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7 Need Satisfaction and Need Frustration as Distinct and Potentially Co-Occurring Constructs:

8 Need Profiles Examined in Physical Education and Sport

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21 All authors declare that they have no conflict of interest.

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Abstract

We explored the combined relationships between need satisfaction and need frustration and their simultaneous associations with motivation, well-being, and ill-being. Data from two cross-sectional samples that represent different physical activity contexts, physical education (N = 274; $M_{\text{age}} = 14.18 \pm 1.42$ years) and leisure-time sport (N = 160; $M_{\text{age}} = 22.98 \pm 8.79$ years), are reported. The identification of distinctive subgroups (need profiles) which had unique associations with motivation, well-being, and ill-being provided evidence for the distinct, yet co-occurring nature of need satisfaction and need frustration and the asymmetrical relationship between need satisfaction and need frustration. Our results suggest that experiencing need satisfaction without need frustration was the most adaptive need profile. Experiences of need satisfaction partly countered the effects of need frustration on motivation, well-being, and ill-being. The current study enhances our understanding of people's psychological need experiences, motivation, and psychological health though highlighting the importance of examining need satisfaction and need frustration in combination rather than isolation.

Keywords: profiles; need satisfaction; need frustration; physical education; sport

Introduction

Research grounded in Basic Psychological Need Theory (BPNT, Deci & Ryan, 1985; Ryan & Deci, 2002) has increasingly focused on both the bright and dark sides of the three basic psychological needs, exploring their simultaneous associations with motivation and psychological functioning (Haerens, Aelterman, Vansteenkiste, Soenens, & Petegem, 2015; Ryan & Deci, 2000). The more recent emphasis on the dark motivational pathway stemmed from the identification of need satisfaction and need frustration as distinct constructs with specific antecedents and outcomes (Bartholomew, Ntoumanis, Ryan, Bosch & Thogersen-Ntoumani, 2011a; Bartholomew, Ntoumanis, Ryan, & Thogersen-Ntoumani, 2011b; Vansteenkiste & Ryan, 2013). Consequently, it is possible that one can experience both the satisfaction and frustration of the three psychological needs within the same environment (Bartholomew et al., 2011b). It is, therefore, important to examine the combined relations between these distinct but potentially co-occurring constructs. In this paper we sought to address this fundamental and understudied issue through examining perceived ‘need profiles’ and their relations with motivation and psychological functioning in two contrasting physical activity contexts, compulsory physical education (PE) and voluntary leisure-time sport.

Basic Psychological Needs and the Motivational Pathways

Basic Psychological Need Theory, one of six mini theories in Self-Determination Theory (SDT), suggests that three basic psychological needs for autonomy (feeling volitional), competence (feeling effective), and relatedness (feeling connected) are essential for human functioning and development (Deci & Ryan, 2000). The theory proposes that when the social environment supports these three basic psychological needs, individuals will experience need satisfaction, autonomous motivation, optimal functioning, and psychological growth (bright motivational pathway). Whereas when the social environment thwarts these needs, individuals will experience need frustration, controlled motivation, non-optimal functioning and psychological ill-health (dark motivational

64 pathway). Thus, experiences of need satisfaction and need frustration can directly influence an
65 individuals' motivation and functioning. Autonomous motivation and well-being occur when
66 autonomy, competence, and relatedness needs are satisfied and individuals engage in activities because
67 they enjoy them or find them inherently interesting (i.e., intrinsic motivation) or valuable (i.e.,
68 identified regulation; e.g., Markland & Tobin, 2010; Milyavskaya & Koestner, 2011). Controlled
69 motivation and ill-being occur when the three psychological needs are frustrated and individuals
70 engage in activities purely to gain rewards or avoid punishments (i.e., external regulation) or escape
71 feelings of guilt/shame and attain feelings of worth (i.e., introjected regulations; e.g., Bartholomew et
72 al., 2018; Haerens et al., 2015). Need frustration has also been associated with 'giving up' and a
73 complete lack of an intention to act (i.e., amotivation; Bartholomew et al., 2018).

74 Research exploring the bright pathway has been prolific with substantial evidence accumulating
75 across multiple life domains, including sport, (Adie, Duda, & Ntoumanis, 2008), education (Reeve &
76 Jang, 2006), health (Halvari, Halvari, Bjørnebekk, & Deci, 2013) work (Van den Broeck,
77 Vansteenkiste, De Witte, Soenens, & Lens, 2010), and interpersonal relationships (Patrick, Knee,
78 Canevello, & Lonsbary, 2007). Within this pathway experiences of need satisfaction, whereby
79 individuals feel they are good at what they do, connected to those around them, and free to make
80 decisions and choose a course of action, have consistently predicted autonomous motivation and
81 psychological and physical well-being (e.g., Milyavskaya & Koestner, 2011; Mouratidis,
82 Vansteenkiste, Sideridis, & Lens, 2011; Williams et al., 2011). However, despite this strength of
83 evidence for the brighter motivational pathway, early work on the darker motivational pathway was
84 less convincing. Initially, non-optimal functioning and the darker motivational pathway was explored
85 through examining low levels of need satisfaction. However, research findings were equivocal, with the
86 strength of associations between low need satisfaction and indices of ill-being, at best, being weak, and
87 in some cases completely absent (Adie et al., 2008; Quested & Duda, 2010). These findings led to the

88 suggestion that the psychological needs are more influential for optimal than non-optimal functioning
89 (Adie et al., 2008; Quested & Duda, 2010).

90 **Low Need Satisfaction and Need Frustration**

91 Given the potential explanatory role of basic psychological needs in non-optimal motivation
92 and even severe maladjustment, a conceptual extension of the theory was necessary. Researchers
93 argued that low scores on measures of need satisfaction did not relate robustly to indices of
94 malfunctioning because they did not adequately capture the intensity of feeling characterized by
95 experiences of need frustration (Bartholomew et al., 2011b; Ryan, Deci & Vansteenkiste, 2016). For
96 instance, individuals who experience low need satisfaction may report feelings of not having as many
97 choices as they would like, not being supported by others, and not being very good at something.
98 Whereas an individual who experiences need frustration would report feelings of being pushed or
99 forced into activities, rejected or excluded from a group, and of being heavily criticized. Whilst low
100 levels of need satisfaction may be associated with less vitality and excitement for physical activity,
101 experiences of need frustration is more likely to be associated with controlled motivation, amotivation
102 and even burnout and other pathological behaviors amongst individuals in these settings. Thus, a
103 distinction needed to be made between a lack of need satisfaction and experiences of need frustration.
104 The differences in the intensity of feelings that conceptually distinguish between the two constructs has
105 led to the suggestion that they may be best viewed as asymmetrical, in that low need satisfaction does
106 not necessarily involve need frustration but need frustration does involve experiences of low need
107 satisfaction (Vansteenkiste & Ryan, 2013).

