Predictors and outcomes of core and peripheral sport motivation profiles: A person-centered study

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Abstract

While previous studies highlighted the importance of the different motivations for doing sports as proposed by self-determination theory, less emphasis has been put on the simultaneous presence of multiple motivations within the same individual. Therefore, the present study aimed to investigate the complex interaction of sport motivations and to identify core (common) and peripheral (uncommon) profiles of people engaged in sports based on a combination of motivations. To achieve this goal, latent profile analysis, a person-centered approach, was performed on responses from 506 participants engaged in sports. For better understanding the extracted profiles, basic psychological need fulfillment was included as profile predictor, while subjective vitality and various engagement-related indicators as outcomes. Four core and peripheral profiles were identified: Moderately Motivated, Highly Motivated, Amotivated, and Poorly Motivated. Contrary to theory, introjected regulation clustered more closely with self-determined motivations. Profile membership was significantly predicted by global need fulfillment, autonomy satisfaction as well as, to a smaller extent, autonomy, relatedness, and competence frustration. The four profiles differed along vitality and some, but not all, engagement-related outcomes.

Keywords: basic psychological needs; latent profile analysis (LPA); motivational profiles; self-determination theory (SDT); sport motivations; vitality;
Participation in sports has usually been considered as an adaptive activity as it has consistently been associated with increased positive (e.g., fitness or self-esteem) and decreased negative (e.g., social anxiety or depression) outcomes (Eime, Young, Harvey, Charity, & Payne, 2013; Vallerand, 2007). However, not all participants experience outcomes wholly and in the same way (i.e., not all individuals experience the same level of self-esteem or the same level of burnout after sports participation). Given that people may engage in sport for various reasons, examining these reasons (i.e., motivational sources) of sports participation has received significant scientific attention. Different motivations may explain important outcomes differently, and most studies so far highlighted their importance through variable-centered approaches (see Ryan & Deci, 2017, for an overview) that are designed to test how one variable is related to another variable. Still, the contribution of this approach might be limited because it focuses on motivations individually instead of their potential joint impact. The current study aims to remedy this weakness by taking a person-centered approach that might be more suitable for investigating the synergistic effects of different motivations. As relatively little attention has been paid to how these motivations interact within individuals by making up core (i.e., common) and peripheral (i.e., uncommon) motivational profiles, the goal of the present study was to examine the complex interplay of sport motivations through latent profile analysis, a person-centered approach. We also investigated how subjective vitality and indicators of the quantity of sports engagement are related to these profiles. Moreover, as it has been neglected so far, we also examined how the profiles are predicted by theoretically-relevant key variables, namely basic psychological need fulfillment during sport.

**Self-Determination Theory’s View of Motivations**

Self-Determination Theory (SDT; Ryan & Deci, 2017) provides a well-established and comprehensive framework for understanding differences in sport engagement quality and well-being during or in relation to engagement. SDT postulates that people have an inner, innate tendency towards greater integration, and optimal engagement and wellbeing-related outcomes are theorized to manifest when this innate tendency is facilitated. One manifestation of this tendency is motivations (i.e., behavioral regulations), which are conceptualized as being multidimensional by nature. Within the framework of SDT, several regulations have been proposed which can be placed on a continuum based on the level of internalization (Ryan & Connell, 1989), namely intrinsic, extrinsic, and amotivation.

At one end of this continuum (ranging from the most to the least self-determined) is **intrinsic motivation** (IM), which involves the highest level of internalization and self-determination. IM is characterized by intrinsic regulation, where the sport is pursued as a result of pleasure and enjoyment associated with the behavior itself. Extrinsic motivation (EM) occurs when behavior is enacted for instrumental, rather than inherent reasons and based on the SDT, EM can be divided into four types of regulations. **Integrated regulation** is the most self-determined form and occurs when the behavior is in line with personal goals, objectives, and the sport becomes congruent with the values and the self. A less self-determined form of EM, compared to integrated regulation, is **identified regulation**, which is evidenced when one does sports due to the positive outcomes (e.g., improved health) associated with it. Moving further along the continuum is **introjected regulation**, which stems from the goal to avoid the subjective experiences of guilt, shame, or to enhance self-esteem through the sport. As the least self-determined form, **external regulation** occurs when either rewards or punishments orient the act of doing sports. Finally, **amotivation** (AM) refers to non-regulation and a lack of intention to act; thus, amotivated individuals do not know why they pursue their sport. In SDT literature (Ryan & Deci, 2017), intrinsic, integrated, and identified regulations are commonly referred to as autonomous or self-determined motivations, while introjected and external regulation are often referred to as controlled or non-self-determined motivations. Referring to the above-mentioned innate tendency, self-determined regulations are more indicative of a facilitated innate tendency, whereas non-self-determined regulations are more indicative of an obstructed innate tendency.

Over the years, several studies based on variable-centered approaches have examined the various predictors and outcomes of these behavioral regulations with the more self-determined forms being associated with adaptive and positive outcomes such as task involvement, positive affect, improved physical activity, or intention to partake in physical activity, while less self-determined regulations are linked to aggression, burnout, boredom, or even doping use (Cresswell & Eklund,
latent profiles are prototypical configurations that allow for substantial levels of within-classification (Muthén, 2002). LPA uses a formal set of objective criteria that guides the process of profile selection, it rests on rigid assumptions that are rarely met (e.g., precise assignment of individuals to a profile rather than considering participants’ likelihood of membership in all profiles on the basis of their prototypical similarity), and it is also sensitive to clustering algorithms, distributions, and measurement scales (Meyer & Morin, 2016; Morin & Wang, 2016). In contrast, the present study focused on latent profile analysis (LPA), which is a flexible approach to profile construction and classification (Muthén, 2002). LPA uses a formal set of objective criteria that guides the process of classification and also allows the estimation of alternative profiles. Moreover, instead of being fixed, latent profiles are prototypical configurations that allow for substantial levels of within-profile
variation (i.e., all participants have a probability of membership of belonging to all profiles instead of being “forced” into a single profile). For this reason, we used LPA in the present study.

Notwithstanding its improvements over cluster analysis, LPA still needs to be complemented with investigations of construct validity to examine the interpretation of the extracted profiles to ascertain that they are indeed meaningful and to make sure that no spurious profiles emerge (Morin, Morizot, Boudrias, & Madore, 2011). Among other things, this can easily be achieved by the direct incorporation of theoretically-relevant outcomes. Besides, while some studies (e.g., Boiché et al., 2008; Gustafsson et al., 2018) included profile outcomes, no person-centered study investigated how profile membership is related to key predictors.

Predictors and Outcomes of Sport Motivational Profiles

A central element of SDT is that the innate human tendency for growth and integration are a function of the fulfillment of three basic psychological needs (Ryan & Deci, 2017), namely autonomy (i.e., acting volitionally, in line with own values), competence (i.e., experiences of mastery and effectiveness), and relatedness (i.e., sense of belongingness and reciprocity). When these three psychological needs are met, individuals are more likely to have the capacity to internalize and integrate current behavioral regulations (Ryan, 1995); in other words, when needs are satisfied within an activity, people start to take ownership for their actions, thus facilitating the internalization process that is the basis for motivational, behavioral regulations. Put differently, when individuals' needs are fulfilled, they function in a healthy and effective way, which enables a higher level of internalization, resulting in more self-determined motivations. While the directionality between needs and motivations have always been assumed, a recent investigation explicitly tested this process model in the context of work and concluded that need satisfaction was indeed related to work motivations over time, but not the other way around (Olafsen, Deci, & Halvari, 2018). This finding is complemented by previous cross-sectional results from sport and health contexts where more self-determined motivations (i.e., intrinsic, integrated, identified) were positively related to need satisfaction, whereas controlled motivations and amotivation were either unrelated or negatively related to it (e.g., Ng et al., 2012; Pelletier, Rocchi, Guertin, Hébert, & Sarrazin, 2017; Weman-Josefsson, Lindwall, & Ivarsson, 2015).

For these reasons, need fulfillment was included as a theoretically-relevant profile predictor.

Previous studies also highlighted several important distinctions from the perspective of outcomes. The inclusion of profile outcomes is important because individuals with more autonomous motivations (as opposed to controlled motivations) are theorized to perform more effectively in sport as well as enjoying it more because these motivations stem from a sense of volition and personal causation (Ryan & Deci, 2000). For instance, Gillet, Vallerand, et al. (2009) concluded that athletes from the least self-determined profile (moderately autonomous and low controlled) had the lowest overall performance throughout the subsequent season. In contrast, the results of Gillet, Berjot, and Paty (2009) suggested that having both autonomous and controlled motivations is detrimental to performance.

