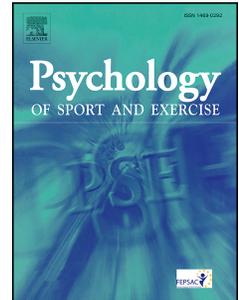# Accepted Manuscript

Changing Teachers' Beliefs regarding Autonomy Support and Structure: The Role of Experienced Psychological Need Satisfaction in Teacher Training

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RUNNING HEAD: Role of Need Satisfaction in Teacher Training

Changing Teachers' Beliefs regarding Autonomy Support and Structure:

The Role of Experienced Psychological Need Satisfaction in Teacher Training

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26 **Abstract**

27 *Objectives*: Grounded in Self-Determination Theory, this study examined whether physical

28 education (PE) teachers' psychological need satisfaction experienced during continuous professional

29 development (CPD) on need-supportive teaching predicted changes in their effectiveness and

30 feasibility beliefs regarding the proposed teaching approach, as well as their intentions to apply this

31 approach and subsequent changes in their self-reported in-class behaviors.

32 *Methods*: Prior to the training, a sample of 80 PE teachers (57.5% men, Mage = 42.70 ± 10.15

33 years) reported on their effectiveness and feasibility beliefs regarding autonomy-supportive and

34 structuring teaching strategies and their in-class application of these strategies. Immediately following

35 the training, these beliefs were assessed again and participants reported on their psychological need

36 satisfaction experienced during the training and their intentions to apply the proposed strategies.

37 Finally, two weeks after the training, participants' self-reported in-class application of the teaching

38 strategies was measured for the second time.

39 *Results*: Psychological need satisfaction experienced during the training related to a change in

40 effectiveness and feasibility beliefs regarding autonomy support and structure, and to teachers'

41 intentions to apply the proposed strategies as reported immediately after receiving the training. In

42 addition, teachers' intentions related to a change in their self-reported in-class application of structuring,

43 but not autonomy-supportive, teaching strategies.

44 *Conclusions*: Experiences of psychological need satisfaction during CPD can help to increase the

45 likelihood that teachers become more convinced about the effectiveness and feasibility of the proposed

46 change and can produce greater intentions toward change, which may relate to actual (albeit) self-

47 reported behavior change.

48 *Key words*: Self-Determination Theory, continuous professional development, psychological need

49 satisfaction, teacher beliefs, motivating teaching strategies

50   *'Supporting students' needs and values might work for some students, but others will definitely*

51   *benefit from a traditional, more rigorous approach.'*

52   *'If I continually try to figure out what my students want, we end up in an endless discussion and*

53   *I don't come to actual teaching at all. Such an approach not only wastes a lot of time, but also takes a*

54   *lot of energy!'*

55   As in any profession, it is important for physical education (PE) teachers and sport coaches to

56   regularly engage in continuous professional development (CPD) programs as to stay up-to-date with

57   innovations in the field and to assimilate new knowledge, skills, and expertise (Opfer & Pedder, 2011).

58   However, during these CPD programs in which innovative or alternative instructional approaches are

59   proposed, participants sometimes confront the CPD provider with critical remarks or skeptical reactions,

60   as the ones in the introductory examples. Not surprisingly, PE teachers and sport coaches do not

61   automatically endorse the messages delivered through CPD, presumably because certain instructional

62   behaviors have become ingrained into their teaching or coaching repertoire and daily routine (Pajares,

63   1992).

64   In the case of PE teachers, many factors, including teachers' personality dispositions (Van den

65   Berghe et al., 2013), the social context in which they teach (Taylor, Ntoumanis & Smith, 2009), the

66   characteristics of their students (Pelletier, Sequine-Levesque & Legault, 2002) and the motivational

67   beliefs they hold (Roth & Weinstock, 2013), may explain why they might (or might not) undergo a

68   change in their teaching approach. With respect to teacher beliefs, if the proposed strategies are

69   perceived as not effective (i.e., effectiveness belief) or too difficult or challenging to apply in practice

70   (i.e., feasibility belief), teachers are unlikely to undertake change (Reeve, 1998; Reeve et al., 2014).

71   Given that prior research has shown that effectiveness and feasibility beliefs underlie teachers' in-class

72   teaching behavior (Pajares, 1992; Reeve et al., 2014; Tsangaridou, 2006) and that teacher beliefs are,

73   in contrast to other determinants of teaching behavior, more malleable through CPD programs

74 (Aelterman, Vansteenkiste, Van den Berghe, De Meyer, & Haerens, 2014), one critical question

75 becomes which dynamics are involved in changing teachers' beliefs and related outcomes.

76   Grounded in Self-Determination Theory (SDT; Deci & Ryan, 2000), we propose that teachers'

77 personal experiences during CPD are critical herein. Specifically, the aim of the present study was to

78 examine whether the satisfaction of PE teachers' basic psychological needs for autonomy (i.e.

79 experiencing a sense of volition and psychological freedom), competence (i.e. experience of personal

80 effectiveness), and relatedness (i.e. experiencing closeness and mutuality in interpersonal

81 relationships) during CPD fosters a change in teachers' beliefs underlying the proposed teaching

82 approach (Ryan & Deci, 2008). In addition, we explored whether experienced need satisfaction would

83 relate directly to PE teachers' intentions to apply the proposed change and to their self-reported in-

84 class behaviors.

85 **Changing Teachers' Beliefs**

86   Research consistently confirms that in-service training is positively related to student outcomes

87 (Darling-Hammond, Holtzman, Gatlin & Heilig, 2005). Therefore, teachers' regular engagement in CPD

88 and life-long learning is strongly encouraged (Opfer & Pedder, 2011). However, the effects of CPD

89 might get diminished when teachers start to express reservations regarding the proposed changes

90 because they hold certain beliefs regarding the recommended strategies (Reeve, 1998; Reeve et al.,

91 2014). A first belief that can hamper but also stimulate teachers to change their current teaching

92 repertoire is their belief regarding the *effectiveness* of offered instructional strategies (Reeve et al.,

93 2014). That is, to the extent that teachers believe that particular teaching strategies are effective, they

94 would perceive them as more meaningful, leading them to more strongly endorse (i.e., internalize)

95 these strategies. For example, if teachers believe that extrinsic motivators (e.g., incentives, rewards)

96 are efficacious in arousing students' motivation, they are more likely to rely on such practices (e.g.,

97 Pajares, 1992; Reeve, 2009). Second, teachers' beliefs regarding the *feasibility* of an alternative

98 instructional approach in everyday teaching practice may also prevent or encourage them from

99   changing their current teaching repertoire (Reeve et al., 2014). That is, if teachers feel more

100 comfortable with and competent in their current way of teaching, and find their ongoing practices more

101 fast-acting, realistic, and therefore relatively easier to enact, they are less likely to undertake change.

