these profiles was associated with greater effort than membership of Profile 4 (*moderately Controlled*), and in turn, membership of Profile 4 predicted greater effort than membership of Profile 1 (*amotivated*).

Discussion

High school PE provides adolescents with important opportunities for sport and exercise participation, and, at its most effective, may help promote lifelong physical activity habits. In studying the implications of high school PE, researchers have focused their attention, in part, upon charting the predictors and outcomes of students' motivation. Much of this study has been underpinned by SDT principles (see Deci & Ryan, 1985, 2000) and has been rooted in particular in the notion that individuals may pursue a given activity due to qualitatively different reasons (or motives). These

Table 1 Results of Logistic Regressions for the Effects of Predictors on Profile Membership

	Latent Profile 1 vs. 2		Latent Profile 1 vs. 3		Latent Profile 1 vs. 4		Latent Profile 1 vs. 5		Latent Profile 2 vs. 3	
	Coef. (*p*)	OR	Coef. (*p*)	OR	Coef. (*p*)	OR	Coef. (*p*)	OR	Coef. (*p*)	OR
Autonomy	0.37 (.024)*	0.42	0.34 (.001)*	0.31	0.23 (.004)*	0.51	0.34 (.015)*	0.28	0.23 (.261)	0.75
Competence	0.26 (.016)*	0.27	0.32 (.001)*	0.23	0.28 (.013)*	0.50	0.45 (<.001)*	0.12	0.26 (.530)	0.85
Relatedness	0.25 (.007)*	0.51	0.31 (.444)	1.27	0.26 (.660)	0.89	0.29 (.003)*	0.42	0.33 (.196)	1.54
Gender	0.51 (.632)	0.78	0.50 (.314)	0.60	0.48 (.432)	0.69	0.79 (.291)	0.43	0.45 (.562)	0.77
Age	0.27 (.370)	1.27	0.28 (.921)	1.03	0.17 (.770)	0.95	0.32 (.429)	1.29	0.14 (.125)	0.81
	Latent Profile 2 vs. 4		**Latent Profile 2 vs. 5**		**Latent Profile 3 vs. 4**		**Latent Profile 3 vs. 5**		**Latent Profile 4 vs. 5**	
	Coef. (*p*)	**OR**	**Coef. (*p*)**	**OR**	**Coef. (*p*)**	**OR**	**Coef. (*p*)**	**OR**	**Coef. (*p*)**	**OR**
Autonomy	0.26 (.476)	1.21	0.24 (.084)	0.66	0.22 (.028)*	1.61	0.22 (.545)	0.88	0.24 (.012)*	0.54
Competence	0.27 (.024)*	1.85	0.43 (.068)	0.45	0.26 (.003)*	2.17	0.46 (.171)	0.53	0.45 (.002)*	0.25
Relatedness	0.24 (.020)*	1.75	0.36 (.569)	0.81	0.29 (.671)	1.13	0.32 (.045)	0.53	0.36 (.034)	0.47
Gender	0.35 (.709)	0.88	0.61 (.327)	0.55	0.41 (.754)	1.14	0.47 (.476)	0.71	0.54 (.394)	0.63
Age	0.18 (.102)	0.75	0.18 (.948)	1.01	0.16 (.630)	0.92	0.16 (.160)	1.25	0.18 (.093)	1.35

Note. Autonomy, competence, and relatedness refer to need satisfaction perceptions. *OR*s reflect the effects of the predictors on the likelihood of membership in the first listed profile relative to the second listed profile. Profile 1 = amotivated; 2 = moderately autonomous; 3 = mixed motivation; 4 = moderately controlled; 5 = highly autonomous; *OR* = odds ratio; Coef. = coefficient.

*$p < .05$.

