

1 **Examining how observed need-supportive and need-thwarting teaching behaviours**  
2 **relate to pupils' affective outcomes in physical education**

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25

26 **Abstract**

27 This study aims to investigate the complexity of the practices of pedagogies of affect in  
28 physical education in response to urgent mental health issues among children and young  
29 people. As a proxy for measuring the effects of pedagogies of affect on pupils' outcomes,  
30 self-determination theory (SDT) has informed teaching approaches for student motivation  
31 and psychological wellness and, thus it could be an indicator perspective for mental health.  
32 Previous SDT studies in physical education have shown the relationship between pupils'  
33 perceptions of need-supportive and need-thwarting teaching behaviours and affective  
34 outcomes. Nevertheless, no attempts have been made to test this teacher-pupil relationship  
35 involving observations of naturalistic teaching behaviour. Accordingly, this study examined  
36 how these observed teaching behaviours relate to pupils' affective outcomes represented by  
37 basic psychological need satisfaction and frustration, (de)motivation, positive and negative  
38 affect, and sense of coherence. Employing a cross-sectional design, this study conducted  
39 observations of one indoor lesson per class and administered a set of questionnaires to pupils.  
40 In total, 20 teachers and 381 pupils aged 11 to 15 from seven different Scottish secondary  
41 schools participated in this study. The results showed that the factor of the observed structure  
42 before the activity was significantly related to affective outcomes, while the observed  
43 controlling teaching behaviour was related to negative outcomes. Although non-significant  
44 relationships between some factors of observed teaching behaviour and pupils' variables  
45 were also found, this observational study is significant as it provides direct evidence of  
46 teacher-pupil interactions in the real-life context for developing pedagogies of affect.

47

48 **Keywords**

49 Pedagogies of affect, mental health, well-being, self-determination theory, Scotland

50

## 51 **Introduction**

52 Studies have shown that the prevalence of health issues among children and young people,  
53 particularly mental health issues, is rising (Smith, 2020). For instance, in the UK, Pitchforth  
54 et al. (2019) found a six-fold increase in the prevalence of mental illness among 4–25-year-  
55 olds in England and a more than two-fold increase in Scotland between 2003 and 2014.  
56 Further, the mental health crisis has been exacerbated by the COVID-19 pandemic,  
57 increasing the need for mental health support and development in schools post-pandemic  
58 (Gagné et al., 2022; Smith, 2020). Thus, it is timely and crucial to develop and implement  
59 critical pedagogies to respond to mental health issues in school physical education (Kirk,  
60 2020). Kirk (2020) names pedagogies of affect, which advocate for the affective domain to  
61 become an explicit focus of teaching in physical education rather than a hoped-for by-product  
62 of teaching motor skills. Within this context, teachers adopt pedagogies of affect when they  
63 focus on teaching and learning in the affective domain. While, as Kirk (2020) shows, there  
64 are pedagogies of affect available to teachers, such as Teaching for Personal and Social  
65 Responsibility (Hellison, 1995) and activist approaches to working with girls (Oliver and  
66 Kirk, 2015), work with pedagogies of affect is still in a developmental phase. Therefore, this  
67 study seeks to understand the practices of pedagogies of affect that naturally occur in real-life  
68 contexts. This is important because it will provide empirical knowledge to equip physical  
69 education teachers who wish to address affective outcomes.

70 Measuring the effects of pedagogies of affect on pupils' outcomes is difficult and  
71 complex because it refers to pupils' feelings, beliefs, aspirations, and attitudes (Wright and  
72 Irwin, 2018). However, as a proxy for this relationship, self-determination theory (SDT: Ryan  
73 and Deci, 2017) has informed teaching approaches and interventions for pupils'  
74 psychological well-being and motivation, thus it could be an indicator perspective for mental  
75 health (Ryan and Deci, 2020). Based on SDT and in the context of school physical education,

76 previous studies revealed that need-supportive teaching behaviours impact psychological  
77 need satisfaction and autonomous forms of motivation, whereas need-thwarting teaching  
78 behaviours predict psychological need frustration and controlled motivation or amotivation  
79 (Haerens et al., 2015; Leo et al., 2022a, 2022b, 2022c; Vasconcellos et al., 2020).

80 A series of observational studies within SDT has been conducted since Haerens et al.  
81 (2013) developed the first version of a need-supportive observation tool for teaching  
82 behaviour dynamics. Following this, Van den Berghe et al. (2013) developed an observation  
83 tool for assessing need-thwarting behaviour and showed its relationship with teachers' self-  
84 reported motivational orientations. Furthermore, De Meyer et al. (2014) tested the  
85 relationships between the observed controlling teaching behaviour and students' controlled  
86 motivation, but they did not find any significant relationships between them. More recently,  
87 some studies have investigated how observed need-supportive and need-thwarting teaching  
88 behaviours related to students' engagement in learning activities (Cents-Boonstra et al., 2021;  
89 González-Peño et al., 2021). Observational studies in the current context are important  
90 because they can yield direct evidence of teachers' naturalistic behaviour (i.e. regular  
91 teaching in routine lessons rather than modified teaching in interventions) to achieve pupils'  
92 outcomes and, thus, have high ecological validity (Haerens et al., 2013). In that sense, an  
93 observation tool allows for identifying specific critical moments and dynamics of teaching  
94 behaviour that might relate to pupils' affective outcomes in a regular lesson. However, no  
95 research has attempted to examine the relationship between observed teaching behaviours  
96 and pupils' variables of affective outcomes.

97

### 98 *Need-supportive and need-thwarting teaching behaviours*

99 SDT is helpful in understanding and measuring social contextual factors, such as the impact  
100 of teachers' teaching behaviour on pupils' affective outcomes; such behaviours are called

101 need-supportive or need-thwarting teaching behaviours. Need-supportive teaching, which has  
102 three factors, autonomy support, structure, and relatedness, is of critical importance, as  
103 several previous studies have shown that an increase in need support from teachers is related  
104 to an increase in pupils' psychological need satisfaction (Haerens et al., 2013; Ryan and Deci,  
105 2020). Conversely, controlling, cold, and chaotic teachers typically are expected to thwart the  
106 psychological needs of pupils, impeding their autonomous motivation and promoting  
107 controlled motivation (Haerens et al., 2015; Van den Berghe et al., 2016).

108       Autonomy support refers to a teacher's instructional and interpersonal behaviour in  
109 understanding pupils' interests, values, and preferences (Reeve, 2009). Autonomy-supportive  
110 teachers use various strategies such as offering meaningful choices and providing  
111 opportunities for pupils' ownership of their learning (Haerens et al., 2013). The perception of  
112 autonomy support from teachers can lead to an increase in pupils' autonomous motivation  
113 and basic psychological need satisfaction (Behzadnia et al., 2018; Haerens et al., 2015) and  
114 enhance their levels of enjoyment and interest (Leptokaridou et al., 2016). Although studies  
115 of autonomy support exist extensively (Reeve, 2009), the factor of structure is necessary to  
116 enhance need satisfaction, especially competence need satisfaction. Teachers can implement  
117 structure with appropriate guidance and clarification to help learners feel competent to  
118 engage in activities (Aelterman et al., 2019). The provision of positive feedback and  
119 encouragement is a crucial part of the structure and has a positive relationship with  
120 motivation and interest (Panadero and Lipnevich, 2022; Stroet et al., 2013). Conversely,  
121 negative evaluative feedback (e.g. lack of nurturance) has been shown to have a negative  
122 effect (Stroet et al., 2013). The provision of relatedness support refers to the quality of  
123 interpersonal relationships between teachers and pupils. This behaviour supports pupils'  
124 relatedness satisfaction, for example, by being attuned and paying attention to what pupils  
125 say (Stroet et al., 2013). If pupils perceive higher relatedness support, this predicts

126 relatedness need satisfaction (Sparks et al., 2016), significantly leading to autonomous  
127 motivation and behavioural and emotional engagement (Chu and Zhang, 2018; Leo et al.,  
128 2023).