102   Within CPD research in general (Pajares, 1992; Tsangaridou, 2006) and SDT-based studies in

103 particular (Reeve et al., 2014; Roth & Weinstock, 2013), effectiveness and feasibility beliefs have been

104 shown to explain why teachers are open for change or rather stay ambivalent, and, in turn, decide to

105 respectively try out or refuse to adopt the offered alternative classroom behavior. Since teachers'

106 beliefs may conflict with the information presented in the CPD program (Reeve, 1998), it is not a

107 straightforward endeavor for CPD providers to foster an alternative teaching approach among teachers

108 (Pajares, 1992). Yet, Aelterman and colleagues (2014) recently showed that PE teachers who received

109 training on need-supportive teaching reported an increase in both effectiveness and feasibility beliefs

110 regarding the proposed teaching approach one month later, compared to teachers in a control group.

111 Furthermore, these changes in teachers' beliefs were significantly associated with changes in teachers'

112 self-reported instructional behaviors, which were also picked up by their students and by external raters

113 (Aelterman et al., 2014).

114 **Psychological Need Satisfaction: The Energizing Basis for Change**

115   From the SDT-perspective, actual changes are more likely to occur to the extent that teachers

116 have fully internalized, that is, self-endorsed, the importance and value of the proposed alternative

117 approach for their teaching practice (Deci & Ryan, 2000). In this respect, prior research in the broader

118 CPD literature has suggested that the way in which CPD is delivered is as important (e.g., O'Sullivan &

119 Deglau, 2006; Swennen, Lunenberg & Korthagen, 2008), if not, more important than its specific content

120 for this internalization process to occur (Aelterman et al., 2013; Deci, 2009). According to SDT, the

121 fulfillment of the basic psychological needs for autonomy, competence, and relatedness is critical

122 herein as these basic needs are said to serve as the psychological nutriments that *energize* personal

123 growth and integrity (Deci & Ryan, 2000). Much like students are more likely to become enthusiastic

124 when teachers manage to support their basic psychological needs (e.g., Reeve, Deci, & Ryan, 2004 for

125 an overview), teachers are more likely to fully accept the proposed teaching strategies during CPD if

126 they experience room for initiative taking (autonomy satisfaction), feel confident to successfully

127 complete the tasks (competence satisfaction) and feel well-connected with both the CPD-provider and

128 the other participants (relatedness satisfaction) during the training (e.g., Baard, Deci, & Ryan, 2004).

129   Studies in other contexts than education, including the organizational setting (Gagné, Koestner,

130 & Zuckerman, 2000) and the health domain (see Ng et al., 2012 for a meta-analysis), indeed showed

131 that need satisfaction engenders a greater openness, receptivity, and internalization of change, while

132 the very blocking of these same needs likely elicits defensiveness and even defiance against change

133 (Hodgins & Knee, 2002; Vansteenkiste & Ryan, 2013). Despite this evidence across different domains,

134 little, if any, attention has been paid to whether teachers' experiences of psychological need satisfaction

135 during CPD are related to their intentions to apply the teaching strategies proposed, and whether their

136 effectiveness and feasibility beliefs about these strategies play a role in this relationship. In fact, only

137 one (unpublished) study partially addressed this issue in a group of teachers involved in a school

138 reform program (Feinberg, Assor, Kaplan, Kanat-Maymon, & Roth, 2005). Specifically, the results of

139 this study indicated that teachers who felt supported in their psychological needs were more likely to

140 identify with the proposed reform, which in turn led to a significant change toward the proposed

141 teaching approach after two years of involvement in the program, whereas no such change was

142 observed in a control group (Feinberg et al., 2005).

143 **The Present Study**

144   According to research applying SDT, the more teachers have their psychological needs fulfilled

145 during the training, the more they will become convinced of the value and effectiveness of the proposed

146 teaching strategies (Baard et al., 2004), and the more they will actually implement the proposed change

147 (Assor, Kaplan, Feinberg & Tal, 2009; Roth, Assor, Kanat-Maymon & Kaplan, 2007). However, studies

148 uncovering the exact role of psychological need satisfaction in processes of change during CPD are

149   scarce (but see Feinberg et al., 2005). In an attempt to contribute to this research area, the present

150   study involved a prospective investigation of these dynamics in a unique sample of PE teachers.

151   Specifically, we examined whether variation in experienced psychological need satisfaction among

152   teachers participating in a teacher training relates to variation in the changes of PE teachers' beliefs

153   regarding the effectiveness and feasibility of proposed strategies, as well as to their intentions to apply

154   the proposed strategies in their lessons as measured immediately after the training, and changes in

155   their self-reported in-class application of these strategies. We expected that the more PE teachers

156   experienced a sense of psychological need satisfaction during the training, the more pronounced the

157   positive change in their effectiveness and feasibility beliefs regarding the proposed autonomy-

158   supportive and structuring strategies would be. Further, it was hypothesized that experienced need

159   satisfaction would not only predict a change in teachers' beliefs, but would also relate to teachers'

160   intentions to apply the proposed teaching strategies in their lessons, which in turn would relate to a

161   change in their reported in–class application of the proposed strategies.

162   **Method**

163   **Participants**

164   The study involved a unique sample of 80 experienced PE teachers (46 men; 57.5%) out of 55

165   different secondary schools with a mean age of 42.70 (*SD* = 10.15) years. The large majority of the

166   teachers (i.e., 89%) came from Flanders, the Dutch-speaking part of Belgium, whereas 11% came from

167   The Netherlands. Teachers had on average 16.64 (*SD* = 10.07) years of teaching experience. All

168   teachers were full-time certified PE teachers, from whom 55.3% obtained a master degree in

169   movement and sport sciences at the university, and 44.7% had engaged in a professional bachelor

170   program in physical education at a university college. Of the participating teachers, 81.3% and 18.8%

171   taught PE in mixed gender and single gender classes, respectively. In addition, 42.1% taught students

172   in an academic track, 22.4% in a technical track, 15.8% in a vocational track, and 19.7% in a

173   combination of different educational tracks.

