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A circumplex approach to (de)motivating styles in physical education: Situations-in-School–Physical Education questionnaire in Spanish students, pre-service and in-service teachers

Building upon self-determination theory and the circumplex approach, the objective of this study was to adapt the Situations-in-School–Physical Education (SIS–PE) questionnaire and to gather validity and reliability evidence in the Spanish PE context. Three samples of 1441 students (46.43% girls), 473 in-service teachers (35.73% women), and 654 pre-service teachers (50.31% women) participated. Multidimensional scaling analyses for the three samples indicated that (de)motivating styles (autonomy support, structure, control, and chaos) were graphically depicted by a two-dimension circular structure that differed into need-supportiveness (horizontal axis) and teacher directiveness (vertical axis). Eight specific approaches (two per stye) were additionally identified (participative, attuning, guiding, clarifying, demanding, domineering, abandoning, and awaiting) drawing an ordered pattern of correlations. Bifactor exploratory structural equation modelling additionally supported four overarching styles and eight specific approaches. Reliability and external validity were met in the three samples. The Spanish versions of the SIS-PE questionnaire are valid and reliable measures of students', in-service, and pre-service teachers' perceptions of (de)motivating styles under an integrative and fine-grained approach.

Keywords: need-supportive style; need-thwarting styles; teaching style; teaching behavior; circumplex model.

Introduction

Physical Education (PE) teachers take a central position in the classroom to guide students in their learning process (White et al., 2021). According to self-determination theory (SDT; Ryan & Deci, 2017), the (de)motivating style from the PE teacher, namely, the specific manner in which (s)he interacts, behaves, and communicates with students in classroom practice (Aelterman et al., 2019), is especially important to improve student outcomes. While PE teacher's motivating styles (i.e., autonomy-support, structure, and involvement) yielded numerous adaptive outcomes in students, demotivating styles (i.e.,

57 control, chaos, and coldness) have been broadly associated with maladaptive outcomes

58 for students (Burgueño et al., 2022; Curran & Standage, 2017; Vasconcellos et al., 2020).

59 This notwithstanding, many PE teachers wonder how to use a highly autonomy-

60 supportive style without falling into a chaotic style, in the same way as they are more

61 likely to confuse structure and control and vice-versa.

62   Building upon SDT (Ryan & Deci, 2017), Aelterman et al. (2019) recently

63 forwarded an integrative and fine-grained conceptualization of (de)motivating teaching

64 styles that integrates autonomy support, structure, control, and chaos into a circular

65 structure in accordance with level both of need-supportiveness (i.e., the extent to which

66 teacher supports or thwarts students' needs) and teacher directiveness (i.e., the degree to

67 which the teacher takes the initiative in learning interactions or transfers it to students

68 themselves) present in each of them. Consistent with this circumplex approach,

69 Aelterman et al. (2019) developed the Situations-in-School (SIS) questionnaire to

70 measure (de)motivating styles from the teacher. Later, the SIS questionnaire was

71 subsequently adapted to the PE context in a sample of Belgian and French in-service

72 teachers (i.e., Situations-in-School–Physical Education (SIS–PE) questionnaire; Escriva-

73 Boulley et al., 2021). Given the need to develop specifically designed instruments for the

74 PE context, it is important to expand validity and reliability evidence of the SIS–PE in

75 other socio-linguistic contexts (e.g., Spanish) and with the different educational agents

76 involved in PE, including secondary students, in-service, and pre-service PE teachers.

77 This will allow us to obtain a more comprehensive and holistic understanding of the

78 (de)motivating styles, as well their respective teaching approaches, in the eyes of

79 students, in-service, and pre-service teachers in the PE context. Therefore, this research

80 sought to adapt the SIS–PE questionnaire (Escriva-Boulley et al., 2021) and to gather

81   validity and reliability evidence for use in students, in-service, and pre-service teachers

82   in the Spanish PE context.

83   *Circumplex approach to (de)motivating teaching styles in PE*

84   Recently, building upon SDT (Ryan & Deci, 2017), a more integrative and fine-grained

85   perspective (i.e., circumplex approach) putting teachers' autonomy-support, structure,

86   control, and chaos within a circular structure (or teaching wheel) along two dimensions

87   (see Figure 1), has been proposed in the educational domain (Aelterman et al., 2019) and

88   PE context (Escriva-Boulley et al., 2021). The horizontal dimension reflects the teacher's

89   level of need-supportiveness, with autonomy-supporting and structuring styles

90   representing more need-supportive teaching behaviors and with controlling and chaotic

91   styles depicting more need-thwarting teaching behaviors. The vertical dimension

92   expresses the teacher's degree of directiveness, with structuring and controlling styles

93   being the most directive styles and with autonomy-supportive and chaotic styles

94   representing the less directive ones.

95   Aelterman et al. (2019) further argue that each of the four abovementioned

96   (de)motivating styles would be composed by two specific teaching approaches.

97   Autonomy-support involves PE teachers displaying an interpersonal tone of receptivity,

98   empathy, and flexibility to attend to students' preferences, choices, and interests

99   (Vansteenkiste et al., 2019). Autonomy-supportive practices are manifested by

100   participative (i.e., the teacher provides students with opportunities for choice, asks them

101   for their opinions, and welcomes their suggestions) and/or attuning approaches (i.e., the

102   teacher fosters students' personal interests, accepts expressions of negative affect, and

103   explains the relevance of each activity performed) (Aelterman et al., 2019). Structure

104   refers to PE teachers taking progress- and process-oriented attitudes to seek alignment

105   with students' levels of ability, strengths, and potential learning (Vansteenkiste et al.,

106   2019). Structuring practices are implemented by guiding (i.e., the teacher provides

107   students with helpful guidelines, growth-oriented feedback, and encouragement for the

108   successful task completion) and/or clarifying approaches (i.e., the teacher clearly informs

109   students about the goals and expectations of the lessons, and follows-up with them to

110   monitor their progress) (Aelterman et al., 2019).

111   Control involves PE teachers adopting a tone of pressure for students to think,

112   feel, and behave in a teacher-prescribed way (Vansteenkiste et al., 2019). Controlling

113   practices are expressed by demanding (i.e., the teacher imposes students' responsibilities

114   and obligations as to what they must to do without tolerating contradictions using explicit

115   and direct strategies, including forceful and commanding language, threats, contingent

116   utilization of rewards, and punishments) and/or domineering approaches (i.e., the teacher

117   puts pressure on students to meet his/her requests through intrusive and manipulative

118   strategies such as guilt-induction, public shame, nonverbal expressions of disapproval,

119   and intimidation) (Aelterman et al., 2019). Finally, chaos refers to PE teachers with a

120   laissez-faire attitude, in which they behave in an unpredictably and inconsistently manner

121   with no clear guidelines, which confuses students and makes it difficult for them to

122   develop their skills and achieve desired outcomes (Vansteenkiste et al., 2019). Chaotic

123   practices are reflected by abandoning (i.e., the teacher leaves students to their fate since,

124   after repeated interventions, he/she has given up) and/or awaiting approaches (i.e., the

125   teacher prefers to wait to how things evolve and if students are able to take the initiative

126   on their own) (Aelterman et al., 2019).

127   [Insert Figure 1 near here, please]

128   In contrast with understanding (de)motivating styles in exclusively categorical

129   terms, the circumplex model allows one to adopt a gradual perspective (Aelterman et al.,

130   2019). In other words, the differences among styles are more progressive and rely on the

131   degree to which each approach within the circumplex model represents need-supportive,

132   relative to need-thwarting teaching practices, as well as high, relative to low, in teacher

133   directiveness. To illustrate, attuning and guiding approaches are high on need-supportive

134   teaching practices, but they are qualitatively different in their level of directiveness, and

135   although the participating and awaiting approaches are both low on teacher directiveness,

136   they differ in the extent to which these are need-supportive versus need-thwarting.

137   ***Associations between the students' and teachers' perception of (de)motivating***
138   ***teaching styles and their need-based experiences***

139   A substantial body of SDT-based research in PE has reported a positive association of

140   students' perceptions of autonomy-supportive and structuring styles from their teacher

141   with the satisfaction of their basic psychological needs for autonomy (i.e., experiences of

142   personal ownership), competence (i.e., experiences of effectiveness and mastery), and

143   relatedness (i.e., experiences of closeness and mutual care) (Curran & Standage, 2017;

144   Vasconcellos et al., 2020). Instead, students' perceptions of teacher control was positively

145   related to the frustration of their needs for autonomy (i.e., experiences of coercion and

146   being controlled), competence (i.e., experiences of ineffectiveness and inferiority), and

147   relatedness (i.e., experiences of loneliness and social exclusion) (Curran & Standage,

148   2017; Vasconcellos et al., 2020). Although little is known about the consequences

149   associated with a chaotic teaching style in PE, a growing number of studies has observed

150   a positive correlation between students' perceptions of a chaotic PE teacher and their need

151   frustration (Burgueño et al., 2022; Burgueño & Medina-Casaubón, 2021).

152   Prior SDT-based research on the association from teachers' need-based

153   experiences to the their own (de)motivating styles showed that in-service teachers' need

154   satisfaction at work was positively associated with autonomy-supporting and structuring

155   styles, while their need frustration at work was positively related to the use of controlling

156 and chaotic styles (Escriva-Boulley et al., 2021; Moè & Katz, 2022; Vermote et al., 2022).

157 Even though an increasing body of research is focusing on chaos, little attention, so far,

158 has been paid to identify antecedents of the adoption of a chaotic style. Therefore,

159 developing instruments that include this demotivating style is a priority issue. Regarding

160 pre-service PE teachers, the single found study, so far, reported that pre-service teachers'

161 need satisfaction was positively associated with their own need-supportive style, while

162 need frustration was positively related to their own need-thwarting style (Burgueño et al.,

163 2023).

164 *Measuring (de)motivating styles from a circumplex approach in PE*

165 The SIS questionnaire was first used to measure both students' and in-service teachers'

166 perceptions of (de)motivating teaching styles in the Flemish secondary education setting

167 (Aelterman et al., 2019). The circular structure for (de)motivating teaching styles has

168 been confirmed in other educational contexts with in-service teachers (Gordeeva &

169 Sychev, 2021; Moè et al., 2022; Vermote et al., 2020), as well as in the sport context with

170 athletes and coaches (Delrue et al., 2019).

171 The SIS questionnaire has been slightly adapted to PE (i.e., SIS–PE questionnaire)

172 with Belgian and French in-service teachers (for a further review of the modifications to

173 the original version see; Escriva-Boulley et al., 2021). In particular, the results from

174 multidimensional scaling analysis (MDS; Borg et al., 2018) supported the circular

175 structure with four overarching teaching styles and eight specific teaching approaches

176 differing in terms of need-supportiveness (i.e., x-axis) and directiveness (i.e., y-axis).

177 Circular structure was additionally underpinned by an ordered pattern of correlations with

178 adjacent approaches being positively correlated (representative of their compatible

179 character), and correlations becoming weaker and even negative (representative of their

180 more conflictual character) when moving along the circumplex. Although evidence in

181   support of discriminant validity and reliability was respectively met, Escriva-Boulley et

182   al. (2021) found higher correlations than expected between attuning and guiding

183   approaches and between domineering and abandoning approaches, as well as marginal

184   reliability scores in participating, abandoning, and awaiting approaches.

185   To the best of our knowledge, no studies to date were found to adapt and test the

186   psychometric properties of the SIS–PE in the Spanish PE context with samples of

187   students, in-service, and pre-service teachers. Considering that Spanish is the second most

188   spoken language in the word, the development of the Spanish version of the SIS–PE will

189   allow us to analyze teacher's behavior in a more integrative and fine-grained manner

190   through a circumplex approach not only according to in-service teachers' perceptions, but

191   also according to the students' and pre-service teachers' perceptions. This gradual view

192   could make a valuable theoretical and practical contribution to the existing PE teaching

193   literature. Specifically, the circumplex approach may point to exactly which autonomy-

194   supportive practices (e.g., providing students with choice) may be closer to an awaiting

195   approach, and which structuring practices (e.g., providing students with clear guidelines

196   for the task completion) may be closer to a demanding approach. Further, by analyzing

197   teaching practice from a gradual view, the circular structure provides a first clue to how

198   PE teachers may shift from one approach to another along the circumplex, depending on

199   the obstacles and facilitators found. This information would be useful for PE teachers to

200   know how to implement more effectively autonomy-supportive and structuring styles and

201   to avoid, simultaneously, falling into controlling and chaotic practices in the PE lessons.