129 In contrast, need-thwarting teaching behaviours such as controlling, cold, and chaotic  
130 teaching behaviours result in negative experiences. Controlling teaching behaviour entails  
131 forcing pupils to comply with what teachers want them to do, making pupils feel pressure,  
132 which, in turn, impacts their psychological need frustration and a lack of motivation  
133 (Behzadnia et al., 2018; Haerens et al., 2015). Chaotic teaching involves the creation of a  
134 laissez-faire climate by letting pupils do what they want, which, however, results in the less  
135 optimal development of student competence (Aelterman et al., 2019; Van den Berghe et al.,  
136 2013). Cold behaviour refers to teachers who are unfriendly and distant from their pupils,  
137 which can potentially thwart pupils' need for relatedness (Van den Berghe et al., 2013). The  
138 literature has identified that the dark side of teaching is associated with less desirable  
139 motivational experiences (Haerens et al., 2015, 2018; Van den Berghe et al., 2016). However,  
140 there is still limited observational research on the relationship between need-thwarting  
141 teaching behaviours and pupils' affective outcomes.

142

### 143 *Affective outcomes*

144 The term *affect* refers to the affective domain, which includes matters such as motivation,  
145 psychological well-being, and resilience (Teraoka et al., 2021). As an example of  
146 conceptualising affective outcomes in a local context, in Scotland's national curriculum (i.e.  
147 *Curriculum for Excellence*), affective outcomes are a significant aspect of learning named  
148 Personal Qualities, which includes motivation, confidence and self-esteem, determination and  
149 resilience, and respect and tolerance (Education Scotland, 2017). In a global context, SDT  
150 has been used to address basic psychological needs, motivation, and psychological well-being

151 and is, thus, a theory for conceptualizing affective outcomes. In this sense, this paper uses  
152 affective outcomes to address multi-dimensional aspects in the affective domain, including  
153 motivational experiences within SDT.

154 The main idea behind SDT is that every human being has three basic psychological needs  
155 (i.e. autonomy, competence, and relatedness) that must be satisfied to facilitate more  
156 autonomous motivation (Ryan and Deci, 2017). Furthermore, SDT describes motivation as a  
157 continuum, emphasising different types of behavioural regulation (Ryan and Deci, 2017).  
158 Autonomous motivation refers to regulations involving experiences of volition and self-  
159 expression, and it is considered the optimal form of motivation. Controlled motivation  
160 denotes behavioural engagement that is characterised by a sense of internal or external  
161 pressure or coercion. Amotivation is defined as a lack of motivation and intention. These  
162 motivational experiences based on the principles of SDT have been applied to the physical  
163 education context across several school-aged populations (Van den Berghe et al., 2014).

164 Another important concept concerning mental health and affective outcomes is well-  
165 being, which has two dimensions: hedonic and eudaimonic well-being (Dodge et al., 2012).  
166 On the one hand, hedonic well-being emphasises constructs such as happiness, positive  
167 affect, low negative affect, and life satisfaction. On the other hand, eudaimonic well-being  
168 focuses on life meaning, human development, resources, and strengths. In relation to SDT, a  
169 high level of basic psychological need satisfaction arguably contributes to one's hedonistic  
170 well-being. Indeed, previous studies have shown that basic psychological need satisfaction  
171 relates to pupils' well-being, such as positive affect (Behzadnia et al., 2018) and vitality  
172 (Haerens et al., 2018). Regarding eudaimonic well-being, in pedagogical research, Lang et al.  
173 (2017) proposed that physical education can contribute to the successful acquisition of new  
174 skills to cope with stress, which are important human capabilities in the affective domain and  
175 are key to fostering resilience. Resilience is also central to a salutogenic approach to health

176 promotion, with the notion of a Sense of Coherence (SOC), where people can see the  
177 meaningfulness, comprehensibility, and manageability of their life situation, aiding in the  
178 maintenance of their health (Antonovsky, 1996). Pedagogically, SOC emphasises how  
179 physical education might help individuals live a good life and highlights that people are  
180 always in a stage of becoming (McCuaig and Quennerstedt, 2018). Yet, the literature has  
181 been limited to investigating the relationship between teaching and eudaimonic well-being,  
182 which can be represented by SOC.

183

#### 184 *Present research*

185 While many studies have examined the relationship between SDT-informed teaching styles  
186 and pupils' outcomes, it is still unknown how observed teaching behaviours relate to pupils'  
187 variables of affective outcomes. As Haerens et al. (2013) noted, observational studies can  
188 contribute direct evidence of teachers' actual behaviour in relation to pupils' outcomes as  
189 these studies have high ecological validity. However, to the best of our knowledge, no  
190 previous study has attempted to examine the relation of observed naturalistic teaching  
191 behaviours on pupils' affective outcomes. Therefore, this study aimed to examine how  
192 observed need-supportive teaching and need-thwarting behaviours are associated with pupils'  
193 affective outcomes represented by basic psychological need satisfaction and frustration,  
194 (de)motivation, positive and negative affect, and SOC.

195

## 196 **Methods**

### 197 *Study design*

198 This study employed a cross-sectional design, which involved the observation of one  
199 indoor lesson per class and the administration of a set of questionnaires to pupils. Regarding  
200 the setup of the observation, one camera was positioned at the corner of a gym to film the



201 lessons, and the teachers were asked to wear a small microphone to record their verbal  
202 instruction and communication with pupils. The teachers themselves chose which of their  
203 classes would be observed, but we asked them to do nothing different from their regular  
204 classes. As a means of validating the observed lesson, all the teachers affirmed that the  
205 recorded videos were a good representation of their regular teaching. At the end of each  
206 observed lesson, we asked pupils to fill out a set of four different questionnaires on affective  
207 outcomes. The contents of the questionnaires are described in the data generation section.  
208 The data collection of this study spanned from October 2018 to May 2019. Ethical approval  
209 for this study was granted by the ethics committee of the university hosting the research. We  
210 explained to the participants that participation was voluntary and that they could decline to  
211 participate in the study. Prior to the observed lessons, informed consent was obtained from  
212 the teachers and assent from the pupils only since they were taking part in a regular  
213 timetabled lesson and the schools were in *loco parentis*. While the pupils were asked to pass  
214 their parents a parent information sheet with an opt-out form, no parents refused.  
215 Additionally, approvals from local councils and headteachers were secured before starting the  
216 data collection process.

217

### 218 *Participants*

219 Participants were recruited through professional contacts at reputable universities in  
220 Scotland using a purposive sampling approach (Etikan et al., 2016). The participating  
221 teachers expressed their responsibility of supporting pupils' affective outcomes in physical  
222 education. Within the Scottish context, the participating teachers expressed an explicit  
223 commitment to teaching for Personal Qualities in the lessons to be observed. A total of 20  
224 teachers and 381 pupils aged 11–15 from seven different Scottish secondary schools agreed  
225 to participate in this study (see Supplemental Material A). The context of this study was non-

226 denominational and state-funded comprehensive school settings, which cater for  
227 approximately 96% of school-aged children in Scotland. The sample consisted of 11 male  
228 and nine female teachers. The teachers' teaching experience ranged from one to 14 years.  
229 Four teachers were Principal Teachers (i.e. heads of the physical education department in  
230 their schools). We observed six S1 classes (i.e. pupils aged 11 and 12), eight S2 classes (i.e.  
231 pupils aged 12 and 13), five S3 classes (i.e. pupils aged 13 and 14), and one S4 class (i.e.  
232 pupils aged 14 and 15). The observed classes included four girls-only classes, two boys-only  
233 classes, and 14 co-educational classes. Activities in the observed classes included basketball,  
234 badminton, gymnastics, modified ball games, volleyball, and high jump. These activities  
235 were part of the normal physical education programmes in the schools.