174   **Procedure**

175   Coordinators of different pedagogical counseling services[1] in Flanders were approached by

176   email and telephone to explore their interest in an in-service CPD training on motivating teaching in the

177   context of PE and to explain the purposes of the research and its timeline. All four contacted

178   coordinators expressed an interest to participate. However, due to the timeline, only three counseling

179   services were actually able to offer the training as a CPD program for PE teachers on a specific

180   occasion within their region. In addition, one comparable counseling service in The Netherlands agreed

181   to take part in the study. Ultimately, five different training days were organized, of which four trainings

182   took place in three different regions of Flanders, and one training took place in The Netherlands. The

183   administration of subscription happened entirely by the support of the pedagogical counseling services,

184   who subsequently sent all contact information of the participants to the coordinating researcher of the

185   study (i.e. first author). All five workshops were delivered by two trainers (i.e. different combinations of

186   the first, second and/or fourth author), who had substantial expertise in delivering workshops and

187   lectures for (PE) teachers about SDT and being need-supportive.

188   Participants in the training were followed on three measurement occasions. First,

189   approximately three weeks before the training, all teachers were invited by email to complete an online

190   questionnaire tapping into their beliefs concerning a need-supportive teaching approach and into their

191   in-class application of such an approach (i.e. pretest/baseline). Second, immediately following the

192   training, teachers were presented with a paper-version questionnaire to obtain data on their beliefs

193   concerning the effectiveness and feasibility of autonomy-supportive and structuring teaching strategies,

194   their experiences during the training, and their intentions to apply the proposed teaching strategies in

195   their own PE lessons (i.e. immediate post-training). Finally, about two to three weeks after the training,

196   PE teachers were again invited to complete an online questionnaire as to report on their actual in-class

197   application of autonomy-supportive and structuring teaching strategies at that moment in time (i.e. two

198   weeks post-training). The study protocol was approved by the Ethical Committee of Ghent University.

199 **CPD Training on Need-supportive Teaching**

200   The training involved a standardized one-day (i.e. 6 hours) in-service CPD training on how to

201 adopt a more need-supportive approach toward students. This workshop-like training was previously

202 systematically developed and optimized for and in close collaboration with experienced secondary

203 school PE teachers in a first study (Aelterman et al., 2013), and was found effective in changing PE

204 teachers' beliefs and teaching behaviors in a second study with a different sample of PE teachers

205 (Aelterman et al., 2014).

206   The training consisted of three interactive parts. Part I (i.e. 1 hour) involved an introduction of

207 SDT as the theoretical framework. Through interactive exercises and discussions, teachers got

208 acquainted with the concepts of motivation, need satisfaction, and need support. In addition, empirical

209 evidence was provided to support the argument that when students feel supported in their basic

210 psychological needs, they better enjoy PE and acknowledge the value and personal benefits

211 associated with PE. Part II (i.e. 2.5 hours) existed of an overview of, respectively, four and five specific

212 instructional strategies to support students' feelings of autonomy (i.e. autonomy support) and

213 competence (i.e. structure) in PE, illustrated by authentic video images (i.e., as good and bad practices)

214 and cases. With regard to autonomy support, (1) adopting an empathic attitude, (2) providing choice,

215 (3) offering a meaningful rationale, and (4) integrating fun elements, were put forward. As for structure,

216 PE teachers were provided with strategies such as (1) giving an overview of the forthcoming lesson, (2)

217 communicating expectations, (3) avoiding the provision of unnecessary information by asking

218 questions, (4) giving positive, informational feedback and (5) offering help when needed. To avoid an

219 overload of information and because relatedness support often co-occurs with autonomy support and

220 even structure, relatedness-supportive strategies were not presented as a separate category, but rather

221 as general basic teaching qualities that help support autonomy and provide structure (Reeve & Jang,

222 2006). Finally, in Part III (i.e. 2.5 hours), PE teachers had the opportunity to practice the motivating

223   strategies through microteaching and role-playing in the gym. In addition, several opportunities for (self-

224   )reflection and peer feedback were created along this application exercise.

225   One central feature of the training (Aelterman et al., 2013) was that the trainers intended to act

226   in accordance with the principles of need support that were conveyed (i.e. congruent teaching;

227   Swennen et al., 2008). Specifically, they attempted to maximize PE teachers' opportunities to have their

228   basic psychological needs for autonomy, competence, and relatedness fulfilled during the training

229   (Aelterman et al., 2013). It is important to note that the present study did not aim to explore the degree

230   to which the trainers were actually need-supportive, but rather focused on teachers' personal

231   experiences during the training.

232   **Measures**

233   *Teacher beliefs*. To assess teacher beliefs we relied on a previously developed questionnaire

234   as to directly tap into effectiveness and feasibility beliefs regarding the specific strategies that were

235   presented during the training (Aelterman et al., 2014). Specifically, the PE teachers were provided with

236   a 15-item list of autonomy-supportive (9 items; e.g., 'I find it personally meaningful that teachers offer

237   choice to all students during the PE lesson') and structuring (6 items; e.g., 'I find it personally

238   meaningful that teachers give an overview of the content and structure of the PE lesson') teaching

239   strategies to be rated twice, that is, once in terms of effectiveness on a five-point Likert scale from 1

240   (*totally disagree*) to 5 (*totally agree*), and once in terms of feasibility with a score ranging from 1 (*totally*

241   *unfeasible*) to 5 (*totally feasible*)**.** All teacher beliefs scales had good internal consistencies with

242   Cronbach's alphas ranging between .73 and .80 at baseline and between .70 and .79 immediately after

243   the training.

244   *Psychological need satisfaction*. To measure teachers' psychological need experienced

245   during the training, the Basic Psychological Need Satisfaction and Need Frustration Scale (BPNSNF;

246   Chen et al., 2015) was used. This recently developed and validated 24-item scale consists of six

247   subscales pertaining to the satisfaction and frustration of the three needs identified in SDT, with each

248   need being assessed by means of eight items, of which four tap into need satisfaction and four into

249   need frustration. For the purposes of the present study, only the need satisfaction subscale was used.

