



## Longitudinal Associations Between Athletes' Psychological Needs and Burnout Across a Competitive Season

Shannon, S., Prentice, G., Brick, N., Leavey, G., & Breslin, G. (2022). Longitudinal Associations Between Athletes' Psychological Needs and Burnout Across a Competitive Season: A Latent Difference Score Analysis. *Journal of Sport and Exercise Psychology, 44*, 240-250. <https://doi.org/10.1123/jsep.2021-0250>

[Link to publication record in Ulster University Research Portal](#)

**Published in:**  
Journal of Sport and Exercise Psychology

**Publication Status:**  
Published online: 05/05/2022

**DOI:**  
[10.1123/jsep.2021-0250](https://doi.org/10.1123/jsep.2021-0250)

**Document Version**  
Author Accepted version

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1 **Abstract**

2 Participation in sport can paradoxically be a source of psychological needs-satisfaction and  
3 psychological needs-frustration. Self-Determination Theory was applied to explain temporal  
4 relationships between athletes' psychological needs-satisfactions and psychological needs-  
5 frustrations and burnout, through a two-wave longitudinal study. Participants included 184  
6 athletes ( $M$  age = 24.04 years,  $SD$  = 5.56, 67.9% male) representing a range of competitive  
7 levels. A latent difference scores model specifying longitudinal relationships between  
8 burnout and needs-satisfactions and needs-frustrations was tested. Significant within-variable  
9 changes were observed for all needs-satisfaction and needs-frustration variables. Longitudinal  
10 associations were found in Models 3 (autonomy-frustration) and 6 (relatedness-satisfaction).  
11 Higher burnout at baseline predicted an increase in autonomy-frustration ( $\beta = .13, p < .05$ ),  
12 whereas higher relatedness-satisfaction at baseline reduced burnout levels later in the season  
13 ( $\beta = -.22, p < .001$ ). To conclude, continuous tracking of athlete burnout levels and fostering  
14 of needs-supportive climates that minimise autonomy-controlling behaviors is recommended  
15 for the burnout prevention in athletes.

16 **Keywords:** Self-determination theory; sport; need satisfaction; need frustration; well-being;  
17 mental health.

18

## Temporal changes in burnout in athletes

19 According to Keyes (2005), mental health encompasses two distinct but correlated  
20 continuums: ill-being (or mental illness) and well-being (or mental health). Mental health can  
21 be measured at global (i.e., day-to-day), contextual (e.g., sport) and situational (i.e., here and  
22 now) levels (Lundqvist, 2011; Vallerand, 2007). Applied as a contextual measure of ill-being  
23 in sport, burnout is a commonly experienced negative psychological syndrome,  
24 encompassing three symptoms: (i) emotional and physical exhaustion, (ii) a reduced sense of  
25 accomplishment, and (iii) the development of a cynical attitude towards the once favored  
26 sport (Raedeke, 1997). Burnout has several deleterious consequences including depressed  
27 mood, impaired social relationships, decreased performance, and temporary or permanent  
28 sport withdrawal (Gustafsson et al., 2017). While challenges remain regarding the diagnostic  
29 ability of burnout instruments (Gerber et al., 2018), it is estimated that approximately 10% of  
30 athletes experience burnout at any one point in time (Madigan, 2021).

31 Burnout is a syndrome that develops over time, insofar as symptoms can be acute and  
32 cease quickly. However, serious issues may arise with increased symptom severity, impacting  
33 an athlete's daily life, and in some circumstances may require a prolonged period of physical  
34 and mental recovery (Gustafsson et al., 2017). Due to intense periods of competition and  
35 performance stress throughout a season, athletes can experience burnout fluctuations that may  
36 pose increased risks to their well-being (Cresswell & Eklund, 2006). For example, multiple  
37 and often unforeseen stressors such as injury, income/funding loss and non-selection can  
38 occur, thereby increasing burnout and subsequent ill-being (Giles et al., 2020). Equally,  
39 foreseen issues such as competitive loss or lack of individual/team progression and increased  
40 training/competition load may increase risk of burnout (Madigan, 2021). To effectively  
41 capture the athletic experience during such circumstances, longitudinal and theoretically  
42 grounded studies of burnout risk factors are warranted (Madigan et al., 2019).

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43           Specifically, longitudinal studies can benefit athlete burnout research because the  
44 temporal nature of burnout syndrome development can be specified alongside multiple  
45 constructs. In doing so, both predictive (i.e., a change in one variable predicts a change in  
46 burnout) and/or reciprocal (i.e., a change in burnout accompanies a change in the same  
47 variable predicting burnout) effects can be studied (Lonsdale & Hodge, 2011). For example,  
48 competence at time 1 predicting change in burnout, while burnout at time 1 predicting change  
49 in competence satisfaction, would suggest a reciprocal relationship in the current study (See  
50 Figure 1). Predictive and reciprocal effects show a trajectory of change over time, and  
51 therefore can offer potential casual explanations that a prior level of, or a change in one  
52 variable, leads to a change in another (Howardson et al., 2017). Some previous studies (e.g.,  
53 Balaguer et al., 2012; Hancox et al., 2017; Sheehan et al., 2018, Stenling et al., 2015) have  
54 commendably used a longitudinal design, and additional theoretical studies have examined  
55 perfectionism (Madigan et al., 2015), coping tendencies (Madigan et al., 2020), and self-  
56 determined motivation (Cresswell & Eklund, 2006; Lonsdale & Hodge, 2011), showing  
57 significant relationships with burnout.

58           Focusing on the concept of motivation, Self-Determination Theory (SDT; Ryan &  
59 Deci, 2000), is a meta-theory of human motivation, behavior and health, specifying that the  
60 origins of self-determined motivation derive from one's basic needs to experience the  
61 satisfaction of autonomy (i.e., provision of choice, volitional behavior), competence (i.e.,  
62 feelings of effectiveness) and relatedness (i.e., sense of belongingness) (see Basic  
63 Psychological Needs Theory [BPNT], Ryan & Deci, 2008). Importantly, psychological needs  
64 receive varied levels of support and control from significant others (e.g., coaches) in an  
65 athlete's prevailing social context. In BPNT, Ryan and Deci (2008) formally hypothesise that  
66 perceptions of need satisfaction/frustration and motivation predict mental health outcomes  
67 such as burnout.