202   Moreover, the students' and teachers' versions of the SIS–PE will contribute to examine

203   the degree of (dis)agreement on perceived (de)motivating styles used in the classroom

204   practice. It will enable us to gather broader basis of evidence to improve initial and

205   continuous teacher education programs.

206 *The present research*

207 The objective of this research was to adapt the SIS–PE questionnaire (Escriva-Boulley et

208 al., 2021) and to gather validity and reliability evidence for use in the Spanish PE context

209 with samples of students, in-service, and pre-service teachers. Given the

210 comprehensiveness of the study, we have concretized the general objective into three

211 more specific objectives: to meet validity evidence based on the SIS–PE questionnaire's

212 internal structure (aim 1); to provide the instrument's reliability evidence (aim 2); and to

213 analyze the SIS–PE questionnaire's external validity (aim 3). Building upon previous

214 research (Aelterman et al., 2019; Delrue et al., 2019; Escriva-Boulley et al., 2021;

215 Vermote et al., 2020), we hypothesized that: 1) Autonomy support, structure, control, and

216 chaos teaching styles would be configured along two dimensions, depicting need-

217 supportiveness (i.e., horizontal dimension) and the level of directiveness (i.e., vertical

218 dimension); 2) Every overarching style (i.e., autonomy support, structure, control, and

219 chaos) would be operationalized into two specific approaches (i.e., participative, attuning,

220 guiding, clarifying, demanding, domineering, abandoning, and awaiting); 3) An ordered

221 pattern of latent correlations among approaches, with adjacent approaches being most

222 highly positively correlated and with the patterns turning into progressively less positive

223 and even negative when one moves further away from that approach along the

224 circumplex; 4) The four overarching (de)motivating styles and the eight specific teaching

225 approaches would obtain an acceptable level of reliability; 5) Students' perceptions of

226 autonomy-supportive and structuring teaching styles would be positively related to their

227 need satisfaction, just as perceived controlling and chaotic teaching styles would be

228 positively associated with their need frustration (Curran & Standage, 2017; Vasconcellos

229 et al., 2020); 6) Each one of the two autonomy-supportive and structuring approaches

230 would be differently related to need satisfaction, as well as each of the two controlling

231 and chaotic approaches would not be equally associated with need frustration in spite of

232 the lack of previous SIS-based research with students; 7) Teachers' need satisfaction at

233 work would be positively associated with their autonomy-supporting and structuring

234 styles, in the same way as need frustration at work would be positively related to their

235 controlling and chaotic styles (Escriva-Boulley et al., 2021; Moè et al., 2022; Vermote et

236 al., 2022); 8) Teachers' need satisfaction at work would be more strongly associated with

237 attuning and guiding than participative and clarifying teaching approaches, while need

238 frustration at work is hypothesized to be more greatly related to domineering and

239 abandoning than demanding and awaiting teaching approaches (Escriva-Boulley et al.,

240 2021; Moè et al., 2022; Vermote et al., 2022); 9) For pre-service teachers were expected

241 to find similar results to those postulated with the in-service PE teacher sample.

242 **Materials and Method**

243 *Design and participants*

244 Three independent and purposive samples were recruited for this cross-sectional study.

245 The first sample included 1441 secondary education students (772 boys and 669 girls)

246 aged 12 to 18 years (M_{age}=15.94, SD=1.66) from several public schools (n=8) in four

247 medium-sized cities [details masked for review process]. Students had two 50-minute

248 compulsory and coeducational PE lessons per week. The class size ranged from 20 to 32

249 students. The second sample consisted of 473 in-service PE teachers (304 men and 169

250 women) aged 24 to 63 years (M_{age}=37.36, SD=7.68). The third sample was made up of

251 654 pre-service PE teachers (325 men and 329 women) aged 20 to 60 years (M_{age}=23.14,

252 SD=4.28) from 10 public universities of [details masked for review process]. The last two

253 samples belonged to most of the geographic areas of Spain. As initial secondary teacher

254 education follows a consecutive model in Spain, both in-service and pre-service PE

255 teachers held a BSc. in Sport and Exercise Sciences, and while in-service teachers self-

reported to have the professional master's program in education (secondary PE), pre-service teachers were enrolled in the professional master's in education from different public universities.

Instruments

Common student, pre-service and in-service teacher measures: (De)motivating teaching styles in PE

To assess (de)motivating teaching styles according to perceptions of students, in-service, and pre-service teachers in PE, we used a translation to Spanish of the SIS–PE questionnaire (Escriva-Boulley et al., 2021) that was originally developed with in-service teachers (Aelterman et al., 2019). Some slight modifications were made to the questionnaire for students and pre-service teachers (see Appendix A). This vignette-based self-reported instrument includes 12 authentic teaching situations, which were either more proactive (e.g., "The teacher presents a difficult lesson that requires a lot of effort from the students") or more reactive (e.g., "A couple of students have been rude and disruptive") in nature and referred to situations dealing with either the learning process or student behavior. For every situation, there are four distinct responses (i.e., 48 items), with each representing an autonomy-supporting, structuring, controlling, and chaotic styles. The SIS–PE questionnaire includes four participative and eight attuning items for a total of 12 autonomy-support items. Seven guiding and five clarifying items together constitute 12 structure items. Seven demanding and five domineering items form 12 control items. Finally, eight abandoning and four awaiting items makes a total of 12 chaos items. For instance, in the in-service/pre-service teachers' SIS-PE questionnaire version, situation 9 states: "It is time for students to participate. You…" that is followed by 4 possible responses: a) suggest different levels of difficulty and ask the students at which level they would like to practice (autonomy support, participative approach); b) demand

281 that it's time to work, whether they like it or not. You explain to them that sometimes

282 they have to learn to do things against their will (control, domineering approach); c) don't

283 plan too much and watch how things develop (chaos, awaiting approach), and d) set out

284 step-by-step the key points that will guide their progress through the learning process

285 (structure, guiding approach). A second example is situation 12, "A student leaves the

286 locker room late for the second time in a row. He/she seems to be somewhere else.

287 You…" followed by 4 response options: a) take the student aside after the lesson and ask

288 if anything is wrong (autonomy support, attuning approach); b) repeat your expectations

289 regarding punctuality in class (structure, clarifying approach); c) explain to the rest of the

290 class that you are disappointed that he/she is late for the second time in a row (control,

291 domineering approach); and d) don't say anything. At the end of the day, you can't

292 intervene with every student, you have to teach first. You focus on the lesson (chaos,

293 abandoning approach). In-service and pre-service teachers were asked to rate on a 7-point

294 Likert-type scale from 1 (does not describe me at all) to 7 (describes me extremely well)

295 to which degree each of the four responses described themselves. Students responded to

296 the same 12 situations, although the vignettes and answers were adapted to represent the

297 students' view of teachers' behaviors (for a further inspection, see Appendix A). They

298 were also asked to rate the extent to which the items correspond to (de)motivating

299 practices from their PE teacher on a 7-point Likert-type scale from 1 (does not describe

300 my teacher at all) to 7 (describes my teacher extremely well).

301 *Students' need-based experiences*

302 To assess students' perceptions of need satisfaction and need frustration in PE lessons,

303 we used the Spanish PE version (Zamarripa et al., 2020) of the Basic Psychological Need

304 Satisfaction and Frustration Scale (Chen et al., 2015). It is preceded by the stem "In my

305 PE lessons…" and followed by 24 items that, grouped into four item per factor, measure

autonomy satisfaction (e.g., "I feel a sense of choice and freedom in the things I

undertake"), competence satisfaction (e.g., "I feel confident that I can do things well"),

relatedness satisfaction (e.g., "I feel that the people I care about also care about me"),

autonomy frustration (e.g., "Most of the things I do feel like I have to"), competence

frustration (e.g., "I feel disappointed with many of my performances"), and relatedness

frustration (e.g., "I feel that people who are important to me are cold and distant towards

me"). Responses were rated on 5-point Likert-type scale from 1 (strongly disagree) to 5

(strongly agree). Consistent with SDT and previous studies in PE, two need-satisfaction

and need-frustration composite scores were calculated by averaging mean values of

autonomy, competence, and relatedness satisfaction and frustration, respectively. In this

research, an acceptable fit was achieved for the hierarchical two-factor confirmatory

factor analysis (CFA) model (χ^2/df=2.68; CFI=.914; TLI=.902; SRMR=.075;

RMSEA=.066, 90%CI=.058–.074).

In-service and pre-service teachers' need-based experiences

To assess in-service teachers' perceptions of need satisfaction and need frustration, we

used the need-satisfaction items of the Basic Psychological Needs at Work Scale for in-

service teachers (Abos et al., 2018) and the need-frustration items from the Basic

Psychological Need Satisfaction and Frustration Scale (Chen et al., 2015), respectively.

Both scales include 12 items that, grouped into four items per factor, measure autonomy

satisfaction (e.g., "I feel free to execute my tasks in my own way"), competence

satisfaction (e.g., "I am able to solve problems at work"), and relatedness satisfaction

(e.g., "When I am with the people from my work environment, I feel as though I can trust

them"); as well autonomy frustration (e.g., "Most of the things I do feel like I have to"),

competence frustration (e.g., "I feel disappointed with many of my performances"), and

relatedness frustration (e.g., "I feel that people who are important to me are cold and

331 distant towards me"). The preceded stems of these scales were "At my work…" for in-

332 service teachers, and "As a PE teacher…" for pre-service teachers. Responses were rated

333 on a 5-point Likert-type scale from 1 (strongly disagree) to 5 (strongly agree).

334 Importantly, whereas for in-service teachers all items related to need-based experiences

335 were measured, pre-service teachers were only asked to rate items concerning

336 competence satisfaction and frustration. In this research, for the in-service teacher sample,

337 a suitable fit was obtained for the hierarchical two-factor CFA model (χ^2/df=2.59;

338 CFI=.94; TLI=.92; SRMR=.071; RMSEA=.058, 90%CI=.053–.064). In the pre-service

339 teacher sample, there was an adequate fit for the two-factor CFA correlated model

340 (χ^2/df=3.07; CFI=.97; TLI=.95; SRMR=.040; RMSEA=.056, 90%CI=.040–.073).

341 ### *Procedure*

342 The SIS-PE adaptation and translation process was conducted following the International

343 Test Commission guidelines (Bartram et al., 2018). Firstly, a forward translation of the

344 French version of the SIS-PE questionnaire to Spanish was developed by a professional

345 translator with experience in educational research. Secondly, an expert panel of three

346 researchers reviewed this first translation to adapt the expressions and to ensure that each

347 situation and item response captures the (de)motivating style and approach translated.

348 Thirdly, a back translation from Spanish to French was developed and compared to the

349 original version. No significant discrepancies were found between both versions and the

350 final versions for students and teachers (see Appendix A) were used for this study.

351 Once the different versions of Spanish SIS-PE questionnaire were developed, the

352 research team contacted with various schools, teachers, and universities to request their

353 collaboration to participate in this study. Previously to the data collection process,

354 informed consent was obtained from all participants. Students completed the

355 questionnaires in a paper-pencil version, while in-service and pre-service teachers

completed an online-based questionnaire. One of the researchers administered the questionnaire to the students in the absence of PE teachers. In-service teachers were contacted by professional-development PE networks and associations for professional teacher training. In-service and pre-service versions of the questionnaires were introduced by an agreement for participation and a brief explanation about how to complete the questionnaires to ensure an accurate completion. This research was approved by the Ethics Committee of the University [details masked for review process] and followed all ethical procedures for the data collection established in the Helsinki Declaration.