250   The stem of the scale was changed into 'During this training…' and the items were slightly adapted as

251   to tap into teachers' experiences of autonomy (e.g., 'I felt a sense of choice and freedom in the things I

252   thought and did'), competence (e.g., 'I felt confident that I could apply the proposed teaching strategies

253   well'), and relatedness (e.g., 'I felt connected with the other participants') satisfaction experienced

254   during the training.

255   *Intention to apply proposed strategies.* Immediately after the training, teachers reported on

256   their intention to apply the proposed teaching strategies in their practice, using the same set of 15 items

257   applied to measure teachers' beliefs. Specifically, teachers indicated on a five-point Likert scale from 1

258   (*absolutely no intention*) to 5 (*definitely have the intention*) to what extent they intended to apply the

259   proposed autonomy-supportive (9 items; α = .76) and structuring (6 items; α = .74) teaching strategies

260   in their current practice.

261   *Application of proposed strategies.* Prior to the training and about two weeks after the

262   training, teachers reported online on their in-class application of autonomy-supportive and structuring

263   teaching strategies, using the same set of 15 items applied to measure teachers' beliefs and intentions.

264   Specifically, teachers indicated on a five-point Likert scale from 1 *(totally disagree)* to 5 *(totally agree)* to

265   what extent they applied autonomy-supportive (9 items) and structuring (6 items) teaching strategies at

266   that moment in time. Internal consistencies were good with Cronbach's alphas of .80 and .71 at the

267   pretest and .82 and .71 two weeks after the training for autonomy support and structure, respectively.

268   **Plan of Analyses**

269   Descriptive statistics, internal consistency coefficients and correlations among the study

270   variables were computed using IBM SPSS Statistics 22.0. Possible associations between teacher

271   characteristics (i.e. teacher sex, teacher age, years of teaching experience, diploma, and educational

272   track they are teaching in) and study variables at baseline (i.e. teacher beliefs and in-class application

273   of autonomy support and structure) were tested by means of MANOVAs and correlations for

274   dichotomous and continuous background variables, respectively.

275   Multilevel modeling is considered the most appropriate method to analyze data that are

276   hierarchically structured (Hox, 2010), as is the case in the present study with 80 PE teachers being

277   nested within 55 schools. However, the number of teachers within schools ranged between one and

278   five per school (for 39 out of the 55 schools, the number of teachers was n = 1), which is considered

279   insufficient to obtain an accurate estimation at the school level (Maas & Hox, 2005). In addition, the

280   estimation of intraclass correlation coefficients (ICCs) in a two-level model using the statistical program

281   MLwin version 2.27 (Rashbash, Steele, Browne, & Goldstein, 2009) indicated that there was no

282   significant variance at the school level (all χ^2(1) < .50, p = 1.00). Therefore, we proceeded with single-

283   level analyses.

284   Although replicating the intervention effects on teachers' beliefs and behaviors was not the

285   purpose of the present study (but see Aelterman et al., 2014), we preliminarily examined whether

286   positive mean-level changes in teachers' effectiveness and feasibility beliefs regarding autonomy

287   supportive and structuring teaching strategies and teachers' in-class application of these strategies

288   could be observed. Relying on repeated measures ANOVAs with teachers' beliefs or self-reported

289   behaviors as the within-subject variables, analyses were performed in distinct models for the

290   dimensions of autonomy support and structure separately.

291   In a next step, structural equation modeling was used to model associations between

292   experienced need satisfaction during the training, changes in beliefs regarding autonomy support and

293   structure, teachers' intentions to apply the proposed strategies, and changes in self-reported in-class

294   application of these strategies. Changes in beliefs and changes in self-reported behaviors were

295   calculated by means of residual change scores. For example, a measure of change in effectiveness

296   belief regarding autonomy support between pre- and posttest free of auto-correlated error was created

297   by regressing the belief measure at the posttest onto the measure at baseline to compute the

298   residualized belief change index (i.e. the difference between the predicted and observed belief score at

299   the posttest). The resulting residualized scores, which can automatically be computed in SPSS, can be

300   interpreted as the amount of increase or decrease in belief scores between baseline and posttest,

301   taking into account the baseline scores. The same procedure was followed for all dependent variables

302   (for an example of this procedure see Haerens, Vereecken, Maes, & De Bourdeaudhuij, 2010).

303   The relatively small sample size ($n < 100$) precluded us from performing SEM with latent

304   variables. Specifically, whereas 80 PE teachers filled out the baseline questionnaire, only 41 teachers

305   participated in the online survey two weeks after the training. Hence, the structural model was tested

306   through path analysis with manifest variables based on maximum likelihood estimation in Mplus

307   (Muthèn & Muthèn, 2007). To evaluate the model fit, the Comparative Fit Index (CFI), the Root Mean

308   Squared Error of Approximation (RMSEA) and the Standardized Root Means Square Residual (SRMR)

309   were selected. According to Hu and Bentler (1999), combined cut-off values to .95 for CFI and close to

310   .06 for RMSEA and .09 for SRMR indicate good fit.

311   **Results**

312   **Preliminary Analyses**

313   **Descriptive statistics.** Means, standard deviations, and correlations among the study

314   variables are presented in Table 1. Pearson bivariate correlations indicated that teacher age was

315   significantly positively related to effectiveness beliefs regarding structure ($r = .28$, $p < .05$) and to the

316   self-reported application of autonomy support ($r = .30$, $p < .01$) and structure ($r = .42$, $p < .01$) at

317   baseline. Teachers' teaching experience related only significantly positively to the application of

318   structuring teaching strategies ($r = .34$, $p < .01$). To examine whether the baseline measures differed

319   according to teacher sex, diploma and educational track, three MANOVAs were conducted. The

320   multivariate effects of teacher sex were not significant, Wilks' Lambda = .91, $F(6,73) = 1.26$, $p = .29$, η^2

321   = .09. However, a significant univariate effect was found for the application of autonomy support,

322    $F(1,78) = 4.87$, $p = .05$, $\eta^2 = .06$, with male ($M = 3.76 \pm .56$), relative to female teachers ($M = 3.49 \pm$

323   .46), reporting to apply more autonomy-supportive teaching strategies. Multivariate effects of diploma,

324   Wilks' Lambda = .87, $F(12,144)$ = .90, p = .55, η^2 = .07, and educational track, Wilks' Lambda = .72,

325   $F(24,245.11)$ = .99, p = .48, η^2 = .08, were not significant, nor were the univariate effects. Based on

326   these results, teacher sex (0 = male, 1 = female) was controlled for in the primary analyses. In addition,

327   because teacher age and years of teaching experience were highly interrelated (r = .93, p < .001), and

328   because teacher age correlated with more study variables, only teacher age was included as a

329   statistical control in the subsequent analyses.