Another investigation of Gillet, Berjot, Vallerand, Amoura, and Rosnet (2012) showed that the highly motivated profile (characterized by high intrinsic, identified and introjected regulation as well as moderate-to-low external regulation and amotivation) was associated with higher levels of performance, but also with higher levels of emotional and physical exhaustion. Gustafsson et al. (2018) examined burnout as a profile outcome and found that the less self-determined profile (amotivated and moderately controlled) was related to higher burnout symptoms. In the present study, subjective vitality was used as an outcome of the different motivational profiles. Vitality refers to the subjectively experienced positive feelings of aliveness and energy and is said to reflect organismic wellbeing and is available to the self (Ryan & Deci, 2017). Indirect evidence coming from cross-sectional sport-related results suggest that more self-determined motivations are positively, whereas controlled motivations and amotivation negatively associated with wellbeing outcomes of vitality (Pelletier, Rocchi, Vallerand, Deci, & Ryan, 2013; Yu et al., 2015).

Finally, the present study also considered a number of engagement-related indicators (i.e., the length, the frequency, and the duration of doing sports), which might be able to provide complementary information to the psychological factors about the quantity (or amount of) of engagement. Given that the focus of the present study was on doing sports in general (instead of a particular type of sport), we opted to use these three indicators as these were more general and could be answered with different sports backgrounds. These indicators were also thought to be better at capturing the self-reported engagement with and the self-reported behavioral aspects of doing sports.
Some previous studies have also considered similar engagement-related quantity indicators and reported more autonomous motivations to be associated with physical activity intentions (Standage et al., 2003), increased physical activity (Sebire et al., 2013), exercising behavior (Lindwall et al., 2017), and better performance at the end of the season (Gillet et al., 2012). We expected similar findings in that more self-determined profiles would be associated with higher sports engagement.

The Present Investigation

The primary purpose of this study was to examine how the different behavioral regulations proposed by the SDT combine within different subgroups of individuals within the context of sport. To achieve this goal, LPA was performed on responses provided by a sample of participants engaged in sports. Based on previous studies listed in Table 1, we expected (Hypothesis 1) two-to-three core profiles and (Hypothesis 2) at least some peripheral profiles to emerge. To support the interpretation and practical relevance of the latent profiles, the secondary purpose was to demonstrate that these profiles relate to key predictors and outcomes. We considered basic psychological needs as predictors, subjective vitality, and various engagement-related variables as outcomes. It was expected that (Hypothesis 3) need fulfillment would predict membership to the more self-determined profiles and that (Hypothesis 4) membership to the more self-determined profiles would be associated with higher levels of vitality and higher levels of self-reported engagement.

We sought to build upon and extend previous research in five ways. First, we included all types of regulations that are proposed by the SDT for a more comprehensive coverage instead of focusing on a subset of motivations that are typically done in variable-centered studies. Second, we used the most advanced person-centered method in the form of latent profile analysis instead of cluster analysis. Third, although it is often neglected in the literature except for some cases (e.g., Gustafsson et al., 2018), we also ascertained the measurement properties of all constructs in the form of preliminary measurement models, which could, in turn, minimize potential biases. Fourth, to better document the construct validity of the profiles, we included subjective vitality and various engagement-related indicators as profile outcomes. Fifth, also neglected in the literature are investigations on the potential predictors of profiles; we addressed this absence by including basic psychological need fulfillment as a profile predictor.

Method

Procedure and Participants

The study was conducted following the guidelines of the Declaration of Helsinki and with the explicit approval of the University Research Ethics Committee. Participants were recruited through different online forums, groups, and websites specialized in sports. First, they were informed about the aims of the study and ensured their anonymity. If they were willing to participate, they had to check a box to provide explicit consent; otherwise, they were excluded. They were then directed to a set of online questionnaires (presented in Hungarian) where they were also filtered out if they did not actively pursue any form of sports at the time of the data gathering.

In the end, 506 Hungarian respondents participated (78.1% female) who were aged between 18 and 66 (M = 26.3, SD = 8.5) and who were engaged in sports. They reportedly lived in either the capital city (54.2%), county capitals (7.9%), cities (26.9%), or country towns (11.1%). The vast majority of them were on amateur level (89.3%), pursued their sport for 1-6 months (20.9%), 7-11 months (9.1%), 1-2 years (17.8%), 3-4 years (16.8%), or 5 years or more (35.4%). Respondents were engaged in a variety of sports, including running, pole-sports (pole fitness, pole dancing), aerobic, rowing, football, gym exercises, basketball, yoga, and volleyball.

Measures

Translation procedure. All instruments previously not validated in Hungarian were translated and back-translated based on the protocol outlined by Beaton, Bombardier, Guillemin, and Ferraz (2000).

Sports motivation (profile indicator). The Sport Motivation Scale II (SMS II; Pelletier et al., 2013) was used to assess the different factors (and reasons) for practicing sports: intrinsic motivation (e.g., “Because it gives me pleasure to learn more about my sport”, α = .80), integrated regulation (e.g., “Because practicing sports reflects the essence of who I am”, α = .83), identified regulation (e.g., “Because I found it is a good way to develop aspects of myself that I value”, α = .80), introjected regulation (e.g., “Because I feel better about myself when I do”, α = .60), external regulation (e.g., “Because I think others would disapprove of me if I did not”, α = .66), amotivation (e.g., “I used to
have good reasons for doing sports, but now I am asking myself if I should continue”, α = .71).
Respondents were able to answer on a seven-point scale (1 = Does not correspond at all; 7 =
Corresponds completely). This instrument demonstrated good psychometric properties in terms of
factor structure and reliability (Pelletier et al., 2013, 2017).

Basic psychological needs (profile predictor). The Hungarian version (Tóth-Király, Morin,
Bóthe, Orosz, & Rigó, 2018) of the Basic Psychological Need Satisfaction and Frustration Scale
(BPNFS; Chen et al., 2015) was used to measure need fulfillment. It is a 24-item measure with six
factors (four items each) including autonomy satisfaction (e.g., “I feel a sense of choice and freedom
in the things I undertake”; α = .76) and frustration (e.g., “I feel forced to do many things I wouldn’t
choose to do”, α = .71), competence satisfaction (e.g., “I feel confident that I can do things well”, α = .83) and frustration (e.g., “I have serious doubts about whether I can do things well”, α = .87), and
relatedness satisfaction (e.g., “I feel that the people I care about also care about me”, α = .84) and
frustration (e.g., “I feel excluded from the group I want to belong to”, α = .79). Items were rated on a
five-point scale (1 = Not true at all for me; 5 = Very true for me). The instruction was slightly
modified so that it referred to the experiences of need satisfaction and frustration during sports by
emphasizing in the instruction that the subsequent questions refer to experiences during sports and by
starting each item with the stem “While doing sports...”. Previous studies (e.g., Rodrigues et al., 2019)
tended to support the questionnaire’s reliability and factorial structure.

Subjective vitality (profile outcome). The Subjective Vitality Scale (Ryan & Frederick,
1997) measures vitality with seven items (e.g., “I feel energized”; α = .91) which are rated on a seven-
point scale (1 = Not true at all; 7 = Very true). The instruction was slightly modified so that it reflected
vitality during sports. Past sports research (e.g., Reinboth, Duda, & Nioumanis, 2004) supported the
factorial validity and internal consistency of this measure.

Quantity of engagement with sports (profile outcome). Participants were asked to respond
to three indicators of the quantity of sport engagement (single-item measures for brevity1) that referred
to: (1) the length of doing sports (i.e., for how long they were doing their sports) using a five-point
scale (1 = 1-6 months; 2 = 7-11 months; 3 = 1-2 years; 4 = 3-4 years; 5 = more than 5 years); (2) the frequency of doing sports (i.e., the number of occasions they were doing their sport on an average week); and (3) the duration of doing sports (i.e., the amount of time spent they were spending doing their sport on an average occasion, expressed in minutes). For duration, a threshold of 240 minutes (4 hours) was used as an upper limit to minimize bias2. Higher values were recoded as missing. Participants reportedly were doing their sports for more than 5 years with an average four occasions per week, and, on an average occasion, they spent 85.93 minutes (SD = 58.85) with their sport. The three items were not summed and were treated separately during analyses.

