Changing teachers' beliefs regarding autonomy support and structure: The role of experienced psychological need satisfaction in teacher training

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Abstract

Objectives: Grounded in Self-Determination Theory, this study examined whether physical education (PE) teachers' psychological need satisfaction experienced during continuous professional development (CPD) on need-supportive teaching predicted changes in their effectiveness and feasibility beliefs regarding the proposed teaching approach, as well as their intentions to apply this approach and subsequent changes in their self-reported in-class behaviors.

Methods: Prior to the training, a sample of 80 PE teachers (57.5% men, Mage = 42.70 ± 10.15 years) reported on their effectiveness and feasibility beliefs regarding autonomy-supportive and structuring teaching strategies and their in-class application of these strategies. Immediately following the training, these beliefs were assessed again and participants reported on their psychological need satisfaction experienced during the training and their intentions to apply the proposed strategies. Finally, two weeks after the training, participants' self-reported in-class application of the teaching strategies was measured for the second time.

Results: Psychological need satisfaction experienced during the training related to a change in effectiveness and feasibility beliefs regarding autonomy support and structure, and to teachers' intentions to apply the proposed strategies as reported immediately after receiving the training. In addition, teachers' intentions related to a change in their self-reported in-class application of structuring, but not autonomy-supportive, teaching strategies.

Conclusions: Experiences of psychological need satisfaction during CPD can help to increase the likelihood that teachers become more convinced about the effectiveness and feasibility of the proposed change and can produce greater intentions toward change, which may relate to actual (albeit) self-reported behavior change.

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‘Supporting students’ needs and values might work for some students, but others will definitely benefit from a traditional, more rigorous approach.’

‘If I continually try to figure out what my students want, we end up in an endless discussion and I don’t come to actual teaching at all. Such an approach not only wastes a lot of time, but also takes a lot of energy!’

As in any profession, it is important for physical education (PE) teachers and sport coaches to regularly engage in continuous professional development (CPD) programs as to stay up-to-date with innovations in the field and to assimilate new knowledge, skills, and expertise (Opfer & Pedder, 2011). However, during these CPD programs in which innovative or alternative instructional approaches are proposed, participants sometimes confront the CPD provider with critical remarks or skeptical reactions, as the ones in the introductory examples. Not surprisingly, PE teachers and sport coaches do not automatically endorse the messages delivered through CPD, presumably because certain instructional behaviors have become ingrained into their teaching or coaching repertoire and daily routine (Pajares, 1992).
In the case of PE teachers, many factors, including teachers’ personality dispositions (Van den Berghe et al., 2013), social context in which they teach (Taylor, Ntoumanis, & Smith, 2009), the characteristics of their students (Pelletier, Seguin-Levesque, & Legault, 2002) and the motivational beliefs they hold (Roth & Weinstock, 2013), may explain why they might (or might not) undergo a change in their teaching approach. With respect to teacher beliefs, if the proposed strategies are perceived as not effective (i.e., effectiveness belief) or too difficult or challenging to apply in practice (i.e., feasibility belief), teachers are unlikely to undertake change (Reeve, 1998; Reeve et al., 2014). Given that prior research has shown that effectiveness and feasibility beliefs underlie teachers’ in-class teaching behavior (Pajares, 1992; Reeve et al., 2014; Tsangaridou, 2006) and that teacher beliefs are, in contrast to other determinants of teaching behavior, more malleable through CPD programs (Aelterman, Vansteenkiste, Van den Berghe, De Meyer, & Haerens, 2014), one critical question becomes which dynamics are involved in changing teachers’ beliefs and related outcomes.

Grounded in Self-Determination Theory (SDT; Deci & Ryan, 2000), we propose that teachers’ personal experiences during CPD are critical herein. Specifically, the aim of the present study was to examine whether the satisfaction of PE teachers’ basic psychological needs for autonomy (i.e., experiencing a sense of volition and psychological freedom), competence (i.e., experiencing personal effectiveness), and relatedness (i.e., experiencing closeness and mutuality in interpersonal relationships) during CPD fosters a change in teachers’ beliefs underlying the proposed teaching approach (Ryan & Deci, 2008). In addition, we explored whether experienced need satisfaction would relate directly to PE teachers’ intentions to apply the proposed change and to their self-reported in-class behaviors.

1. Changing teachers’ beliefs

Research consistently confirms that in-service training is positively related to student outcomes (Darling-Hammond, Holtzman, Gatlin, & Heilig, 2005). Therefore, teachers’ regular engagement in CPD and life-long learning is strongly encouraged (Opfer & Pedder, 2011). However, the effects of CPD might get diminished when teachers start to express reservations regarding the proposed changes because they hold certain beliefs regarding the recommended strategies (Reeve, 1998; Reeve et al., 2014). A first belief that can hamper but also stimulate teachers to change their current teaching repertoire is their belief regarding the effectiveness of offered instructional strategies (Reeve et al., 2014). That is, to the extent that teachers believe that particular teaching strategies are effective, they would perceive them as more meaningful, leading them to more strongly endorse (i.e., internalize) these strategies. For example, if teachers believe that extrinsic motivators (e.g., incentives, rewards) are efficacious in arousing students’ motivation, they are more likely to rely on such practices (e.g., Pajares, 1992; Reeve, 2009). Second, teachers’ beliefs regarding the feasibility of an alternative instructional approach in everyday teaching practice may also prevent or encourage them from changing their current teaching repertoire (Reeve et al., 2014). That is, if teachers feel more comfortable with and competent in their current way of teaching, and find their ongoing practices more fast-acting, realistic, and therefore relatively easier to enact, they are less likely to undertake change.