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68           Applying an SDT perspective on the aetiology of burnout and confirmed in the  
69 broader research field of sport and exercise psychology, needs-supportive social  
70 environments predict needs satisfaction, whereas controlling environments predict needs  
71 frustration (Matosic et al., 2016; Ntoumanis et al., 2017). Throughout a competitive season  
72 for example, a needs-supportive coach, teammate, and/or member of support staff may  
73 encourage and support development (e.g., competence-support), offer input and choice (e.g.,  
74 autonomy-support), and offer a warm regard for the athlete (e.g., relatedness-support).  
75 Equally, however, perceived needs-controlling social agents may denigrate the athlete (e.g.,  
76 competence-control), dismiss their input (e.g., autonomy-control) and/or be distant and cold  
77 towards the athlete (e.g., relatedness-control). Moreover, experiences of success/failure,  
78 injury and recognition (e.g., awards) can exert a role in needs-satisfaction and needs-  
79 frustration (Ntoumanis et al., 2018). Earlier cross-sectional research established that such  
80 features of this athletic experience likely protect from, or increase risk of burnout,  
81 accordingly, however given the cross-sectional design, reverse causality could not be rejected  
82 (Bartholomew et al., 2011a; Bartholomew et al., 2011b). Although further systematic review  
83 evidence (Li et al., 2013), and some preliminary longitudinal research (Hancox et al., 2017;  
84 Quested & Duda, 2011) has indicated that burnout is inversely associated with needs  
85 satisfaction, and positively associated with needs frustration (Hancox et al., 2017), Gerber et  
86 al. (2018) and others (Madigan, 2021) have emphasized that due to analytical and/or study  
87 design limitations, it remains equally plausible that burnout exerts a reciprocal role in the  
88 satisfaction or frustration of basic psychological needs. As such, while the directionality of  
89 the needs-satisfaction/frustration and burnout relationship is hypothesized linearly in SDT's  
90 casual chain, the testing of reciprocal and/or reverse causality effects require a more  
91 comprehensive, methodologically thorough testing across multiple timepoints.

92 One way to achieve reciprocal testing of such relationships is to employ Latent  
93 Difference Score Modelling (LDSM). Specifically, LDSM can allow for the assessment of  
94 within-individual change of variables such as burnout and needs-satisfaction/frustration  
95 between adjacent time points (e.g., beginning and middle of a competitive season), and  
96 individual differences in such changes, as well as the dynamic relationships between those  
97 constructs (Chen et al., 2018; Mund & Nestler, 2019). While authors applying LDSM  
98 approaches to burnout are increasingly common, the majority of existing researchers have  
99 relied on the use of cross-lagged panel models or linear regression that do not allow for an  
100 assessment of cross-construct ‘changes to changes’ relationships (Madigan, 2021).

101 To our best knowledge, no studies have examined whether temporal changes in  
102 needs-satisfaction/frustration link with changes in burnout, and vice versa through an LDSM  
103 approach. Hence, the aim of the present study was to test an SDT model specifying temporal  
104 change relationships between athletes’ psychological needs and burnout across a competitive  
105 sporting season using LDSM.

### 106 **Hypotheses tested**

107 We hypothesized that due to within-season changes, individual psychological needs-  
108 satisfactions or psychological needs-frustrations (i.e., competence, autonomy, and  
109 relatedness) at timepoint 1 would predict a within-variable latent change ( $\Delta$ ), controlling for  
110 the relationship between adjacent raw timepoint 1 and 2 scores (Hypothesis 1,  $H_1$ ) (e.g.,  
111  $competence_{T1} > \Delta competence$ ; controlling for  $competence_{T1} > competence_{T2}$ ). As athletes’  
112 competitive experiences vary widely, we did not specify any direction of change, such that  
113 both negative and positive associations were expected. We expected a latent change in  
114  $\Delta burnout$  in Hypothesis 2 ( $H_2$ ), again not specifying any direction of association. Then,  
115 focusing on variable-to-variable changes, we hypothesized that individual needs satisfactions  
116 and frustrations at timepoint 1 would negatively and positively predict  $\Delta burnout$ , respectively

117 (Hypothesis 3, H<sub>3</sub>), controlling for the aforesaid relationships. Lastly, while SDT clearly  
118 specifies burnout as an outcome of needs satisfactions and frustrations, we explored the  
119 fourth hypothesis that burnout at timepoint 1 would, respectively, negatively and positively  
120 predict individual  $\Delta$ needs-satisfactions and  $\Delta$ needs-frustrations (Hypothesis 4, H<sub>4</sub>),  
121 controlling for the aforementioned relationships.

## 122 **Methods**

### 123 *Inclusion criteria, recruitment, procedure and participants*

124 Ethical approval was granted by the lead author's academic institution, and informed consent  
125 and being  $\geq 18$  years old were within the ethical conditions. Participants confirmed their  
126 athlete status through a widely used item (Shannon et al., 2021) consistent with the definition  
127 of sport, namely, 'are you an athlete involved in a structured, competitive physical activity?'  
128 (Rejeski & Brawley, 1988). Recruitment strategies involved sending an email invitation to  
129 sports clubs across Ireland and the United Kingdom, survey links distributed on Twitter and  
130 social media outlets, and SMS/WhatsApp messages to sports team coaches, captains and  
131 players to share and forward (i.e., snowball sampling). The online survey took approximately  
132 nine minutes to complete, and comprised demographic questions (i.e., gender, age) and  
133 sporting factors (i.e., sport type, average training and competition hours per-week, level of  
134 competition [i.e., elite, sub-elite, amateur]; Lonsdale et al., 2009), alongside psychometric  
135 scales (see below).

136 Data were collected between May 2018 to May 2019 through an encrypted online  
137 questionnaire using SurveyMonkey software. Data obtained from online surveys have shown  
138 consistent factorial validity with paper-based studies, and have shown the added benefit of  
139 minimising attrition and false responses (Lonsdale et al., 2006). To ensure a valid window for  
140 capturing temporal changes, we applied past research recommendations suggesting a 12-  
141 week period for the aetiology of athlete burnout symptoms (Gustafsson et al., 2018; Lonsdale

142 et al., 2009). As such, data were collected in two separate timepoints (i.e., baseline = week 0;  
143 post = 12 weeks following baseline), and email reminders were sent to all consenting  
144 participants. Following the two waves of data collection, participants' data were matched  
145 through unique participant identifier codes. To ensure that any possible changes took place  
146 because of sporting participation, those athletes reporting their participation as 'off-season' or  
147 'pre-season' at one or more timepoints were excluded.

148 Subsequently, a total of 605 athletes completed baseline measures, and 184 athletes  
149 completed the two waves of data collection, resulting in a 30.4% retention rate. There were  
150 no significant baseline differences on the study outcomes among those athletes with one or  
151 two waves of completed data ( $p > .05$ ). Among the 184 athletes with two waves of data, the  
152 mean age was 24.04 years ( $SD = 5.56$ ) and included 67.9% males. Ninety four percent of the  
153 sample took part in interactive team sports, whereas 6% participated in individual sports.  
154 Sixty seven percent reported their competitive level as amateur (i.e., local/county leagues),  
155 25% were semi-elite (i.e., semi-professional, regional or country representative), 1% elite  
156 (i.e., professional, international), and 7% recreational (i.e., low-level participation). The mean  
157 duration of training was 6.74 hours ( $SD = 2.42$ ) per week, whereas competition amounted  
158 2.84 hours ( $SD = 1.91$ ) per week. 9.8% of the sample reported a recent injury at timepoint 2.