Statistical Analyses

Preliminary analyses. The psychometric properties of the measures were tested with
preliminary measurement models using the robust weighted least square mean- and variance-adjusted
(WLSMV) estimator in Mplus 8 (Muthén & Muthén, 1998-2017) given that this estimator is more
suitable for the ordinal nature of Likert scales and when response categories follow asymmetric
thresholds (Finney & DiStefano, 2013; Morin, Myers, & Lee, 2018) such as in the present case. For
the SMS II, we contrasted two alternative six-factor models, one based on confirmatory factor analysis
(CFA) and the other on exploratory structural equation modeling (ESEM). In CFA, factors are defined
by their corresponding scale items, but cross-loadings to other, non-target factors are forced to zero,
while is ESEM, the same cross-loadings are estimated, but are targeted to be as close to zero as

1 Results of prior studies suggested that single-item self-reported measures have adequate levels of reliability and
validity and thus might be considered accurate as indicators of physical activity and sport engagement (e.g.,
Milton, Clemes, & Bull, 2013; van Poppel, Chinapaw, Mokkink, van Mechelen, & Terwee, 2010; Wanner et al.,
2014).
2 We based this decision on the available survey results of the Hungarian Central Statistical Office (2011)
according to which an average Hungarian person (aged between 15 and 74) on an average day spends almost 12
hours (712 minutes in the report) with satisfying his or her physiological needs (i.e., eating, hygiene, sleeping).
Almost 8 hours (461 minutes in the report) are spent on activities related to societal functioning (e.g., working),
while the remaining approximately 4 hours (268 minutes in the report) are spent on free or leisure time activities.
For this reason, we assumed that these 4 hours should be used as an upper threshold for the highest amount of
free time one individual can have in our sample in order to minimize bias.
possible (see Browne, 2001 or Tóth-Király, Bőthe, Rigó, & Orosz, 2017). Recent investigations in motivations (Guay, Morin, Litalien, Valois, & Vallerand, 2015; Tóth-Király, Orosz, et al., 2017) highlight the importance of contrasting competing CFA and ESEM models as the latter often results in more precise parameter estimates. Need fulfillment was modeled as a bifactor-ESEM model (based on Tóth-Király, Morin, et al., 2018) representing a global factor of need fulfillment and six specific factors (satisfaction and frustration x autonomy, competence, and relatedness), whereas vitality was estimated in a standard CFA model. More information is available in Appendix 1 of the online supplementary document and in Table S1 to S7. The final preliminary models were then used to save factor scores (with a mean of 0 and a standard deviation of 1) that were used in the main analyses. While factor scores do not control for measurement error the same way as fully latent variables do, they still provide a partial control by giving more weight to items with lower errors (Morin & Marsh, 2015) and thus considered better in profile estimation relative to manifest scores.

**Latent profile analyses (LPA).** Models with one to eight profiles were estimated with the robust maximum likelihood (MLR) estimator available in Mplus 8. In order to avoid potential issues stemming from converging on suboptimal local maximum, 5000 random sets of start values were estimated with 1000 iterations, and the 200 best solutions were retained for final optimization (Hipp & Bauer, 2006). The means and the variances of the motivational factors were freely estimated in all profiles (Diallo, Morin, & Lu, 2016). To identify the most adequate solution with the optimal number of profiles, the meaningfulness, the theoretical adequacy, and the statistical adequacy of the solutions were considered (Morin, 2016). For statistical adequacy, a variety of indicators were examined: the Akaike Information Criterion (AIC), the Bayesian Information Criterion (BIC), the Constant AIC (CAIC), the Sample-Size-Adjusted BIC (SSABIC), the adjusted Lo-Mendell-Rubin (aLMR) likelihood ratio test, and the Bootstrap Likelihood Ratio Test (BLRT). A lower value on AIC, BIC, CAIC, and SSABIC suggests a better fitting solution. The aLMR and the BLRT tests compare the estimated model (e.g., four classes) with a model having one less class (e.g., three classes) and a non-significant p-value (p > .050) indicates that the model with one less class should be accepted. Finally, entropy highlights the precision of the classification with values ranging from 0 (lower accuracy) to 1 (higher accuracy). The information criteria (i.e., AIC, BIC, CAIC, and SSABIC) often keep improving with the addition of more profiles, a graphical examination of “elbow plots” could facilitate the decision making where the point after which the slope flattens suggest that the optimal number of profiles have been reached.

Following the suggestions of Diallo et al. (2016), more emphasis should be put on BIC and CAIC in the case of high accuracy (i.e., > .800), while SSABIC and BLRT are preferred in the case of low accuracy (i.e., < .500). At the same time, increasing statistical evidence suggests that AIC, aLMR, and BLRT should not be used during profile selection (e.g., Diallo et al., 2016; Henson, Reise, & Kim, 2007; Peugh & Fan, 2013). For this reason, these indicators are reported for the sake of transparency but are not used for profile selection. Instead, more emphasis was put on the interpretation of elbow plots.

**Profile predictors and outcomes.** Once the final solution was identified, multinominal logistic regression was conducted to test the associations between the predictors (global need fulfillment and its specific dimensions) and the likelihood of membership into the different profiles using the Mplus’ auxiliary “R3STEP” function for predictors. The regression coefficients indicate the likelihood of belonging to the target profile compared to the referent one. For simplicity, these coefficients were converted to odds ratios (OR) which indicates how much the likelihood of group membership into the target group changes relative to the referent group (e.g., an OR of 2 suggests that respondent is two times more likely to be member of the target profile compared to the referent profile). The final profiles were compared on the outcomes using Mplus’ auxiliary “BCH” function that is suitable for continuous outcomes (Morin, 2016).

**Results**

Fit indices for the different profile solutions are presented in Table 2. Generally, all entropy values were high for all profile solutions (> .800). With the inclusion of additional profiles, the information criteria of AIC, BIC, CAIC, and SSABIC continuously decreased; thus, elbow plots (see Figure S1 in the online supplements) were examined with a particular focus on BIC and CAIC (Diallo et al., 2016). This plot indicated that the flat part was reached around the 3-4-5-profile solutions. Carefully contrasting these alternative configurations revealed that the addition of a fourth profile did
result in a qualitatively distinct and relatively large profile, whereas moving from 4 to 5 only lead to an arbitrary division of an existing profile into two similar ones. Consequently, the four-profile solution was retained which is graphically presented in Figure 1 with classification probabilities reported in Table S9 and the exact numerical values are presented in Table S10. Profile 1 (28.3% of the respondents, n = 143) was identified as a Moderately Motivated profile as it was characterized by average levels on intrinsic, integrated, identified, and introjected regulations, but lower than average scores on external regulation and amotivation. Profile 2 (22.3% of the respondents, n = 113) was a Highly Motivated profile, as evidenced by the very high levels of intrinsic, integrated, identified, and introjected motivations with average levels of external regulation and lower levels of amotivation. Profile 3 (20.1% of the respondents, n = 102) was an Amotivated profile and was characterized by very low levels of intrinsic, integrated, identified and introjected motivations, average levels of external regulation, and higher levels of amotivation. Finally, Profile 4 (29.3% of the respondents, n = 148) was characterized by average scores on intrinsic, integrated, identified, and introjected regulations, but higher than average scores of external regulation and amotivation thus was labeled as a Poorly Motivated profile.

The predictors of general need fulfillment, and the specific factors were added to the final 4-profile solution. The multinominal logistic regression results support the meaningfulness of the extracted profiles with well-defined associations between the predictors and profile membership (see Table 3). General need fulfillment differentiated well between the profiles and was associated with lower likelihood of membership in the profiles characterized non-self-determined motivations compared to self-determined motivations (e.g., not experiencing need fulfillment decreased the likelihood of belonging to the Moderately Motivated profile [Profile 1] relative to the Amotivated one [Profile 3; OR = 0.155]). Autonomy satisfaction differentiated the profiles in a similar, theoretically-reasonable direction. Other specific factors also differentiated some profiles: relatedness frustration predicted higher likelihood membership to the Poorly Motivated compared to the Moderately Motivated and Amotivated ones, while autonomy-competence-relatedness frustration predicted higher likelihood of membership to the Highly Motivated profile relative to the Moderately Motivated one4.