108 Initial work establishing need satisfaction and need frustration as distinct constructs was
109 conducted in the sport domain (Bartholomew et al., 2011ab). In their research, Bartholomew and
110 colleagues (2011b), were able to provide support for the distinctiveness of need satisfaction and need
111 frustration through developing, validating, and testing a measure of psychological need frustration.

112 Initial support for the incremental predictive validity of the need frustration subscales was also
113 provided in that need frustration accounted for additional variance in vitality and exhaustion above and
114 beyond that due to need satisfaction. As expected, need frustration added especially to the prediction of
115 exhaustion, the negative outcome. Moreover, further support for the utility of considering need
116 frustration at both between- and within-person levels was provided in a second paper by Bartholomew
117 and colleagues (2011a). Across three separate samples, they simultaneously examined both the bright
118 and dark motivational pathways. Athletes' perceptions of need satisfaction were more strongly related
119 to positive outcomes such as vitality and positive affect, whereas their experiences of need frustration
120 more consistently predicted maladaptive outcomes such as disordered eating, burnout, depression, and
121 perturbed physiological arousal.

122 Evidence for the factorial validity of need frustration as distinct from need satisfaction has also
123 been evidenced in the development of additional measures that capture both need experiences at the
124 general domain level rather than the domain specific level, for example the Balanced Measurement of
125 Psychological Needs scale (Sheldon & Hilpert, 2012) and the Basic Psychological Need Satisfaction
126 and Frustration scale (Chen et al., 2015). It has been demonstrated that this distinction was not simply
127 due to effects associated with the positive (satisfaction) versus negative (frustration) scale items (Costa,
128 Ntoumanis, & Bartholomew, 2014). Moreover, the predictive validity of need frustration in terms of
129 the robust relations between need frustration and controlled motivation and maladaptive outcomes,
130 such as negative affect (Stebbing, Taylor, Spray, & Ntoumanis, 2012; Teixeira, Silva, Palmeria,
131 2018), exhaustion (Bartholomew, Ntoumanis, Cuevas, & Lonsdale, 2014; Stebbings et al., 2012),
132 disengagement (Jang, Kim, & Reeve, 2016), depressive symptoms (Chen et al., 2015), compromised
133 relational functioning (Costa et al., 2014), and psychological distress (Teixeira et al., 2018), have been
134 consistently exhibited across multiple contexts including health (Halvari, Halvari, Williams, & Deci,
135 2017), work (Olafsen, Niemiec, Halvari, Deci, & Williams, 2017), interpersonal relationships (Costa et

136 al., 2014), exercise (Teixeria et al., 2018), compulsory physical education (Haerens et al., 2015) and
137 voluntary sport (Bartholomew et al., 2011ab). The distinct role of need frustration has also been found
138 in studies using longitudinal (Jang et al., 2016) and diary designs (Mabbe, Soenens, Vansteenkiste, Van
139 der Kaap-Deeder & Mouratdis, 2018; Van der Kaap-Deeder, Vansteenkiste, Soenens & Mabbe, 2019)
140 and it is proposed that need frustration may represent a critical transdiagnostic process, that helps to
141 explain the covariation between different forms of problem behaviour (Campbell, Boone,
142 Vansteenkiste & Soenens, 2018). The emergence of need frustration as both conceptually and
143 empirically distinct from low need satisfaction has provided a more nuanced understanding of both
144 optimal and non-optimal functioning. However, we know little about the combined relations between
145 these distinct but potentially co-occurring constructs and their resulting associations with positive and
146 negative outcomes.

147 **Need Profiles**

148 Observations of physical activity environments often reveal mixed patterns of positive and
149 negative events (Smoll & Smith, 2002). These events may have the potential to facilitate feelings of
150 both need satisfaction and need frustration which may, in turn, be simultaneously associated with
151 motivation and psychological health. This was alluded to in the work of Bartholomew and colleagues
152 (2011a), for example, when the need for autonomy was highly frustrated, greater autonomy satisfaction
153 was related to less exhaustion, whereas when autonomy frustration was lower, satisfaction was not
154 associated with exhaustion. It appears that there may simultaneous effects of need satisfaction and need
155 frustration on the outcomes experienced by individuals. Indeed, in the exercise setting need
156 satisfaction, due to its associations with autonomous motivation, was found to have a small protective
157 effect against the negative effects of need frustration on psychological well-being, suggesting that there
158 may be an optimal need satisfaction and need frustration profile (Teixeira et al., 2018). However, since
159 these studies and much of the research on need satisfaction and need frustration carried out to date has

160 taken a variable-centered approach, our understanding of the concomitant associations of need
161 frustration and need satisfaction with motivation and psychological health is limited.

162 Over the last 20 years, person-centered approaches have increased in popularity due to their
163 contribution to both our theoretical and practical understanding of motivation (e.g., Haerens et al.,
164 2018; Ntoumanis, 2002; Vansteenkiste, Sierens, Soenens, Luyckx, & Lens, 2009; Wang & Biddle,
165 2001, Wang, Morin, Liu, & Chian, 2016). These approaches enable us to explore questions about how
166 motivational constructs combine through identifying specific subgroups with different patterns of
167 relationships to motivational variables, rather than how relationships apply to the average person in the
168 sample (Morin & Wang, 2015; Wang et al., 2016). The benefits of employing a person-centered
169 approach to SDT and its constructs is described in previous work in relation to profiles of autonomous
170 and controlled motivation (e.g., Vansteenkiste et al., 2009) and profiles of need supportive and need
171 thwarting behaviours (e.g., Haerens et al., 2018). These can also be applied to profiles of need
172 satisfaction and need frustration given their distinct but co-occurring nature.