236

#### 237 *Data generation*

238 This paper reports the quantitative measurements of observed teaching behaviours and  
239 pupils' variables of affective outcomes. Observations were focused on the extent to which  
240 teachers behaved in a need-supportive or need-thwarting way. Pupils' variables were  
241 measured using self-reported questionnaires. All the questionnaires were validated and  
242 determined as reliable for adolescent populations in previous studies.

243 *Observed teaching behaviour.* Teaching behaviour was assessed using the observation  
244 criteria of need-supportive and need-thwarting teaching styles, which were proposed by  
245 Haerens et al. (2013) and Van den Berghe et al. (2013). The observation measures included  
246 overarching factors of teaching style based on SDT, namely, autonomy support (three items),  
247 structure before the activity (five items), structure during the activity (seven items),  
248 relatedness support (five items), control (seven items), cold (five items), and chaos (four  
249 items). Each item was coded periodically (i.e. every five minutes) using a four-point

250 frequency scale, including 0 (never observed), 1 (sometimes observed), 2 (often observed),  
251 and 3 (always observed).

252 A total of 126 intervals (ranging from 4 to 12 intervals) were coded by two trained  
253 observers who are familiar with SDT and pedagogical research. The first observer coded all  
254 the intervals twice two weeks apart to assess intra-rater reliability. Intra-rater reliability was  
255 adequate at 0.85, which was calculated based on intraclass correlation coefficients (ICC).  
256 Consequently, the second observer independently coded the identical intervals. Inter-rater  
257 reliability was adequate at 0.83, which was calculated based on ICC. Although inter-rater  
258 reliability was secured, the two observers had a discussion to reach 100% agreement on the  
259 coding to determine the final scores. The final summed scores for the total duration of the  
260 lesson were divided by the number of coded intervals to compute the mean scores for each  
261 item. Dimensional scale scores were computed by averaging those items reflecting each of  
262 the seven factors.

263 *Basic psychological needs.* The Basic Psychological Need Scale-Revised (BPNS-R)  
264 adapted to the physical education context (Haerens et al., 2015) was used to measure pupils'  
265 basic psychological need satisfaction and frustration with the observed lessons. In total, there  
266 were 24 items: four items for autonomy satisfaction (e.g. 'I felt a sense of choice and freedom  
267 in the things I undertook'), four items for competence satisfaction (e.g. 'I felt confident that I  
268 could do the exercises well'), four items for relatedness satisfaction (e.g. 'I felt that the class  
269 members I cared about also cared about me'), four items for autonomy frustration (e.g. 'I felt  
270 forced to do many exercises I wouldn't choose to do'), four items for competence frustration  
271 (e.g. 'I felt disappointed with many of my performances'), and four items for relatedness  
272 frustration (e.g. 'I felt excluded from the group I wanted to belong to'). A five-point scale  
273 was used to score these items: 1 (not true for me), 2 (not really true for me), 3 (sometimes  
274 true for me), 4 (often true for me), and 5 (very true for me).

275        *Motivation.* The Behavioural Regulation in Physical Education Questionnaire (BRPEQ;  
276 Aelterman et al., 2012) was used to assess pupils' motivation towards the lesson they  
277 undertook. The items described the reasons why pupils engaged in the lesson. There were 20  
278 items for the statement 'I put effort into this physical education (PE) class': eight items for  
279 autonomy motivation (e.g. 'because I find this PE class personally meaningful'), eight items  
280 for controlled motivation (e.g. 'because I had to prove myself'), four items for amotivation  
281 (e.g. 'I don't see why this PE class is part of the curriculum'). A five-point scale was used for  
282 these items: 1 (not true for me), 2 (not really true for me), 3 (sometimes true for me), 4 (often  
283 true for me), and 5 (very true for me).

284        *Well-being.* The short form of the Positive and Negative Affect Schedule (PANAS;  
285 Thompson, 2007) was used to measure a wide conception of psychological well-being (i.e.  
286 hedonistic well-being) in pupils. The pupils were asked to what extent they felt each of the  
287 five positive feelings (e.g. active) and five negative feelings (e.g. afraid). The pupils indicated  
288 their feeling at the end of the observed lesson using a five-point scale: 1 (not at all), 2 (a  
289 little), 3 (moderately), 4 (quite a bit), and 5 (extremely). In addition, the simplified three-item  
290 Sense of Coherence Scale (SOC; Lundberg and Peck, 1995) was used to measure the aspect  
291 of eudaimonic well-being, which refers to the manageability, meaningfulness, and  
292 comprehensibility of life for individuals. The question used to measure manageability was as  
293 follows: 'Do you usually see a solution to problems and difficulties that other people find  
294 hopeless?' The question used to measure meaningfulness was as follows: 'Do you usually  
295 feel that your daily life is a source of personal satisfaction?' The question used to measure  
296 comprehensibility was as follows: 'Do you usually feel that the things that happen to you in  
297 your daily life are hard to understand?' The pupils were asked to respond to each question  
298 with 'yes, usually', 'yes, sometimes', or 'no'. For the questions of manageability and  
299 meaningfulness, 'yes, usually' weighed two points, 'yes, sometimes' weighed one point, and

300 'no' weighed zero points. For the question of comprehensibility, the point system was  
301 reversed. The scale scores were computed by summing the points, with the total ranging from  
302 0 to 6. A higher score indicated a higher SOC.

303

#### 304 *Data analysis*

305 We computed descriptive statistics and Cronbach's alpha for each factor of the  
306 measurements using SPSS 27. As Taber (2018) noted, Cronbach's alpha values are  
307 considered acceptable at  $\alpha \geq .7$ , good at  $\alpha \geq .8$ , and excellent at  $\alpha \geq .9$ . Although Cronbach's  
308 alpha values were below .7 for some of the factors in this study, we still intended to include  
309 these factors into the analysis for explorative purposes. We used Pearson's correlation to  
310 examine relationships among the factors of observed teaching behaviours, and relationships  
311 among the factors of pupils' variables of affective outcomes. Also, since the dataset extracted  
312 from teachers and pupils was treated as a two-level hierarchical data structure, multilevel  
313 correlations were conducted to examine the relationships between observed teaching  
314 behaviours and pupils' variables. The values represent class-level correlation coefficients.  
315 Following this, we ran separate hierarchical linear models for each factor of pupils' variables.  
316 The first task in the hierarchical linear modelling was to estimate two-level null models for  
317 pupils' autonomy satisfaction (Null Model A), competence satisfaction (Null Model B),  
318 relatedness satisfaction (Null Model C), autonomy frustration (Model D), competence  
319 frustration (Null Model E), relatedness frustration (Null Model F), autonomous motivation  
320 (Null Model G), controlled motivation (Null Model H), amotivation (Null Model I), positive  
321 affect (Null Model J), negative affect (Null Model K), and SOC (Null Model L). The ICC  
322 was computed to explain the proportion of variance at class level. Next, the scores of  
323 observed teaching behaviours (i.e. autonomy support, structure before activity, structure  
324 during activity, relatedness support, control, cold, and chaos) were included as a level-two

325 variable in the models (Full Model A to L). The scores of observed teaching behaviour were  
326 grand mean centred. Multi-level analyses (i.e. multilevel correlations and hierarchical linear  
327 modelling) were conducted using the statistical software HAD ver.17 developed by Shimizu  
328 (2016).