The outcomes of vitality and the quantity of sport engagement were added to the final 4-profile solution. The within-profile means, standard errors, and pairwise comparisons across the different profiles are reported in Table 4. All these comparisons are statistically significant, which further supports the construct validity of the retained profile solution. Subjective vitality significantly differed across all profiles, being highest in the Highly Motivated profile and lowest in the Amotivated profile. Members of the Highly Motivated profile were reportedly engaged in sport the most along the indicators of length, frequency, and duration of doing sports, followed by the Poorly Motivated, the Moderately Motivated, and the Amotivated profiles, although not all profiles differed from one another.

**Discussion**

The present study aimed to expand on previous variable-centered and cluster analytic approaches (e.g., Gillet et al., 2012; Ntoumanis, 2002) by identifying prototypical profiles of participants engaged in sports based on the simultaneous consideration of the different behavioral regulations proposed by the SDT (Ryan & Deci, 2017). Also, theoretically reasonable predictors and outcomes were incorporated into the final profile solution as it was important not just to investigate the potential consequences of the different behavioral regulations (Gustaffson et al., 2018), but also the relevant variables that orient these regulations. Thus, the application of the person-centered approach of latent profile analysis was particularly well-suited for this study, providing a way to assess the interplay of the different behavioral regulations.

The results revealed four distinct profiles representing different core (which manifest across different life contexts) and peripheral (which might only manifest in specific life contexts) configurations of behavioral regulations, thus supporting Hypothesis 1 and 2. More specifically,
Profile 1 represented a Moderately Motivated profile average levels on intrinsic, integrated, identified, and introjected regulations, but lower than average scores on external regulation and amotivation. Possibly, these participants do not have any dominant reasons as to why they engage in sports as apparent by the fact that none of the profile indicators had higher than average scores. At the same time, having lower than average external regulation and amotivation suggests that these less optimal forms of motivation are not dominant. This configuration might be classified as a core profile as it has been reported in several previous studies (e.g., Boiché et al., 2008; Gillet et al., 2012) and in other contexts as well (e.g., Howard et al., 2016).

Profile 2 was a Highly Motivated profile and was characterized by high levels of intrinsic, integrated, identified, and introjected motivations with lower levels of external regulation and amotivation. Participants in this profile do not only engage in sports due to personal enjoyment or due to the positive effects of sports, but also because of internal pressures such as avoidance of guilt and shame or the pursuit of pride and self-esteem. Introjected regulation clustering more closely with the self-determined behavioral regulations as opposed to the controlled ones have already been reported in studies inside (Lindwall et al., 2017) and outside the field of physical activity (e.g., Howard, Gagné, Morin, & Van den Broeck, 2016; Litalien et al., 2018), suggesting that this finding might not be a unique phenomenon. Moreover, through meta-analytic approaches, Howard, Gagné, and Bureau (2017) identified introjected regulation as being equidistant from the adjacent regulations, implying that it might be a “greyer” regulation instead of being completely black or white. These findings underscore the importance of preliminary examination instead of the implicit clustering of factors.

Profile 3 included Amotivated participants (i.e., high level of amotivation, and very low levels of intrinsic, integrated, identified and introjected regulations with external regulation being around average) who reportedly did not know why they pursued sports. Using the work of Legault et al. (2006), amotivated participants might not see a value in doing sports or might question their beliefs about their abilities or the efforts that they make. Future studies are needed to examine the unique aspects of amotivation in more detail. Overall, this profile was similar to prior studies (Gustafsson et al., 2018; Gillet et al., 2012), suggesting that it might be interpreted as a core profile.

Finally, Profile 4 was a Poorly Motivated profile and included participants who did sports for predominantly controlled reasons (e.g., other people would disapprove non-engagement) or do not know why they engage in sports at all. This core profile solution is similar to the amotivated and controlled profile identified by Gustaffson et al. (2018) as well as Lindwall et al. (2017). These two studies are particularly relevant given that LPA was used in those studies as well, but more profiles were extracted, though there are some similarities in terms of the overall shape of the profiles (Morin & Marsh, 2015). These discrepancies between the studies might stem from methodological differences, given that sport motivations were modeled with ESEM which in turn resulted in a more precise representation that further supports the value of this approach not just inside (e.g., Howard, Gagné, Morin, & Forest, 2018; Tóth-Király, Vallerand, Böthe, Rigó, & Orosz, 2019), but outside the scope of the SDT (e.g., Arens & Morin, 2016; Tóth-Király, Böthe, & Orosz, 2017) as well. The minor differences might also be attributed to the different characteristics of the samples: for instance, participants with different characteristics than the ones recruited in this study might endorse different motivations of motivations (e.g., it is reasonable to assume that external regulation might be more predominant among professional athletes who earn money through sports compared to amateur athletes). The specifications of the models could also influence the results; for example, freely estimating profile indicator means and variances versus freely estimating only profile indicator means could theoretically lead to the identification of different profiles. Overall, our findings support the notion of Vallerand (1997) in that intentional acts such as sports involve different combinations of behavioral regulations with the results suggesting that participants engaged in sport indeed draw motivation from multiple sources, reinforcing the use of rigorous person-centered approaches. At the same time, we have to note that interaction tests in variable-centered approaches are not inherently wrong or biased and could lead to meaningful conclusions; still, we believe that variable- and person-centered approaches should instead be viewed as complementary rather than opposing and that using a combination of both could provide more detailed information of the constructs of interest (Bergman & Trost, 2006).

Predictors of Sport Motivation Profiles
Little research has been carried out to identify the variables that orient individuals toward different sport motivation profiles, a limitation that we sought to address by including the global need fulfillment and its specific factors as predictors. Our results revealed that the relative likelihood of profile membership differed as a function of general need fulfillment during sports; that is, individuals experiencing higher global need fulfillment belonged to the more self-determined profiles relative to the non-self-determined ones, supporting Hypothesis 3. Previous variable-centered analyses showed that psychological need satisfaction is positively related to more autonomous behavioral regulations (Sebire et al., 2013). Therefore, the global fulfillment of the three psychological needs during sports appear to be highly critical in the promotion of more autonomous motivations. As for the specific factors, autonomy satisfaction also predicted profile membership over and above the general factor and in a similar manner. When participants act voluntarily and feel free to act independently during physical activity, they engage in sports more autonomously (e.g., intrinsic motivation, integrated or identified regulation).

Other need fulfillment specific factors also significantly predicted profile membership, although to a lesser extent. Somewhat unexpectedly, autonomy-competence-relatedness frustration specific factors differentiated the Moderately Motivated and the Highly Motivated profiles in that frustration was associated with higher membership likelihood to the second profile. That is, when participants more strongly feel like a failure or when they feel alone and deprived of choice during sports; they are more likely to be highly motivated to engage in sports. From this perspective, engaging in sports might be perceived as a way of countering or compensating for the need frustrated experiences (Vansteenkiste & Ryan, 2013) which has been reported in prior studies as well outside the field of sports (Tóth-Király, Bőthe, Märki, Rigó, & Orosz, 2019). Need frustrated experiences may be associated with lower self-esteem, which could be compensated with sports, which mostly depends on one’s efforts. When people feel like a failure and think that they are not competent enough in sports, they might experience self-doubt. However, based on our results, this sense of frustration could be countered by doing more sports so that self-worth may at least be partially restored by achieving a new personal best in running, for instance. As autonomous motivations are characterized by volition and choice, it is reasonable to assume that doing sports is a conscious and explicitly chosen way of compensation for need frustration. This proposition aligns well with the proposed need restoration role of competence which suggests that in a setback situation characterized by need frustration, people might put more effort into and have more autonomous motivations in their subsequent activity (Gardner, Pickett, & Brewer, 2000; Radel et al., 2013). Moreover, the cross-sectional findings are also in line with the experimental results of Fang et al. (2018), who also found support for the restoration process of competence frustration.

In a similar vein, experiencing loneliness during sports was related to membership to the Poorly Motivated profile compared to the Moderately Motivated and Amotivated ones. This finding is reasonable considering that the Poorly Motivated profile was characterized by external regulation (i.e., doing sports to gain social rewards or avoid social punishments) and relatedness frustrated participants might engage in sports to gain social rewards such as meaningful relationships with others. Relatedness has already been shown to have a unique predictive effect over and above the general need fulfillment factor (e.g., Sánchez-Oliva et al., 2017; Tóth-Király, Bőthe, Orosz, & Rigó, 2019) which is further supported in the present study. Still, future studies should investigate these findings to corroborate their replicability further.