Table 2 Outcome Means and Pairwise Comparisons Between Profiles

Profile Means					Pairwise Comparisons									
1-AM	2-MA	3-MM	4-MC	5-HA	1 vs. 2	1 vs. 3	1 vs. 4	1 vs. 5	2 vs. 3	2 vs. 4	2 vs. 5	3 vs. 4	3 vs. 5	4 vs. 5
							Effort							
−0.997	0.212	0.087	−0.498	0.851	−1.209	−1.084	−0.498	−1.848	0.125	0.71	−0.639	0.585	−0.764	−1.35
							p value							
.15	.085	.183	.062	.081	<.001*	<.001*	.004*	<.001*	.401	<.001*	<.001*	.001*	<.001*	<.001*

Note. Differences between profiles: 1 < 4 < 2 = 3 < 5. Profile 1 = amotivated; 2 = moderately autonomous; 3 = mixed motivation; 4 = moderately controlled; 5 = highly autonomous. AM = amotivated; MA = moderately autonomous; MM = mixed motivation; MC = moderately controlled; HA = highly autonomous.
*$p < .05$.

motivational regulations range in nature from those that are highly autonomous, or self-determined (i.e., intrinsic motivation, integrated regulation, identified regulation), through to those that are typically considered more controlled and are driven by guilt, pressure, reward seeking, and/or the avoidance of punishment (i.e., introjected regulation, external regulation). Broadly, this research has demonstrated that higher quality (i.e., autonomous) motives align positively with desirable outcomes. In developing this literature, researchers have often relied on the use of variable-centered approaches, such as collapsing scores on motivation regulations into a single "relative autonomy" index. Recently, however, researchers have offered a range of alternative methods for modeling SDT regulations (see Chemolli & Gagné, 2014). In this investigation, we adopted a person-centered approach to the study of motivation in PE and used one of these suggested methods (i.e., LPA) to (a) model the different patterns that students display on SDT motivational regulations and (b) examine how these naturally occurring patterns (or profiles) align with theorized predictors (e.g., need satisfaction) and a relevant outcome (i.e., effort in PE).

We specified latent profiles consisting of intrinsic motivation, identified regulation, introjected regulation, external regulation, and amotivation, and, consistent with recent PE research using a Singaporean cohort (Wang et al., 2016), our analyses revealed evidence of five qualitatively distinct profiles. The composition of several of our five profiles demonstrated support for the distinction between forms of motivation that are traditionally considered more controlled or autonomous in nature. In Profiles 2 (*moderately autonomous*) and 5 (*highly autonomous*), for example, we observed low levels of amotivation, "controlled" motives (i.e., external regulation, introjected regulation) that were low or close to average, and "autonomous" motives (i.e., identified regulation, intrinsic motivation) that were slightly or well above sample averages. On the reverse, students in Profile 4 (*moderately Controlled*) displayed above average amotivation, close to average levels of external and introjected regulations, and below average identified regulation and intrinsic motivation. These profiles not only supported the continuum notion in SDT (i.e., the proposed "simplex" structure whereby regulations that are more closely related in a conceptual sense are more strongly correlated than those that are further from one another on the continuum; Ryan & Deci, 2000), but they also aligned relatively closely with profiles that were apparent in Wang et al.'s (2016) investigation. Specifically, although Wang et al. created profiles that did not include amotivation, they also observed profiles that were supportive of the continuum notion (i.e., their Profiles 5, 2, and 1).

Our remaining two profiles (i.e., *mixed motivation* and a*motivated*) were again similar in nature to profiles observed by Wang et al. (2016; see "*internalized regulation*" and "*strong controlled motivation*") but were not wholly consistent with the SDT continuum notion. Profile 1, labeled *amotivated* (and similar in nature to Wang et al.'s Profile 4), characterized 14.6% of our sample who reported strong amotivation, close to average external regulation, and very low identified regulation and intrinsic motivation. Perhaps most interesting about this profile, however, was that these students also reported low levels of introjected regulation. Similarly, in our *mixed motivation* profile (see consistency with Wang et al.'s Profile 3), 23.9% of students reported average or close to average levels of amotivation and external regulation, alongside high levels of identified regulation, intrinsic motivation, *and* introjected regulation. Introjected regulation is often considered to be predominantly controlled in nature (as exemplified in the RAI scoring method; Grolnick & Ryan, 1987) and therefore may not have been expected to align with motives that are recognized as highly autonomous (i.e., identified regulation, intrinsic motivation). These findings indicate that, in some instances, individuals may endorse introjected and autonomous motives to a similar degree. As a result, if, for example, high levels of introjection may complement high levels of autonomous motivation, this may call into question notions regarding the controlled nature of introjection. Indeed, recent meta-analytic examination of the continuum structure of SDT (Howard et al., 2017) indicates that—when measured in different domains, locations, and using a range of instruments—introjected regulation is as closely related to identified regulation as it is to external regulation and may not actually be clearly distinguishable as a controlling form of motivation (see also Gillison, Osborn, Standage, & Skevington, 2009). This study highlights the complexity of introjected regulation and encourages further work that will enable us to better understand the boundary conditions (i.e., different types of outcomes and moderating factors) under which introjection is consistent (or contrasts) with autonomous motives.