330   **Mean-level Changes in Teacher Beliefs and Behaviors.** Table 2 summarizes the results of

331   the repeated measures ANOVA analyses indicating that, after controlling for teacher sex and age,

332   mean-level increases were statistically significant for effectiveness and feasibility beliefs regarding the

333   dimension of autonomy support, but not with respect to the dimension of structure. In addition,

334   significant mean-level increases were obtained for teachers' self-reported application of autonomy-

335   supportive, but not structuring teaching strategies.

336   **Primary Analyses**

337   The structural model testing associations between experienced need satisfaction during the

338   training, changes in teachers' beliefs, intentions to apply the proposed strategies, and changes in self-

339   reported application of these strategies showed a good fit with the data, $\chi^2(17)$ = 24.27, p = .11; CFI =

340   .97; RMSEA = .07; SRMR = .08. Figure 1 represents the results of the path analysis, unadjusted for

341   teacher sex and age. Experienced psychological need satisfaction during the training related positively

342   to residual changes in teachers' effectiveness and feasibility beliefs regarding autonomy support and

343   structure and was directly positively related to teachers' intentions to apply the autonomy-supportive

344   and structuring teaching strategies as reported immediately after the training. Further, residual changes

345   in effectiveness beliefs regarding both autonomy support and structure were positively associated with

346   intentions to apply the proposed strategies, respectively. Interestingly, only residual changes in

347   feasibility beliefs regarding autonomy support, but not structure, were positively related to teachers'

348   intentions. Finally, teachers' intentions to apply the structuring, but not the autonomy-supportive,

349   strategies were significantly associated with a residual change in their self-reported in-class application

350   of the respective teaching approach. All associations remained statistically significant after controlling

351   for teacher sex and age.

352   **Discussion**

353   Given that CPD programs for teachers are likely to be more successful when teachers fully

354   accept and endorse the proposed change (e.g., Assor et al., 2009; Baard et al., 2004; Deci, 2009), it is

355   critical that teachers have their basic psychological needs for autonomy, competence, and relatedness

356   fulfilled during these programs (e.g., Aelterman et al., 2013; Assor et al., 2009; Roth et al., 2007).

357   However, the role of psychological need satisfaction in processes of change during CPD has only

358   scarcely been studied so far (but see Feinberg et al., 2005). The present study aimed at contributing to

359   this literature by examining the role of experienced psychological need satisfaction during the training in

360   predicting changes in PE teachers' beliefs regarding the effectiveness and feasibility of proposed

361   teaching strategies, as well as PE teachers' intentions to apply the proposed strategies in their lessons

362   and subsequent changes in their self-reported application of these strategies.

363   **Changing Beliefs Underlying Need-Supportive Teaching Strategies**

364   Recent intervention research using a pretest-posttest control group design in the PE context

365   provided evidence that CPD on need-supportive teaching leads to positive changes in effectiveness

366   and feasibility beliefs regarding autonomy support and structure, and that these changes are related to

367   changes in teacher-reported behavior (Aelterman et al., 2014). Although replicating these intervention

368   effects was not the purpose of the present study, the results largely align with this previously conducted

369   intervention study (Aelterman et al, 2014), by showing that, also in a new sample of PE teachers

370   participating in the same training, teachers' effectiveness and feasibility beliefs regarding autonomy

371   support, but not structure, increased at the mean-level. These findings appear to confirm previous

372   findings (Aelterman et al, 2014) suggesting that despite the ingrained teaching repertoire that teachers

373 have built up, there is still room to change and/or innovate teachers' beliefs regarding current and

374 alternative ways of teaching. The positive changes in beliefs regarding autonomy support, rather than

375 structure, are in line with prior literature showing that teachers find the concept of autonomy support

376 more innovative, presumably because they are less familiar with it (Aelterman et al., 2013; Reeve,

377 1998). As a result there is a greater opportunity for change in the perceived effectiveness and feasibility

378 of autonomy support. Alternatively, the CPD providers might have been biased toward a stronger

379 emphasis on autonomy support when delivering the training. Although the allotted time and the number

380 of proposed strategies was fairly balanced between autonomy support and structure, when presenting

381 the proposed structuring strategies, it is possible that the trainers at times shifted the attention away

382 from the content of structure to how structure can be delivered (i.e. in an autonomy-supportive fashion).

383 In this respect, it would be useful for future research to videotape the workshops as to quantify the

384 amount of time spent to each dimension and to verify whether a predominant shift towards autonomy

385 support was actually the case.

386   Examining the impact of CPD on teachers' beliefs is of added value because these beliefs are

387 indicative of teachers' acceptance or internalization of the proposed alternative way of teaching (Reeve,

388 1998; Reeve et al., 2014). Indeed, in line with previous studies claiming that teachers' beliefs underlie

389 their in-class teaching behavior (Pajares, 1992; Tsangaridou, 2006), the present study showed that a

390 change in teachers' effectiveness and feasibility beliefs is associated with teachers' intentions to apply

391 the proposed strategies, especially with respect to autonomy support. These findings suggest that to

392 foster teachers' intentions to apply the proposed teaching approach in their daily practice, it is important

393 for CPD providers to inform teachers on the benefits of applying these strategies and at the same time

394 indicate how teachers can apply the recommended strategies in a feasible way.