Outcomes of Sport Motivation Profiles

Finally, the results presented above showed well-differentiated associations between outcomes of subjective vitality. Being a member of the Highly Motivated profile was related to increased levels of vitality, followed by the Moderately Motivated, the Poorly Motivated, and the Amotivated profiles. Ryan and Deci (2017) interpret vitality as an index of organismic wellness that is available to the self in the form of energy that can be used to conduct volitional activities. Vitality is said to be enhanced, on the one hand, by the satisfaction of basic psychological needs and, on the other hand, by performing activities for self-determined reasons. Consequently, doing sports for self-determined reasons (e.g., enjoying it, finding it an integral part of one's life or being able to develop certain aspects of the self through sports) could maintain or even enhance vitality. Conversely, non-self-determined behavioral regulations characterized by external rewards, punishment, or uncertainty stemming from amotivation could reduce vitality. These results also corroborate the cross-sectional
findings of Pelletier et al. (2013, 2017), who found that more self-determined motivations were associated with increased levels of vitality. It is also important to note that vitality was the highest in the Highly Motivated profile even though introjected regulation (which was also high in this profile) is typically unrelated to or negatively related to vitality (Assor, Vansteenkiste, & Kaplan, 2009; Pelletier et al., 2017). The presence of high self-determined motivations may be able to buffer the deleterious effects of introjected regulation, which has already been demonstrated to be the case for academic motivations (Gillet, Morin, & Reeve, 2017).

Other, sport-related variables (i.e., the quantity of sport engagement) were also compared as a function of profile membership. Most, but not all, variables differed across the profiles, partially supporting Hypothesis 4. The Highly Motivated profile was related to the most time spent with sports, members of this engaged in their sports for the longest time, and they also did so more frequently, thus making this profile desirable as members appear to be alive and energetic. Granero-Gallegos et al. (2012), as well as Lindwall et al. (2017), came to similar conclusions concerning weekly practice time. The more nuanced results pertain to the Poorly Motivated profile, whose members reportedly practiced their sports more than members of the Moderately Motivated and Amotivated profiles, yet their subjective vitality was lower. One potential reason for this finding might be that Poorly Motivated participants are driven by extrinsic social rewards and punishment, which, in turn, would suggest that doing sports is not fully endorsed by them and that they feel obligated to do sports. By contrast, members of the Moderately Motivated profile exercise less in terms of time and frequency, but they appear alive and energetic during sports engagement. Finally, the Amotivated profile might be the least desirable, which is in line with prior studies emphasizing the detrimental effects of amotivation (e.g., Howard et al., 2016; Lonsdale, Hodge, & Rose, 2009). All these results suggest that being more self-determined and volitionally motivated for sports is associated with an increased quantity of behavioral engagement.

Limitations, Future Directions, and Practical Implications

Some limitations of the present research need to be acknowledged. We relied on a single sample of Hungarian participants, which makes it hard to assess the generalizability of our findings to other groups. Replications should be made, including participants from other cultures or participants from other age groups. The sample was also not balanced in terms of gender, with females being overrepresented and was not representative of professional athletes, a limitation that should also be addressed in subsequent studies. As self-reported data was used, responses could be influenced by different biases (e.g., social desirability), particularly about the self-reported time one spends on doing sports. Although the utilized threshold was based on prior empirical evidence, future studies should circumvent this limitation by either obtaining objective information about sport (e.g., performance, measuring actual time spent on doing sports via, for instance, smartwatches or fitness trackers) or by collecting responses from relevant others (e.g., coaches, team-mates) as well. The use of single-item measures is also a limitation that should be addressed by using multi-item scales to more fully grasp the actual engagement of the participants. The quality of engagement should also be assessed in future studies (see Hodge, Lonsdale, & Jackson, 2009, for an example). We also relied on a cross-sectional design, which precludes any form of directional or causal interpretation. Although the treatment of predictors and outcomes was guided by theoretical considerations, similar to variable-centered studies (e.g., Olafsen et al., 2018), future longitudinal person-centered studies are needed to establish directionality between the variables and to examine the within-person and within-sample stability of the profiles. While vitality and engagement-related correlates are important indicators, more variables could be included that are of additional relevance, such as competition or burnout. Given recent advancements in person-centered studies and basic psychological needs (Gillet et al., 2019; Tóth-Király, Bóthe, Orosz, & Rigó, 2018), it might be interesting to test how need fulfillment profiles are related to sport motivation profiles.

There is accumulating evidence on the field of SDT suggesting that autonomy-supportive interpersonal behavior (i.e., autonomy-supportive coaching) is cardinal in the development of self-determined motivations, need fulfillment and a range of outcomes such as decreased burnout and increased flow, wellbeing, engagement, goal motives or physical self-worth (e.g., Gaudreau et al., 2016; Healy, Ntoumanis, van Zanten, & Paine, 2014; Isoard-Gautheur, Guillet-Descas, & Lemyre, 2010; Smith, Ntoumanis, & Duda, 2010; Thøgersen-Ntoumani & Ntoumanis, 2006). These associations between the need-supportive behavior and self-determined motivations do not only hold...
within the context of sports, but outside of it as well (e.g., Wang, Morin, Ryan, & Liu, 2016). Social agents should aim to provide autonomy-support, involvement, and structure at the same time (Mageau & Vallerand, 2003; Yu, Chen, Levesque-Bristol, & Vansteenkiste, 2018) for their people engaged in sports. Autonomy-supportive atmosphere (i.e., the foundation of the need for autonomy) might be constructed by providing people engaged in sports with alternative choices and rationale behind the activities that they conduct and, at the same time, by relying on a non-evaluative and informational way of communication instead of the use of controlling language (i.e., “must”; Reeve & Jang, 2006). Structure (i.e., the foundation of the need for competition) is people’s perceived associations between how they behave and what the result is going to be. An optimal structure might be achieved by setting optimal yet challenging tasks, explicit rules, and directions, encouraging them to try to improve, and also by setting clear guidelines and goals. This way, people engaged in sports are more likely to know the consequences of their behavior. Finally, involvement (i.e., the foundation of the need for relatedness) is present when social agents are concerned with the people engaged in sports and that they understand their perspective. Additionally, in the case of team sports, peers also contribute to the experiences of relatedness as well. In sum, in accordance with Reeve and Halusic (2009), basic psychological needs as antecedents of motivations could easily be used to elicit more self-determined motivations and profiles, which, in turn, may lead to positive outcomes. Thus, incorporating elements of need-supportive interventions and practices into the training program could have substantive implications.

References


Figure 1
*Characteristics of the latent profiles based on sport motivations*

Note. Indicators are estimated from factor scores saved from preliminary measurement models with a mean of 0 and a standard deviation of 1 where zero signifies that a profile indicator is on an average level, scores substantially higher than zero are considered above average, while scores substantially lower than zero are considered below average.; IMOT: intrinsic motivation; EMIN: extrinsic motivation integrated regulation; EMID: extrinsic motivation identified regulation; EMIJ: extrinsic motivation introjected regulation; EMER: extrinsic motivation external regulation; AMOT: amotivation. Profile 1: Moderately Motivated; Profile 2: Highly Motivated; Profile 3: Amotivated; Profile 4: Poorly Motivated.
Table 1  
Previous person-centered studies on motivational profiles†