Data analysis

For the provision of validity evidence based on internal structure of the different versions of the SIS-PE questionnaire (aim 1), MDS analyses (Borg et al., 2018) were run through the Proxcal procedure in IBM® SPSS Statistics (version 28.00 for Windows), as well as different factor models performed in Mplus (version 8.4; Muthén & Muthén, 2015-2018). Firstly, MDS provide a graphical representation of the dimensional structure of the instrument. Namely, items that are highly positively correlated will be displayed closely to each other in the geographical area, whereas highly negatively correlated items will be shown in the opposite space. By running analyses with one to six dimensions, we aimed to inspect if the data could be adequately represented by a two-dimension solution. For these analyses, Euclidian distance and ordinal proximity transformation measures with standardized item scores were utilized (Borg et al., 2018). For a better interpretation and selection of the best-fit representation, normalized raw stress with values close to 0 and the Tucker's congruence coefficient with scores up to 0.95 as acceptable were adopted (Borg et al., 2018). To expand validity evidence based on the SIS-PE's internal structure, we tested the robustness of different plausible factor models: a) an eight-factor CFA model, in which items loaded on their respective (de)motivating teaching approach); b) a

second-order four-factor CFA model, in which four hierarchical factors (i.e., the four overarching styles) were specified by two primary-order factors (i.e., their two respective approaches); c) a structural equation modelling (ESEM) approach, in which items loaded on eight domain factors (i.e., the eight approaches), and d) a bifactor ESEM approach, in which items loaded both on eight domain factors (i.e., the eight specific approaches) and on four global factors (i.e., the four overarching styles). The models were run by the weighted least square mean and variance adjusted (WLSMV) estimator given that it is more robust to Likert-type scales and considering non-normal data (Li, 2016). Complementary to the WLSMV estimator, the rotation target oblique was used for ESEM approach and orthogonal for bifactor ESEM approach. Assessment of each model's fit was made by a combination of goodness-of-fit measures: the coefficient between chi squared and degrees of freedom (χ^2/df), Comparative Fit index (CFI), Tucker-Lewis index (TLI), Standardized Root Mean-Square Residual (SRMR), Root Mean Square Error of Approximation (RMSEA) together with the 90% confidence interval (90%CI) and Akaike Information Criterion (AIC). Values up to 3 for the χ^2/df coefficient, higher than .95 for CFI and TLI, and lower than .060 for SRMR and RMSEA are indicative of a good fit to data, while an acceptable fit is obtained with scores as high as 5 for the χ^2/df coefficient, over .90 for CFI and TLI, and below .080 for SRMR and RMSEA (Kline, 2016). AIC is typically used to select between competing models, indicating that the model with the lowest score would be chosen as the most parsimonious (Kline, 2016). Thereupon, mean scores and latent correlations from the measurement model of the structural equation modelling (SEM) approach were reported for the four (de)motivating styles with each other and eight approaches with each other. Further, correlations show a good level of discriminant validity with values up to .85, while scores as high as .90 are indicative of reasonable discriminant validity (Kline, 2016).

406   For inspection of the SIS-PE questionnaire's reliability for the three samples (aim

407   2), McDonald's omega (ω) coefficient was computed, considering .70 as good cut-off

408   point and .60 as a reasonable cut-off score, respectively (Dunn et al., 2014). For analysis

409   of external validity of the SIS-PE questionnaire (aim 3), a two-step SEM approach was

410   conducted (Kline, 2016). The first step includes testing the robustness of a measurement

411   model, in which the target variables are freely correlated. The second step consists of a

412   structural model in which the different associations from independent variables to

413   dependent variables are tested. For the student sample, two-step SEM tested the

414   associations from students' perceptions (de)motivating styles and approaches from the

415   teachers (i.e., independent variables) to their need satisfaction and frustration (i.e.,

416   dependent variables). For the in-service and pre-service teacher samples, two-step SEM

417   examined the associations of in-service and pre-service teachers' perceptions of need

418   satisfaction and frustration (in the case of pre-service teachers, only need for competence)

419   at work (i.e., independent variables) with their own (de)motivating styles and approaches

420   (i.e., dependent variables).

421   **Results**

422   *Validity evidence based on the SIS-PE internal structure (aim 1)*

423   *Multidimensional scaling analyses: Dimensionality*

424   To assess if the range of hypothesized teaching practices were depicted along two

425   dimensions, a one- up to a six-dimension configuration was separately examined based

426   on the non-metric MDS analyses for the student, in-service, and pre-service PE teacher

427   samples. We selected a two-dimension instead of one-dimension solution given that it

428   had a reduction in normalized raw stress of 0.13, 0.14, and 0.11 for students, in-service,

429   and pre-service PE teachers, respectively, and because the additional decrease in

430 normalized raw stress for the three-dimension solution was much smaller (i.e., 0.05 for

431 students and in-service teachers, and 0.04 for pre-service teachers). Tucker's congruence

432 scores were 0.94 for the two-dimension solution in students, in-service, and pre-service

433 teachers, while the three-dimension representation obtained values of 0.97 considered as

434 unacceptable. Further, the screen-test verified this selection by suggesting the suitability

435 of a two-dimension representation for the three samples.

436   [Insert Figure 2 near here, please]

437   The first dimension of the circular pattern (i.e., the X-axis in Figure 2, 3, and 4)

438 could be interpreted as need-thwarting, relative to need-supportive teaching behaviors.

439 Teaching practices with the control items (lower left quadrant) and chaos items (upper

440 left quadrant) had negative coordinates, while the autonomy-support items (upper right

441 quadrant) and the structure items (lower right quadrants) had positive coordinates on this

442 dimension. The second dimension (i.e., Y-axis) could be interpreted in terms of teacher

443 directiveness. The chaos items and the autonomy-support items (except for two items in

444 the in-service teacher sample) had positive coordinates on this dimension. Conversely,

445 the structure items (except for one item in the in-service teacher sample and another item

446 in the pre-service sample) along with the control items (except for two in the student

447 sample) had negative coordinates on this dimension. Altogether, the four theoretically

448 hypothesized styles (i.e., autonomy support, structure, control, and chaos) could greatly

449 be depicted in distinct areas by the circumplex across the three samples.

450   [Insert Figure 3 near here, please]

451 *Multidimensional scaling analysis: Distinction into approaches*

452 A more thorough examination of the content and the position of every item in the

453 circumplex structure (see Appendix B and C) showed that each of the four styles (i.e.,

454 autonomy support, structure, control, and chaos) was divided into two distinguishable

approaches. In general, for the three samples, four autonomy-support items referring to providing opportunities for choice and promoting initiative fell into the participative approach, whereas eight other autonomy-support items that concern the teachers' tendency to accept the students' opinions and feelings, and the provision of meaningful rationale for activities fell into the attuning approach. Only three items from the in-service teacher sample were found in coordinates that are distinct from what is theoretically hypothesized, with one item (participative7) falling into the attuning-approach subarea and two another items (attuning2 and attuning5) into the clarifying-approach subarea.

[Insert Figure 4 near here, please]

Further, seven other structure items, which included providing feedback, help and encouragement, as well as useful strategies for the task completion lied on the guiding approach, while five structure items referring to reporting goals and expectations for the lesson were situated on the clarifying approach. However, there were various items in ubications different from theoretically expected, with two items (clarifying12 and guiding2) situated on the attuning-approach subarea in students; one item (guiding2) falling into the attuning-approach subarea and two other items (i.e., clarifying1 and clarifying8) into the attuning-approach subarea in in-service teachers. In pre-service teachers, one item (guiding6) was situated on the attuning-approach subarea and another item (guiding2) very near the center of the circumplex structure.

Moreover, seven control items that concern to underscore students' tasks and obligations, put pressure on them for strict compliance and use (threats of) punishments lied on the demanding approach, while five another control items referring to intrusive controlling strategies such as guilt-induction, withdrawal of attention or nonverbal displays of disappointment were situated on the domineering approach. Nonetheless, some items were found to fall into other areas of the circumplex structure, with two items

480 (demanding4 and domineering11) situated on the awaiting-approach subarea in students,

481 two items (demanding8 and demanding11) lying on the domineering-approach subarea

482 for in-service teachers, as well as one item (demanding1) falling into the clarifying-

483 approach subarea and two other items (demanding8 and demanding11) into the

484 domineering-approach subarea in pre-service teachers.

485   Finally, eight chaos items referring to indifference and ignoring student activity

486 when an action from the teacher is required fell into the abandoning approach, whereas

487 four chaos items concern to wait to see how the situation evolves and letting things unfold

488 itself were situated on the awaiting-approach subarea. Two items were detected with a

489 position different from theoretically expected. Particularly, one item (awaiting1) in

490 students and another item (awaiting9) in in-service teachers from the awaiting approach

491 fell into the abandoning-approach subarea.

492 *Factor modeling approaches: Internal structure*

493 Table 1 shows goodness-of-fit measures obtained for every plausible factor model tested.

494 The eight-factor and four-factor CFA models obtained a poor fit to the observed data in

495 the three samples, while ESEM and bifactor ESEM models had an acceptable fit to data

496 in the student, in-service, and pre-service teacher samples. In addition, the bifactor ESEM

497 model obtained a lower AIC value than ESEM model, which suggested that the bifactor

498 ESEM model was the most parsimonious and best-fitting one.

499   [Insert Table 1 near here, please]

500   An examination of the bifactor ESEM parameter estimates revealed that, overall,

501 global factors for autonomy support, structure, control and chaos, and domain factors for

502 participative, attuning, guiding, clarifying, demanding, domineering, abandoning and

503 awaiting approaches were well-defined in students (see Appendix D), in-service teachers

504 (see Appendix E) and pre-service teachers (see Appendix F). In the student sample, the

505   four global factors (autonomy support: λ = from .32 to .63; structure: λ = from .10 to .71;

506   control: λ = from .30 to .62; and chaos: λ = from .38 to .73), the eight domain factors

507   (participative: λ = between .29 and .65; attuning: λ = between .40 and 73; guiding: λ =

508   between .38 and .75; clarifying: λ = between .38 and .62; demanding: λ = between .32

509   and .56; domineering: λ = between .34 and .58; abandoning: λ = between .37 and 72; and

510   awaiting: λ = between 42. and .92) were, in general, well-defined by significant target

511   factor loadings. There were items with poor target factor loadings, which matched with

512   the problematic items found in MDS (see Appendix C for a further theoretical

513   explanation).

514   For the in-serve teacher sample, most target factor loadings were significant and

515   evidenced generally both well-defined global factors (autonomy support: λ = from .08 to

516   .75; structure: λ = from .32 to .62; control: λ = from .18 to .66; chaos: λ = from .31 to .62)

517   and well-defined domain factors (participative: λ = between .08 to .75; attuning: λ =

518   between .33 and .58; guiding: λ = between .37 and .64; demanding: λ = between .01 and

519   .46; domineering: λ = between .50 and .68; abandoning: λ = between .30 and .66; and

520   awaiting: λ = between .45 and .70). In addition to the problematic items found in MDS

521   for in-service teachers, the bifactor ESEM model revealed that two items (i.e., part1 and

522   part9) had marginal factor loadings on the global autonomy-support factor and the domain

523   participative-approach factor, suggesting that both could represent neutral teaching

524   behaviors (see Appendix C for a further theoretical explanation).

525   For the pre-service teacher sample, the four global factors (autonomy support: λ

526   = from .31 to .88; structure: λ = from .01 to .65; control: λ = from .33 to .98; and chaos:

527   λ = from .25 to .85), the eight domain factors (participative: λ = between .38 and .59;

528   attuning: λ = between .44 and .66, guiding: λ = between .07 and .69; clarifying: λ =

529   between .43 and .61, demanding: λ = between .32 and .65; domineering: λ = between .41

530   and .64; abandoning: λ = between .49 and .66; and awaiting: λ = between 47. and .64)

531   were, in general, well-defined by significant target factor loadings. Some items obtained

532   a low factor loading on expected global and domain factors, although they were the same

533   as the ones considered as problematic in MDS (see Appendix C for a further theoretical

534   explanation).

535   *Correlational patterns*

536   As can be observed in students (Table 2), in-service teachers (Table 3), and pre-service

537   teachers (Table 4), autonomy support and structure styles were positively intercorrelated,

538   just as control and chaos styles were positively correlated with one other. Besides,

539   autonomy support was negatively correlated with control and chaos in the in-service and

540   pre-service teacher samples, while it was only negatively associated with chaos in the

541   student sample. Structure was negatively correlated with chaos in the three samples,

542   whereas it was positively associated with control in the student sample and negatively

543   related to control in the in-service and preservice teacher samples. Additionally, latent

544   correlations among the four (de)motivating styles were between -.62 and .84 in students,

545   between -.61 and .83 in in-service teachers, and between -.63 and .77 in pre-service

546   teachers.