173 Specifically, person-centered approaches provide a test of the distinctiveness of need
174 satisfaction and need frustration depending on the number and combinations of profiles that emerge
175 from the data. If these constructs are distinct, the number of profiles that emerge should be more than
176 just profiles characterized by simple opposites (high-low, low-high). On the other hand, if the
177 constructs are not distinct and instead fall along a single continuum, then a limited number of profiles
178 should emerge since individuals could not perceive need satisfaction and frustration to be
179 simultaneously high or low (Haerens et al., 2018; Vansteenkiste et al., 2009). The use of need profiles
180 will also allow for the proposition of asymmetry between low need satisfaction and need frustration to
181 be empirically tested (Vansteenkiste & Ryan, 2013). If, by definition, need frustration must involve low
182 levels of need satisfaction, a high satisfaction-high frustration profile should not emerge. Moreover,
183 with a person-centered approach it is also possible to explore how the combination of experiencing

184 need satisfaction and need frustration within an environment is associated with motivation and
185 psychological health. We can explore the additive and interactive associations of need satisfaction and
186 frustration in relation to optimal and non-optimal functioning (Vansteenkiste et al., 2009). For example,
187 can need frustration be beneficial to an individual, and is this influenced by simultaneous perceptions
188 of need satisfaction which can serve to counter the distinct negative effects of need frustration, or is
189 need frustration universally maladaptive? Exploring these questions is vital if we are to provide a more
190 nuanced theoretical and practical understanding of these key motivational constructs.

191 **The Present Study**

192 The purpose of the present study was to examine within-person combinations (i.e. profiles) of
193 need satisfaction and need frustration and to examine associations between these profiles and
194 motivation, well-being, and ill-being. We explored this within two physical activity contexts that
195 represented both a compulsory (PE) and voluntary (sport) participation setting. Many people's early
196 experiences of sport and physical activity are within a compulsory PE setting before choosing to
197 engage in voluntary sport later in life. It is, therefore, important to understand people's psychological
198 need experiences and their associated outcomes in both these types of settings. We sought to provide a
199 strong test of the distinctiveness of need satisfaction and need frustration through exploring the
200 emergent profiles in two samples which differed in the extent to which participants could choose to
201 participate in physical activity, a compulsory PE setting and a voluntary leisure-time sport setting.
202 Individuals in a voluntary sport setting may experience less need frustration and more need satisfaction
203 given the optional nature of participation and thus we expected differences in the profile characteristics
204 to emerge in the two samples. Furthermore, compulsory and voluntary physical activity settings offer
205 an important application of the constructs outlined in the introduction because they are environments
206 where both need supports and need thwarts could be salient. Although many teacher/coach behaviors
207 have positive effects on students and athletes, maladaptive teaching and coaching strategies are not

208 altogether uncommon (Bartholomew, Ntoumanis, & Thogersen-Ntoumani, 2009; Soenens, Sierens,
209 Vansteenkiste, Dochy, & Goossens, 2012).

210 We employed a person-centered approach to identify need profiles that represented distinctive
211 subgroups characterized by differences in experiences of need satisfaction and need frustration. It was
212 anticipated, based on the previous research which has established the distinct and co-occurring nature
213 of need satisfaction and need frustration, that two profiles would emerge that were characterized by
214 differences in need satisfaction and need frustration (high-low and low-high). Furthermore, because we
215 hypothesized that need satisfaction and need frustration are distinct constructs, we also anticipated that
216 other profiles may emerge which could be characterized as moderate on one or both of need
217 satisfaction or need frustration. We did not expect a high-high profile to emerge since need satisfaction
218 and need frustration are proposed to be asymmetrical (Vansteenkiste & Ryan, 2013).

219 In addition, we examined whether there were any differences in the associations with optimal
220 (e.g., autonomous motivation, well-being, and enjoyment) and non-optimal functioning (e.g., controlled
221 motivation and burnout) through experiencing different combinations of need satisfaction and need
222 frustration. It was anticipated that the profile characterized as high need satisfaction-low need
223 frustration would be associated with more optimal outcomes, whereas the profile characterized as low
224 need satisfaction-high need frustration would be associated with more non-optimal outcomes. We were
225 also interested in exploring whether the other profiles that emerged would provide evidence to support
226 a protective effect of need satisfaction, in that need satisfaction may offset the negative effects of need
227 frustration to a certain extent. It might be that experiences of need frustration are not universally
228 maladaptive if they are also accompanied by feelings of need satisfaction. Moreover, since we did not
229 expect the sport sample to experience high need frustration due to the voluntary nature of their
230 participation, we were also interested to see whether absolute or relative levels of need frustration were
231 critical to optimal or non-optimal functioning. For example, do individuals who score low on need

232 frustration (i.e., below scale mid-point), but are considered high relative to the rest of the sample in
233 profile analyses, still experience non-optimal functioning?

234 **Method**

235 **Participants**

236 Two independent samples were collected for the study. Sample 1 consisted of a total of 274 PE
237 students ($n = 135$ males; $n = 139$ females) from a secondary high school located in the East of England,
238 United Kingdom. The students were aged between 11 to 16 years ($M = 14.18$, $SD = 1.42$) and were in
239 school years 7-11 (Year 7, $n = 54$; Year 8, $n = 58$; Year 9, $n = 58$; Year 10, $n = 53$; Year 11, $n = 51$).
240 Although ethnicity data were not formally recorded, the vast majority of students were white. Students
241 were taught in single-sex and mixed ability classes for PE. When data was collected students were
242 participating in activities of athletics, rounders, cricket, and football.

243 Sample 2 focused on a voluntary leisure-time sport setting and involved 160 athletes ($n = 73$
244 males; $n = 87$ females) from community and university sports clubs. The participants were aged
245 between 12 to 55 years ($M = 22.98$, $SD = 8.79$) and the majority were White British (92.5%;
246 Black/Black British 1.9%; Mixed Parentage 2.5%; Asian/Asian British 0.6%; other ethnicities 2.5%).
247 They were participating in 14 different sports (individual sports $n = 74$; team, $n = 86$) and competed at
248 either club (27.5%), county (19.4%), or national (53.1%) level. Participants had an average of 6.46
249 years participating in their sport ($SD = 5.84$).