<table>
<thead>
<tr>
<th>Study</th>
<th>Participants</th>
<th>Profile factors</th>
<th>Method</th>
<th>#</th>
<th>Name of profiles</th>
</tr>
</thead>
</table>
| Boiché et al (2008)    | N = 210      | Intrinsic motivation toward stimulation, intrinsic motivation toward knowledge or accomplishment, identified regulation, introjected regulation, external regulation, amotivation | CA     | 3 | (1) self-determined with low amotivation  
(2) moderate with average amotivation  
(3) non-self-determined with high amotivation |
|                        | M<sub>age</sub> = 13.26 |                                                                                   |        |   |                                                                                  |
| Gillet et al. (2009)   | N = 170      | Intrinsic motivation, identified regulation, introjected regulation, external regulation, amotivation | CA     | 4 | (1) High autonomous – high controlled with low amotivation  
(2) Moderate autonomous – low controlled with low amotivation  
(3) High autonomous – moderate controlled with low amotivation  
(4) Moderate autonomous – high controlled with low amotivation |
|                        | M<sub>age</sub> = 13.42 |                                                                                   |        |   |                                                                                  |
|                        | N = 250      |                                                                                   |        | 3 | (1) Moderate autonomous – low controlled with low amotivation  
(2) Moderate autonomous – moderate controlled with low amotivation  
(3) High autonomous – high controlled with low amotivation |
|                        | M<sub>age</sub> = 15 |                                                                                   |        |   |                                                                                  |
| Gillet et al. (2012)   | N = 153      | Intrinsic motivation, identified regulation, introjected regulation, external regulation, amotivation | CA     | 3 | (1) Low motivation with low amotivation  
(2) Moderate motivation with low amotivation  
(3) High motivation with low amotivation |
|                        | M<sub>age</sub> = 14 |                                                                                   |        |   |                                                                                  |
|                        | N = 150      |                                                                                   |        | 3 | (1) Low motivation with low amotivation  
(2) Moderate motivation with low amotivation  
(3) High motivation with low amotivation |
|                        | M<sub>age</sub> = 41.29 |                                                                                   |        |   |                                                                                  |
| Guérin & Fortier (2012)| N = 120      | Intrinsic motivation, identified regulation, introjected regulation, external regulation | CA     | 3 | (1) self-determined  
(2) motivated  
(3) low motivated |
|                        | M<sub>age</sub> = 47.3 |                                                                                   |        |   |                                                                                  |
| Gustafsson et al. (2018)| N = 391     | Intrinsic motivation, identified regulation, introjected regulation, external regulation, amotivation | LPA    | 5 | (1) amotivation  
(2) low motivation with low amotivation  
(3) moderately autonomous with low amotivation  
(4) amotivated and moderately controlled  
(5) highly motivated with low amotivation |
|                        | M<sub>age</sub> = 20.6 |                                                                                   |        |   |                                                                                  |
| Lindwall et al. (2017) | N = 1084     | Intrinsic motivation, identified regulation, introjected regulation,               | LPA    | 6 | (1) low motivation  
(2) self-determined with high introjected regulation and low amotivation  
(3) self-determined with low introjected regulation and low amotivation |
<p>|                        | M&lt;sub&gt;age&lt;/sub&gt; = 45 |                                                                                   |        |   |                                                                                  |</p>
<table>
<thead>
<tr>
<th>Study</th>
<th>N</th>
<th>M age</th>
<th>Motivation/Regulation/Amotivation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Matsumoto &amp; Takenake (2004)</td>
<td>486</td>
<td>45.2</td>
<td>Intrinsic motivation, identified regulation, introjected regulation, external regulation, amotivation</td>
</tr>
<tr>
<td>Ntoumanis (2002)</td>
<td>428</td>
<td>14.84</td>
<td>Intrinsic motivation, identified regulation, introjected regulation, external regulation, amotivation, effort enjoyment, boredom, cooperation, unequal recognition</td>
</tr>
</tbody>
</table>

Note. † Literature search was performed on May 20, 2018.; N: sample size; M age: average age of the participants; CA: cluster analysis; LPA: latent profile analysis; PE: physical education; #: number of profiles identified in the study.
Table 2

Fit statistics for the latent profiles and class enumeration

<table>
<thead>
<tr>
<th>Model</th>
<th>LL</th>
<th># of fp</th>
<th>Scaling</th>
<th>AIC</th>
<th>CAIC</th>
<th>BIC</th>
<th>SSABIC</th>
<th>Entropy</th>
<th>aLMR</th>
<th>BLRT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Profile</td>
<td>-3808.890</td>
<td>12</td>
<td>0.925</td>
<td>7641.780</td>
<td>7704.498</td>
<td>7692.498</td>
<td>7654.409</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>2 Profiles</td>
<td>-3384.286</td>
<td>25</td>
<td>1.105</td>
<td>6818.572</td>
<td>6949.235</td>
<td>6924.235</td>
<td>6844.882</td>
<td>0.811</td>
<td>&lt; .001</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>3 Profiles</td>
<td>-3213.007</td>
<td>38</td>
<td>1.611</td>
<td>6502.015</td>
<td>6700.623</td>
<td>6662.623</td>
<td>6542.007</td>
<td>0.833</td>
<td>.421</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>4 Profiles</td>
<td>-3122.390</td>
<td>51</td>
<td>1.318</td>
<td>6346.779</td>
<td>6613.333</td>
<td>6562.333</td>
<td>6400.453</td>
<td>0.812</td>
<td>.085</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>5 Profiles</td>
<td>-3046.562</td>
<td>64</td>
<td>1.113</td>
<td>6221.125</td>
<td>6555.623</td>
<td>6491.623</td>
<td>6288.480</td>
<td>0.839</td>
<td>.016</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>6 Profiles</td>
<td>-2985.537</td>
<td>77</td>
<td>1.139</td>
<td>6125.074</td>
<td>6527.517</td>
<td>6450.517</td>
<td>6206.111</td>
<td>0.842</td>
<td>.389</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>7 Profiles</td>
<td>-2924.970</td>
<td>90</td>
<td>1.142</td>
<td>6029.941</td>
<td>6500.329</td>
<td>6410.329</td>
<td>6124.659</td>
<td>0.844</td>
<td>.124</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>8 Profiles</td>
<td>-2899.411</td>
<td>103</td>
<td>1.109</td>
<td>6004.823</td>
<td>6543.156</td>
<td>6440.156</td>
<td>6113.223</td>
<td>0.860</td>
<td>.033</td>
<td>&lt; .001</td>
</tr>
</tbody>
</table>

Note. LL: loglikelihood; # of fp: number of free parameters; AIC: Akaike Information Criterion; CAIC: constant AIC; BIC: Bayesian Information Criterion; SSABIC: Sample-Size Adjusted BIC; aLMR: p-value associated with the adjusted Lo-Mendell-Rubin likelihood ratio test; p-value associated with the bootstrap likelihood ratio test.
### Table 3

**Results from the multinominal logistic regressions for the effects of the predictors on profile membership**

<table>
<thead>
<tr>
<th>Predictors</th>
<th>Moderately Motivated vs. Highly Motivated</th>
<th>Moderately Motivated vs. Amotivated</th>
<th>Moderately Motivated vs. Poorly Motivated</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coeff. (SE)</td>
<td>OR</td>
<td>Coeff. (SE)</td>
</tr>
<tr>
<td>Need fulfillment</td>
<td>0.604 (0.211)**</td>
<td>1.829</td>
<td>-1.862 (0.308)**</td>
</tr>
<tr>
<td>Autonomy satisfaction</td>
<td>1.071 (0.248)**</td>
<td>2.918</td>
<td>-0.893 (0.314)**</td>
</tr>
<tr>
<td>Relatedness satisfaction</td>
<td>0.179 (0.204)</td>
<td>1.196</td>
<td>0.336 (0.234)</td>
</tr>
<tr>
<td>Competence satisfaction</td>
<td>0.078 (0.267)</td>
<td>1.081</td>
<td>-0.259 (0.233)</td>
</tr>
<tr>
<td>Autonomy frustration</td>
<td>0.444 (0.219)*</td>
<td>1.559</td>
<td>-0.050 (0.236)</td>
</tr>
<tr>
<td>Relatedness frustration</td>
<td>0.640 (0.245)**</td>
<td>1.896</td>
<td>0.085 (0.283)</td>
</tr>
<tr>
<td>Competence frustration</td>
<td>0.605 (0.252)**</td>
<td>1.831</td>
<td>-0.073 (0.274)</td>
</tr>
</tbody>
</table>