547   [Insert Table 2 near here, please]

548   By decomposing the four wider areas into eight subareas, correlational patterns

549   were clearer for the three samples. Overall, evidence was met for an ordered pattern, with

550   each subarea being most highly associated with the adjacent subareas (e.g., attuning

551   approach was strongly related to participative and guiding approaches) and the pattern

552   becoming decreasing positive and increasing negative as one moves along the circle

553   across the three samples. The correlations situated on the diagonal were representative of

554   the magnitude of the correlation among each couple of adjacent subareas. Further, latent

555   correlations between the eight (de)motivating approaches ranged from -.46 to .86 in

556   students, from -.58 to .90 in in-service teachers, and from -.67 to .87 in pre-service

557   teachers. Altogether, results met evidence in support of the SIS-PE's discriminant

558   validity.

559   [Insert Table 3 near here, please]

560   ***Reliability (aim 2)***

561   Tables 2, 3, and 4 display that, across the three samples, reliability scores were suitable

562   for the four styles with McDonald's omega (ω) scores being between .71 to .89 in

563   students, between .73 and .77 in in-service teachers, and between .70 and .79 in pre-

564   service teachers. Moreover, the eight approaches generally obtained suitable levels of

565   reliability, with McDonald's omega ranging from .70 to 86 in students and from .70 to

566   .75 both in in-service teachers and in pre-service teachers. There were some values

567   between .60 and .70 that could be interpreted as minimally acceptable, such as demanding

568   (ω=.61) and domineering (ω=.61) approaches for students, demanding (ω=.64) approach

569   for pre-service teachers. Nevertheless, marginal values were also found in participative

570   approach (ω=.53) for in-service teachers, as well as participative (ω=.53) and awaiting

571   (ω=.58) approaches for pre-service teachers.

572   [Insert Table 4 near here, please]

573   ***Structural equation modeling (aim 3)***

574   For students, Figure 5 includes the paths both from perceived (de)motivating

575   teaching styles and from approaches to need-based experiences. Firstly, and after

576   verifying the robustness of the measurement model (see Appendix G), the structural

577   model was tested with a good fit to the data: $\chi^2(df=382)=956.50$, $p<.001$; $\chi^2/df=2.50$;

578   CFI=.934; TLI=.925; SRMR=.066; RMSEA=.048(90%CI=.044–.052). Figure 5a shows

579   that the students' perception of autonomy support and structure were positively associated

580   with need satisfaction (β=.54, *p*<.001; β=.21, *p*<.001), and with need frustration (β=-.20,

581   *p*<.001; β=-.13, *p*=.014) negatively. Perceived control and chaos were positively related

582   to need frustration (β=.15, *p*=.008; β=.39, *p*<.001). Secondly, once the robustness of the

583   measurement model was underpinned (see Appendix G), the structural model was tested

584   with an acceptable fit: χ^2(*df*=360)=957.66, *p*<.001; χ^2/*df*=2.66; CFI=.929; TLI=.916;

585   SRMR=.061; RMSEA=.063(90%CI=.057–.069). Figure 5b displays that students'

586   perceptions of participative (*β*=.20, *p*=.001), attuning (*β*=.34, *p*<.001), guiding (*β*=.22,

587   *p*=.013), and clarifying (*β*=.12, *p*=.028) approaches were positively associated with their

588   need satisfaction, while perceived domineering (*β*=-.14, *p*=.007) and abandoning (*β*=-.18,

589   *p*<.001) did it negatively. Perceived demanding (*β*=.14, *p*=.006), domineering (*β*=.19,

590   *p*=.001), abandoning (*β*=.30, *p*=.001), and awaiting (*β*=.12, *p*=.039) approaches were

591   positively related to need frustration, whereas clarifying domineering (*β*=-.15, *p*=.003)

592   approaches did it negatively.

593   [Insert Figure 5 near here, please]

594   For in-service teachers, Figure 6 includes the associations of need-based

595   experiences on (de)motivating styles and of approaches, respectively. On the one hand,

596   once the robustness of the measurement model was met (see Appendix G), the structural

597   model was tested with an acceptable fit: χ^2(*df*=382)=1494.244, *p*<.001; χ^2/*df*=3.911;

598   CFI=.910; TLI=.899; SRMR=.074; RMSEA=.071(90%CI=.067–.075). Figure 6a shows

599   that in-service teachers' need satisfaction was positively associated with their autonomy

600   support (*β*=.43, *p*<.001), structure (*β*=.61, *p*<.001), and control (*β*=.18, *p*<.001). In-

601   service teachers' need frustration was positively related to their control (*β*=.45, *p*<.001)

602   and chaos (*β*=.38 *p*<.001), while being negatively associated with structure (*β*=.11,

603   *p*=.027). On the other hand, and once support for the measurement model was met, the

604   structural model was tested with an acceptable fit: $\chi^2(df=360)=723.75$ $p<.001$; $\chi^2/df=2.01$;

605   CFI=.926; TLI=.911; SRMR=.062; RMSEA=.046(90%CI=.041–.051). Figure 6b

606   displays that in-service teachers' need satisfaction was positively related to participative

607   (β=.27, $p<.001$), attuning (β=.52, $p<.001$), guiding (β=.61, $p<.001$), and clarifying

608   (β=488, $p<.001$) approaches, as well as to demanding (β=.23, $p<.001$) approach. Need

609   satisfaction was negatively associated with domineering (β=-.18, $p<.001$) and awaiting

610   (β=-.08, p=.045) approaches. Moreover, in-service teachers' need frustration was

611   positively associated with demanding (β=.38, p=.011), domineering (β=.48, p=.011),

612   abandoning (β=36, p=.011), and awaiting (β=.20, p=.011) approaches, and with clarifying

613   (β=-.32, p=.011) approach negatively.

614   [Insert Figure 6 near here, please]

615   For pre-service teachers, Figure 7 includes the relationship between competence-

616   based experiences with (de)motivating styles and approaches. Firstly, and after endorsing

617   the measurement model (see Appendix G), the structural model was tested with a suitable

618   fit to the data: $\chi^2(df=382)=961.582$, $p<.001$; $\chi^2/df=2.52$; CFI=.925; TLI=.915;

619   SRMR=.062; RMSEA=.048(90%CI=.044–.052). Figure 7a shows that pre-service

620   teachers' competence satisfaction was positively associated with autonomy support

621   (β=.11, p=.001), structure (β=.29, $p<.001$), control (β=.15, $p<.001$), while being

622   negatively related to chaos (β=-.22, $p<.001$). Need frustration was positively associated

623   with control (β=.35, $p<.001$) and chaos (β=.33, $p<.001$), and with structure (β=-.09,

624   p=.004) negatively. Secondly and once support for the measurement model was gathered

625   (see Appendix G), the structural model was tested with a good fit to the data:

626     $\chi^2(df=360)=779.59$, $p<.001$; $\chi^2/df=2.17$; CFI=.946; TLI=.935; SRMR=.051;

627   RMSEA=.042(90%CI=.038–.046). Pre-service teachers' competence satisfaction was

628   positively related to attuning (β=.13, $p<.001$), guiding (β=.23, $p<.001$), clarifying (β=.12,

629 *p*=.007), and demanding (β=.22, *p*<.001) approaches, as well as to domineering (β=-.33,

630 *p*<.001), and abandoning (β=-.25, *p*<.001) approaches. Instead, competence frustration

631 was positively associated with demanding (β=.14, *p*<.001), domineering (β=.33, *p*<.001),

632 abandoning (β=.33, *p*<.001), and awaiting (β=.21, *p*<.001) approaches.

633 [Insert Figure 7 near here, please]

634 **Discussion**

635 The present research aimed to adapt the SIS-PE questionnaire (Escriva-Boulley et al.,

636 2021) and to test the psychometric properties for use in the Spanish PE context with

637 samples of students, in-service, and pre-service teachers. Altogether, the results gathered

638 evidence to consider the Spanish SIS-PE questionnaire as a valid and reliable measure of

639 students', in-service, and pre-service teachers' perceptions of (de)motivating teaching

640 styles under a circumplex approach in the Spanish PE context.

641 *A circumplex approach to (de)motivating styles in PE (aim 1)*

642 Consistent with our hypotheses and following both the original SIS questionnaire

643 (Aelterman et al., 2019) and the adaptation to PE (Escriva-Boulley et al., 2021), the

644 results from MDS showed that the wide array of (de)motivating teaching practices were

645 best depicted graphically by a two-dimension circumplex pattern for students, in-service,

646 and pre-service teachers in PE. In three samples, the horizontal dimension (i.e., x-axis)

647 represented the degree to which teachers are need-supportive, relative to need-thwarting,

648 with autonomy-supportive and structuring styles having positive coordinates, and with

649 controlling and chaotic styles having negative coordinates on this dimension. The vertical

650 dimension (i.e., y-axis) denoted the teachers' level of directiveness, reflecting the extent

651 to which teachers give up more initiative to students in the classroom with structuring or

652 controlling styles (negative coordinates), or students have more opportunities to perform

653   a leading role when teachers adopt an autonomy-supportive or chaotic style (positive

654   coordinates). Consistent with Aelterman et al. (2019) and Escriva-Boulley et al. (2021),

655   our findings also gathered additional support for a more fine-grained picture by discerning

656   among eight teaching approaches. Particularly, every overreaching (de)motivating style

657   could be decomposed into two specific teaching approaches.

658   In line with the instrument's original version (Aelterman et al., 2019) and different

659   adaptations with teachers (Escriva-Boulley et al., 2021; Vermote et al., 2020), the

660   correlational results drew a gradual and ordered pattern among the eight teaching

661   approaches across the three sample, with each approach being most positively correlated

662   with adjacent ones (e.g., participative approach with attuning and guiding approaches)

663   and with correlations turning into non-significant (e.g., participative approach with

664   demanding and awaiting approaches) or even negative (e.g., participative approach with

665   abandoning and domineering approaches) when moving along the circular model.

666   Nonetheless, there were some exceptions at the boundaries between high and low teacher

667   directiveness, where certain adjacent approaches (e.g., attuning and clarifying approaches

668   in students; and domineering and abandoning approaches in both in-service and pre-

669   service teachers) showed higher correlations than expected. That is, students' perceptions

670   of an attuning approach covaried more strongly with a clarifying than a participative

671   approach. Similarly, in both in-service and pre-service teachers, a domineering approach

672   went more easily hand in hand with an abandoning approach than with a demanding

673   approach. These results would partially contribute to argue why the obtained findings in

674   our study did not draw a perfect circular, but rather an oval (in students and pre-service

675   teachers) or rhomboid (in in-service teachers) structure, with the less directive practices

676   clustering on the upper side and the more directive ones on the lower side, differentiated

677   from each other according to their more need-supportive (right side) or more need-

678   thwarting (left side) nature.

679   Complementary to MDS analyses, the results of our study were the first to gather

680   a basis of psychometrical evidence for the SIS-PE's internal structure. Particularly, the

681   bifactor ESEM model obtained a good fit to the student, in-service, and pre-service

682   teacher data compared to other plausible factor models. Overall, these results suggest that

683   items could represent both four overarching (de)motivating styles (i.e., autonomy

684   support, structure, control, and structure) and eight specific teaching approaches (i.e.,

685   participative, attuning, guiding, clarifying, demanding, domineering, abandoning, and

686   awaiting) in the Spanish PE context with samples of students, in-service, and pre-service

687   teachers.

688   *Reliability for (de)demotivating styles and approaches in the Spanish SIS-PE*
689   *questionnaire*

690   In accordance both with the original version of the SIS questionnaire (Aelterman et al.,

691   2019) and the adapted version to PE with in-service teachers (SIS-PE; Escriva-Boulley

692   et al., 2021), the findings from this study showed a good reliability level for each of the

693   four (de)motivating styles in the three samples. Regarding the eight teaching approaches,

694   the results found that, although most of teaching approaches obtained good reliability

695   scores, some of them had a marginal value. Following previous research with teachers

696   (Escriva-Boulley et al., 2021; Vermote et al., 2020), low scores were found in

697   participating approach for the two teacher samples and in awaiting approach for pre-

698   service teachers. Likely, these poor values would be partially explained by the small

699   number of items (i.e., four) comprising them, which might have underestimated the

700   degree of reliability of each item (Dunn et al., 2014). For the in-service teacher sample,

701   marginal values in participative approach could also be explained by a maximization of

702   measurement errors in two items (i.e., part1 and part9). These items could be interpreted

703   by in-service teachers more as neutral teaching behaviors than participative practices.