329

## 330 **Results**

331 The means, standard deviations, Cronbach's alpha, and correlations for the factors of  
332 observed teaching behaviour are reported in Table 1. Cronbach's alpha for the factor of  
333 observed cold teaching behaviour was excellent at .91. Further, the factors of observed  
334 relatedness support and control teaching had good reliability at .88 and .80, respectively.  
335 Cronbach's alpha for the observed structure before the activity factor was acceptable at .70.  
336 The factors of observed autonomy support ( $\alpha = .45$ ), structure during the activity ( $\alpha = .53$ ),  
337 and chaos ( $\alpha = .56$ ) had relatively low internal consistency. Despite the low internal  
338 consistency, we will include the dimensions in the analysis to report a systematic view of the  
339 teaching styles and their relations to pupils' affective outcomes for explorative purposes. The  
340 decision was made with references to the original works by Haerens et al. (2013) and Van  
341 den Berghe et al. (2013) as they also reported a similar issue. We will return to this point in  
342 the discussion.

343 Regarding the significant correlations among the factors of observed teaching behaviour,  
344 the observed autonomy support was positively correlated with structure during the activity ( $r$   
345  $= .51, p < .05$ ). The observed structure before the activity was positively correlated with  
346 structure during the activity ( $r = .72, p < .01$ ) and relatedness support ( $r = .61, p < .01$ ), and  
347 negatively correlated with chaotic teaching ( $r = -.56, p < .05$ ). The observed structure during  
348 the activity was positively correlated with relatedness support ( $r = .56, p < .05$ ) and  
349 negatively correlated with chaotic teaching ( $r = -.57, p < .01$ ). There was a significant

350 negative correlation between relatedness support and all the factors of need-thwarting  
351 teaching behaviour (control;  $r = -.73, p < .01$ , cold;  $r = -.58, p < .01$ , chaos;  $r = -.71, p < .01$ ),  
352 and relatedness support had a significant positive relationship with structure before and  
353 during the activity. Among the factors of need-thwarting teaching behaviour, the observed  
354 controlling teaching was positively correlated with cold ( $r = .86, p < .01$ ) and chaotic ( $r = .73,$   
355  $p < .01$ ) teaching. Further, there was a significant positive correlation between cold teaching  
356 and chaotic teaching ( $r = .80, p < .01$ ). Also, chaotic teaching had a significant negative  
357 relationship with structure before and during the activity, and relatedness support.

358 <Insert Table 1 around here>

359 In terms of the relationships among the pupils' variables of affective outcomes, the  
360 results showed that pupil variables were significantly correlated (see Supplemental Material  
361 B). All need satisfaction outcomes were positively correlated with autonomous motivation,  
362 positive affect, and SOC, whereas they were negatively correlated with all need frustration  
363 outcomes, controlled motivation, amotivation, and negative affect. All need frustration  
364 outcomes showed significant positive correlations with controlled motivation, amotivation,  
365 and negative affect. In contrast, they were negatively correlated with autonomous motivation,  
366 positive affect, and SOC. Autonomous motivation demonstrated a significant positive  
367 correlation with positive affect and SOC, whereas it was negatively associated with  
368 controlled motivation, amotivation, and negative affect. Controlled motivation was positively  
369 correlated with amotivation and negative affect, whereas there was a negative correlation  
370 with positive affect and SOC. Amotivation was positively correlated with negative affect and  
371 SOC. Finally, SOC was positively correlated with all need satisfaction outcomes,  
372 autonomous motivation, positive affect, and SOC while it was negatively correlated with all  
373 need frustration outcomes, controlled motivation, amotivation, and negative affect.

374 In Table 2, the matrix represents class-level correlation coefficients of the relationship  
375 between observed teaching behaviour and pupils' variables of affective outcomes. With  
376 regard to the relationships between the observed teaching behaviour and pupils' variables at  
377 class level, the factor of observed structure before the activity demonstrated a significant  
378 positive correlation with all need satisfaction outcomes (autonomy;  $r = .66, p < .05$ ,  
379 competence;  $r = .63, p < .05$ , relatedness;  $r = .62, p < .05$ ) and autonomous motivation ( $r$   
380  $= .69, p < .05$ ), whereas it was negatively correlated with all need frustration outcomes  
381 (autonomy;  $r = -.74, p < .05$ , competence;  $r = -.62, p < .05$ , relatedness;  $r = -.67, p < .05$ ) and  
382 amotivation ( $r = -.66, p < .05$ ). Furthermore, there was a significant positive correlation at  
383 class level between the factor of observed control teaching and autonomy frustration ( $r = .57,$   
384  $p < .05$ ).

385 <Insert Table 2 around here>

386 The results of the hierarchical linear models (see Supplemental Material C) indicated a  
387 significant variance at class level in all null models for autonomy satisfaction ( $\chi^2(19) =$   
388  $52.69, p < .01, ICC = 8\%$ ), competence satisfaction ( $\chi^2(19) = 70.44, p < .01, ICC = 12\%$ ),  
389 relatedness satisfaction ( $\chi^2(19) = 61.86, p < .01, ICC = 10\%$ ), autonomy frustration ( $\chi^2(19)$   
390  $= 93.75, p < .01, ICC = 16\%$ ), competence frustration ( $\chi^2(19) = 69.79, p < .01, ICC = 12\%$ ),  
391 relatedness frustration ( $\chi^2(19) = 57.52, p < .01, ICC = 9\%$ ), autonomous motivation ( $\chi^2(19) =$   
392  $73.99, p < .01, ICC = 12\%$ ), controlled motivation ( $\chi^2(19) = 66.24, p < .01, ICC = 11\%$ ),  
393 amotivation ( $\chi^2(19) = 59.42, p < .01, ICC = 17\%$ ), positive affect ( $\chi^2(19) = 74.24, p < .01,$   
394  $ICC = 13\%$ ), negative affect ( $\chi^2(19) = 38.85, p < .01, ICC = 5\%$ ), and SOC ( $\chi^2(19) = 31.26,$   
395  $p < .01, ICC = 3\%$ ). The results from models that included the observed teaching behaviour  
396 showed that the factor of the structure before the activity was significantly positively related  
397 to autonomy satisfaction ( $\beta = .54, S.E. = .21, t(12) = 2.54, p < .05$ ), competence satisfaction  
398 ( $\beta = .82, S.E. = .24, t(12) = 3.34, p < .01$ ), relatedness satisfaction ( $\beta = .74, S.E. = .28, t(12) =$



399 2.62,  $p < .05$ ), autonomous motivation ( $\beta = .82$ ,  $S.E. = .25$ ,  $t(12) = 3.26$ ,  $p < .01$ ), positive  
400 affect ( $\beta = .68$ ,  $S.E. = .22$ ,  $t(12) = 3.10$ ,  $p < .01$ ), and SOC ( $\beta = .67$ ,  $S.E. = .27$ ,  $t(12) = 2.50$ ,  $p$   
401  $< .05$ ). In contrast, there was a significant negative relationship between the factor of the  
402 structure before the activity and autonomy frustration ( $\beta = -.68$ ,  $S.E. = .22$ ,  $t(12) = -3.10$ ,  $p$   
403  $< .01$ ), competence frustration ( $\beta = -.72$ ,  $S.E. = .21$ ,  $t(12) = -3.39$ ,  $p < .01$ ), relatedness  
404 frustration ( $\beta = -.58$ ,  $S.E. = .20$ ,  $t(12) = -2.83$ ,  $p < .05$ ), amotivation ( $\beta = -.69$ ,  $S.E. = .27$ ,  $t(12)$   
405  $= -2.54$ ,  $p < .05$ ), and negative affect ( $\beta = -.34$ ,  $S.E. = .12$ ,  $t(12) = -2.85$ ,  $p < .05$ ).  
406 Furthermore, as the score of observed autonomy support was higher, the score of competence  
407 frustration was significantly higher ( $\beta = .32$ ,  $S.E. = .12$ ,  $t(12) = 2.60$ ,  $p < .05$ ), and the score  
408 of positive affect was significantly lower ( $\beta = -.45$ ,  $S.E. = .13$ ,  $t(12) = -3.52$ ,  $p < .01$ ).