**Note.** SE: standard error associated with the coefficient; OR = odds ratio.; *p < .05; **p < .01; ***p < .001.

### Table 4

**Outcome means and pairwise comparisons between the four profiles of sports motivations**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Moderately Motivated</th>
<th>Highly Motivated</th>
<th>Amotivated</th>
<th>Poorly Motivated</th>
<th>Differences between profiles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SE)</td>
<td>Mean (SE)</td>
<td>Mean (SE)</td>
<td>Mean (SE)</td>
<td></td>
</tr>
<tr>
<td>Vitality</td>
<td>0.248 (0.067)</td>
<td>0.461 (0.073)</td>
<td>-0.731 (0.069)</td>
<td>-0.096 (0.055)</td>
<td>2 &gt; 1 &gt; 4 &gt; 3</td>
</tr>
<tr>
<td>Length of doing sports</td>
<td>-0.172 (0.096)</td>
<td>0.391 (0.075)</td>
<td>-0.386 (0.119)</td>
<td>0.127 (0.097)</td>
<td>2 &gt; 4 &gt; 1 = 3</td>
</tr>
<tr>
<td>Frequency of doing sports</td>
<td>-0.117 (0.068)</td>
<td>0.585 (0.133)</td>
<td>-0.493 (0.075)</td>
<td>-0.003 (0.091)</td>
<td>2 &gt; 4 = 1 &gt; 3</td>
</tr>
<tr>
<td>Duration of doing sports</td>
<td>75.854 (2.578)</td>
<td>91.538 (3.145)</td>
<td>67.645 (2.999)</td>
<td>83.941 (3.230)</td>
<td>4 = 1 &gt; 3; 2 &gt; 1; 2 = 4</td>
</tr>
</tbody>
</table>

**Note.** SE: standard error associated with the mean.; Outcomes (except for duration of doing sports) were estimated from factor scores with a mean of zero and a standard deviation of one where zero signifies that an outcome is on an average level, scores substantially higher than zero are considered above average, while scores substantially lower than zero are considered below average.
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Predictors and outcomes of core and peripheral sport motivation profiles: A latent profile analysis study

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We would also be happy to have some of these materials brought back into the main manuscript, or included as published appendices if you deem it useful. We developed these materials to provide additional technical information and to keep the main manuscript from becoming needlessly long.
Appendix 1: Results related to the preliminary measurement models estimated in the present study

Model Estimation

In the present study, before conducting the latent profile analysis (LPA), preliminary measurement models were estimated on the scales measuring sport motivations, need fulfillment, and subjective vitality. This initial step was necessary (1) to verify the psychometric properties of the instruments and (2) to create factor scores on the basis of these measurement model to serve as indicators in LPA. Given that fully latent variables cannot easily be included in mixture models as they would substantially increase model complexity and computation time, previous studies have shown that factor scores are better, relative to scale scores, at preserving the underlying nature of measurement models and at providing partial control for measurement errors by giving more weight to the items with lower measurement errors (Kam, Morin, Meyer, & Topolnytsky, 2016; Morin, Meyer, Creusier, & Biétry, 2016).

During the estimation of preliminary measurement models, we relied on the work of Morin and colleagues (Morin, Arens, & Marsh, 2016a; Morin, Arens, Tran, & Caci, 2016a; Morin et al., 2017) by investigating the potential sources of construct-relevant psychometric multidimensionality for the constructs of interest. In the case of multidimensional constructs, it is often the case that more than one source of construct-relevant psychometric multidimensionality is present in the data. The first source refers to the association between items and their relation to conceptually-related, yet non-target constructs. This source can be accounted for by including freely estimated cross-loadings in the measurement models in the form of exploratory structural equation modeling (ESEM; Marsh, Morin, Parker, & Kaur, 2014) when it is theoretically reasonable. Additionally, simulation studies (Morin et al., 2016a, 2016b) and reviews (Asparouhov, Muthén, & Morin, 2015) also underscore the importance of freely estimated cross-loadings that, when set to zero, result in bias parameter estimates (i.e., factor correlations) and could potentially modify the meaning of the construct at hand. Prior empirical motivational studies on real data also supported the importance of comparing competing CFA and ESEM models (Guay, Morin, Litalien, Valois, & Vallerand, 2015; Litalien, Guay, & Morin, 2015; Tóth-Király, Orosz, et al., 2017). For this reason, alternative CFA and ESEM models were contrasted for the SMS II.

The second source reflects on the simultaneous assessment of global and specific constructs that are expected to be co-existent. This source can be accounted for by including a global theoretically-relevant factor in the measurement model in the form of a bifactor model (Reise, 2012). In this model, the global (G-) factor is thought to be coexistent with the specific (S-) factors. Therefore, an important advantage of bifactor models is that they allow the total item covariance matrix to be partitioned into global components (corresponding to the shared variance among all items) and specific components (corresponding to the covariance in a subset of items not explained by the G-factor). This modeling approach is of major relevance for need fulfillment as it has been used in relation to need satisfaction (Sánchez-Oliva et al., 2017), need frustration (Myers, Martin, Ntoumanis, Celini, & Bartholomew, 2014) and need fulfillment (Tóth-Király, Morin, Bőthe, Orosz, & Rigó, 2018) as well. In addition, studies have also supported the use of bifactor modeling by showing that the G- and some (but not all) S-factors contribute to a wide range of outcomes (Sánchez-Oliva et al., 2017; Tóth-Király, Bőthe, Orosz, & Rigó, 2018). Based on these findings, building on first-order models, we contrasted bifactor CFA and ESEM models as suggested by Morin and colleagues (Morin et al., 2016a, 2016b, 2017). Given that subjective vitality is unidimensional, this construct was modelled following the standard CFA specification.

In model assessment, commonly used goodness-of-fit indices were relied on: the comparative fit index (CFI), the Tucker-Lewis Index (TLI), the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR). In the case of CFA and TLI, values higher than .90 and .95 are respectively to indicate adequate and excellent fit to the data; for RMSEA, values smaller than .08 or .06 for the RMSEA support acceptable and excellent model fit, respectively; and for SRMR, values below .05 are considered good and values below .10 are considered acceptable (Hu & Bentler, 1999; Marsh, Hau, & Grayson, 2005). At the same time, parameter estimates (i.e., factor loadings and correlations) associated with each model were also compared. Finally, model-based omega composite reliability (ω; McDonald, 1970) was calculated from the final measurement models to examine the reliability of the factors. Compared to Cronbach’s
alpha, omega has the advantage of providing a more realistic estimate of reliability by taking the standardized factor loadings and the corresponding error variances into account.

**Results**

As a first step, the adequacy of the measurement models was tested. Goodness-of-fit indices are reported in Table S1, while parameter estimates are presented in Table S2. For the SMS II, the fit of the CFA solution was borderline satisfactory and although the factors were well-defined by the corresponding factors loadings ($|\lambda| = .432$ to $.941, M = .759$), the associations between them ($|r| = .018$ to $.909; M = .561$) call into question the validity of this representation. Conversely, the ESEM solution did not only result in improved model fit ($\Delta CFI = +.060; \Delta TLI = +.071; \Delta RMSEA = -.063; \Delta SRMR = -.052$), but also similarly well-defined target factors ($|\lambda| = .249$ to $.886, M = .611$), reduced factor correlations ($|r| = .010$ to $.621; M = .364$), and small cross-loadings ($|\lambda| = .001$ to $.427, M = .108$) that do not undermine the definition of the factors. Latent correlations between the factors are reported in Table S3.

As for the predictor variable of need fulfillment, the comparison of the first-order CFA and ESEM solutions revealed that the ESEM solution had superior fit relative to the CFA one ($CFI: .989$ vs. $.954$; $TLI: .980$ vs. $.947$; $RMSEA: .043$ vs. $.070$; $SRMR: .018$ vs. $.047$). The examination of parameter estimates (Table S4) showed that factors were well-defined by their respective factor loadings ($ESEM: |\lambda| = .009$ to $.917, M = .598$; $CFA: |\lambda| = .353$ to $.887, M = .783$). Several cross-loadings were statistically significant, though these remained relatively small in magnitude ($|\lambda| = .011$ to $.616, M = .116$). One competence satisfaction item appeared to load more strongly on the opposing competence frustration factor, but it was deemed negligible as the definition of the factors was not undermined. Finally, inter-factor correlations were also reduced in the ESEM solution compared to the CFA one ($ESEM: |r| = .184$ to $.523, M = .363$; $CFA: |r| = .289$ to $.879, M = .604$; see Table S5). Based on the available information, the ESEM model was retained.