704   Regarding the pre-service teacher sample, our results suggest that they were less sensitive

705   to distinguishing between participative and awaiting approaches. A further rationale

706   could be because they are adjacent approaches within the circumplex model and both are

707   characterized by a low directiveness, which could have maximized the measurement

708   errors in their items. To illustrate, the teacher allows his/her students to participate in a

709   joint decision process (i.e., participative approach), but the room offered to them is too

710   open and may even, temporarily, create confusion and uncertainty, given that the teacher

711   remains on standby and seeing if students are capable to take the initiative in the target

712   on-going activity (i.e., awaiting approach). Concerning the student sample, we found

713   minimally acceptable scores for demanding and domineering approaches in students,

714   which aligned with prior research in young athletes (Delrue et al., 2019). It could be

715   thought that since control is composed by demanding and domineering approaches,

716   students are less sensitive to perceive when their teacher uses one or another controlling

717   approach in classroom practice. To illustrate, when the teacher explains to all students

718   that he/she was disappointed because some of them were late to class, most of them could

719   interpret that their teacher adopted a demanding approach by requiring timeliness and

720   discipline, while those students arriving late could perceive as their teacher used a

721   domineering approach by interpreting their message as a personal attack. This fact would

722   increase the measurement error in items and, therefore, reliability levels were attenuate

723   in both controlling approaches (Dunn et al., 2014).

Criterion variables for (de)motivating styles and approaches in the Spanish SIS-PE questionnaire (aim 3)

External validity for the Spanish SIS-PE version was met for the three samples. In students, our results were consistent with previous SDT-based research (Burgueño et al., 2022; Curran & Standage, 2017; Vasconcellos et al., 2020), such that students' perceptions of the two motivating styles were positively related to need satisfaction, with autonomy support having a greater association than structure. Contrasted with Vasconcellos et al. (2020), these findings underline that autonomy support played a greater role than structure in fostering students' need satisfaction, suggesting that taking a teaching behavior based more on understanding than guidance would be more beneficial for students to feel their autonomy, competence, and relatedness as more satisfied in PE classroom practice. Similarly, perceived two demotivating styles were positively associated with students' need frustration, although chaos had a higher association than control. These findings highlight that chaos was more much detrimental than control to facilitate students' need frustration, in line with prior research with youth athletes (Delrue et al., 2019). This would lie in that students would be prone to feel their needs as more frustrated, when they perceive their teacher as adopting a tone relied more on laissez-faire than pressure in PE lessons.

Furthermore, our results revealed that students' perceptions of attuning and guiding approaches were more strongly associated, than participative and clarifying approaches, with their need satisfaction. Moreover, perceived domineering and abandoning approaches were more highly linked, than demanding and awaiting approaches, to need frustration. Consistent with Vansteenkiste et al. (2019), these findings suggested that that some autonomy-supportive (i.e., attuning) and structuring (i.e., guiding) approaches more strongly support need satisfaction, while other approaches of autonomy support (i.e., participative) and structure (i.e., clarifying) foster students'

750   need satisfaction to a lesser degree. Hence, participative and clarifying approaches are

751   thought to be more need-enabling approaches, since they would create the conditions

752   necessary for students to satisfy their needs (Aelterman et al., 2019; Vansteenkiste et al.,

753   2019). Likewise, our results raise that while some controlling (i.e., domineering) and

754   chaotic (i.e., abandoning) approaches actively facilitate students' need frustration, other

755   more need-depriving approaches (i.e., demanding and awaiting) could not directly

756   facilitate students' need frustration, but rather hamper potential need-support (Aelterman

757   et al., 2019; Vansteenkiste et al., 2019).

758   In in-service PE teachers, and following previous studies with in-service

759   generalist teachers (Moè & Katz, 2022; Vermote et al., 2022), our findings showed

760   positive associations of need satisfaction with structure and, to lesser extent, with

761   autonomy supportive, and positively relationships between need frustration and chaos

762   and, to lesser extent, control. An explanation would be that when teachers feel high levels

763   of need satisfaction at work, they are prone to use motivating styles in classroom,

764   although they would prefer to adopt a more directive than understanding attitude to have

765   the feeling of efficiently managing the classroom and optimally guiding their students in

766   the PE practice (Cheon et al., 2020). Instead, when PE teachers feel high need frustration

767   at work, they tend to adopt demotivating styles in their practice, with highly controlling

768   instead of chaotic strategies, to direct their students in the classroom given that they think

769   that it is better to do anything than nothing (Cheon et al., 2020). Regarding pre-service

770   PE teachers, the findings revealed positive associations of competence satisfaction with

771   structure and, to lesser extent, with control, and positively relationships between

772   competence frustration and chaos and, to lesser extent, control. Given the lack of previous

773   research in pre-service teachers, these results suggest that when pre-service teachers feel

774   efficient in managing the classroom (i.e., competence satisfaction), they would tend to be

more directive using more structuring than controlling practices in order to optimally

guide their students in PE. Conversely, pre-service PE teachers would be prone to adopt

need-thwarting strategies, with more chaotic than controlling practices, when they feel

unable in addressing students' learning in the PE lessons.

Moreover, our results in both samples of teachers indicated, as in students, that

attuning and guiding approaches would better represent need-supportive approaches

while participative and clarifying approaches would be merely need-enabling approaches,

in the same way as domineering and abandoning approaches would be truly need-

thwarting approaches, and demanding and awaiting approaches would be simply need-

depriving approaches (Aelterman et al., 2019; Vansteenkiste et al., 2019). Considering

that not all teaching approaches were equally need-supportive or need-thwarting in

students, in-service and pre-service teachers, this study gathers more evidence in favor of

the circumplex structure regarding a more gradual perspective for (de)motivating

teaching styles in PE.

Implications for teaching practice

The availability of the Spanish students' and in-service and pre-service teachers' versions

of the SIS-PE would be useful for PE teachers, students, and researchers, among others.

The application of the Spanish SIS-PE questionnaires allows to know the students' and

teachers' perceptions regarding (de)motivating teaching styles and, in addition, to analyze

the degree of agreement between students' and teachers' reports to discover differences

or similarities concerning their views. For example, PE teachers can use this instrument

every once a while during the academic year to have their students evaluate aspects of

their planning, assessment, and their teaching behavior. This information could help

teachers to be more aware of the perception of the whole group or of each of their students

about their teaching behaviors in order to reinforce what they are doing or, on the

800   contrary, to change it. Indeed, the SIS-PE questionnaire could be applied in intervention

801   research as a diagnostic point or to assess, in the eyes of students and teachers, the

802   potential changes in (de)motivating styles, as well as other motivational outcomes, after

803   a school-based PE intervention program. Thus, Ahmadi et al.'s (2023) classification

804   system about need-supportive teaching strategies could be used in intervention research

805   for in-service and/or pre-service PE teachers to train how to implement motivating

806   teaching strategies both to effectively manage the classroom and to optimally guide

807   students' learning without falling into demotivating practices in the PE lesson.

808   The three Spanish SIS-PE questionnaires will also allow researchers to focus on the

809   moment-to-moment and day-to-day changes in the eyes both of students and their PE

810   teachers. This will make it possible to gather a basis of evidence on how PE teachers

811   could progressively change along the circumplex away from more need-supportive to

812   need-thwarting approaches, or vice versa, depending on students' characteristics (e.g.,

813   school grade, gender, or motor competence), situational characteristics (e.g., the content

814   to be taught, class schedule, or classroom size) or their need-satisfying and need-

815   frustrating experiences. For instance, a PE teacher might "regress" (i.e., changes from

816   need-supportive to need-thwarting practices) or "progress" (i.e., changes from need-

817   thwarting to need-supportive practices) over specific periods of the academic year.

818   Furthermore, the SIS-PE would be useful to ascertain how the four (de)motivating

819   styles or their respective teaching approaches may be combined in classroom practice in

820   the eyes of students and teachers, which would allow us to expand and refine not only the

821   number of retained profiles based on (de)motivating styles, but also their potential

822   implications for students or teachers. This body of evidence would be helpful to enhance

823   initial and continuous programs for in-service and pre-service PE teachers on the

824   beneficial and detrimental effects of their own teaching behavior in classroom practice.

825   *Limitations and future research directions*

826   The current research has various limitations. First, although the students' and teachers'

827   versions of the SIS-PE questionnaire are considered valid and reliable measures in the

828   Spanish PE context, future studies in other countries and cultures are required to test the

829   psychometric properties of the different versions of the instrument. Further, it is necessary

830   that new research checks the content of some items to maximize the instrument's validity

831   and reliability evidence, which, depending on the culture and language, could have

832   problems to capture the meaning of the (de)motivating approaches to which they

833   theoretically belong. Second, this study was cross-sectional, which made it impossible to

834   establish causal relationships among the target variables. Further longitudinal and/or

835   experimental research is, therefore, required to shed more light on the associations of

836   (de)motivating styles, and their respective teaching approaches, with need-based

837   experiences over time. In this same vein, future studies may also consider analyzing the

838   relationships between (de)motivating teaching styles, and their respective approaches,

839   and another more distal outcomes among students, as well as examining the potential

840   antecedents of these (de)motivating styles and the eight teaching approaches among in-

841   service and pre-service teachers in PE. Third, the three independent samples represented

842   students, in-service, and pre-service teachers in secondary PE. Further studies are

843   recommended to expand the students' and teachers' versions of the SIS-PE questionnaire

844   with students and teachers of other educational levels.

845   **Conclusions**

846   The present study gathers evidence to consider the Spanish SIS-PE questionnaire as a

847   valid and reliable measure of the students' and in-service and pre-service teachers'

848   perception of (de)motivating styles and approaches in PE. Besides, this research provides

849   support for a circumplex model proposed for the SIS-PE questionnaire in the eyes of

850 students, in-service, and pre-service teachers in PE. The results support a gradual

851 perspective for (de)motivating teaching styles, with teaching approaches differing from

852 one another in a more progressive rather than a categorical view.

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967   Table 1. Goodness-of-fit measures for the alternative factor models for SIS-PE.

	$\chi^2(df)$	χ^2/df	CFI	TLI	SRMR	RMSEA(90%CI)	AIC
Secondary physical education Students							
8-factor CFA	2367.67(1052)	2.25	.852	.841	.063	.043(.041–.046)	121692.55
4-hierarchical factor CFA	2574.67(1066)	2.42	.830	.821	.075	.046(.044–.048)	121908.56
8-factor ESEM	1170.39(772)	1.52	.954	.935	.023	.028(.025–.031)	120683.50
Bi-factor ESEM	939.25(618)	1.52	.964	.934	.018	.028(.024–.031)	120613.67
In-service physical education teachers							
8-factor CFA	3097.86(1052)	2.94	.659	.635	.075	.064(.062–.067)	66773.93
4-hierarchical factor CFA	3240.64(1066)	3.04	.640	.628	.082	.070(.068–.072)	66989.94
8-factor ESEM	1223(.24(772)	1.58	.925	.897	.029	.035(.031–.039)	65503.50
Bi-factor ESEM	1278.08(618)	2.07	.930	.902	.022	.035(.032–.039)	65461.00
Pre-service physical education teachers							
8-factor CFA	2435.81(1052)	2.32	.804	.789	.061	.045(.043–.047)	93468.33
4-hierarchical factor CFA	2562.91(1066)	2.40	.787	.775	.066	.046(.044–.049)	93572.24
8-factor ESEM	1404.39(772)	1.82	.910	.899	.027	.035(.032–.038)	92711.86
Bi-factor ESEM	882.90(618)	1.43	.962	.931	.020	.026(.022–.029)	92579.48

968   Note. CFA = confirmatory factor analysis; ESEM = exploratory structural equation

969   modelling.

970

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972

973   Table 2. Descriptive statistics, reliability coefficients, and latent correlations of students' perceptions of (de)motivating teaching styles and

974   (de)motivating teaching approaches and need-based experiences.