395 **The Role of Psychological Need Satisfaction**

396   More central to the present study was to investigate the role of psychological need satisfaction

397 in predicting changes in teachers' beliefs, their intentions immediately after the training and changes in

398   their self-reported behaviors. Results of the path analyses indicated that the more PE teachers reported

399   their psychological needs for autonomy, competence, and relatedness to be fulfilled during the training,

400   the larger the change in their effectiveness and feasibility beliefs regarding both the proposed

401   autonomy-supportive and structuring strategies. Although we did not investigate associations of the

402   three basic needs independently, these results show that if PE teachers experience a sense of

403   initiative, volition, and ownership during the change process (i.e. autonomy), feel capable to implement

404   the proposed change (i.e. competence), and feel comfortable during the training (i.e. relatedness)

405   altogether, they are more likely to change their perceived effectiveness and feasibility of the proposed

406   alternative way of teaching, which may be indicative of a fuller acceptance and endorsement of the

407   importance and value of the proposed change (Assor et al., 2009; Baard et al., 2004; Deci, 2009).

408   Presumably, if CPD providers manage to successfully offer need-fulfilling opportunities for teachers

409   during the training, they may increase teachers' receptivity and openness to reflect on their current

410   teaching practice and may reduce any defensiveness and resistance against the proposed change

411   (Hodgins & Knee, 2002; Vansteenkiste & Ryan, 2013).

412   Interestingly, experienced need satisfaction did not only relate to a change in teachers' beliefs,

413   but also was directly associated with teachers' intentions to apply the proposed teaching strategies.

414   These findings largely confirm our hypotheses and are in accordance with prior work pointing to the

415   facilitating role of psychological need satisfaction in processes of change during CPD (Assor et al.,

416   2009; Feinberg et al., 2005). A possible explanation may be that experiencing a sense of autonomy,

417   competence, and relatedness during the training has a directly energizing effect on teachers' intentions

418   to apply the proposed teaching approach, irrespective of the cognitive processes that need satisfaction

419   engenders (i.e. change in perceived effectiveness and feasibility). Alternatively, since we did not control

420   for social desirability, it is also possible that if teachers had a positive, need satisfying experience

421   during the training, they had a desire to please the trainer and thus indicated to carry out the proposed

422   teaching approach, regardless of their personal beliefs.

423   Teachers' intentions to apply the proposed strategies immediately after receiving the training

424   were then found to relate to a change in teachers' self-reported application of structure, but not

425   autonomy support. So, even though PE teachers had higher intentions to apply autonomy-supportive

426   and structuring strategies when they had their basic needs more fulfilled, these intentions did not get

427   translated into an increase of the application of autonomy-supportive strategies two weeks after the

428   training. Notably, at the mean-level teachers only reported a significant increase in their application of

429   autonomy support, but not structure. Thus, although the training did not produce mean-level increases

430   in self-reported structure, those teachers who intended to apply the proposed structuring teaching

431   strategies (as reported immediately following the training) said that they had increased the application

432   of these strategies from pre- to post-training. As for autonomy support, the opposite pattern emerged,

433   with self-reported autonomy-supportive strategies increasing on average but not being predicted by

434   teacher intentions at the end of the training. A potential explanation for these inconsistent findings is

435   that teachers who intended to implement the autonomy-supportive strategies found out that it was more

436   difficult than expected to implement these strategies into their daily practice. Alternatively, although

437   teachers with low intentions may have been skeptical to apply the strategies they may have found out

438   that doing so is easier or brings more benefits than anticipated. In this respect, it would be useful for

439   future research to include multiple follow-up moments assessing both (changes in) beliefs and

440   (changes in) behaviors (Clarke & Hollingsworth, 2002) and to measure more directly PE teachers'

441   reasons for intending or not intending and applying or not applying certain strategies.

442   Overall, whereas previous research argued that changing teachers' beliefs can be considered a

443   primary proximal target of CPD (Aelterman et al., 2014; Pajares, 1992), the present findings might

444   suggest that fostering experiences of psychological need satisfaction during the training represents an

445   equally critical target. Future research can shed light on the degree to which the CPD providers actually

446   acted in a need-supportive way. According to SDT, teachers are more likely to feel satisfied in their

447   basic needs when the CPD providers adopt an autonomy-supportive (e.g., rationale provision;

18

448 acceptance of resistance), structuring (e.g., overview; positive feedback; experiential learning provision)

449 and warm (e.g., involvement and dedication; expression of respect) style (Assor et al., 2009; Baard et

450 al., 2004; Reeve, 2009). It is important to note that many of these need-supportive strategies are very

451 similar to strategies used within CPD more generally, even when there is not a specific focus on need

452 support. For example, making time for teachers to share ideas and experiences (i.e. active

453 participation), listening to and discussing teachers' tensions and disagreements and creating

454 experiential learning opportunities that are close to teachers' daily practice are strategies that have

455 frequently been recommended for the design and delivery of CPD (O'Sullivan & Deglau, 2006).

456 However, we suggest that, apart from its content, also the way CPD providers implement such

457 strategies (i.e., 'how') might determine whether they lead to enhanced feelings of psychological need

458 satisfaction during the training (Aelterman et al., 2013), an issue that warrants further investigation.

459   Although, the present study was conducted in the specific context of physical education, its

460 topic might be of interest and value for research and practice within the broader CPD literature as well

461 as to the sport-coaching context. Having provided evidence for the role of psychological need

462 satisfaction during CPD to get teachers to actually experiment with the proposed teaching strategies, it

463 is critical to help CPD providers to adopt an instructional approach that is supportive of teachers' or

464 coaches' basic needs ('train the trainer'; Loughran, 2006). In addition, offering CPD that concurs well

465 with what teachers and coaches expect from effective CPD both in terms of content and method of

466 delivery (Aelterman et al., 2013; O'Sullivan & Deglau, 2006) can help CPD providers overcome the

467 recurrent problem of the predictable failure of reform (Assor et al., 2009; Deci, 2009). This is particularly

468 important because CPD has the purpose of supporting PE teachers and coaches in providing good

469 quality instruction for students and athletes (Opfer & Pedder, 2011).