250 **Procedure**

251 In both samples, ethical approval for the research procedures was obtained from the lead
252 author's institutional body and followed the guidelines of the British Psychological Society. In the PE
253 sample, data was collected in the summer term of the school year by a trained research assistant who
254 led the data collection and was available to answer any questions. At the start of a normal curriculum
255 PE lesson, students completed an anonymous multi-section questionnaire, which took approximately

256 10 minutes to complete in quiet classroom conditions. The research assistant was available to support
257 any student with reading the items of the questionnaire.

258 In voluntary sport sample, athletes were provided with an anonymous multi-section
259 questionnaire to complete either in person or were emailed the link to an online version, which was
260 created using Smart Survey. The questionnaire took approximately 15 minutes to complete, with
261 82.4% of data collected through the online survey and 17.6% through completing the paper
262 questionnaire under the supervision of the research assistant. Following the completion of the
263 questionnaire, the participants were informed they could contact the research assistant at any time
264 using the details provided on their information sheet should they have any further questions.

265 **Measures**

266 Participants completed a multi-section questionnaire that collected the following information.
267 Students and athletes both completed:

268 **Personal details.** In the PE sample, this section of the questionnaire contained questions related
269 to age, gender, and year group. In the voluntary sport sample, this section contained questions related to
270 age, gender, ethnicity, sport, level of participation, and length of time of participation.

271 **Psychological Need Satisfaction.** The degree to which students or athletes experienced
272 satisfaction of the three psychological needs was assessed using 15 items derived from three previously
273 validated questionnaires. The satisfaction of the need for autonomy was assessed using five items
274 (Standage, Duda, & Ntoumanis, 2003); an example item is 'I have some choice in what I want to do'.
275 The satisfaction of the need for competence was assessed using the five items of the competence
276 subscale within the Intrinsic Motivation Inventory (IMI; McAuley, Duncan & Tammen, 1989). An
277 example item is 'I think I do pretty well in comparison to other players/athletes/students'. Finally, the
278 satisfaction of the need for relatedness was assessed using the five item acceptance subscale of the
279 Need for Relatedness Scale (Richer & Vallerand, 1998). An example item is 'I feel valued'. In sample

280 1 all items were preceded by the stem of ‘most recently in PE...’, while in sample 2 the stem of ‘most
281 recently in my sport...’ was used. Responses were scored on a 7-point Likert scale which ranged from
282 strongly disagree (1) to strongly agree (7). All subscales have demonstrated adequate construct validity
283 and internal reliability in previous research conducted within sport and PE contexts (e.g., Bartholomew
284 et al., 2011ab; Standage et al., 2003).

285 **Psychological Need Frustration.** In both samples the degree to which students or athletes
286 experienced frustration of the three psychological needs was assessed using the 12-item Psychological
287 Need Thwarting Scale (PNTS; Bartholomew et al., 2011b). Four items assessed each subscale and were
288 measured on a 7-point Likert scale, ranging from strongly disagree (1) to strongly agree (7). In sample
289 1, the items were modified for the PE context and preceded by the stem ‘in a PE lesson...’ Example
290 items for each subscale are, ‘I feel prevented from making choices with regards to the way I learn’,
291 (Autonomy), ‘There are situations where I am made to feel I am not very good at PE.’ (Competence),
292 and ‘I feel I am rejected by those around me.’ (Relatedness). In sample 2, the original items of the
293 PNTS were used and were preceded by the stem ‘in my sport...’ Example items are ‘I feel prevented
294 from making choices with regard to the way I train (Autonomy), ‘situations occur in which I am made
295 to feel incapable’ (Competence), and ‘I feel other people dislike me’ (Relatedness). The construct
296 validity and internal reliability of the PNTS has been evidenced in previous research (Bartholomew et
297 al., 2011ab; Costa, Coppolino, & Olivia, 2015).

298 Students in the PE sample completed the following measure:

299 **Behavioral Regulations in Physical Education.** Students’ motivational regulations were
300 assessed using the Perceived Locus of Causality scale (PLOC: Goudas, Biddle, & Fox, 1994). Four
301 items assessed each type of motivational regulation using a 7-point Likert scale, ranging from strongly
302 disagree (1) to strongly agree (7), items were preceded by the stem ‘I take part in PE...’. Example
303 items include ‘but I don’t know why’ (amotivation), ‘because that is what I am supposed to do’

304 (external), ‘because I would feel bad about myself if I didn’t’ (introjected), ‘because it is important for
305 me to do well in PE’ (identified), and ‘because PE is fun’ (intrinsic). The PLOC scale has evidenced
306 acceptable levels of reliability and validity in previous research both within the UK and across
307 cultures (Wang, Hagger, & Liu, 2009).

308 While athletes in the voluntary sport sample, completed the measures of:

309 **Enjoyment.** The degree to which athletes experienced enjoyment during their training sessions
310 was assessed using the 7-item Interest/Enjoyment subscale from the IMI (McAuley et al., 1989). The
311 items followed the stem ‘most recently I have...’ and were adapted to suit the sport training and
312 coaching context. Items were scored on a 7-point Likert scale, from strongly disagree (1) to strongly
313 agree (7). An example item was ‘found training very interesting’, the IMI’s subscales have exhibited
314 acceptable construct validity and internal reliability in previous research (Tsigilis & Theodosiou, 2003).

315 **Well-being.** To assess the degree to which athletes felt positive energy most recently, a 5-item
316 version of the Subjective Vitality Scale (SVS; Ryan & Frederick, 1997) was used. This was scored on a
317 7-point Likert scale, from strongly disagree (1) to strongly agree (7), with items following the stem
318 ‘most recently when doing my sport I have...’. An example item is ‘felt alive and full of vitality’. The
319 scale has demonstrated adequate construct validity and internal reliability in previous research (e.g.,
320 Gagné, Ryan, & Bargmann, 2003; Reinboth, Duda, & Ntoumanis, 2004).

321 **Burnout.** Athletes’ symptoms of burnout were assessed using the 15-item Athlete Burnout
322 Questionnaire (ABQ; Raedeke & Smith, 2001). The measure consists of three, 5-item subscales which
323 measure physical and emotional exhaustion (e.g., ‘wiped out from my sport’), reduced accomplishment
324 (e.g., I am not achieving much in my sport’) and sport devaluation (e.g., ‘less concerned about being
325 successful in my sport than I used to’). Each item followed the stem ‘usually, when training for my
326 sport with my coach I feel...’ and answers were given on a 5-point Likert scale of strongly disagree (1)

327 to strongly agree (5). The scale has demonstrated adequate construct validity and internal reliability in
328 previous research (Lemyre, Roberts, & Stray-Gundersen, 2007).