Our ability to isolate participants' introjected motives within these *amotivated* and *mixed motivation* profiles may help to illustrate the distinction between LPA and variable-centered modeling approaches that rely on the use of a single index (e.g., RAI, SDI). Indeed, given the weightings that are typically applied when creating these indexes (i.e., negative weights for amotivation, external regulation, and introjected regulation and positive weights for identified regulation and intrinsic motivation), had we opted to compute a single index in this investigation, it may have masked important information about the precise nature of introjection within some of these profiles. Accordingly, we encourage further research that draws from best-practice recommendations for person-centered analyses (i.e., LPA) to determine the consistency of such motive patterns in different contexts, and the implications for students who endorse such profiles. Aside from the conceptual implications associated with these profiles, it was also interesting to note that the *moderately controlled* profile was the most common in our sample—accounting for over a quarter (i.e., 27.2%) of all participants—and that a further 14.6% of students were most likely members of the *amotivated* profile. Replication efforts are needed to enable robust conclusions about the consistency of these profiles; however, the prominence of these profiles (characterizing over 40% of our sample) underscores the need for continued intervention work designed to bolster (some) students' autonomous motivation and minimize controlled motivation (and amotivation) for PE (see, e.g., Cheon, Reeve, & Song, 2016; Sparks, Lonsdale, Dimmock, & Jackson, 2017).

In reflecting upon the practical significance of these profiles, it was noteworthy that students' profile membership was predicted by their need satisfaction perceptions and that membership of different profiles also accompanied differences in self-reported effort in PE. Consistent with theoretical tenets outlined in SDT (Deci & Ryan, 1985), we observed, for example, that strong perceptions of need satisfaction predicted membership of profiles that were characterized by relatively high autonomous motivation alongside relatively low controlled motivation (and amotivation). For example, we observed that when students reported strong need satisfaction perceptions, they were more likely to be members of Profiles 2 (*moderately autonomous*) and 5 (*highly autonomous*) relative to Profiles 1 (*amotivated*) and 4 (*moderately controlled*). Interestingly, although need satisfaction predicted membership in either a predominantly higher (i.e., Profiles 2, 3, and 5) or lower quality motivation profile (i.e., Profiles 1 and 4), autonomy, competence, and relatedness need satisfaction did not predict differential membership within those profiles in which autonomous motives were above average (i.e., Profiles 2, 3, and 5). Therefore, it might be possible that additional (unmeasured) factors (e.g., students' perceptions regarding the importance of PE) may determine whether students develop a highly autonomous, moderately autonomous, or mixed motivation profile when their needs are satisfied in PE.