470 **Teacher Characteristics**

471   When studying behavior change processes during CPD, the inclusion of key characteristics of

472 teachers is critical as to explain why some teachers are open to change and others rather hold on to

473   their current teaching behavior. In the present study, some interesting associations between the

474   included teacher characteristics and outcomes at baseline emerged. Specifically, male teachers tended

475   to apply more autonomy-supportive teaching strategies. In addition, older teachers reported to perceive

476   structure as more effective and said to engage more frequently in both autonomy-supportive and

477   structuring teaching behaviors. Although older teachers may be more comfortable with traditional

478   teacher-centered approaches (Kirk, 2011; Van den Berghe et al., 2013), the present findings contract

479   such a portrayal of older teachers. Perhaps, older teachers have gradually adapted their style over the

480   years and evolved along with a change of attitude among students, presumably because they found out

481   that teaching in need-supportive ways entails more benefits, both for their students (Cheon, Reeve, &

482   Moon, 2012) and themselves (Cheon, Reeve, Yu, & Jang, 2014).

483   **Limitations and Future Directions**

484   Several limitations are noteworthy when interpreting the present findings. First, a major

485   methodological limitation of the study is that no control group was included, not all variables (e.g.,

486   intentions to apply the proposed strategies) were measured at baseline, and social desirable

487   responding was not controlled for, which may have violated the internal validity of the results. Although

488   a previous intervention study provided evidence for the positive effects of the training on PE teachers'

489   beliefs and teaching behaviors (Aelterman et al, 2014) and the present study aimed at looking into

490   underlying mechanisms in a unique sample of PE teachers rather than replicating these findings, the

491   design precluded us from concluding that the favorable changes in teachers' effectiveness and

492   feasibility beliefs and in in-class teaching behaviors were actually due to the training, rather than to

493   other confounding variables. Future studies aimed at gaining insight in experienced psychological need

494   satisfaction during the training as an underlying mechanism in changing teachers' beliefs are

495   recommended to rely on a pretest-posttest control group design to draw more valid conclusions.

496   A second limitation relates to the measurements that were used. As for the beliefs

497   questionnaire, teachers were asked to rate every single item on a list of need-supportive teaching

498 strategies (e.g., 'I find it personally meaningful that teachers offer choice to all students during the PE

499 lesson') in terms of both effectiveness and feasibility. This similar set of items was also used to assess

500 teachers' intentions and application of the proposed strategies. Future research could include multiple

501 items for effectiveness and feasibility beliefs separately. For example, to assess feasibility beliefs,

502 questions could be 'How easy is providing choice to all students during the PE lesson?' or 'Does

503 providing choice to all students during the PE lesson take much effort or class time?'. In addition,

504 although we considered positive changes in teachers' beliefs and higher intentions to apply the

505 proposed teaching strategies as indicative of a fuller acceptance and endorsement of the importance

506 and value of the proposed change, it would be interesting for future research to actually include a

507 measurement of internalization (i.e. types of regulation; Deci & Ryan, 2000) to examine whether

508 experienced need satisfaction during the training relates to higher internalization of the proposed

509 change. Further, the present study relied exclusively on teachers' self-reports to assess teachers' in-

510 class application of the proposed teaching strategies. Although self-reported data are valuable, they are

511 often subject to overestimation, social desirability, and influenced by teachers' previous experiences.

512 Future studies could therefore complement these self-reports with more objective methods to map out

513 teachers' actual in-class application of the proposed teaching strategies. For example, PE lessons can

514 be videotaped and rated by external observers using a coding scheme of need-supportive teaching

515 behaviors, as the one that was recently developed by Haerens and colleagues (2013).

516 Future studies can also elaborate on the current study by providing objective information

517 regarding the quality and consistency of intervention implementation, not only in terms of what CPD

518 providers deliver, but also in how they deliver the training. Therefore, it could be useful to make

519 videotapes of the different workshops as to obtain external ratings of the degree to which the training is

520 need-supportive (i.e. fidelity check), as to investigate whether the degree to which the trainer acts in a

521 need-supportive way relates to participants' experiences of need satisfaction during the training. Such

522 observations could also help to permanently revise and optimize both the 'what' and 'how' of the

523 training.

524   Further, it would be interesting for future studies to investigate whether the obtained structural

525 model applies to teachers with different personal characteristics. Specifically, it might be useful to

526 address teachers' general motivational orientation as well as potential reasons for resistance against

527 the training message to explore whether control- and autonomy-oriented teachers would differ in their

528 receptivity toward the proposed change (e.g., Reeve, 2009), and would hence require a different

529 approach to meet their basic psychological needs. Such information might be helpful to better attune

530 the training to teachers with a different general motivational orientation.

531   Finally, it is important to acknowledge that generalizability of our findings to a broader audience

532 of PE teachers is limited by the relatively small (n < 100) sample size and by potential selection bias

533 stemming from the use of teachers who voluntarily subscribed for the CPD program offered by the

534 pedagogical counseling service in their region. Although the present findings are promising in

535 illustrating the critical role of fostering psychological need satisfaction during CPD, future research is

536 needed to replicate these results on a larger scale in order to gather stronger evidence for this claim in

537 the broader educational context.

538 **Conclusion**

539   Although CPD is aimed at providing PE teachers with new knowledge, skills, and expertise,

540 teachers often express reservations against the proposed change because they believe the proposed

541 strategies are not effective or feasible. Fostering satisfaction of the psychological needs for autonomy,

542 competence, and relatedness can produce greater receptivity toward change, so that PE teachers

543 come to fully accept and endorse the proposed change. Greater attention on 'how' CPD providers can

544 maximize teachers' opportunities to have their basic psychological needs met during training could help

545 to increase the likelihood that teachers change their beliefs regarding the proposed teaching strategies

546 and become inclined to apply these strategies in their practice.

547

548 **Foot Notes**

549   [1] In Flanders, pedagogical counseling services are governmentally subsidized entities that provide

550 advice to educational institutions such as schools as to support and strengthen the quality of education.

551 Pedagogical counseling services work both demand- and supply-driven and the in-service CPD training

552 that was offered as part of the present study especially fits within the supply-driven nature of their

553 operation. Each pedagogical counseling service is responsible for a particular region in Flanders.