409

## 410 **Discussion**

411 This study aimed to understand the practices of pedagogies of affect that naturally occur in  
412 physical education in response to urgent mental health issues among young people. In this  
413 respect, this study was the first to attempt to examine the relationships between observed  
414 naturalistic teaching behaviours and pupils' affective outcomes, including motivational  
415 experiences within SDT. In this section, we will discuss the reliability of the scale for  
416 observed teaching behaviour, followed by a discussion on the relationships among pupils'  
417 variables of affective outcomes, and the relationships between observed teaching behaviours  
418 and pupils' variables.

419

### 420 *Observed teaching behaviours*

421 The findings showed that the factors of the observed structure before the activity ( $\alpha$   
422  $= .70$ ), relatedness support ( $\alpha = .88$ ), controlling teaching ( $\alpha = .80$ ), and cold teaching ( $\alpha$   
423  $= .91$ ) had adequate levels of internal consistency, while the factors of observed autonomy

424 support ( $\alpha = .45$ ), structure during the activity ( $\alpha = .53$ ), and chaotic teaching ( $\alpha = .56$ ) did  
425 not demonstrate a satisfactory level of internal consistency. Indeed, previous studies reported  
426 a similar issue. Haerens et al. (2013) reported moderate reliability of autonomy support with a  
427 Cronbach's alpha of .59. This was also the case in Van den Berghe et al. (2013), where the  
428 researchers noted that the internal consistency for observed autonomy support and chaotic  
429 teaching was low, with a Cronbach's alpha of .30 and .48, respectively. These results,  
430 including this study's findings, indicate that the current form of the observation tool might  
431 not reflect autonomy support, structure during the activity, and chaotic teaching as precisely  
432 as the dimensions theoretically proposed in SDT. Alternatively, additional items may be  
433 needed to formulate each dimension solely and systematically. Based on SDT research,  
434 Aelterman et al. (2019) recently developed a new integrative scale of teaching styles with  
435 four factors (i.e. autonomy support, structure, control, and chaos) that are more closely  
436 related to each other as an alternative to separate scales for the three psychological needs.  
437 This can ensure a more systematic assessment of teaching styles, which could be used for  
438 further refinement of the observation tool.

439 In terms of the relationships among the factors of observed teaching behaviour, it should  
440 be recognised that teachers whose behaviour showed higher levels of structure during the  
441 activity were more likely to show higher levels of autonomy support, structure before the  
442 activity, and relatedness support. The significant teaching behaviours, such as providing  
443 students with a rationale for tasks, delivering substantive feedback, and offering necessary  
444 help during activities, also contributed to autonomy and relatedness support. Previous studies  
445 also showed that providing the aspects of structure in an autonomy-supportive way would  
446 benefit optimal pupils' motivational experiences (Aelterman et al., 2019; Jang et al., 2010).  
447 Furthermore, we found a binary relation between relatedness support and need-thwarting  
448 teaching behaviours. This result could indicate that the presence of relatedness support,

449 including teachers attuning and empathy, would be necessary to refrain from need-thwarting  
450 behaviour.

451

452 *Relationships among the pupils' variables of affective outcomes*

453 Regarding the relationships among the pupils' variables of affective outcomes, in line with  
454 SDT, the results showed that need satisfaction was significantly related to autonomous  
455 motivation and negatively related to amotivation, whereas need frustration was significantly  
456 related to controlled motivation and amotivation, which was consistent with Haerens et al.  
457 (2015). The present study also showed that positive affect was related to all need satisfaction  
458 outcomes, lower all need frustration outcomes, higher autonomous motivation, lower  
459 controlled motivation, and lower amotivation, while negative affect was related to lower all  
460 need satisfaction outcomes, higher all need frustration outcomes, lower autonomous  
461 motivation, higher controlled motivation, and higher amotivation. Behzadnia et al. (2018)  
462 similarly found significant relationships among need satisfaction, need frustration,  
463 autonomous and controlled motivation, and positive and negative affect. Importantly, the  
464 present study indicated that SOC was related to higher all need satisfaction outcomes,  
465 autonomous motivation, positive affect, and lower all need frustration outcomes. This finding  
466 aligns with previous research suggesting that meeting the three basic psychological needs and  
467 experiencing positive affect are important predictors of a sense of meaning in life (Martela et  
468 al., 2018). Furthermore, SOC elaborates on the salutogenic framework for health promotion  
469 (Antonovsky, 1996). From a salutogenic perspective, physical education has the potential to  
470 enhance health and well-being by focusing on understanding the meaning of the activity, as  
471 well as recognising the meaningfulness within movements (Fletcher and Ní Chróinín, 2022;  
472 Quennerstedt, 2019). For practical implications, when pupils perceive activities as  
473 meaningful and connecting with their core values, they are more likely to be motivated to

474 engage in activities (Boonekamp et al., 2021). Consequently, this heightened motivation can  
475 lead to more positive affective outcomes.

476

477 *Relationships between observed teaching behaviours and pupils' variables of affective*  
478 *outcomes*

479 The results showed that the factor of the observed structure before the activity was  
480 significantly related to pupils' basic psychological need satisfaction, autonomous motivation,  
481 positive affect, and SOC, whereas it had a negative association with their basic psychological  
482 need frustration, amotivation, and negative affect. This result suggested that teachers who  
483 provided clear instructions and rationales for the activities might have made pupils feel more  
484 comfortable engaging in the lessons, thereby increasing their autonomous motivation and  
485 producing affective outcomes. Teaching strategies in relation to the structure of before the  
486 activity include adapting tasks to suit each pupil's ability, designing challenging activities,  
487 and providing effective models before task participation (Leo et al., 2022a). Conversely,  
488 teachers' provision of ambiguous or unclear instructions and rationales before the activity  
489 might impact pupils' feelings of frustration, demotivation and negative affect. This finding  
490 reinforces the significance of teachers' provision of structure in fostering pupils' autonomous  
491 motivation and minimizing amotivation in physical education classes (Chu and Zhang, 2018;  
492 Leo et al., 2022a, 2022b, 2022c). Moreover, we found that the observed controlling teaching  
493 behaviour had a positive correlation with autonomy frustration. This finding can add to  
494 previous research that observed that control was related to controlled motivation and  
495 amotivation (De Meyer et al., 2014) and lower student engagement (González-Peño et al.,  
496 2021). Also, it should be noted that autonomy frustration had no significant relationship with  
497 all the dimensions of teaching styles when including them in the hierarchical linear model.  
498 Instead, only the observed structure before the activity had a negative significant relation in

499 the model. In other words, the relationship between observed controlling teaching behaviour  
500 and autonomy frustration was significantly correlated interchangeably when simply looking  
501 at the two variables, but the correlation may have been influenced by the introduction of the  
502 observed structure before the activity, which significantly coincided with the lessons.  
503 Nevertheless, the findings indicate that the small effect size limits its application to practices.  
504 Probably, it does not mean that observed teaching behaviour has a direct impact on pupils'  
505 psychological variables, though they are significantly correlated. Notwithstanding, the effect  
506 size results are meaningful in that they can be used for future research on international and  
507 cross-cultural comparisons and future meta-analyses on the influence of observed teaching  
508 behaviour on pupils' outcomes.