The evidence that we observed for profile-related differences on effort was largely consistent with existing theoretical (e.g., Deci & Ryan, 2000) and research (e.g., Gillet & Vallerand, 2014) evidence regarding the implications of PE motivation. Specifically, students who were likely members of more autonomous (relative to more controlled) profiles reported that they expended greater effort in PE. There is empirical evidence showing positive associations between self-reported effort in PE and physical activity-related outcomes, (e.g., increased activity levels: Haerens et al., 2010; exercise self-efficacy: Jackson, Whipp, Chua, Pengelley, & Beauchamp, 2012) and to indicate that effort in PE may align with lower levels of undesirable outcomes (e.g., nonparticipation, sedentary and passive behavior in PE: Aelterman et al., 2016; social physique anxiety: Cox, Ullrich-French & Sabiston, 2013). Therefore, profile differences on PE effort may have indirect implications for students' physical activity participation. Testing this assumption in the future by assessing a more comprehensive network of profile outcomes would be worthwhile (e.g., motor skill proficiency, academic performance, physical activity participation). In doing so, and in light of our finding that students in Profiles 2 and 3 did not display different effort perceptions, it would be particularly valuable to assess well-being (rather than behavioral or self-reported behavioral) outcomes. In the future, it would be interesting to examine whether students in these profiles differ in well-being outcomes due to the elevated levels of introjection and external regulation in Profile 3, or whether the relatively high levels of intrinsic motivation and identified regulation may protect against any maladaptive effects of introjected and external regulation. Indeed, Howard et al. (2016, p. 74) noted that, "the presence of external regulation in a profile appears unimportant when combined with autonomous forms of motivation." It was noteworthy in our investigation that students in the *moderately autonomous* profile and the *mixed motivation* reported consistent effort perceptions. *Mixed motivation* was characterized by high levels of autonomous and controlled forms of motivation, and in other studies, profiles similar to our *mixed motivation* profile have also been shown to align with relatively positive correlates (e.g., Moran, Diefendorff, Kim, & Liu, 2012; Ratelle, Guay, Vallerand, Larose, & Senécal, 2007).

This study is among the first to document latent motivation profiles in PE, and is the first to do so while (a) modeling need satisfaction as a predictor of profile membership, (b) including perceptions of amotivation, and (c) examining profile-related differences on effort. In addition, this study also provides important insight into the prevalence of "less adaptive" motivational profiles in PE and might be used to help researchers and teachers identify those students who most require intervention to improve their PE experiences. With respect to design limitations, however, it is necessary to acknowledge that these findings provide no insight into causal processes. Although we drew from theory to specify (and refer to) need satisfaction as "predictors," and effort as an "outcome," of profile membership, our observational design precludes any insight regarding the extent to which, for example, profile membership was truly *determined by* need satisfaction perceptions. In the future, it would be valuable to use related person-centered methods—such as latent transition analysis (see, e.g., Kam et al., 2016)—in conjunction with intervention efforts to identify whether interventions that are successful in bolstering need satisfaction (e.g., through student-centered learning; Goodyear & Dudley, 2015) are also responsible for changing the nature and/or number of emergent profiles, as well as students' latent profile membership (e.g., encouraging students to move from a more controlled to a more autonomous profile). Second, it is important to recognize the limitations that accompany the self-report nature of the work. Self-reports are the commonly preferred method for assessing need satisfaction and motivation perceptions; however, work that builds on this investigation might utilize more objective methods for the assessment of in-class effort or engagement (e.g., by using pedometers or accelerometers, or by using teacher reports). Finally, in seeking to demonstrate evidence for the practical utility of LPA, researchers interested in studying the implications of PE motivation might consider assessing a broader range of correlates or outcomes. In this investigation, we assessed effort only, and in the future, it would be particularly interesting for researchers to model whether, and how, membership of different latent motivation profiles within PE might predict "better" motor competence and learning outcomes.

In summary, this investigation demonstrates both conceptual and practical potential associated with the use of LPA to study motivational profiles in high school PE. Analyses revealed evidence of qualitatively distinct motivation profiles, which were characterized, in ways that were largely consistent with theory, by differences on students' need satisfaction and effort perceptions. Furthermore, comparisons between profiles emphasized the importance of quality (rather than simply quantity) of motivation, and the important role psychological need satisfaction plays in promoting high-quality motivation profiles. Conceptually, the use of LPA provides an intuitive way to model complex, multiconstruct networks, and to understand the development and implications of emergent profiles. In a practical sense, relative to variable-centered methods that document the properties of individual motivational regulations (or indexes designed to summarize those regulations), the person-centered nature of LPA offers a holistic approach for understanding students' experiences in PE. Future work that expands our understanding of the characteristics and correlates of motivation profiles may be extremely valuable for informing intervention strategies and prioritizing target populations.

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