In the next step, the ESEM model was complemented with a general factor representing need fulfillment apart from the six specific factors. The fit of this model was also adequate ($CFI: .993$; $TLI = .985$; $RMSEA = .038$; $SRMR = .016$). Parameter estimates are reported in Table S6. In addition to the good fit, the general need fulfillment factor, which is of major theoretical relevance, was well-defined by the scale items ($|\lambda| = .251$ to $.774, M = .614$). While relatedness satisfaction ($|\lambda| = .507$ to $.822, M = .637$) retained a relatively high degree of specificity over and above the global factor, autonomy satisfaction ($|\lambda| = .207$ to $.596, M = .406$), autonomy frustration ($|\lambda| = .224$ to $.601, M = .439$), relatedness frustration ($|\lambda| = .341$ to $.623, M = .486$) and competence frustration ($|\lambda| = .337$ to $.598, M = .443$) retained a moderate amount of specificity, whereas competence satisfaction ($|\lambda| = .025$ to $.438, M = .188$) retained a relatively small amount of specificity once the global factor was taken into account. Finally, the magnitude of cross-loadings also decreased compared to the six-factor ESEM model ($|\lambda| = .001$ to $.236, M = .090$).

The Subjective Vitality Scale also had acceptable fit to the data (save for RMSEA) with correlated uniquenesses specified between two pairs of items. The first between items 6 and 7 was included a priori given the similar wording of these two items, while another one was included between items 1 and 2 during the preliminary analysis following the suggestions of modification indices. The inspection of standardized parameter estimates revealed a well-defined vitality factor ($|\lambda| = .687$ to $.935, M = .800$). Model-based reliabilities for all models—which can be seen in Table S8—indicate generally acceptable levels of reliability. In the case of the bifactor model, it also needs to be noted that S-factors are generally weaker in bifactor models where a global factor is modelled. Finally, these reliability indices highlight that it is important to rely on models with latent variables given that these are naturally corrected for measurement error and it would be more concerning if the present study relied on scale scores instead of completely reliable factor scores. Subsequently, these factor scores were saved and served as a basis for the correlation analyses (Table S8) and the LPA.
References used in the supplementary document


### Table S1

*Goodness-of-Fit Statistics for the Estimated Models*

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<tr>
<th>Model</th>
<th>$\chi^2$</th>
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<th>TLI</th>
<th>RMSEA</th>
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</table>

*Note.* CFA: Confirmatory factor analysis; ESEM: Exploratory structural equation modeling; $\chi^2$: Robust chi-square test of exact fit; df: Degrees of freedom; CFI: Comparative fit index; TLI: Tucker-Lewis index; RMSEA: Root mean square error of approximation; 90% CI: 90% confidence interval of the RMSEA. *p < 0.01.
### Table S2

Parameter estimates for the six-factor CFA and ESEM solutions of the Sport Motivation Scale

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<td>EMIN (λ)</td>
<td>EMID (λ)</td>
<td>EMIJ (λ)</td>
<td>EMER (λ)</td>
<td>AMOT (λ)</td>
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**Note.** CFA: Confirmatory factor analysis; ESEM: Exploratory structural equation modeling; λ: Factor loading; δ: Item uniqueness; Target factor loadings are in bold.; *p < .05; **p < .01.
Table S3

Latent Factor Correlations from the Six-Factor CFA and ESEM Solutions for the Sport Motivation Scale

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<th>Introjected</th>
<th>External</th>
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Note. CFA: Confirmatory factor analysis; ESEM: Exploratory structural equation modeling; Values above the diagonal are from the ESEM model; Values below the diagonal are from the CFA model.; * p < .05; ** p < .01.
### Table S4

Parameter estimates the six-factor CFA and ESEM solutions of the BPNSFS

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**Note.** CFA: Confirmatory factor analysis; ESEM: Exploratory structural equation modeling; S: Need satisfaction; Fr: Need frustration; A: Need for autonomy; C: Need for competence; R: Need for relatedness; λ: Factor loading; δ: Item uniqueness; Target factor loadings are in bold; *p < .05; **p < .01.
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*Note.* CFA: Confirmatory factor analysis; ESEM: Exploratory structural equation modeling; Values above the diagonal are from the ESEM model; Values below the diagonal are from the CFA model.; * p < .05; ** p < .01.
Table S6
Parameter estimates for the bifactor-ESEM solution of need fulfillment including one general factor and six specific factors

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Note. Fu: Global (G-Factor) representing need fulfillment; S-Factors: Specific factors from the bifactor model; S: Need satisfaction; Fr: Need frustration; A: Need for autonomy; C: Need for competence; R: Need for relatedness; λ: Factor loading; δ: Item uniqueness; Target factor loadings are in bold.; *p < .05; **p < .01.
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*Note.* Vit: Vitality; λ: Factor loading; δ: Item uniqueness; Target factor loadings are in bold.; *p < .05; **p < .01
## Table S8
### Correlations and reliability indices for the variables of the study

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</tr>
<tr>
<td>17</td>
<td>.230</td>
<td>.376</td>
<td>.199</td>
<td>.354</td>
<td>.033</td>
<td>-.235</td>
<td>.120</td>
<td>.176</td>
<td>-.090</td>
<td>.021</td>
<td>.056</td>
<td>.125</td>
<td>.001</td>
<td>.201</td>
<td>.125</td>
<td>.291</td>
<td></td>
</tr>
</tbody>
</table>

### Note.
IMOT: intrinsic motivation; EMIN: extrinsic motivation integrated regulation; EMID: extrinsic motivation identified regulation; EMII: extrinsic motivation introjected regulation; EMER: extrinsic motivation external regulation; AMOT: amotivation; N-Fu: need fulfillment global factor; A-Sa: autonomy satisfaction; R-Sa: relatedness satisfaction; C-Sa: competence satisfaction; A-Fr: autonomy frustration; R-Fr: relatedness frustration; C-Fr: competence frustration; VIT: vitality; \( \omega \): McDonald’s model-based omega reliability coefficient; \(* p < .05; ** p < .01.\)
Table S9
Classification Probabilities for the Most Likely Latent Profile Membership (Column) by Latent Profile (Row)

<table>
<thead>
<tr>
<th></th>
<th>Average motivated</th>
<th>Introjected self-determined</th>
<th>Amotivated</th>
<th>Non-self-determined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average motivated</td>
<td>0.880</td>
<td>0.028</td>
<td>0.025</td>
<td>0.067</td>
</tr>
<tr>
<td>Introjected self-determined</td>
<td>0.037</td>
<td>0.924</td>
<td>0.000</td>
<td>0.040</td>
</tr>
<tr>
<td>Amotivated</td>
<td>0.034</td>
<td>0.000</td>
<td>0.910</td>
<td>0.056</td>
</tr>
<tr>
<td>Non-self-determined</td>
<td>0.076</td>
<td>0.019</td>
<td>0.037</td>
<td>0.868</td>
</tr>
</tbody>
</table>
Table S10

*Exact means of the different motivations in the final retained 4-profile solution*

<table>
<thead>
<tr>
<th></th>
<th>Average motivated (Profile 1)</th>
<th>Introjected self-determined (Profile 2)</th>
<th>Amotivated (Profile 3)</th>
<th>Non-self-determined (Profile 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Variance</td>
<td>Mean</td>
<td>Variance</td>
</tr>
<tr>
<td>1. IMOT</td>
<td>0.046</td>
<td>0.496</td>
<td>-1.037</td>
<td>0.306</td>
</tr>
<tr>
<td>2. EMIN</td>
<td>-0.123</td>
<td>0.270</td>
<td>-1.100</td>
<td>0.352</td>
</tr>
<tr>
<td>3. EMID</td>
<td>-0.082</td>
<td>0.369</td>
<td>-1.104</td>
<td>0.301</td>
</tr>
<tr>
<td>4. EMIJ</td>
<td>-0.085</td>
<td>0.258</td>
<td>-1.008</td>
<td>0.364</td>
</tr>
<tr>
<td>5. EMER</td>
<td>-0.532</td>
<td>0.227</td>
<td>0.228</td>
<td>0.581</td>
</tr>
<tr>
<td>6. AMOT</td>
<td>-0.447</td>
<td>0.143</td>
<td>-0.615</td>
<td>0.326</td>
</tr>
</tbody>
</table>

Note. IMOT: intrinsic motivation; EMIN: extrinsic motivation integrated regulation; EMID: extrinsic motivation identified regulation; EMIJ: extrinsic motivation introjected regulation; EMER: extrinsic motivation external regulation; AMOT: amotivation; Factors were estimated from factor scores with a mean of 0 and a standard deviation of 1.
**Figure S1**

*Elbow plot for the information criteria used in class enumeration*

*Note.* AIC: Akaike Information Criterion; BIC: the Bayesian Information Criterion; CAIC: Constant AIC; SSABIC: Sample-Size-Adjusted BIC.