#### 159 *Outcome variables*

##### 160 *Psychological needs satisfaction and frustration*

161 The adapted 18-item Need Satisfaction and Frustration Scale (NSFS; Longo et al., 2016) was  
162 completed by participants. All items were scored on a 7-point Likert scale ranging from  
163 strongly disagree (1) to strongly agree (7). The scale incorporates six 3-item subscales for  
164 each psychological need satisfied/frustrated, and mean scores were produced accordingly.  
165 Example items include: *In my sport...* 'I feel very close and connected with other people'  
166 (i.e., relatedness satisfaction), and 'I feel a bit alone when with other people' (i.e., relatedness



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167 frustration). Higher scores indicate increased levels of needs satisfaction/frustration (Longo et  
168 al., 2016), and a previous study among athletes (Shannon et al., 2021) found factorial validity  
169 support for a 6-factor model wherein individual psychological needs satisfied/frustrated can  
170 be isolated for analyses. In the present study, Cronbach's alpha ( $\alpha$ ) for baseline and follow-up  
171 were as follows: competence satisfaction ( $\alpha = .89$  and  $.89$ ); competence frustration ( $\alpha = .85$   
172 and  $.87$ ); relatedness satisfaction ( $\alpha = .84$  and  $.89$ ); relatedness frustration ( $\alpha = .87$  and  $.90$ );  
173 autonomy satisfaction ( $\alpha = .71$  and  $.90$ ); autonomy frustration ( $\alpha = .72$  and  $.75$ ).

### 174 *Athlete burnout*

175 Athlete burnout was assessed through the 15-item Athlete Burnout Questionnaire (ABQ;  
176 Raedeke & Smith, 2001), a valid and psychometrically robust measure of burnout  
177 (Gustafsson et al., 2018). Items were scored on a 5-point Likert scale ranging from 1 (Almost  
178 never) to 5 (Almost Always). Mean scores were produced for each of the three factors of  
179 emotional and physical exhaustion (e.g., "I feel overly tired from my sports participation"),  
180 reduced sense of accomplishment (e.g., "I'm not achieving much in sport") and sport  
181 devaluation (e.g., "I have negative feelings towards sport") are included (Gustafsson et al.,  
182 2016). A composite burnout factor was calculated, with the subfactors treated as observed  
183 variables, and higher scores reflected increased presence of burnout (Gerber et al., 2018).  
184 Cronbach's alpha values were  $\alpha = .88$  for baseline and  $\alpha = .90$  at follow-up in the present  
185 study.

### 186 *Data management and statistical analysis*

187 Raw data were transferred from SurveyMonkey software (Palo Alto, CA) into SPSS (Version  
188 25; IBM Corp, NY). Two of the research team cleaned the data, inspected outliers, and then  
189 confirmed that all variables displayed acceptable skewness and kurtosis statistics. Missing  
190 data (ranging from 2-5% on study outcomes), were found to be missing completely at random  
191 (MCAR), based on Little's MCAR test result ( $p > .05$ ), allowing the use of the Expectation

192 Maximisation (EM) algorithm with intercorrelated items to inform replacement of any  
193 missing data with EM imputed values (Field, 2013). Prior to the main analyses, descriptive  
194 statistics for timepoint 1 and timepoint 2 variables were estimated in Table 1, wherein  
195 averaged variable scores were produced. Moreover, Table 2 included bivariate correlations of  
196 the study variables at baseline and timepoint 2.

197 *Latent Difference Scores Model*

198 The LDSM enabled testing of the study hypotheses examining temporal changes, both within  
199 persons, and across study variables (Ferrer & McCardle, 2010). In the present two-wave LDSM  
200 study, a latent difference variable (i.e., ‘ $\Delta$ ’) represents the difference between variables  
201 measured on adjacent timepoints of baseline (e.g., Competence Satisfaction-week 0) and  
202 follow-up (e.g., Competence Satisfaction-week 13), corrected for measurement error (Stenling  
203 et al., 2015). A total of six structural equation models were formulated on the basis of each  
204 individual psychological need satisfied/frustrated acting as the predictor variable, with burnout  
205 representing the outcome variable.

206 As displayed in Figure 1, the standardised beta ( $\beta$ ) coefficients relating to paths between  
207 timepoint 2 and baseline, and from timepoint 2 and the latent change score, are constrained to  
208 1. Applying this method means that the latent change variable (i.e.,  $\Delta$ Competence Satisfaction)  
209 variable absorbs the within-person changes from one time to the next (Howardson et al., 2017).  
210 All variables measured at baseline were allowed to covary, as were latent difference scores of  
211 the Needs Satisfaction/Frustrations and Burnout variables. Thereafter,  $\beta$  coefficients were  
212 specified from baseline scores of the predictor variable (i.e., Competence Satisfaction) onto the  
213 outcome variable (i.e.,  $\Delta$ Burnout), whilst including a  $\beta$  coefficient from the baseline score of  
214 the outcome variable (i.e., Burnout) onto the latent difference score of the predictor variable  
215 (i.e.,  $\Delta$ Competence Satisfaction). A statistically significant pathway between a baseline  
216 predictor variable score to an external variable’s latent change score represents evidence of a

217 one-way (e.g., Higher Competence Satisfaction at baseline predicts reduced Burnout over time)  
218 association, whereas significant paths in both directions represents a reciprocal (e.g., Burnout  
219 at baseline predicts  $\Delta$ Competence Satisfaction whilst Competence at baseline predicts  
220  $\Delta$ Burnout) association over time (Chen et al., 2018).

221 Goodness-of-fit indices recommended by Hu and Bentler (1999) were used to assess  
222 the adequacy of the difference score model. The comparative fit index (CFI), and the Tucker-  
223 Lewis Index (TLI) were reported, with values of  $> .90$  deemed acceptable, and  $> .95$  as good-  
224 to-excellent. The root mean square error of approximation (RMSEA) was reported, with  $< 0.08$   
225 considered adequate model fit. We also included the Chi-Square ( $\chi^2$ ) statistic, but approached  
226 with caution given the Likert-scaled nature of our data, and sample size sensitivities. Gender  
227 (i.e., male/female), recent injury (i.e., Yes/No) and sport type (i.e., individual/team) (Lonsdale  
228 et al., 2009) were included as statistical controls. Figures with evidence of longitudinal  
229 relationships were produced specifying standardized beta ( $\beta$ ) coefficient values for each direct  
230 path, and  $R^2$  values related to the proportion of total variance predicted on the latent difference  
231 variables. Bollen-Stine bootstrapping was conducted with 5000 samples to improve the  
232 accuracy of parameter estimates and fit indices (Byrne, 2001), and 95% confidence intervals  
233 (CI's) were produced for significant effects.