	Items	Range	M(SD)	γ_1	γ_2	ω	1	2	3	4	5	6	7	8	9	10
(De)motivating styles																
1. Autonomy support	12	1-7	4.34(1.34)	-0.27	-0.53	.89	-	.84***	-.62***	-.19***					.68***	-.38***
2. Structure	12	1-7	5.11(1.11)	-0.66	0.01	.88		-	.73***	-.38***					.64***	-46***
3. Control	12	1-7	4.14(0.94)	0.11	-0.20	.71			-	.14**					.18**	.45***
4. Chaos	12	1-7	2.58(1.16)	0.92	0.51	.87				-					-.12*	.38***
(De)motivating approaches																
1. Participative	4	1-7	4.12(1.52)	-0.16	-0.76	.72	-	.85***	.72***	.68***	.56***	.25***	-.16***	-.13*	.38***	-.35***
2. Attuning	8	1-7	4.56(1.32)	-0.40	-0.42	.84		-	.86***	.82***	.68***	.18**	-.35***	-.24***	.41***	-.37***
3. Guiding	7	1-7	5.06(1.30)	-0.77	0.11	.86			-	.85***	.76***	.07	-.49***	.43***	.34***	-.40***
4. Clarifying	5	1-7	5.15(1.11)	-0.51	-0.14	.70				-	.79***	.12*	-.42***	-.38***	.33***	-.28***
5. Demanding	7	1-7	4.60(0.99)	-0.22	0.07	.61					-	.74***	-.07	-.14*	.23***	-.31***
6. Domineering	5	1-7	3.68(1.20)	0.11	-0.33	.61						-	.53***	.46***	.02	.31***
7. Abandoning	8	1-7	2.57(1.28)	0.91	0.27	.85							-	.86***	-.25***	.34***
8. Awaiting	4	1-7	2.58(1.20)	0.86	0.28	.71								-	-.20**	.29***
Need-based experiences																
9. Need satisfaction	12	1-5	3.69(0.74)	-0.40	-0.12	.87									-	-.45***
10. Need frustration	12	1-5	2.29(0.84)	0.53	-0.12	.89										-

975   *Note*. γ_1=Standardized coefficient of skewness; γ_2=Standardized coefficient of kurtosis. ***$p<.001$, **$p<.01$, *$p<.05$

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Table 3. Descriptive statistics, reliability coefficients, and latent correlations of in-service physical education teachers' perceptions of (de)motivating teaching styles and (de)motivating teaching approaches and need-based experiences.

|	Items	Range	M(SD)	γ_1	γ_2	ω	1	2	3	4	5	6	7	8	9	10
(De)motivating styles																
1. Autonomy support	12	1-7	5.61(0.63)	-0.28	-0.17	.73	-	.83***	-.22***	-.47***					.38***	-.23***
2. Structure	12	1-7	5.88(0.54)	-0.17	-0.21	.76		-	-.19**	-.61***					.53***	-.35***
3. Control	12	1-7	2.95(0.85)	0.36	-0.18	.77			-	.64***					-.14***	.31***
4. Chaos	12	1-7	1.88(0.55)	0.59	0.05	.75				-					-.16***	.26***
(De)motivating approaches																
1. Participative	4	1-7	5.07(0.98)	-0.46	-0.09	.53	-	.80***	.44***	.40***	-.26***	-.37***	-.42***	-.14***	.16***	-.05
2. Attuning	8	1-7	5.89(0.60)	-0.33	-0.16	.75		-	.80***	.68***	-.16***	-.31***	-.56***	-.23***	.46***	-.29***
3. Guiding	7	1-7	6.08(0.54)	-0.29	-0.25	.74			-	.61***	-.09*	-.30***	-.58***	-.16***	.47***	-.33***
4. Clarifying	5	1-7	5.59(0.79)	-0.36	-0.22	.70				-	.26***	.12**	-.24***	-.41***	.38***	-.12*
5. Demanding	7	1-7	3.17(0.98)	0.27	-0.22	.71					-	.90***	.56***	-.01	-.04	.21***
6. Domineering	5	1-7	2.39(0.97)	0.62	-0.16	.70						-	.70***	.16***	-.17***	.35***
7. Abandoning	8	1-7	1.57(0.53)	1.08	0.83	.73							-	.30***	-.23***	.34***
8. Awaiting	4	1-7	2.60(1.09)	0.50	-0.57	.70								-	-.07*	.14**
Need-based experiences																
9. Need satisfaction	12	1-5	4.44(0.40)	-0.98	1.24	.80									-	-.72***
10. Need frustration	12	1-5	1.74(0.47)	0.82	1.27	.73										-

Note. γ_1=Standardized coefficient of skewness; γ_2=Standardized coefficient of kurtosis. ***$p<.001$, **$p<.01$, *$p<.05$

983   Table 4. Descriptive statistics, reliability coefficients, and latent correlations of pre-service physical education teachers' perceptions of

984   (de)motivating teaching styles and (de)motivating teaching approaches and competence-based experiences.

	Items	Range	M(SD)	γ_1	γ_2	ω	1	2	3	4	5	6	7	8	9	10
(De)motivating teaching styles																
1. Autonomy support	12	1-7	5.81(0.62)	-0.33	0.08	.77	-	.77***	-.13***	-.48***					.09	-.04
2. Structure	12	1-7	5.81(0.57)	-0.23	-0.37	.70		-	-.19***	-.63***					.17***	-.16***
3. Control	12	1-7	3.07(0.86)	0.32	-0.14	.79			-	.56***					.16***	.06
4. Chaos	12	1-7	1.86(0.57)	1.15	1.66	.76				-					.01	-.66***
(De)motivating teaching approaches																
1. Participative	4	1-7	5.37(0.90)	-0.35	-0.42	.53	-	.76***	.51***	.28***	-.17**	-.29***	-.32***	-.13**	-.09	.09
2. Attuning	8	1-7	6.04(0.62)	-0.55	0.52	.75		-	.82***	.56***	-.05	-.17***	-.56***	-.38***	.11*	-.05
3. Guiding	7	1-7	6.05(0.59)	-0.37	-0.30	.73			-	.65***	.01	-.18***	-.67***	-.42***	.20***	-.15***
4. Clarifying	5	1-7	5.47(0.80)	-0.39	0.04	.70				-	.41***	.30***	-.30***	-.34***	.12*	-.11**
5. Demanding	7	1-7	3.51(0.91)	0.11	-0.14	.64					-	.84***	.44***	.15***	.14**	-.01
6. Domineering	5	1-7	2.45(1.02)	0.63	0.01	.70						-	.64***	.36***	-.17***	.07
7. Abandoning	8	1-7	1.49(0.55)	1.95	1.49	.75							-	.68***	-.02	.19***
8. Awaiting	4	1-7	2.44(0.88)	0.70	0.62	.58								-	-.10*	.18***
Need-based experiences																
9. Competence satisfaction	4	1-5	3.97(0.75)	-0.78	0.73	.84									-	-.65***
10. Competence frustration	4	1-5	2.04(0.79)	0.47	-0.54	.73										-

985   *Note*. γ_1=Standardized coefficient of skewness; γ_2=Standardized coefficient of kurtosis. ***$p<.001$, **$p<.01$, *$p<.05$

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989 Figure 1. Circumplex approach to (de)motivating teaching styles and approaches in

990 physical education.
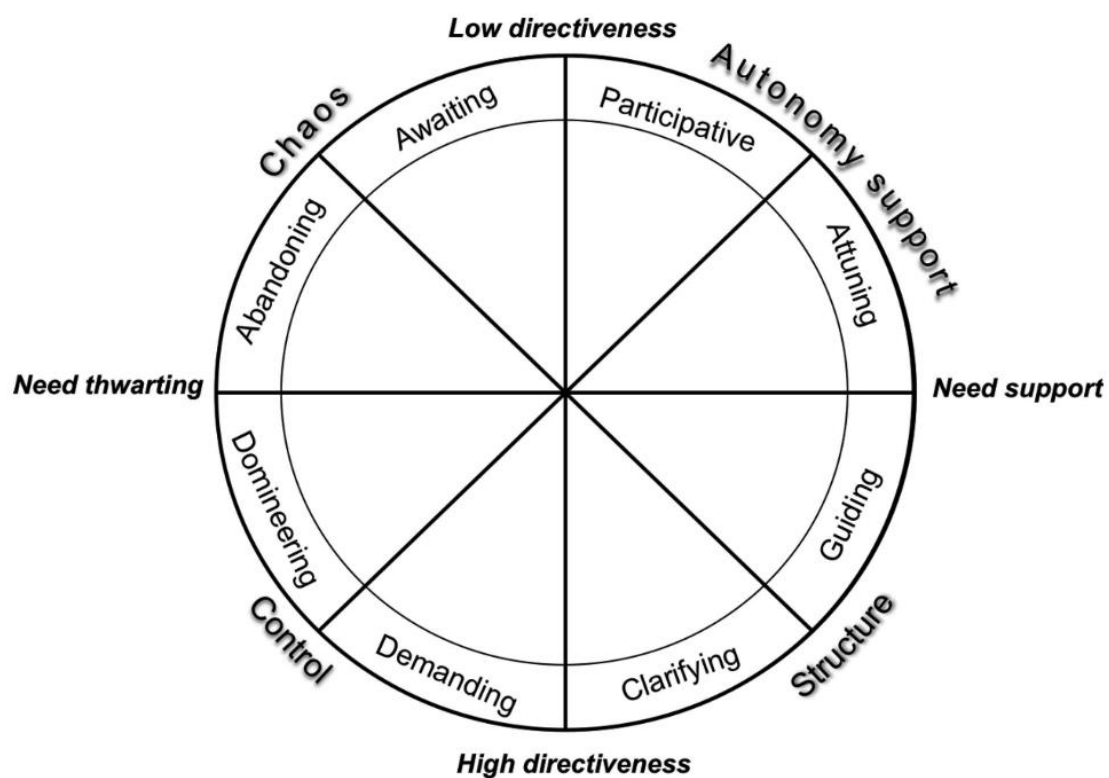
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992 *Note*. Graphical representation taken from Aelterman et al. (2019)