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687 Table 1

688 *Descriptive Statistics and Correlations among Study Variables*

|	M	SD	Min	Max	1	2	3	4	5	6	7	8
Δ Effectiveness belief												
1. Autonomy support	.00	.32	-.84	.84	-							
2. Structure	.00	.36	-.97	.77	.52**	-						
Δ Feasibility belief												
3. Autonomy support	.00	.38	-1.37	1.00	.41**	.26*	-					
4. Structure	.00	.45	-1.65	.86	.27*	.31**	.67**	-				
5. Need satisfaction	3.86	.37	3.08	4.67	.23	.28*	.27*	.22	-			
Intention to apply												
6. Autonomy support	3.91	.48	2.00	5.00	.57**	.50**	.40**	.19	.40**	-		
7. Structure	4.01	.48	3.00	5.00	.33**	.53**	.20	.19	.33**	.69**	-	
Δ Application												
8. Autonomy support	.00	.36	-1.09	.83	-.01	.20	.20	.09	-.12	.10	.38*	-
9. Structure	.00	.47	-1.56	.94	-.03	.24	.17	-.01	.04	.34*	.44**	.70**

689 *Note.* * $p < .05$; ** $p < .01$.

690   Table 2

691   *Mean-Level Changes in Teachers' Effectiveness and Feasibility Beliefs and In-class Application of*

692   *Proposed Strategies*

	Baseline	After training		
	$M \pm SD$	$M \pm SD$	F	η^2
Effectiveness belief				
Autonomy support	4.06 ± .44	4.23 ± .44	7.51**	.09
Structure	4.18 ± .50	4.24 ± .45	3.52	.05
Feasibility belief				
Autonomy support	3.50 ± .47	3.63 ± .46	6.07*	.08
Structure	3.81 ± .50	3.90 ± .47	.93	.01
In-class application				
Autonomy support	3.65 ± .56	3.77 ± .54	5.35*	.13
Structure	3.68 ± .50	3.77 ± .57	.54	.01

693   *Note.* *p < .05; **p < .01.

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Role of Need Satisfaction in Teacher Training
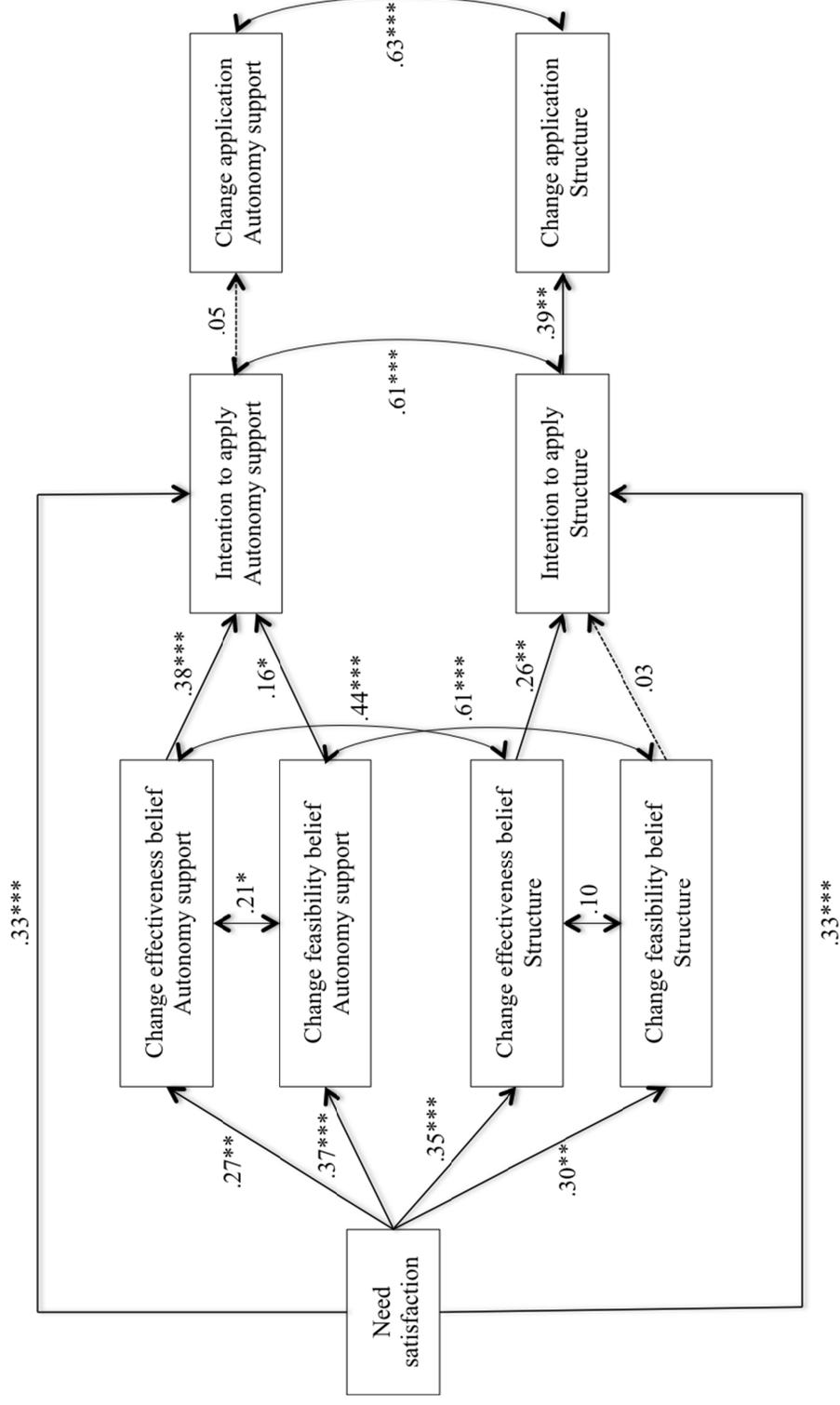
Figure 1. Path model for relations between experienced need satisfaction during training, residual change scores in beliefs, intentions to apply the proposed teaching strategies and residual change scores in teacher-reported application of these strategies, $\chi^2(17) = 24.27$, $p = .11$; CFI = .97; RMSEA = .07; SRMR = .08. $^{**}p < .01$; $^{***}p < .001$."

Highlights

- We examine how experienced need satisfaction during CPD relates to teacher change
- Experienced need satisfaction increases perceived effectiveness and feasibility
- Need satisfaction directly fosters teachers' intentions to apply proposed change
- In turn, intentions relate to changes in self-reported in-class teaching behavior
- It is critical to maximize opportunities for need satisfaction during CPD