234  
235 *Insert Figure 1: Hypothesized latent change score Model 1 including competence*  
236 *satisfaction and burnout as predictor and outcome variables*  
237

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245 **Results**

246 *Descriptive statistics*

247 Table 1 presents the mean and standard deviation scores for the study outcomes at adjacent  
248 timepoints. The sample's mean burnout levels were slightly below (2.48) and above (2.51)  
249 the mid-point of 2.50 in the Likert scale response format at baseline and follow-up,  
250 respectively, suggesting the presence of burnout 'sometimes' among the sample. In terms of a  
251 mid-point of 3.50 in the Likert scale response format all mean sample needs satisfaction  
252 scores were above this threshold at both timepoints, and relatedness frustration was below,  
253 suggesting moderate-to-high levels of needs satisfaction, and low levels of relatedness-  
254 frustration throughout. However, mean autonomy frustration levels were above 3.50 value at  
255 both timepoints, and competence frustration was close (i.e., baseline = 3.34 and follow-up =  
256 3.39), indicating a regular experience of these frustrations throughout.

257 The correlation matrix showed a preponderance of significant variable-to-variable  
258 associations at baseline, follow-up, and across timepoints. Most relevant for the main  
259 analyses, the outcome variable of Burnout at Timepoint 2 was significantly associated with  
260 all needs satisfaction and needs frustration variables at timepoint 1, indicating possible  
261 evidence of a longitudinal relationship (See Table 2). Relatedly, however, Burnout at  
262 timepoint 1 was significantly associated with both competence and relatedness satisfaction  
263 and frustration at timepoint 2, indicating the possibility of longitudinal reciprocal  
264 relationships (See Table 2).

265 *Latent Difference Scores Models 1-6*

266 The LDSM analyses showed that all models aside from Model 3 (n.b., autonomy frustration)  
267 were within the recommended cut-off points for adequate fit outlined by Hu and Bentler  
268 (1999) (see Table 3). Modification indices for Model 3 presented a solution, including the  
269 estimation of a covariance path with item 2 at timepoint 1 to item 3 at timepoint 2. As both

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270 items displayed a similarity in meaning (i.e., ‘I feel forced to follow directions’ and ‘I feel  
271 under pressure to follow procedures’) a covariance path between the items was added,  
272 resulting in an acceptable fitting model (see Table 3).

273 In Model 1, despite  $R^2$  values of .20 ( $\Delta$ competence frustration) and .10 ( $\Delta$ burnout)  
274 only H<sub>1</sub> was supported, as competence frustration at timepoint 1 predicted a significant latent  
275 negative change in  $\Delta$ competence frustration ( $\beta = -.43, p < .001$ ), controlling for the  
276 relationship between competence frustration at timepoint 1 and competence frustration at  
277 timepoint 2.

278 Likewise, Model 2 showed no significant longitudinal variable-to-variable  
279 associations (H<sub>3-4</sub>), or within-variable changes for burnout (H<sub>2</sub>), and only competence  
280 satisfaction at timepoint 1 predicted a significant negative latent change in  $\Delta$ competence  
281 satisfaction ( $\beta = -.48, p < .001$ ). Therefore, while competence frustration reduced in model 1,  
282 so did competence satisfaction.

283 Model 3 showed significant negative within-variable latent change in  $\Delta$ autonomy  
284 frustration (H<sub>1</sub>;  $\beta = -.79, p < .001$ ), and  $\Delta$ burnout (H<sub>2</sub>;  $\beta = -.37, p < .001$ ). Furthermore, while  
285 autonomy frustration at timepoint 1 did not predict a latent change in  $\Delta$ burnout (H<sub>3</sub>), burnout  
286 at timepoint 1 predicted a positive latent change in  $\Delta$ autonomy frustration (H<sub>4</sub>;  $\beta = .13, p <$   
287  $.05$ ). Therefore, the support for H<sub>4</sub> indicated some evidence of a causal relationship that the  
288 significant positive change in autonomy frustration was partly explained by athletes’ having  
289 higher burnout symptoms at the beginning of a season. The covariation path between the  
290 latent difference scores was also positive ( $\beta = .30$ ). Figure 2 illustrates these paths in visual  
291 form, and notably significant proportions of variance were explained for latent change in  
292  $\Delta$ autonomy frustration ( $R^2 = .59$ ) and  $\Delta$ burnout ( $R^2 = .13$ ).

293 Despite sharing conceptual characteristics with autonomy frustration, results for  
294 Model 4 (autonomy satisfaction) did not align with Model 4, despite a significant negative

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295 within-variable latent change in  $\Delta$ autonomy satisfaction ( $H_1; \beta = -.51, p < .001$ ). As such, the  
296 significant latent change in  $\Delta$ autonomy satisfaction was not explained by any prior levels of  
297 burnout ( $H_4$ ). Controlling for the above within-variable and variable-to-variable associations  
298 also resulted in a non-significant latent change in  $\Delta$ burnout ( $H_{2,3}$ ).

299 Model 5 (relatedness frustration) showed some unique findings in that both negative  
300 latent changes in  $\Delta$ relatedness frustration ( $H_1; \beta = -.38, p < .001$ ) and  $\Delta$ burnout ( $H_2; \beta = -.40,$   
301  $p < .001$ ) were shown. However, these longitudinal changes were not explained by any  
302 variable-to-variable associations ( $H_{3,4}$ ).

303 Lastly, Model 6 showed some evidence of longitudinal associations such that both  
304 negative latent changes in  $\Delta$ relatedness satisfaction ( $H_1; \beta = -.47, p < .001$ ) and  $\Delta$ burnout ( $H_2;$   
305  $\beta = -.48, p < .001$ ) were significantly predicted by their respective timepoint 1 values.  
306 Further, the significant latent change in  $\Delta$ burnout was inversely associated with prior levels  
307 of relatedness satisfaction ( $H_3; \beta = -.22, p < .001$ ). Further support was shown in the inverse  
308 covariation path of the difference scores ( $\beta = -.45$ ). Despite those findings, there was no  
309 evidence of the relationship being casually reciprocal, as burnout at timepoint 1 did not  
310 significantly predict latent change in  $\Delta$ relatedness satisfaction ( $H_2$ ). Model 6 findings are  
311 visually depicted in Figure 3.