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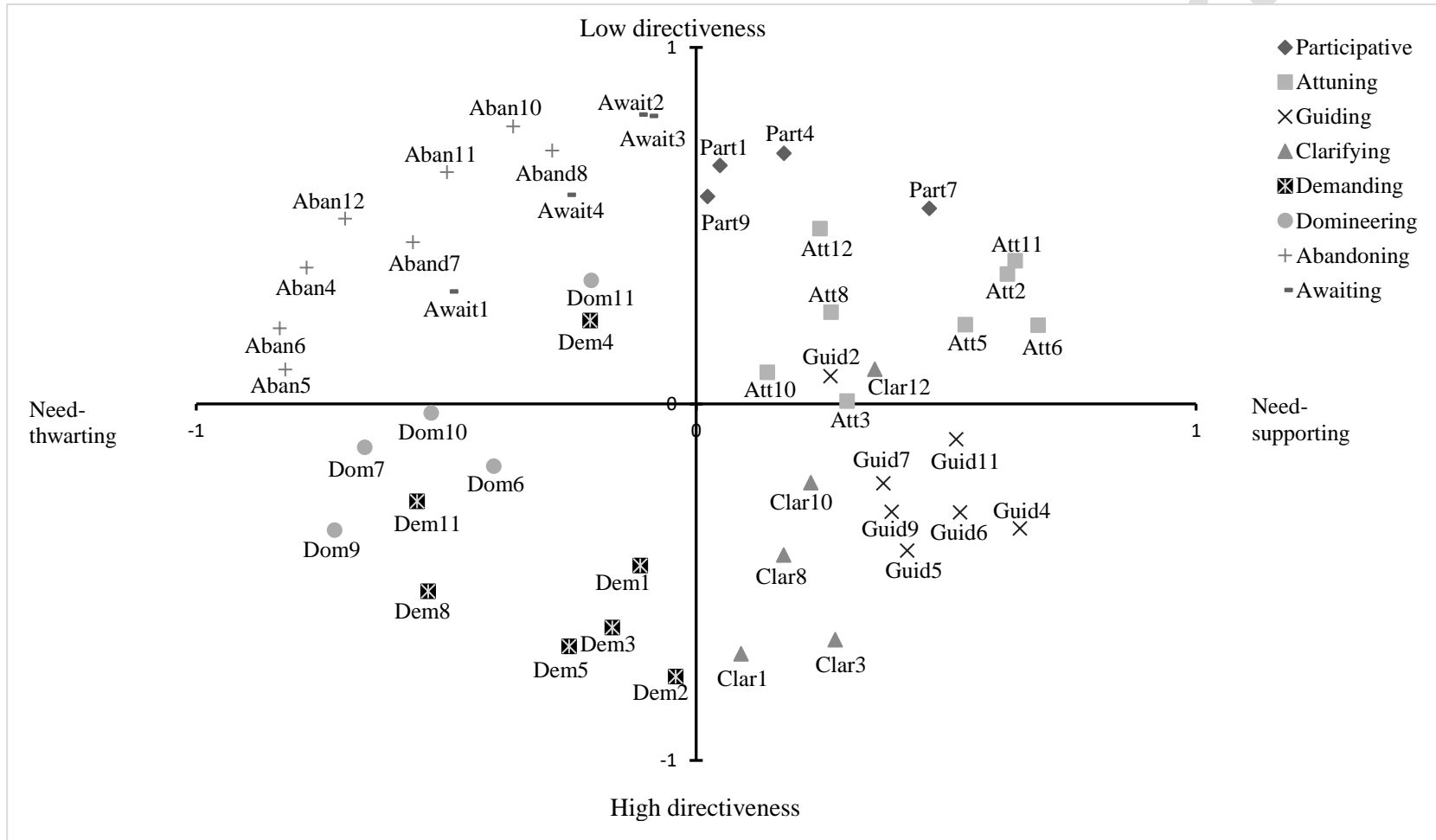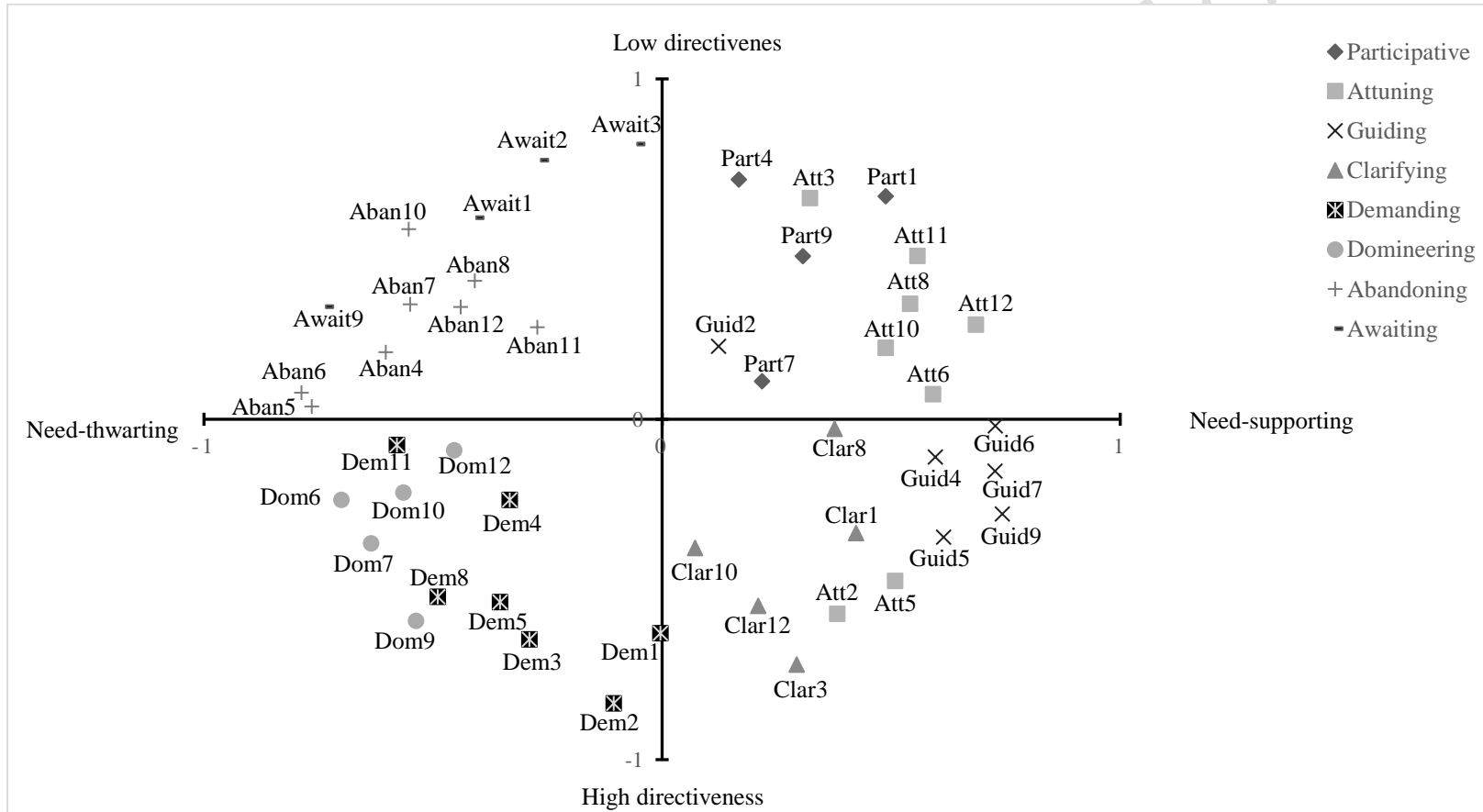
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1004   Figure 2. Two-dimension representation of the SIS–PE items in secondary students

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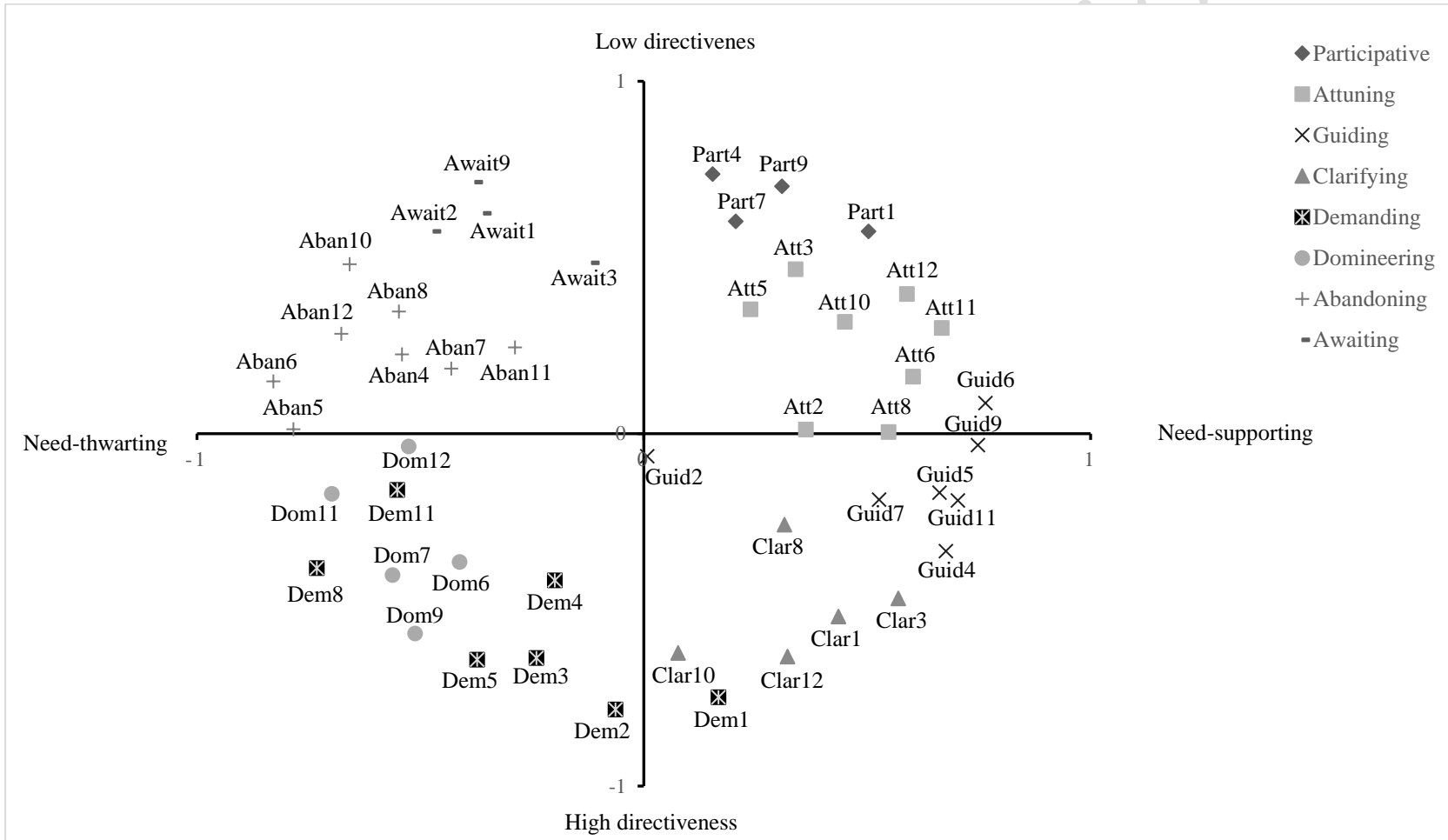1007 Figure 3. Two-dimension representation of the SIS – PE items in in-service physical education teachers.

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1011   Figure 4. Two-dimension representation of the SIS–PE items in pre-service physical education teachers.

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1014   Figure 5. Predictive associations from perceived (de)motivating styles and approaches

1015   to need-based experiences in students.
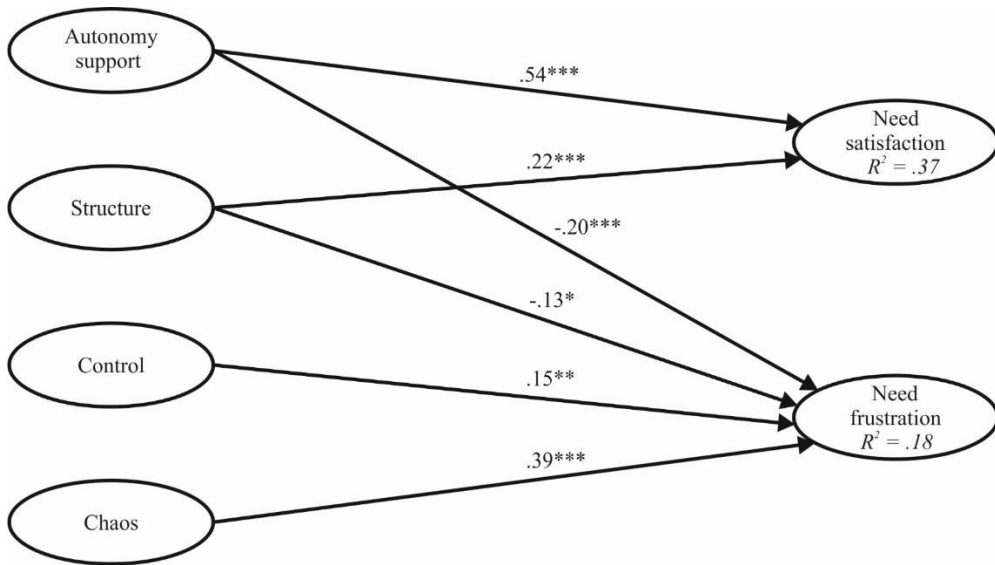
Figure 5a. Paths from (de)motivating teaching styles to need-based experiences in students.
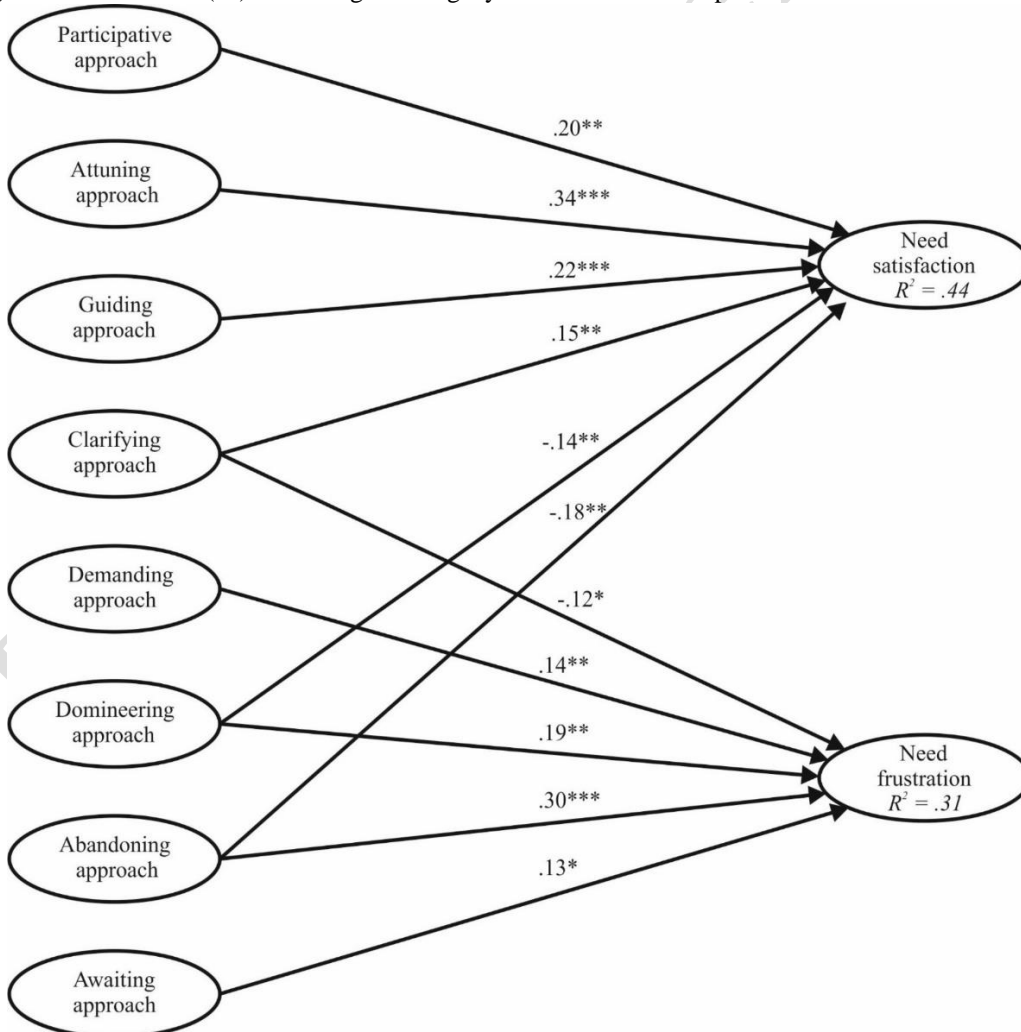
Figure 5b. Paths from (de)motivating teaching approaches to need-based experiences in students.