329 **Data Analysis**

330 In both samples, means, standard deviations, correlations, and internal consistency estimates
331 were computed for all study variables and Confirmatory Factor Analyses were performed on all
332 measures. Person-centred analyses were employed to examine our research question concerning the
333 existence of different psychological need profiles. Multivariate Analysis of Variance (MANOVA) was
334 used to explore whether experiencing different combinations of need satisfaction and need frustration
335 had associations with the motivation, well-being, and ill-being experienced by students and athletes.

336 Specifically, a hierarchical cluster analysis was conducted with the whole sample to identify
337 groups of students/athletes based on their experiences of need satisfaction and need frustration. Prior to
338 the cluster analysis, the cases with missing data on any of the two needs were excluded (sport sample n
339 = 2). In addition, all the variables were standardized using Z scores (mean of 0 and a standard deviation
340 of 1). Z scores of greater than +/-0.5 were used as criteria to describe whether a profile scored relatively
341 'high' or 'low' in comparison to their peers.

342 For both samples, we used the hierarchical cluster method whereby each observation starts out
343 as its own cluster. Subsequently, new clusters are formed by the combination of the most similar
344 clusters until either all clusters are grouped into one cluster or the researcher considers that a
345 parsimonious solution has been achieved. Ward's method was used in the hierarchical cluster analysis,
346 as this can minimize the within-cluster differences and to avoid problems with forming long, snake-like
347 chains found in other methods (Aldenderfer & Blashfield, 1984). The agglomeration schedules and
348 dendrogram were used to determine the potential number of clusters that existed within the data. To
349 check the replicability of the cluster solution we followed the procedures outlined in Haerens et al.
350 (2018), we randomly split each of the sample (students and athletes) in half. We used the first half to

351 determine the clusters using a k-mean clustering methods with random initial seed points. For the
352 second half, another k-mean was conducted using the centroid values obtained from the hierarchical
353 methods as the initial seed points. The original and newly obtained clusters were compared using
354 kappa-index. A one-way Multivariate Analysis of Variance (MANOVA) was used to establish that the
355 need profiles were significantly different in their experiences of need satisfaction and need frustration,
356 while the five behavioral regulations were used to compare across the profiles to establish concurrent
357 validity for the PE sample. For the athlete sample, a one-way MANOVA was conducted using cluster
358 as the independent variable and the outcome variables (enjoyment, well-being, and burnout) as
359 dependent variables. In addition, differences by gender among the clusters were examined using chi-
360 square tests.

361 **Results**

362 **Preliminary Analyses**

363 **Descriptive Statistics.** Table 1 presents the means, standard deviations, internal consistency
364 estimates, and bivariate correlations for all variables in both the PE and sport samples. For the PE
365 sample, the mean scores for need satisfaction, need frustration, and introjected regulation were close to
366 the scale mid-point. Mean scores for external, identified and intrinsic regulation were above the scale
367 mid-point, while for amotivation the mean score was low. For the voluntary sport sample, mean scores
368 for need satisfaction, enjoyment, well-being were high, and need frustration and burnout were low.

369 Across both samples, as expected, need satisfaction was positively correlated with autonomous
370 motivational regulations and positive outcomes, and negatively correlated with controlled motivational
371 regulations, amotivation and negative outcomes. The opposite was true for need frustration, being
372 positively correlated with controlled motivational regulations, amotivation and negative outcomes, and
373 negatively associated with autonomous motivational regulations and positive outcomes.

374 **Primary Analyses**

375 **Identification of need profiles.** For the PE sample, the agglomeration coefficients showed that
376 there were incremental increases from five to four clusters (21.6%) and four to three clusters (22%), but
377 when three clusters were merged to two, the increase in the agglomeration coefficients was 45%,
378 therefore suggesting a three-cluster solution to be suitable. The dendrogram also supported a three-cluster
379 solution for classifying experiences of need satisfaction and need frustration. A one-way MANOVA
380 confirmed that the profiles differed in levels of need satisfaction and need frustration, *Pillai's Trace* =
381 .845, $F(4, 542) = 99.17$, $p < .001$, $\eta^2 = .42$. The means, standard deviations, and Z scores of the three
382 profiles are shown in Table 2. With the first split-half PE sample (N = 124), the k-means cluster analysis
383 with free means correctly classified 90.3% of the students in the respective cluster. The second split-half
384 with centroids obtained from the hierarchical methods used as the initial seed points, correctly classified
385 91.3% of the students in the original clusters. This confirmed the stability of the profiles found in the
386 hierarchical cluster analysis.

387 For the sport sample, the hierarchical cluster analysis found a four-profile solution to be suitable
388 to characterize the sample (Table 3). This was determined by the incremental percentage of the
389 agglomeration coefficients from merging one cluster to the next. There was a small incremental
390 increase from five to four clusters (29.5%), but as four clusters were merged to three clusters, there was
391 a large (50%) increase in the coefficients, when three clusters were merged to two, the increase in the
392 agglomeration coefficients was 58%, thus showing a four cluster-solution to be suitable. The
393 dendrogram also supported a four-cluster solution with clear equal distribution of the cases. A one-way
394 MANOVA confirmed that the profiles differed in need satisfaction and need frustration, *Pillai's Trace*
395 = 1.42, $F(6, 308) = 127.00$, $p < .001$, $\eta^2 = .71$. With the first random split-half sample (N = 85), the k-
396 means cluster analysis with free means correctly classified 91.8% of the students in the respective
397 clusters. The second split-half with centroids obtained from the hierarchical methods used as the initial

398 seed points, correctly classified 89.0% of the athletes in the original clusters. This confirmed the
 399 stability of the profiles found in the hierarchical cluster analysis.