509 It should be noted that no significant relationships were found between the remaining  
510 factors of observed teaching behaviours (i.e. relatedness support, cold, and chaos) and pupils'  
511 variables of affective outcomes. A potential explanation for these non-significant associations  
512 is the low internal consistency and the sample size used in this study, which could be  
513 considered limitations of this study. An explanation for the non-significant relationship  
514 between the observed relatedness support and pupils' affective outcomes is that teachers'  
515 relatedness support, such as being empathic and warm, may not have aligned with pupils'  
516 expectations and needs. It perhaps led to a mismatch between what teachers intended to  
517 communicate and what pupils perceived or interpreted. Alternatively, relatedness could be  
518 perhaps most influenced by peers rather than teachers (Vasconcellos et al., 2020). Hence, in  
519 this study, the fact that teachers' relatedness support was observed did not mean that there  
520 was an increase in pupils' relatedness satisfaction at the class level, which had little  
521 correlation with affective outcomes. Moreover, especially for the factors of control and  
522 chaos, we knew we were less likely to observe the participating teachers exhibiting cold and  
523 chaotic teaching behaviours since they had expressed an interest in the affective domain

524 during the purposive sampling. If a larger sample size was obtained with simple random  
525 sampling, cold and chaotic teaching behaviours could potentially be observed more readily.

526

### 527 *Strengths, limitations, and future research*

528 The most important contribution of this study to pedagogical research was examining the  
529 relationships between observed naturalistic teaching behaviours and pupils' affective  
530 outcomes, which is crucial because observational studies provide direct evidence of teacher–  
531 pupil interactions in real-life contexts. However, there are some limitations to be considered.

532 First, we did not provide a satisfactory level of internal consistency in the observation tool.

533 While Haerens et al. (2013) provided compelling evidence supporting the validity of the  
534 observation tool, indicating significant relationships with pupil perceptions, this was probably  
535 not the case in the present study. Further investigations are needed to develop an observation  
536 tool to measure teaching behaviours as precisely as possible. Second, we filmed only one  
537 lesson from each teacher, so that teachers' general teaching style might not have been  
538 captured. For instance, even if lower autonomy support was observed in one lesson, it could  
539 be an isolated incident, and the teacher might offer higher autonomy support usually, and vice  
540 versa. As teachers could behave differently in every lesson depending on day-to-day  
541 circumstances, future research should adopt a longitudinal approach to reflect teachers'  
542 general teaching styles and changes. Simultaneously, it should be necessary to consider  
543 pupils' affective outcomes in the long term, rather than in a single lesson, which might  
544 produce one-off outcomes.

545

### 546 **Conclusions**

547 This study aimed to examine the relationships between observed need-supportive teaching  
548 and need-thwarting behaviours and pupils' basic psychological need satisfaction and

549 frustration, (de)motivation, positive and negative affect, and SOC. The results showed that  
550 the factor of the observed structure before the activity was significantly related to affective  
551 outcomes. However, no significant relationships were found between the observed  
552 relatedness, cold, chaos, and pupils' variables of affective outcomes. Nonetheless, the study  
553 findings are important because, to the best of our knowledge, this study is the first to  
554 investigate the relationships between teaching behaviours and pupils' affective outcomes  
555 through observations and in line with SDT research. However, further research is needed to  
556 develop an observation tool to measure teaching behaviours in relation to pupils' affective  
557 outcomes and to consider the long-term change in teaching and learning. Overall, this study  
558 reaffirms the necessity of implementing pedagogies of affect to respond to the key issues of  
559 school physical education, especially those related to pupils' mental health and well-being.  
560 Concerning practical implications, the findings of this study implore teachers to practice  
561 need-supportive teaching and avoid need-thwarting teaching in their lessons on a regular  
562 basis. In particular, the provision of structure appeared to be the most significant form of  
563 need-supportive teaching. Teachers can develop the provision of structure by establishing  
564 clear expectations for activities, providing appropriate challenges for advanced learners, and  
565 offering additional support or modifications for pupils who may require it. This, in turn, helps  
566 meet the diverse needs of each pupil, enhancing affective outcomes and potentially  
567 contributing to better mental health.

568

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702

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**Table 1.** Descriptive statistics, internal consistency and correlations among observed teaching behaviour

	<i>M</i>	<i>SD</i>	<i>α</i>	1	2	3	4	5	6	7
Observed										
1 Autonomy support	.97	.55	.45	1.00	.35	.51*	.42	-.32	-.13	-.36
2 Structure before activity	.92	.39	.70		1.00	.72**	.61**	-.41	-.36	-.56*
3 Structure during activity	1.30	.32	.53			1.00	.56*	-.26	-.24	-.57**
4 Relatedness support	2.22	.73	.88				1.00	-.73**	-.58**	-.71**
5 Control	.22	.28	.80					1.00	.86**	.73**
6 Cold	.04	.14	.91						1.00	.80**
7 Chaos	.07	.12	.56							1.00

N<sub>teachers</sub> = 20 \*\**p* < 0.01; \**p* < 0.05 α: Cronbach's alpha

**Table 2.** Multi-level correlations between observed teaching behaviour and pupils' variables of affective outcomes

	Autonomy satisfaction	Competence satisfaction	Relatedness satisfaction	Autonomy frustration	Competence frustration	Relatedness frustration	Autonomous motivation	Controlled motivation	Amotivation	Positive affect	Negative affect	Sense of coherence	
Observed													
1	Autonomy support	.06	-.16	.13	.03	.36	-.12	.00	.05	-.13	-.53	-.32	-.39
2	Structure before activity	.66*	.63*	.62*	-.74*	-.62*	-.67*	.69*	-.52	-.66*	.41	-.63	.59
3	Structure during activity	.25	.17	.22	-.36	-.20	-.31	.28	-.25	-.32	-.03	-.23	.03
4	Relatedness support	.37	.28	.38	-.50	-.29	-.31	.28	-.34	-.36	.15	-.18	.22
5	Control	-.50	-.28	-.34	.57*	.24	.17	-.41	.24	.40	-.10	.02	-.26
6	Cold	-.29	-.30	-.21	.46	.26	.07	-.40	.10	.34	-.08	-.16	-.28
7	Chaos	-.29	-.30	-.23	.46	.22	.13	-.33	.17	.35	-.06	.07	-.25

N<sub>teachers</sub> = 20; N<sub>pupils</sub> = 381    \*\*:  $p < 0.01$ ; \*:  $p < 0.05$

**Supplemental Material A. Participants and school contexts**

School	Enrolment <sup>1</sup>	SIMD <sup>2</sup>	Teacher	Sex	Teaching experience	PT <sup>3</sup>	Pupils' grade	Class setting	Number of pupils			Activity
									Boys	Girls	Others	
1	1228	20% least deprived area	Miss A	Female	11	PT	S1	Girls-only	-	22	-	Basketball
			Mr B	Male	13	-	S3	Co-ed	19	6	-	Badminton
			Miss C	Female	4	-	S3	Co-ed	13	8	1	Ball game
			Miss D	Female	8	-	S2	Girls-only	-	17	-	Badminton
			Miss E	Female	10	-	S2	Co-ed	13	11	-	Gymnastics
2	360	30% least deprived area	Mr F	Male	5	-	S1	Co-ed	7	12	-	Gymnastics
3	605	30% least deprived area	Mr G	Male	11	PT	S3	Co-ed	15	5	-	Basketball
			Mr H	Male	11	-	S1	Co-ed	3	16	-	Ball game
			Mr I	Male	2	-	S2	Co-ed	10	10	-	Volleyball
			Miss J	Female	2	-	S3	Co-ed	2	17	-	Ball game
4	1260	10% least deprived area	Miss K	Female	2	-	S1	Co-ed	10	11	1	Basketball
			Miss L	Female	3	-	S2	Co-ed	15	11	-	Volleyball
			Mr M	Male	10	-	S2	Co-ed	10	10	-	Volleyball
			Mr N	Male	14	PT	S4	Co-ed	9	5	-	Ball game
5	610	30% least deprived area	Mr O	Male	13	PT	S3	Co-ed	7	2	-	Badminton
			Miss P	Female	2	-	S2	Girls-only	-	22	-	Basketball
			Mr Q	Male	14	-	S2	Boys-only	15	-	-	Gymnastics
6	873	30% most deprived area	Mr S	Male	3	-	S1	Co-ed	10	10	-	High jump
7	1750	10% least deprived area	Miss T	Female	1	-	S2	Boys-only	11	-	-	Badminton
			Mr U	Male	2	-	S1	Girls-only	-	15	-	Basketball

Note:

1. Enrolment means the total number of pupils in a school.

2. The Scottish Index of Multiple Deprivation (SIMD) is a relative measure of deprivation across 6,976 small areas in Scotland. SIMD ranks the areas from most deprived (ranked 1) to least deprived (ranked 6,976).