1016   *Note.* Significant paths are only shown. ***$p<.001$, **$p<.01$, *$p<.05$

1017   Figure 6. Predictive associations from need-based experiences to (de)motivating styles

1018   and approaches among in-service physical education teachers
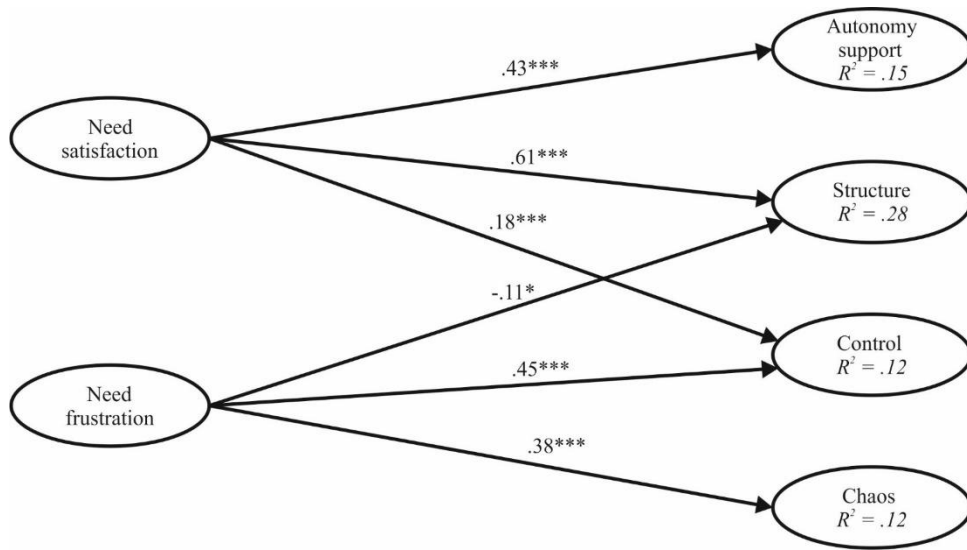
Figure 6a. Paths from need-based experiences to (de)motivating teaching approaches in in-service teachers
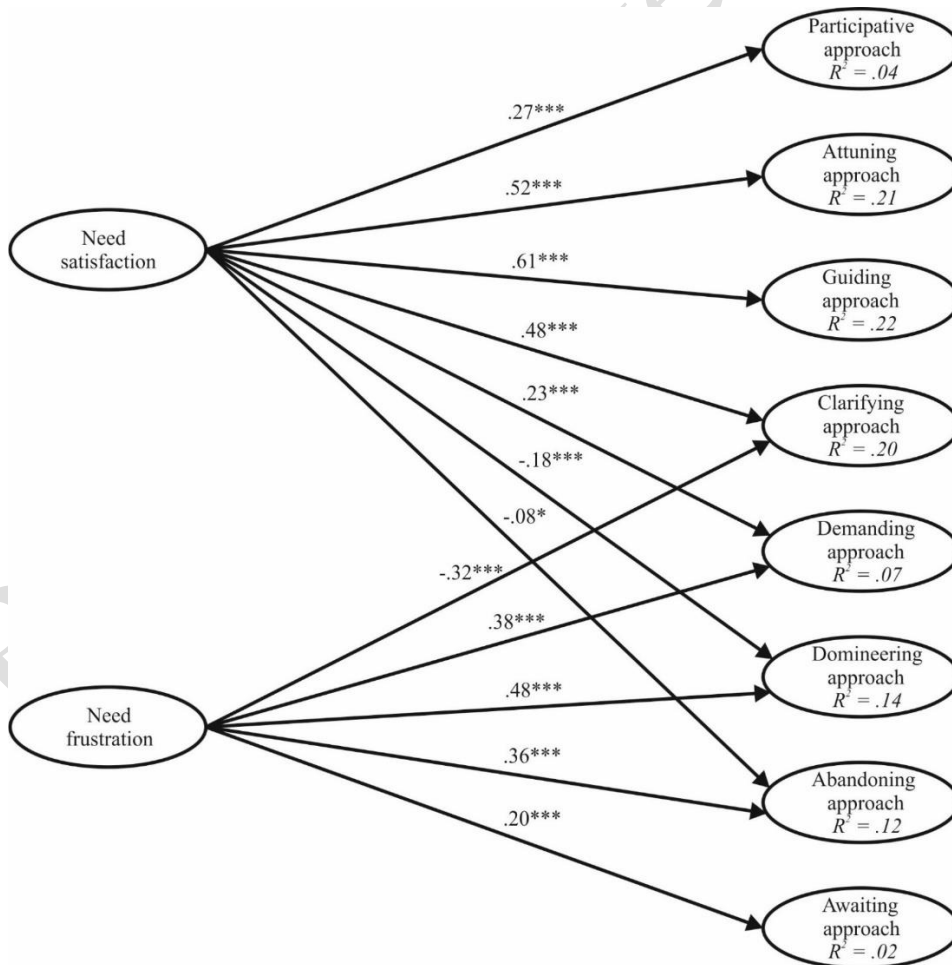

Figure 6b. Paths from need-based experiences to (de)motivating teaching approaches in in-service teachers

1019   Note: Significant paths are only depicted. ***$p<.001$, **$p<.01$, *$p<.05$

1020 Figure 7. Predictive associations from competence-based experiences to (de)motivating

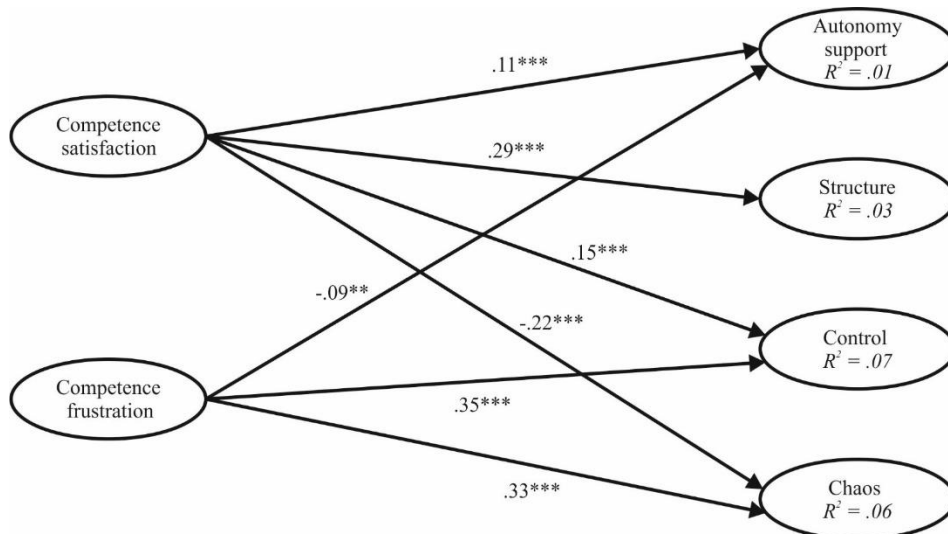1021 styles and approaches in pre-service physical education teachers

Figure 7a. Paths from competence-based experiences to (de)motivating teaching approaches in pre-service teachers
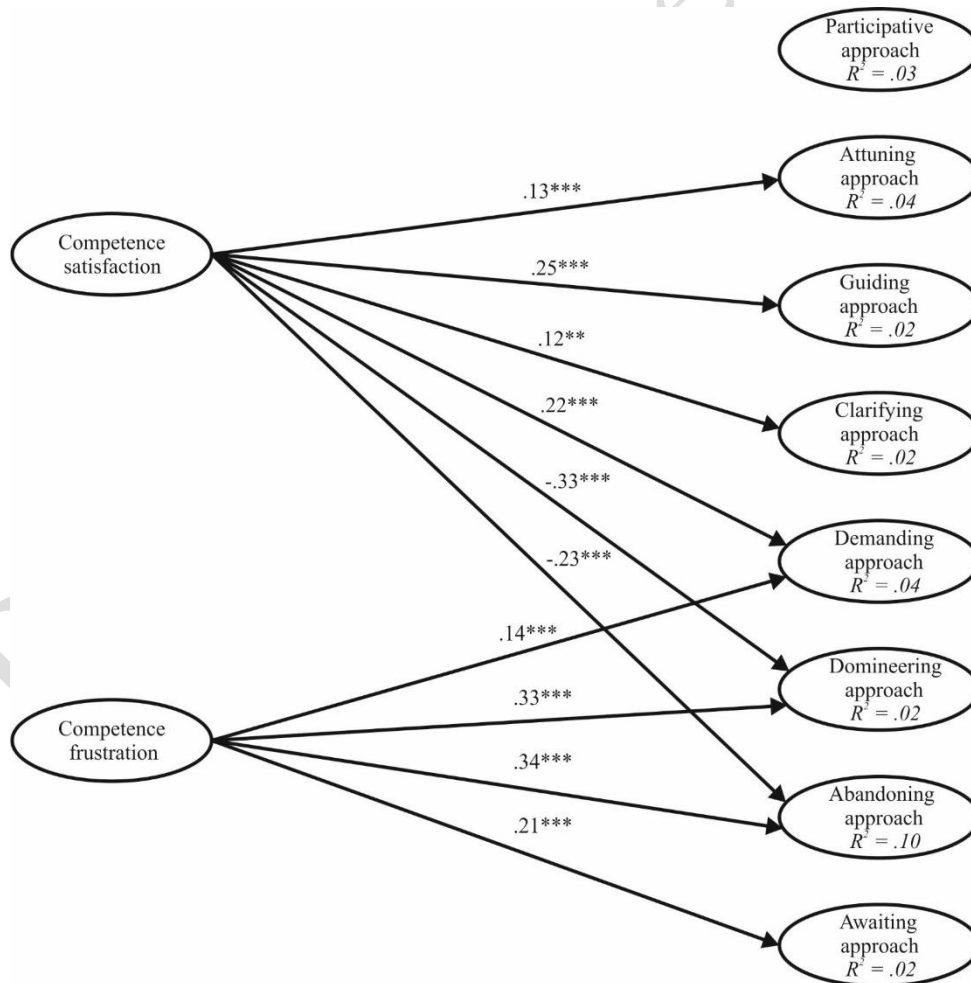

Figure 7b. Paths from competence-based experiences to (de)motivating teaching approaches in pre-service teachers

1022 *Note.* Significant paths are only shown. ***p<.001, **p<.01, *p<.05