312 ***Insert Table 1: Study outcome variable mean scores and standard deviations (SD) for***  
313 ***timepoint 1 (T1) and timepoint 2 (T2)***

314 ***Insert Table 3: Summary of fit statistics for latent difference scores models 1-6***

315 ***Insert Figure 2: Model 3: LDSM with autonomy frustration and burnout as predictor and***  
316 ***outcome variable***

317 ***Insert Figure 3: Model 6: LDSM with relatedness and burnout as predictor and outcome***  
318 ***variables***

319

320 **Discussion**

321 *Main findings*

322 This study advanced testing of Self-Determination Theory (Ryan & Deci, 2000) in athlete  
323 mental health research by examining temporal changes between athletes' psychological needs  
324 and burnout through a two-wave longitudinal design. Significant within-variable negative  
325 changes were shown in all needs-satisfaction and needs-frustration variables (supporting H<sub>1</sub>),  
326 highlighting the differential, orthogonal effect of how sporting participation can both reduce  
327 negative experiences of needs-frustration whilst paradoxically also decrease adaptive  
328 experiences of psychological needs satisfaction (Isoard-Gauthier et al., 2012; Stenling et al.,  
329 2015). Moreover, several models showed significant negative within-variable changes in  
330 burnout levels (supporting H<sub>2</sub>), indicating that burnout is not an inevitability of sporting  
331 participation (Madigan, 2021). Thereafter, our models displayed some evidence of causal  
332 links between specific psychological needs satisfactions and frustrations and burnout, to the  
333 extent that: (a) higher burnout levels at the beginning of a competitive season predicted an  
334 increase in autonomy frustration later in the season (i.e., H<sub>4</sub>), and (b) higher levels of  
335 relatedness satisfaction at the beginning of a season related to lower levels of burnout later in  
336 the season, and offered a protective effect (i.e., H<sub>3</sub>). Overall, our findings support the  
337 rationale for continuous tracking of athlete burnout levels (Madigan et al., 2021), in addition  
338 to fostering needs-supportive climates for enhancing needs satisfaction (Ntoumanis et al.,  
339 2018).

340 *Study uptake and descriptive results*

341 The present study employed recruitment through online methods, and consistent with  
342 demographic assessments of the sporting population (Vella & Swann, 2021) included a  
343 diverse and representative sample of sports participants, allowing for a degree of  
344 generalisation. Although the retention rate of 30.4% may be considered low, given the

345 present study was solely web-based and did not include any recruitment in physical locations  
346 or incentives, this figure is relatively high (Sánchez-Fernández et al., 2012). Future efforts to  
347 boost retention in likewise studies may consider the personalisation of email reminders,  
348 rather than standardized email messages as used in the present study (Sánchez-Fernández et  
349 al., 2012).

350         Given mean scores were shown to be close to or above the mid-point of the Likert  
351 scale response format for each respective psychological need at adjacent timepoints, except  
352 for relatedness satisfaction, it is arguable that on average, athletes can concomitantly  
353 experience needs-satisfaction and needs-frustration in their sport (Bartholomew et al., 2011a).  
354 Moreover, the correlation matrix confirmed significant within- and between-timepoint  
355 variable relationships, to the extent that burnout at timepoint 2 and 1 was significantly  
356 associated with all needs-satisfaction and frustration variables at timepoint 1 and 2. As such,  
357 our findings support extant longitudinal research showing associations with burnout and  
358 motivational variables during a competitive sporting season where psychological changes  
359 invariably occur (Cresswell & Eklund, 2006; Lonsdale & Hodge, 2011). The significant  
360 associations also justified the specification of a latent difference scores model to explore  
361 evidence of possible causal links (Mund & Nestler, 2019; Myers et al., 2018).

#### 362 *Models tested and implications*

363 Specifying the study variables within separate LDSM models responded to recent calls  
364 (Madigan et al., 2021) that athlete burnout research requires advanced statistical  
365 methodologies to determine possible evidence of casual links. All six models adequately  
366 fitted the data and in several incidences within-variable changes were observed in  
367 psychological needs and burnout (supporting H<sub>1-2</sub>) (Chen et al., 2018). Specifically, all needs  
368 satisfaction and needs frustrations decreased in Models 1-6, whilst burnout decreased in  
369 Models 3 and 6. Despite the reduction of needs frustration and burnout being a welcomed



370 finding, the decline of needs-satisfactions was not (Bhavsar et al., 2019). Therefore, a  
371 somewhat paradoxical story emerged regarding the athletes' sporting experiences throughout  
372 their competitive seasons in this study.

373 To provide context, our findings suggest that athletes may have perceived a lessening  
374 of the frustration of their needs as the season progressed, possibly because as time develops  
375 and contact time increases improved communication may be established between teammates,  
376 players, and coaches (Bartholomew et al., 2011a; Bhavsar et al., 2019). Further, some athletes  
377 begin to internalise their reasons for participating in their sport (i.e., shift from external  
378 motivation to identified regulation) and experience an increase in autonomous motivation  
379 (Pelletier et al., 2013). Equally, however, as the season progressed athletes likely feel  
380 dissatisfied with the extent to which their needs were being met, perhaps in a practical sense,  
381 related to negative affect regarding win-loss ratios (Stanley et al., 2021), non-selection,  
382 engagement with needs-thwarting social agents (e.g., coaches, teammates, instructors)  
383 (Matosic et al., 2016; Shannon et al., 2019; Shannon et al., 2021), and/or a perceived lack of  
384 personal and team challenges and development (e.g., stagnation, boredom). These findings  
385 reinforce the proposed theoretical differentiation between psychological needs satisfaction  
386 and frustration variables and although conceptually related, they are distinct entities (Longo  
387 et al., 2016).

388 Higher burnout at the beginning of the season predicted an increase in autonomy  
389 frustration later in the season in Model 3 (supporting H4) revealing a somewhat paradoxical  
390 story. Conceptually, SDT hypothesises a linear link, to the extent that needs-  
391 satisfaction/frustration are corollary variables to burnout. However, given burnout predicted  
392 an increase in autonomy frustration, the reverse link can be argued, as autonomy frustration  
393 refers to a lack of perceived agency in one's behavior (Ryan & Deci, 2017), and burnout  
394 involves a reduced sense of one's abilities and accomplishments (Raedeke, 1997). Athlete

395 burnout measurement tools are widely available (Madigan et al., 2019), and therefore if  
396 average scores are close to or above the midpoint on the Likert scale (e.g., ‘sometimes-to-  
397 always’ as reference) early in a season, use of autonomy-supportive behaviors and the  
398 minimisation of autonomy-controlling behaviors may be a solution for the future prevention  
399 of autonomy frustration (Ntoumanis et al., 2018). In a practical sense, those involved in  
400 athlete provision may attempt to highlight and continuously reinforce the importance of an  
401 athlete’s contribution to the team, encourage initiative, and reduce controlling language  
402 (Bechter et al., 2018). Doing so may also prevent the subsequent negative effects of  
403 autonomy frustration such as amotivation, ill-being and early drop-out (Bhavsar et al. 2019).