3. PT means Principal Teacher



**Supplemental Material B.** Descriptive statistics, internal consistency and correlations among pupils' variables of affective outcomes

	<i>M</i>	<i>SD</i>	<i>α</i>	1	2	3	4	5	6	7	8	9	10	11	12
1 Autonomy satisfaction	3.22	.85	.74	1.00	.67**	.53**	-.31**	-.24**	-.13*	.67**	-.13*	-.40**	.56**	-.23**	.28**
2 Competence satisfaction	3.78	.88	.86		1.00	.60**	-.33**	-.51**	-.27**	.72**	-.25**	-.49**	.61**	-.39**	.35**
3 Relatedness satisfaction	3.57	.97	.85			1.00	-.22**	-.35**	-.36**	.49**	-.23**	-.29**	.43**	-.34**	.31**
4 Autonomy frustration	2.22	.80	.72				1.00	.43**	.38**	-.35**	.35**	.48**	-.21**	.26**	-.13*
5 Competence frustration	1.97	.84	.76					1.00	.55**	-.30**	.48**	.41**	-.30**	.44**	-.29**
6 Relatedness frustration	1.77	.74	.65						1.00	-.18**	.52**	.37**	-.16**	.52**	-.26**
7 Autonomous motivation	3.72	.90	.90							1.00	-.12*	-.59**	.56**	-.28**	.28**
8 Controlled motivation	1.91	.74	.82								1.00	.39**	-.11*	.34**	-.25**
9 Amotivation	1.48	.80	.89									1.00	-.33**	.39**	-.18**
10 Positive affect	3.23	.87	.73										1.00	-.11*	.28**
11 Negative affect	1.29	.52	.76											1.00	-.19**
12 Sense of coherence	3.65	1.26	.30												1.00

N<sub>pupils</sub> = 381    \*\*:  $p < 0.01$ ; \*:  $p < 0.05$     α: Cronbach's alpha

**Supplemental Material C. Relationships between observed teaching behaviour and pupils' variables of affective outcomes**

	Autonomy Satisfaction (Model A)							Competence Satisfaction (Model B)							Relatedness Satisfaction (Model C)									
	Null Model A			Full Model A				Null Model B			Full Model B				Null Model C			Full Model C						
	$\beta$	<i>S.E.</i>	<i>t</i>	$\beta$	<i>S.E.</i>	<i>t</i>		$\beta$	<i>S.E.</i>	<i>t</i>	$\beta$	<i>S.E.</i>	<i>t</i>	$\beta$	<i>S.E.</i>	<i>t</i>	$\beta$	<i>S.E.</i>	<i>t</i>	$\beta$	<i>S.E.</i>	<i>t</i>		
Fixed effects:																								
Intercept	3.22	.07	46.98	**	3.35	.40	8.42	**	3.78	.08	47.40	**	3.91	.46	8.48	**	3.58	.08	42.52	**	3.38	.53	6.36	**
Autonomy support <sup>a</sup>					-.09	.12	-7.77	<i>n.s.</i>					-.17	.14	-1.24	<i>n.s.</i>					-.01	.16	-.05	<i>n.s.</i>
Structure before activity <sup>a</sup>					.54	.21	2.54	*					.82	.24	3.34	**					.74	.28	2.62	*
Structure during activity <sup>a</sup>					-.14	.31	-4.45	<i>n.s.</i>					-.57	.36	-1.58	<i>n.s.</i>					-.51	.41	-1.24	<i>n.s.</i>
Relatedness support <sup>a</sup>					-.10	.13	-7.74	<i>n.s.</i>					.01	.15	.06	<i>n.s.</i>					.08	.18	.47	<i>n.s.</i>
Control <sup>a</sup>					-.92	.49	-1.89	<i>n.s.</i>					.21	.56	.37	<i>n.s.</i>					-.11	.65	-1.18	<i>n.s.</i>
Cold <sup>a</sup>					.92	.90	1.02	<i>n.s.</i>					-.11	1.05	-1.1	<i>n.s.</i>					.16	1.21	.13	<i>n.s.</i>
Chaos <sup>a</sup>					.37	1.00	.37	<i>n.s.</i>					-.67	1.15	-.58	<i>n.s.</i>					.39	1.33	.29	<i>n.s.</i>
<i>R</i> <sup>2</sup>				.06							.07							.05						
	$\sigma^2$	<i>S.D.</i>	$\chi^2$	$\sigma^2$	<i>S.D.</i>	$\chi^2$		$\sigma^2$	<i>S.D.</i>	$\chi^2$		$\sigma^2$	<i>S.D.</i>	$\chi^2$		$\sigma^2$	<i>S.D.</i>	$\chi^2$		$\sigma^2$	<i>S.D.</i>	$\chi^2$		
Random effects:																								
Intercept	.06	.24	52.69	**	.02	.13	29.12	**	.09	.30	70.44	**	.03	.18	37.96	**	.10	.31	61.86	**	.05	.22	40.79	**
Level 1 residual	.67	.87			.67	.82			.68	.82			.68	.82			.84	.92			.84	.92		

N<sub>teachers</sub> = 20; N<sub>pupils</sub> = 381

\*\**p* < 0.01; \**p* < 0.05; *n.s.* = not significant

<sup>a</sup>: grand mean centred

Supplemental Material C. (Continued)

	Autonomy Frustration (Model D)							Competence Frustration (Model E)						Relatedness Frustration (Model F)										
	Null Model D			Full Model D				Null Model E			Full Model E			Null Model F			Full Model F							
	$\beta$	<i>S.E.</i>	<i>t</i>	$\beta$	<i>S.E.</i>	<i>t</i>		$\beta$	<i>S.E.</i>	<i>t</i>	$\beta$	<i>S.E.</i>	<i>t</i>	$\beta$	<i>S.E.</i>	<i>t</i>	$\beta$	<i>S.E.</i>	<i>t</i>	$\beta$	<i>S.E.</i>	<i>t</i>		
Fixed effects:																								
Intercept	2.23	.08	27.22	**	2.25	.41	5.46	**	1.97	.08	25.94	**	2.07	.40	5.17	**	1.77	.06	28.53	**	2.18	.38	5.69	**
Autonomy support <sup>a</sup>					.22	.13	1.74	<i>n.s.</i>					.32	.12	2.60	*					.00	.12	.04	<i>n.s.</i>
Structure before activity <sup>a</sup>					-.68	.22	-3.10	**					-.72	.21	-3.39	**					-.58	.20	-2.83	*
Structure during activity <sup>a</sup>					.18	.32	.55	<i>n.s.</i>					.34	.31	1.07	<i>n.s.</i>					.21	.30	.69	<i>n.s.</i>
Relatedness support <sup>a</sup>					.01	.14	.10	<i>n.s.</i>					-.07	.13	-.52	<i>n.s.</i>					-.05	.13	-.39	<i>n.s.</i>
Control <sup>a</sup>					.71	.50	1.42	<i>n.s.</i>					-.11	.49	-.23	<i>n.s.</i>					-.04	.47	-.08	<i>n.s.</i>
Cold <sup>a</sup>					-.51	.94	-.55	<i>n.s.</i>					.05	.90	.06	<i>n.s.</i>					-.09	.87	-.11	<i>n.s.</i>
Chaos <sup>a</sup>					-.07	1.03	-.07	<i>n.s.</i>					.11	1.00	.11	<i>n.s.</i>					-.47	.96	-.49	<i>n.s.</i>
	<i>R</i> <sup>2</sup>				.12					.09						.05								
	$\sigma^2$	<i>S.D.</i>	$\chi^2$		$\sigma^2$	<i>S.D.</i>	$\chi^2$		$\sigma^2$	<i>S.D.</i>	$\chi^2$		$\sigma^2$	<i>S.D.</i>	$\chi^2$		$\sigma^2$	<i>S.D.</i>	$\chi^2$		$\sigma^2$	<i>S.D.</i>	$\chi^2$	
Random effects:																								
Intercept	.10	.32	93.75	**	.03	.16	38.96	**	.08	.29	69.79	**	.02	.14	31.57	**	.05	.22	57.52	**	.02	.15	35.96	**
Level 1 residual	.54	.73			.54	.73			.62	.79			.62	.79			.50	.71			.50	.71		