400 ***Description of the profiles.*** In both samples the first profile identified was classified as
 401 relatively ‘Low Satisfaction-High Frustration’ (PE n = 95 [34.7%]; Sport n = 35 [22.2%]), with both
 402 students and athletes experiencing very low need satisfaction and very high need frustration. The
 403 second profile was identified as relatively ‘High Satisfaction-Low Frustration’ (PE n = 103 [37.6%];
 404 Sport n = 31 [19.6%]). As the label suggests these students and athletes had very high need satisfaction
 405 and very low need frustration. In the PE sample, the third profile was characterized by moderate
 406 experiences of both need satisfaction and need frustration and was classified as relatively ‘Moderate
 407 Satisfaction-Moderate Frustration’ (n = 76 [27.7%]). However, in the sport sample two profiles
 408 emerged that were characterized by moderate experiences of need satisfaction but differed on
 409 experiences of need frustration. Athletes in the third profile had moderate experiences of need
 410 satisfaction and low need frustration and were identified as relatively ‘Moderate Satisfaction-Low
 411 Frustration’ (n = 49 [31.0%]). Whereas, athletes in the fourth profile had moderate experiences of need
 412 satisfaction and high need frustration and were classified as relatively ‘Moderate Satisfaction-High
 413 Frustration’ (n = 43 [27.2%]). There were significant differences in gender distribution for the PE
 414 sample among the three profiles ($\chi^2_{(2)} = 22.80, p < .001$), but not for the sport sample ($p > .05$).

415 ***Exploring differences in need profiles.*** The results of the one-way MANOVAs with cluster
 416 (from the hierarchical cluster analysis) as the independent variable and the five behavioral regulations
 417 (PE) or four outcomes (sport) as dependent variables showed a significant multivariate effect (PE: *Pillai's*
 418 *Trace* = .58, $F(10, 536) = 21.71, p < .001, \eta^2 = .29$; Sport: *Pillai's Trace* = .534, $F(12, 459) = 8.28, p <$
 419 $.001, \eta^2 = .18$). Follow-up ANOVAs Tukey's honestly significant difference (HSD) tests revealed
 420 significant differences across the three PE profiles in all the behavioral regulations, except for introjected
 421 regulation and across the four sport profiles for all outcome variables. As shown in Table 2, pairwise

422 comparisons revealed significant differences between two clusters for most of the behavioural
423 regulations, except introjected regulation. However, there were no differences in the pairwise
424 comparisons in external regulation between the ‘Moderate Satisfaction-Moderate Frustration’ and ‘High
425 Satisfaction-Low Frustration’ profiles. The pairwise comparisons for the sport sample are presented in
426 Table 3 and show that the ‘High Satisfaction-Low Frustration’ cluster scored high in enjoyment and well-
427 being compared to the other three clusters and lower in burnout compared to the ‘Low Satisfaction-High
428 Frustration’ cluster. The athletes from the ‘Moderate Satisfaction-Low Frustration’ profile and ‘Moderate
429 Satisfaction-High Frustration’ did not differ in any of the four outcomes.

430 In both samples, the most adaptive profile was the ‘High Satisfaction-Low Frustration’ profile
431 with students and athletes reporting high scores for intrinsic and identified regulations, enjoyment and
432 well-being and low scores for external regulation, amotivation, and burnout. The least adaptive profile
433 was the ‘Low Satisfaction-High Frustration’ profile with students and athletes reporting very high scores
434 for amotivation, and high external regulation and burnout, and very low scores for identified and intrinsic
435 regulation, and low enjoyment and well-being

436 **Discussion**

437 The current study explored the combined relationships between need satisfaction and need
438 frustration and their simultaneous associations with motivation and psychological health within two
439 physical activity contexts. Although there is considerable evidence across the BPNT literature to
440 support the distinctiveness of need satisfaction and need frustration (see Vansteenkiste & Ryan, 2013),
441 this study provides an insight into the combined effects of these distinct constructs. We established the
442 co-occurring nature of the psychological needs in two separate contexts, through identifying subgroups
443 characterized by different combinations of need satisfaction and need frustration (psychological need
444 profiles). Moreover, we were able to demonstrate that the different psychological need profiles had
445 unique associations with motivation, well-being, and ill-being. We therefore extend the existing

446 literature on psychological need experiences by 1) providing empirical evidence for the distinct, yet co-
447 occurring, nature of need satisfaction and need frustration, 2) providing evidence to support the
448 proposed asymmetrical relationship between low need satisfaction and need frustration, and 3)
449 demonstrating the importance of the combined, rather than separate, associations of need satisfaction
450 and need frustration with motivation and psychological health.

451 **Psychological Need Profiles as Distinct, Yet Co-occurring Constructs**

452 We found evidence in both samples of the distinct, yet co-occurring, nature of need satisfaction
453 and need frustration. The emergence of more than two profiles that were not simply characterized by
454 opposite experiences of need satisfaction and need frustration (e.g., high-low and low-high) suggested
455 that individuals' were reporting that they simultaneously experienced both need frustration and need
456 satisfaction during the course of a typical PE lesson or training session. Moreover, the modest to strong
457 negative correlations which are consistent with those reported in previous literature support the distinct
458 nature of need satisfaction and need frustration and their potential to co-occur (e.g., Bartholomew et al.,
459 2011ab; Haerens et al., 2015). Although the voluntary sport setting provided a more nuanced set of
460 findings in terms of identifying one more profile than the PE sample, the outcomes associated with the
461 profiles suggests that there was a degree of stability and generalizability of the profiles in the two
462 contexts. This occurred despite large variations in the experiences of need satisfaction and need
463 frustration between the two contexts.

464 In both contexts, support was also found for the proposed asymmetrical relationship between
465 need satisfaction and need frustration (Vansteenkiste & Ryan, 2013) since a 'High Satisfaction-High
466 Frustration' profile did not emerge. Instead, in the sport sample a 'Moderate Satisfaction-Low
467 Frustration' and 'Moderate Satisfaction-High Frustration' profile emerged while in the PE a 'Moderate'
468 profile was evident. The profiles identified in our samples suggest that experiencing need frustration
469 within a context may prevent high need satisfaction being experienced. For example, when need

470 frustration was moderate or high only low or moderate levels of need satisfaction were experienced,
471 whereas when need frustration was not experienced, need satisfaction was experienced to at least
472 moderate levels. These are potentially important implications given the considerable evidence across
473 all life domains associating experiences of need satisfaction with optimal functioning (Mouratidis et al.,
474 2011; Milyavskaya & Koestner, 2011; Reeve & Jang, 2006; Van den Broeck et al., 2010; Williams et
475 al., 2011) and experiences of need frustration with deleterious effects (Bartholomew et al., 2011ab,
476 2018; Costa et al., 2014, 2015; Halvari et al., 2017; Haerens et al., 2015; Olafsen et al., 2017).
477 Moreover, this occurs even when in absolute terms the average need frustration for the sport sample is
478 low in relation to the 7-point measurement scale.