404 Higher relatedness at the beginning of the season predicted a decrease in burnout later  
405 in the season in Model 6, supporting meta-analytical findings of social constructs and burnout  
406 that included 10 relatedness-focused studies (Pacewicz et al., 2019). Previous studies  
407 applying SDT (e.g., DeFreese & Smith. 2013), have shown that perceived support (regardless  
408 of actual received support) from teammates, was inversely correlated with burnout. In  
409 practice, athletes who have an established close and reciprocal relationships with their  
410 teammates/coaching staff earlier in a season, may have a better capacity to buffer negative  
411 effects, and thus functionally adapt to burnout symptoms (Hartley & Coffee, 2019). As a  
412 psychological need, relatedness satisfaction may be theoretically viewed as a global positive  
413 social construct (Ryan & Deci, 2017). Therefore, positive adaptive social behaviors that  
414 follow may include disclosing frustrations to teammates and coaching staff, shared use of  
415 coping behaviors, and rational forms of cognitive appraisal (Lu et al., 2016). Contrastingly,  
416 negative social interactions such as insensitive behavior, neglect or intrusion are positively  
417 linked with burnout (Pacewicz et al., 2019), but relatedness frustration did not show any  
418 significant longitudinal associations with burnout in Model 5.

419 *Study limitations*

420 Key strengths of this study included the use of a longitudinal design, the testing of SDT, and  
421 recruitment of a diverse athletic sample. However, future studies could address the limitations  
422 of our study by utilising three or more measurement timepoints. Furthermore, the inclusion of  
423 linked self-reports from coaches and teammates alongside a larger athlete sample would  
424 provide additional information pertaining to the relative influence of needs-satisfying and  
425 frustrating sources (Ntoumanis et al., 2018). Lastly, as burnout and general mental health  
426 experiences may be more intense and have unique features in elite athletes (e.g., professional,  
427 international competitors) (Vella & Swann, 2021), further research may consider a focused  
428 sample approach for increased precision which may have additional study implications and  
429 practical recommendations.

430 *Conclusion*

431 The present study addressed gaps within SDT and broader literature of athlete burnout by  
432 adopting a longitudinal design, and testing several theoretical hypotheses related to darker  
433 and brighter athletic experiences (Bhavsar et al., 2019). Collectively, our study underscores  
434 the need for continuous tracking of athlete burnout levels throughout competitive seasons  
435 (Madigan et al., 2021), in addition to fostering needs-supportive climates for enhancing needs  
436 satisfaction (Ntoumanis et al., 2018) and protecting against athlete burnout (Bartholomew et  
437 al., 2009). With the widescale availability of valid athlete burnout measurement tools, the  
438 capturing of burnout levels is relatively quick, and practically feasible (Madigan et al., 2019).  
439 Tentatively, we suggest that if average levels are close to, or above the midpoint on the Likert  
440 scale format (e.g., ‘sometimes’ as reference), early on in a season, it may be prudent to  
441 implement multiple means to provide autonomy-support and minimise autonomy-control,  
442 such as providing opportunities for athlete input into team matters, and reinforcing the  
443 freedom for initiative taking, while minimising controlling language and behaviors  
444 (Ntoumanis et al., 2018). Given the protective effect that relatedness satisfaction exerted on

445 subsequent burnout levels in the present study, an environment characterized by reciprocal  
446 support and compassion is desired (Chen et al., 2018), as are regular opportunities to share  
447 coping behaviors (e.g., relaxation, cognitive appraisal) (Delrue et al., 2019). As athlete  
448 mental health promotion should be considered as fundamental to the sporting experience  
449 (Reardon et al., 2019), sporting organisations, policy makers and those involved in  
450 intervention design may consider the proposed evidence-based and theoretically derived  
451 techniques in areas of programme design. Future research may advance the present study by  
452 gathering athlete, coach and teammate data, whilst including additional timepoints.

#### 453 ***Compliance with Ethical Standards***

454 All authors agree that we have no conflict of interest to report.

455 All procedures performed in studies involving human participants were in accordance with  
456 the ethical standards of the institutional and/or national research committee and with the 1964  
457 Helsinki declaration and its later amendments or comparable ethical standards.

458 Informed consent was obtained from all individual participants included in the study.

#### 459 **References**

460

461 Balaguer, I., González, L., Fabra, P., Castillo, I., Mercé, J., & Duda, J. L. (2012). Coaches'  
462 interpersonal style, basic psychological needs and the well-and ill-being of young soccer  
463 players: A longitudinal analysis. *Journal of Sports Sciences*, 30(15), 1619-1629.

464 Bartholomew, K. J., Ntoumanis, N., & Thøgersen-Ntoumani, C. (2009). A review of  
465 controlling motivational strategies from a self-determination theory perspective:  
466 Implications for sports coaches. *International Review of Sport and Exercise Psychology*,  
467 2(2), 215-233.

468 Bartholomew, K. J., Ntoumanis, N., Ryan, R. M., & Thøgersen-Ntoumani, C. (2011a).  
469 Psychological need thwarting in the sport context: Assessing the darker side of athletic  
470 experience. *Journal of Sport and Exercise Psychology*, 33(1), 75-102.