N<sub>teachers</sub> = 20; N<sub>pupils</sub> = 381

\*\**p* < 0.01; \**p* < 0.05; *n.s.* = not significant

<sup>a</sup>: grand mean centred

Supplemental Material C. (Continued)

	Autonomous Motivation (Model G)							Controlled Motivation (Model H)							Amotivation (Model I)									
	Null Model G			Full Model G				Null Model H			Full Model H				Null Model I			Full Model I						
	$\beta$	<i>S.E.</i>	<i>t</i>	$\beta$	<i>S.E.</i>	<i>t</i>	$\beta$	<i>S.E.</i>	<i>t</i>	$\beta$	<i>S.E.</i>	<i>t</i>	$\beta$	<i>S.E.</i>	<i>t</i>	$\beta$	<i>S.E.</i>	<i>t</i>	$\beta$	<i>S.E.</i>	<i>t</i>			
Fixed effects:																								
Intercept	3.73	.08	44.87	**	3.67	.47	7.79	**	1.91	.07	29.26	**	2.12	.44	4.87	**	1.48	.08	17.82	**	1.67	.51	3.26	**
Autonomy support <sup>a</sup>					-.07	.14	-.49	<i>n.s.</i>					.15	.13	1.12	<i>n.s.</i>				.02	.16	.11	<i>n.s.</i>	
Structure before activity <sup>a</sup>					.82	.25	3.26	**					-.35	.23	-1.53	<i>n.s.</i>				-.69	.27	-2.54	*	
Structure during activity <sup>a</sup>					-.16	.37	-.44	<i>n.s.</i>					.04	.34	.11	<i>n.s.</i>				.19	.39	.49	<i>n.s.</i>	
Relatedness support <sup>a</sup>					-.16	.16	-1.03	<i>n.s.</i>					-.06	.14	-.39	<i>n.s.</i>				.06	.17	.34	<i>n.s.</i>	
Control <sup>a</sup>					-.32	.57	-.55	<i>n.s.</i>					.41	.53	.78	<i>n.s.</i>				.25	.62	.40	<i>n.s.</i>	
Cold <sup>a</sup>					-.61	1.07	-.57	<i>n.s.</i>					-.88	1.00	-.88	<i>n.s.</i>				.07	1.18	.06	<i>n.s.</i>	
Chaos <sup>a</sup>					.65	1.18	.55	<i>n.s.</i>					-.07	1.09	-.06	<i>n.s.</i>				-.09	1.28	-.07	<i>n.s.</i>	
	<i>R</i> <sup>2</sup>				.08							.04							.08					
	$\sigma^2$	<i>S.D.</i>	$\chi^2$		$\sigma^2$	<i>S.D.</i>	$\chi^2$		$\sigma^2$	<i>S.D.</i>	$\chi^2$		$\sigma^2$	<i>S.D.</i>	$\chi^2$		$\sigma^2$	<i>S.D.</i>	$\chi^2$	$\sigma^2$	<i>S.D.</i>	$\chi^2$		
Random effects:																								
Intercept	.10	.32	73.99	**	.03	.19	38.07	**	.06	.24	66.24	**	.04	.19	47.91	**	.11	.33	96.96	**	.06	.24	59.42	**
Level 1 residual	.71	.84			.71	.84			.48	.70			.48	.70			.53	.73		.53	.73			

N teachers = 20; N pupils = 381

\*\**p* < 0.01; \**p* < 0.05; *n.s.* = not significant

<sup>a</sup>: grand mean centred

Supplemental Material C. (Continued)

	Positive Affect (Model J)							Negative Affect (Model K)						Sense of Coherence (Model L)										
	Null Model J			Full Model J				Null Model K			Full Model K			Null Model L			Full Model L							
	$\beta$	<i>S.E.</i>	<i>t</i>	$\beta$	<i>S.E.</i>	<i>t</i>	$\beta$	<i>S.E.</i>	<i>t</i>	$\beta$	<i>S.E.</i>	<i>t</i>	$\beta$	<i>S.E.</i>	<i>t</i>	$\beta$	<i>S.E.</i>	<i>t</i>	$\beta$	<i>S.E.</i>	<i>t</i>			
Fixed effects:																								
Intercept	3.22	.08	39.74	**	3.55	.41	8.55	**	1.29	.04	35.18	**	1.34	.22	5.99	**	3.65	.08	45.99	**	3.98	.50	7.92	**
Autonomy support <sup>a</sup>					-.45	.13	-3.52	**					-.05	.07	-.80	<i>n.s.</i>					-.24	.15	-1.58	<i>n.s.</i>
Structure before activity <sup>a</sup>					.68	.22	3.10	**					-.34	.12	-2.85	*					.67	.27	2.50	*
Structure during activity <sup>a</sup>					-.57	.33	-1.76	<i>n.s.</i>					.24	.18	1.33	<i>n.s.</i>					-.58	.40	-1.43	<i>n.s.</i>
Relatedness support <sup>a</sup>					.11	.14	.77	<i>n.s.</i>					.01	.07	.10	<i>n.s.</i>					.02	.17	.12	<i>n.s.</i>
Control <sup>a</sup>					-.06	.51	-.13	<i>n.s.</i>					-.03	.28	-.12	<i>n.s.</i>					.13	.62	.20	<i>n.s.</i>
Cold <sup>a</sup>					.92	.94	.99	<i>n.s.</i>					-.49	.50	-.97	<i>n.s.</i>					.18	1.11	.16	<i>n.s.</i>
Chaos <sup>a</sup>					-.74	1.04	-.71	<i>n.s.</i>					.31	.57	.54	<i>n.s.</i>					-.78	1.27	-.61	<i>n.s.</i>
	<i>R</i> <sup>2</sup>				.10							.04									.03			
	$\sigma^2$	<i>S.D.</i>	$\chi^2$		$\sigma^2$	<i>S.D.</i>	$\chi^2$		$\sigma^2$	<i>S.D.</i>	$\chi^2$		$\sigma^2$	<i>S.D.</i>	$\chi^2$		$\sigma^2$	<i>S.D.</i>	$\chi^2$		$\sigma^2$	<i>S.D.</i>	$\chi^2$	
Random effects:																								
Intercept	.10	.31	74.24	**	.02	.14	32.16	**	.01	.11	38.85	**	.00	.05	24.03	*	.04	.21	31.26	**	.00	.04	20.42	<i>n.s.</i>
Level 1 residual	.66	.81			.66	.81			.26	.51			.26	.51			1.54	1.24			1.54	1.24		

N<sub>teachers</sub> = 20; N<sub>pupils</sub> = 381

\*\**p* < 0.01; \**p* < 0.05; *n.s.* = not significant

<sup>a</sup>: grand mean centred