479 **Psychological Need Profiles: Associations with Motivation and Psychological Health**

480 Unique associations, that were consistent with our hypotheses, emerged between the different
481 need profiles and students' and athletes' motivation, well-being, and ill-being. These highlighted the
482 role of need satisfaction and need frustration in leading the association of the profiles with the
483 outcomes. In both samples, individuals in profiles characterized by opposites in need satisfaction and
484 frustration reported more optimal outcomes when need satisfaction was high (High Satisfaction-Low
485 Frustration) and less optimal outcomes when need frustration was high (Low Satisfaction-High
486 Frustration). These findings are consistent with the established literature on the distinct effects of need
487 frustration and need satisfaction (e.g., Bartholomew et al., 2011b; Vansteenkiste & Ryan, 2013).
488 Despite this clear pattern between the adaptive and maladaptive profiles characterized by either need
489 satisfaction or need frustration, in the PE sample our findings suggest that introjected regulation is
490 associated with both need satisfaction and need frustration. This is consistent with previous research
491 which has shown the introjected regulation of competitive swimmers (Pelletier, Fortier, Vallerand, &
492 Briere, 2001) and adolescents participating in PE class (Haerens et al., 2015) to be significantly
493 associated with constructs in both the bright and dark motivational pathway.

494 Although the ‘High Satisfaction-Low Frustration’ profile was the most adaptive profile in both
495 samples there was evidence in the more nuanced set of profiles that emerged in the sport sample for the
496 potential countering effects of need satisfaction. The variable-centered literature overwhelmingly
497 attests to the detrimental effects of experiences of need frustration (e.g., Bartholomew et al., 2011ab,
498 2014; Chen et al., 2015; Costa et al., 2014; Jang et al., 2016; Stebbings et al., 2012; Teixeira et al.,
499 2018), however our person-centered analyses reveal that these can be affected by concomitant
500 experiences of need satisfaction. Specifically, we found that when experiences of need satisfaction
501 were moderate, experiences of need frustration appeared to be less detrimental to the outcomes
502 reported by athletes. To illustrate this, a comparison of the outcomes of the ‘Low Satisfaction-High
503 Frustration’ and ‘Moderate Satisfaction-High Frustration’ profiles revealed that despite experiencing
504 need frustration athletes experienced less burnout and more enjoyment and higher well-being when
505 need satisfaction was also experienced. Moreover, this effect was also evidenced at different levels of
506 need frustration when similar experiences of need satisfaction (as indicated by the labels for the
507 profiles) occurred. There was no difference in the outcomes experienced in the ‘Moderate-Satisfaction-
508 High Frustration’ and the ‘Moderate Satisfaction-Low Frustration’ profiles, despite one set of athletes
509 experiencing need frustration. Although it should be noted that despite the similar ‘moderate’ labels,
510 the athletes in the latter profile experienced higher need satisfaction scores than those in the former
511 profile, which may account for the lack of difference in outcomes. However, collectively, our results
512 suggest that concurrent experiences of need satisfaction are critical to people’s optimal and non-
513 optimal functioning, especially when need frustration is experienced. However, there may be limits to
514 this protective effect of experiences of need satisfaction since athletes in all other profile combinations
515 did not fare as well in outcome experiences as athletes in the ‘High Satisfaction-Low Frustration’
516 profile.

517 **Limitations and Future Research**

518 This study makes an important and unique contribution to the motivation literature by providing
519 an insight into the combined relations between need satisfaction and need frustration and their
520 associations with motivation and psychological health. However, further research in different life
521 domains is needed to corroborate and extend the findings on this fundamental and understudied issue.
522 Future research may also wish to address the limitations of the current study which include its cross-
523 sectional design and reliance on domain specific self-report measures. Such work may wish to employ
524 domain general measures (e.g., those by Chen et al., 2015 and Sheldon & Hilpert, 2012) to assess need
525 satisfaction and need frustration and utilize objective measures of outcomes. Moreover, it may wish to
526 consider whether analyzing profiles of the separate needs of competence, autonomy, and relatedness,
527 rather than at a global level as in the current study, in relation to their satisfaction and frustration would
528 be fruitful. Theoretical propositions indicate that all three psychological needs are equally important for
529 optimal functioning (Deci & Ryan, 2000), but it is possible that the satisfaction or frustration of a
530 particular need is more or less damaging to the outcomes experienced by an individual. Employing
531 person-centered analyses at the specific need level would provide important empirical support for this
532 theoretical proposition and combining this with a within-person perspective could examine whether the
533 nature of the context (compulsory versus voluntary) is influential. Once the psychological need profiles
534 have been corroborated in different life domains it would also be beneficial to examine them in the
535 context of the sequence of the bright and dark motivational pathways. This would enable us to ascertain
536 the nomological network associated with the psychological need profiles. Future research may also
537 wish to consider the longitudinal examination of need profiles and draw from the longitudinal Growth
538 Mixture Analysis work on psychological needs (e.g., Gillet et al., 2017; Ratelle & Duchesne, 2014) to
539 explore if and how profile membership changes over time and the antecedents and outcomes associated
540 with such changes. These areas provide interesting opportunities for the future that will develop our
541 conceptual and practical understanding of psychological need experiences.

542 In summary, the emergence of distinct need profiles supports the proposition that need
543 satisfaction and need frustration are best viewed as separate and distinct, yet co-occurring, constructs. It
544 is important to consider the combined associations of need satisfaction and need frustration since there
545 was evidence of a protective effect of experiences of need satisfaction when individuals experienced
546 need frustration. Consequently, this concurrent view of psychological needs provides a more nuanced
547 understanding of people's optimal and non-optimal functioning. Our study emphasizes the importance
548 of exploring these interesting and influential combinations of need experiences in greater detail if we
549 are to fully understand their associations with optimal and non-optimal functioning.