- 471 Bartholomew, K. J., Ntoumanis, N., Ryan, R. M., Bosch, J. A., & Thøgersen-Ntoumani, C.  
472 (2011b). Self-determination theory and diminished functioning: The role of interpersonal  
473 control and psychological need thwarting. *Personality and Social Psychology Bulletin*,  
474 37(11), 1459-1473.
- 475 Bechter, B. E., Dimmock, J. A., Howard, J. L., Whipp, P. R., & Jackson, B. (2018). Student  
476 motivation in high school physical education: A latent profile analysis approach. *Journal of*  
477 *Sport and Exercise Psychology*, 40(4), 206-216.
- 478 Bhavsar, N., Ntoumanis, N., Quedsted, E., Gucciardi, D. F., Thøgersen-Ntoumani, C., Ryan, R.  
479 M., & Bartholomew, K. J. (2019). Conceptualizing and testing a new tripartite measure of  
480 coach interpersonal behaviors. *Psychology of Sport and Exercise*, 44, 107-120.
- 481 Byrne, B. M. (2001). Structural equation modeling with AMOS, EQS, and LISREL:  
482 Comparative approaches to testing for the factorial validity of a measuring instrument.  
483 *International Journal of Testing*, 1(1), 55-86.
- 484 Chen, L. H., Wu, C. H., Lin, S. H., & Ye, Y. C. (2018). Top-down or bottom-up? The  
485 reciprocal longitudinal relationship between athletes' team satisfaction and life  
486 satisfaction. *Sport, Exercise, and Performance Psychology*, 7(1), 1-12.
- 487 Cresswell, S. L., & Eklund, R. C. (2006). The nature of player burnout in rugby: Key  
488 characteristics and attributions. *Journal of Applied Sport Psychology*, 18(3), 219-239.
- 489 Delrue, J., Soenens, B., Morbée, S., Vansteenkiste, M., & Haerens, L. (2019). Do athletes'  
490 responses to coach autonomy support and control depend on the situation and athletes'  
491 personal motivation?. *Psychology of sport and exercise*, 43, 321-332.
- 492 DeFreese, J. D., & Smith, A. L. (2013). Teammate social support, burnout, and self-  
493 determined motivation in collegiate athletes. *Psychology of Sport and Exercise* 14(2), 258-  
494 265.
- 495 Field, A. (2013). *Discovering statistics using IBM SPSS statistics*. Sage, London.

## Temporal changes in burnout in athletes

- 496 Ferrer, E., & McArdle, J. J. (2010). Longitudinal modeling of developmental changes in  
497 psychological research. *Current Directions in Psychological Science*, *19*(3), 149-154.
- 498 Gerber, M., Gustafsson, H., Seelig, H., Kellmann, M., Ludyga, S., Colledge, F., & Bianchi, R.  
499 (2018). Usefulness of the Athlete Burnout Questionnaire (ABQ) as a screening tool for the  
500 detection of clinically relevant burnout symptoms among young elite athletes. *Psychology*  
501 *of Sport and Exercise*, *39*, 104-113.
- 502 Giles, S., Fletcher, D., Arnold, R., Ashfield, A., & Harrison, J. (2020). Measuring well-being  
503 in sport performers: where are we now and how do we progress?. *Sports Medicine*, *50*(7),  
504 1255-1270.
- 505 Gustafsson, H., DeFreese, J. D., & Madigan, D. J. (2017). Athlete burnout: Review and  
506 recommendations. *Current Opinion in Psychology*, *16*, 109-113.
- 507 Gustafsson, H., Carlin, M., Podlog, L., Stenling, A., & Lindwall, M. (2018). Motivational  
508 profiles and burnout in elite athletes: A person-centered approach. *Psychology of Sport and*  
509 *Exercise*, *35*, 118-125.
- 510 Hartley, C., & Coffee, P. (2019). Perceived and received dimensional support: Main and  
511 stress-buffering effects on dimensions of burnout. *Frontiers in Psychology*, *10*, 1724.
- 512 Hancox, J. E., Quested, E., Ntoumanis, N., & Duda, J. L. (2017). Teacher-created social  
513 environment, basic psychological needs, and dancers' affective states during class: A diary  
514 study. *Personality and Individual Differences*, *115*, 137-143.
- 515 Howardson, G. N., Karim, M. N., & Horn, R. G. (2017). The latent change score model: A  
516 more flexible approach to modeling time in self-regulated learning. *Journal of Business*  
517 *and Psychology*, *32*(3), 317-334.
- 518 Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure  
519 analysis: Conventional criteria versus new alternatives. *Structural equation modeling: a*  
520 *multidisciplinary journal*, *6*(1), 1-55.

## Temporal changes in burnout in athletes

- 521 Isoard-Gautheur, S., Guillet-Descas, E., & Lemyre, P. N. (2012). A prospective study of the  
522 influence of perceived coaching style on burnout propensity in high level young athletes:  
523 Using a self-determination theory perspective. *The Sport Psychologist*, 26(2), 282-298.
- 524 Keyes, C. L. (2005). Mental illness and/or mental health? Investigating axioms of the  
525 complete state model of health. *Journal of Consulting and Clinical Psychology*, 73(3), 539.
- 526 Li, C., Wang, C. J., & Kee, Y. H. (2013). Burnout and its relations with basic psychological  
527 needs and motivation among athletes: A systematic review and meta-analysis. *Psychology  
528 of Sport and Exercise*, 14(5), 692-700.
- 529 Longo, Y., Gunz, A., Curtis, G. J., & Farsides, T. (2016). Measuring need satisfaction and  
530 frustration in educational and work contexts: The Need Satisfaction and Frustration Scale  
531 (NSFS). *Journal of Happiness Studies*, 17(1), 295-317.
- 532 Lonsdale, C., & Hodge, K. (2011). Temporal ordering of motivational quality and athlete  
533 burnout in elite sport. *Medicine & Science in Sports & Exercise*, 43(5), 913-921.
- 534 Lonsdale, C., Hodge, K., & Rose, E. A. (2006). Pixels vs. Paper: Comparing Online and  
535 Traditional Survey Methods in Sport Psychology. *Journal of Sport & Exercise Psychology*,  
536 28(1), 100-108
- 537 Lonsdale, C., Hodge, K., & Rose, E. (2009). Athlete burnout in elite sport: A self-  
538 determination perspective. *Journal of Sports Sciences*, 27(8), 785-795.
- 539 Lu, F. J. H., Lee, W. P., Chang, Y., Chou, C., Hsu, Y., Lin, J., et al. (2016). Interaction of  
540 athletes' resilience and coaches' social support on the stress-burnout relationship: a  
541 conjunctive moderation perspective. *Psychology of Sport and Exercise*, 22, 202-209.
- 542 Lundqvist, C. (2011). Well-being in competitive sports—The feel-good factor? A review of  
543 conceptual considerations of well-being. *International Review of Sport and Exercise  
544 Psychology*, 4(2), 109-127.

## Temporal changes in burnout in athletes

- 545 Madigan, D. J., Stoeber, J., & Passfield, L. (2015). Perfectionism and burnout in junior  
546 athletes: A three-month longitudinal study. *Journal of Sport and Exercise Psychology*,  
547 37(3), 305-315.
- 548 Madigan, D. J., Gustafsson, H., Smith, A., Raedeke, T., & Hill, A. P. (2019). The BASES  
549 expert statement on burnout in sport. *The Sport and Exercise Scientist*, 61, 6-7.
- 550 Madigan, D. J., Rumbold, J. L., Gerber, M., & Nicholls, A. R. (2020). Coping tendencies and  
551 changes in athlete burnout over time. *Psychology of Sport and Exercise*, 48, 101666.
- 552 Madigan, D. J. (2021). Diagnosing problems, prescribing solutions, and advancing athlete  
553 burnout research. In Z. Zenko & L. Jones (Eds.), *Essentials of exercise and sport*  
554 *psychology: An open access textbook* (pp. 664–682). Society for Transparency, Openness,  
555 and Replication in Kinesiology. <https://doi.org/10.51224/B1028>
- 556 Matosic, D., Ntoumanis, N., & Quested, E. (2016). Antecedents of need supportive and  
557 controlling interpersonal styles from a self-determination theory perspective: A review and  
558 implications for sport psychology research. In M. Raab, P. Wylleman, R. Seiler, A. -M.  
559 Elbe, & A. Hatzgeorgiadis (Eds), *Sport and exercise psychology research: From theory to*  
560 *practice* (pp. 145-180). Academic Press, London.
- 561 Mund, M., & Nestler, S. (2019). Beyond the cross-lagged panel model: Next-generation  
562 statistical tools for analyzing interdependencies across the life course. *Advances in Life*  
563 *Course Research*, 41, 100249. <https://doi.org/10.1016/j.alcr.2018.10.002>
- 564 Myers, N. D., Ntoumanis, N., Gunnell, K. E., Gucciardi, D. F., & Lee, S. (2018). A review of  
565 some emergent quantitative analyses in sport and exercise psychology. *International*  
566 *Review of Sport and Exercise Psychology*, 11(1), 70-100.
- 567 Ntoumanis, N., Quested, E., Reeve, J., & Cheon, S. H. (2018). Need supportive  
568 communication: Implications for motivation in sport, exercise, and physical activity. In B.



## Temporal changes in burnout in athletes

- 569 Jackson, J. Dimmock, & J. Compton (Eds), *Persuasion and communication in sport,*  
570 *exercise, and physical activity*, (pp.155-169). Abingdon, UK: Routledge.
- 571 Ntoumanis, N., Thøgersen-Ntoumani, C., Quested, E., & Hancox, J. (2017). The effects of  
572 training group exercise class instructors to adopt a motivationally adaptive communication  
573 style. *Scandinavian Journal of Medicine & Science in Sports*, 27(9), 1026-1034.
- 574 Pacewicz, C. E., Mellano, K. T., & Smith, A. L. (2019). A meta-analytic review of the  
575 relationship between social constructs and athlete burnout. *Psychology of Sport and*  
576 *Exercise*, 43, 155-164.
- 577 Pelletier, L. G., Rocchi, M. A., Vallerand, R. J., Deci, E. L., & Ryan, R. M. (2013). Validation  
578 of the revised sport motivation scale (SMS-II). *Psychology of sport and exercise*, 14(3),  
579 329-341
- 580 Quested, E., & Duda, J. L. (2011). Antecedents of burnout among elite dancers: A longitudinal  
581 test of basic needs theory. *Psychology of Sport and Exercise*, 12(2), 159-167.
- 582 Raedeke, T. D. (1997). Is athlete burnout more than just stress? A sport commitment  
583 perspective. *Journal of Sport and Exercise Psychology*, 19(4), 396-417.
- 584 Raedeke, T. D., & Smith, A. L. (2001). Development and preliminary validation of an athlete  
585 burnout measure. *Journal of Sport and Exercise Psychology*, 23(4), 281-306.
- 586 Reardon, C. L., Hainline, B., Aron, C. M., Baron, D., Baum, A. L., Bindra, A., . &  
587 Engebretsen, L. (2019). Mental health in elite athletes: International Olympic Committee  
588 consensus statement (2019). *British journal of sports medicine*, 53(11), 667-699.
- 589 Rejeski, W. J., & Brawley, L. R. (1988). Defining the boundaries of sport psychology. *The*  
590 *Sport Psychologist*, 2(3), 231-242.
- 591 Ryan, R. M., & Deci, E. L. (2000). The " what " and " why " of goal pursuits: Human needs and  
592 the self-determination of behavior. *Psychological Inquiry*, 11(4), 227-268.

## Temporal changes in burnout in athletes

- 593 Ryan, R. M., & Deci, E. L. (2008). Self-determination theory and the role of basic  
594 psychological needs in personality and the organization of behavior. In O. P. John, R. W.  
595 Robins, & L. A. Pervin (Eds.), *Handbook of personality: Theory and research*, (pp. 654-  
596 678). New York, NY, US: The Guilford Press.
- 597 Ryan, R. M., & Deci, E. L. (2017). *Self-determination theory: Basic psychological needs in*  
598 *motivation, development, and wellness*. Guilford Publications, New York.
- 599 Sánchez-Fernández, J., Muñoz-Leiva, F., & Montoro-Ríos, F. J. (2012). Improving retention  
600 rate and response quality in Web-based surveys. *Computers in Human Behavior*, 28(2),  
601 507-514.
- 602 Shannon, S., Breslin, G., Haughey, T., Sarju, N., Neill, D., Lawlor, M., & Leavey, G. (2019).  
603 Predicting Student-Athlete and Non-Athletes' Intentions to Self-Manage Mental Health:  
604 Testing an Integrated Behaviour Change Model. *Mental Health & Prevention*, 13, 92-99.
- 605 Shannon, S., Prentice, G., & Breslin, G. (2021). Athletes' Psychological Needs and Coaches'  
606 Interpersonal Behaviors: A Within-Person Latent Profile Analysis. *Journal of Sport and*  
607 *Exercise Psychology*, 43(1), 71-82.
- 608 Sheehan, R. B., Herring, M. P., & Campbell, M. J. (2018b). Longitudinal relations of mental  
609 health and motivation among elite student-athletes across a condensed season: Plausible  
610 influence of academic and athletic schedule. *Psychology of Sport and Exercise*, 37, 146-  
611 152.
- 612 Stanley, P. J., Schutte, N. S., & Phillips, W. J. (2021). A meta-analytic investigation of the  
613 relationship between basic psychological need satisfaction and affect. *Journal of Positive*  
614 *School Psychology* (in press).
- 615 Stenling, A., Lindwall, M., & Hassmén, P. (2015). Changes in perceived autonomy support,  
616 need satisfaction, motivation, and well-being in young elite athletes. *Sport, Exercise, and*  
617 *Performance Psychology*, 4(1), 50.

## Temporal changes in burnout in athletes

- 618 Vallerand, R. J. (2007). Intrinsic and extrinsic motivation in sport and physical activity: a  
619 review and a look at the future. In G. Tenenbaum & R. C. Eklund (Eds.), *Handbook of*  
620 *sport psychology*, (pp. 59-83). John Wiley & Sons.
- 621 Vella, S. A., & Swann, C. (2021). Time for mental healthcare guidelines for recreational  
622 sports: A call to action. *British Journal of Sports Medicine*, 55, 184-185.