550

551 **Compliance with Ethical Standards**

552

553 **Ethical approval:**

554 All procedures performed in studies involving human participants were in accordance with the ethical

555 standards of the institutional research committee of the lead author and with the 1964 Helsinki

556 declaration and its later amendments or comparable ethical standards

557

558 **Informed consent:**

559 Informed consent was obtained from all individual participants included in the studies

560

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Table 1. Means, standard deviations, and correlations within each sample.

| <i>Sample 1: Physical Education</i> | | | | | | | | | | |
|--|------|------|-------|----------|-------|-------|-------|-------|------|------|
| Variable | M | SD | Scale | α | 1. | 2. | 3. | 4. | 5. | 6. |
| 1. Need Satisfaction | 3.85 | 1.32 | 1-7 | .95 | - | | | | | |
| 2. Need frustration | 3.37 | 1.41 | 1-7 | .89 | -.66* | - | | | | |
| 3. Amotivation | 2.72 | 1.62 | 1-7 | .91 | -.65* | .68* | - | | | |
| 4. External | 4.22 | 1.80 | 1-7 | .90 | -.33* | .42* | .59* | - | | |
| 5. Introjected | 3.59 | 1.34 | 1-7 | .81 | .23* | .01* | -.08 | .45* | - | |
| 6. Identified | 4.53 | 1.59 | 1-7 | .91 | .74* | -.60* | -.78* | -.39* | .33* | - |
| 7. Intrinsic | 4.41 | 1.76 | 1-7 | .93 | .76* | -.61* | -.79* | -.44* | .26* | .93* |
| <i>Sample 2: Voluntary Leisure-Time Sport</i> | | | | | | | | | | |
| Variable | M | SD | Scale | α | 1. | 2. | 3. | 4. | 5. | |
| 1. Need satisfaction | 5.53 | .63 | 1-7 | .87 | - | | | | | |
| 2. Need frustration | 2.07 | .72 | 1-7 | .83 | -.40* | - | | | | |
| 3. Enjoyment | 5.58 | .88 | 1-7 | .89 | .56* | -.48* | - | | | |
| 4. Wellbeing | 5.22 | .91 | 1-7 | .85 | .53* | -.34* | .57* | - | | |
| 5. Burnout | 1.76 | .58 | 1-5 | .87 | -.51* | .52* | -.42* | -.49* | - | |

Note: * $p < .01$

Table 2. Cluster Means, Standard Deviations, and z Scores for the Solution of the Hierarchical Cluster Analyses: Physical Education Sample

| Variables | Cluster 1 (N = 95) | | Cluster 2 (N = 103) | | Cluster 3 (N = 76) | | F Value | η^2 |
|-------------------------------------|-----------------------------|------|-----------------------------|------|-----------------------------|------|----------|----------|
| | 'Low S / High F' | | 'High S /Low F' | | 'Moderate S / Moderate F' | | | |
| | Mean (Z) | SD | Mean (Z) | SD | Mean (Z) | SD | | |
| <i>Clustering Dimensions</i> | | | | | | | | |
| 1. Need Satisfaction | 2.55 _a (-.98) | .84 | 5.10 _b (.94) | .61 | 3.78 _c (-.05) | .82 | 280.06** | .67 |
| 2. Need Frustration | 4.87 _a (1.06) | .91 | 2.06 _b (-.93) | .60 | 3.27 _c (-.07) | .72 | 344.55** | .72 |
| <i>Outcomes</i> | | | | | | | | |
| 3. Intrinsic | 2.98 _a | 1.67 | 5.80 _b | .79 | 4.35 _c | 1.28 | 117.90** | .47 |
| 4. Identified | 3.20 _a | 1.48 | 5.74 _b | .84 | 4.55 _c | 1.07 | 117.53** | .47 |
| 5. Introjected | 3.52 _a | 1.37 | 3.72 _a | 1.41 | 3.50 _a | 1.19 | .78 | ns |
| 6. External | 5.28 _a | 1.64 | 3.47 _b | 1.69 | 3.96 _b | 1.50 | 32.26** | .19 |
| 7. Amotivation | 4.16 _a | 1.65 | 1.56 _b | .60 | 2.48 _c | 1.03 | 123.24** | .48 |
| 8. Gender (% Male) | 33.7 | | 67.0 | | 44.7 | | | |

Notes. Cluster descriptions are relative to one another in the sample. * $p < .05$, ** $p < .01$, Means in the same row that do not share subscripts differed at $p < .05$ using Tukey's HSD

Table 3. Cluster Means, Standard Deviations, and z Scores for the Solution of the Hierarchical Cluster Analyses: Sport Sample

| Variables | Cluster 1 (N = 35) | | Cluster 2 (N = 31) | | Cluster 3 (N = 49) | | Cluster 4 (N = 43) | | F Value | η^2 |
|-------------------------------------|------------------------------|------|------------------------------|-----|-----------------------------|-----|----------------------------|-----|----------|----------|
| | 'Low S /High F' | | 'High S / Low F' | | 'Mod S / Low F' | | 'Mod S / High F' | | | |
| | Mean (Z) | SD | Mean (Z) | SD | Mean (Z) | SD | Mean (Z) | SD | | |
| <i>Clustering Dimensions</i> | | | | | | | | | | |
| 1. Need Satisfaction | 4.66 _a (-1.38) | .35 | 6.26 _b (1.15) | .26 | 5.42 _c (-.18) | .28 | 5.85 _d (.50) | .33 | 171.02** | .77 |
| 2. Need Frustration | 2.73 _a (.90) | .38 | 1.23 _b (-1.16) | .22 | 1.64 _c (-.59) | .31 | 2.64 _a (.78) | .52 | 136.42** | .73 |
| <i>Outcomes</i> | | | | | | | | | | |
| 3. Enjoyment | 5.02 _a | .86 | 6.46 _b | .39 | 5.49 _c | .89 | 5.49 _c | .67 | 21.27** | .29 |
| 4. Well-being | 4.62 _a | 1.09 | 5.93 _b | .72 | 5.20 _c | .70 | 5.25 _c | .75 | 14.17** | .22 |
| 5. Burnout | 2.33 _a | .63 | 1.43 _b | .49 | 1.54 _b | .36 | 1.79 _b | .48 | 23.92** | .32 |
| 6. Gender (% Male) | 54.3 | | 45.2 | | 40.8 | | 44.2 | | | |

Notes. Cluster descriptions are relative to one another in the sample. * $p < .05$, ** $p < .01$, Means in the same row that do not share subscripts differed at $p < .05$ using Tukey's HSD.