Within CPD research in general (Pajares, 1992; Tsangaridou, 2006) and SDT-based studies in particular (Reeve et al., 2014; Roth & Weinstock, 2013), effectiveness and feasibility beliefs have been shown to explain why teachers are open for change or rather stay ambivalent, and, in turn, decide to respectively try out or refuse to adopt the offered alternative classroom behavior. Since teachers’ beliefs may conflict with the information presented in the CPD program (Reeve, 1998), it is not a straightforward endeavor for CPD providers to foster an alternative teaching approach among teachers (Pajares, 1992). Yet, Aelterman et al. (2014) recently showed that PE teachers who received training on need-supportive teaching reported an increase in both effectiveness and feasibility beliefs regarding the proposed teaching approach one month later, compared to teachers in a control group. Furthermore, these changes in teachers’ beliefs were significantly associated with changes in teachers’ self-reported instructional behaviors, which were also picked up by their students and by external raters (Aelterman et al., 2014).

2. Psychological need satisfaction: the energizing basis for change

From the SDT-perspective, actual changes are more likely to occur to the extent that teachers have fully internalized, that is, self-endorsed, the importance and value of the proposed alternative approach for their teaching practice (Deci & Ryan, 2000). In this respect, prior research in the broader CPD literature has suggested that the way in which CPD is delivered is as important (e.g., O’Sullivan & Deglau, 2006; Swennen, Lunenberg, & Korthagen, 2008), if not, more important than its specific content for this internalization process to occur (Aelterman et al., 2013; Deci, 2009). According to SDT, the fulfillment of the basic psychological needs for autonomy, competence, and relatedness is critical herein as these basic needs are said to serve as the psychological nutrients that energize personal growth and integrity (Deci & Ryan, 2000). Much like students are more likely to become enthusiastic when teachers manage to support their basic psychological needs (e.g., Reeve, Deci, & Ryan, 2004 for an overview), teachers are more likely to fully accept the proposed teaching strategies during CPD if they experience room for initiative taking (autonomy satisfaction), feel confident to successfully complete the tasks (competence satisfaction) and feel well-connected with both the CPD-provider and the other participants (relatedness satisfaction) during the training (e.g., Baard, Deci, & Ryan, 2004).

Studies in other contexts than education, including the organizational setting (Gagné, Koestner, & Zuckerman, 2000) and the health domain (see Ng et al., 2012 for a meta-analysis), indeed showed that need satisfaction engenders a greater openness, receptivity, and internalization of change, while the very blocking of these same needs likely elicits defensiveness and even defiance against change (Hodgins & Knee, 2002; Vansteenkiste & Ryan, 2013). Despite this evidence across different domains, little, if any, attention has been paid to whether teachers’ experiences of psychological need satisfaction during CPD are related to their intentions to apply the teaching strategies proposed, and whether their effectiveness and feasibility beliefs about these strategies play a role in this relationship. In fact, only one (unpublished) study partially addressed this issue in a group of teachers involved in a school reform program (Feinberg, Assor, Kaplan, Kanat-Maymon, & Roth, 2005). Specifically, the results of this study indicated that teachers who felt supported in their psychological needs were more likely to identify with the proposed reform, which in turn led to a significant change toward the proposed teaching approach after two years of involvement in the program, whereas no such change was observed in a control group (Feinberg et al., 2005).

3. The present study

According to research applying SDT, the more teachers have their psychological needs fulfilled during the training, the more
they will become convinced of the value and effectiveness of the proposed teaching strategies (Baard et al., 2004), and the more they will actually implement the proposed change (Assor, Kaplan, Feinberg, & Tal, 2009; Roth, Assor, Kanat-Maymon, & Kaplan, 2007). However, studies uncovering the exact role of psychological need satisfaction in processes of change during CPD are scarce (but see Feinberg et al., 2005). In an attempt to contribute to this research area, the present study involved a prospective investigation of these dynamics in a unique sample of PE teachers. Specifically, we examined whether variation in experienced psychological need satisfaction among teachers participating in a teacher training relates to variation in the changes of PE teachers’ beliefs regarding the effectiveness and feasibility of proposed strategies, as well as to their intentions to apply the proposed strategies in their lessons as measured immediately after the training, and changes in their self-reported in-class application of these strategies. We expected that the more PE teachers experienced a sense of psychological need satisfaction during the training, the more pronounced the positive change in their effectiveness and feasibility beliefs regarding the proposed autonomy-supportive and structuring strategies would be. Further, it was hypothesized that experienced need satisfaction would not only predict a change in teachers’ beliefs, but would also relate to teachers’ intentions to apply the proposed teaching strategies in their lessons, which in turn would relate to a change in their reported in-class application of the proposed strategies.

4. Method

4.1. Participants

The study involved a unique sample of 80 experienced PE teachers (46 men; 57.5%) out of 55 different secondary schools with a mean age of 42.70 (SD = 10.15) years. The large majority of the teachers (i.e., 89%) came from Flanders, the Dutch-speaking part of Belgium, whereas 11% came from The Netherlands. Teachers had on average 16.64 (SD = 10.07) years of teaching experience. All teachers were full-time certified PE teachers, from whom 55.3% obtained a master degree in movement and sport sciences at the university, and 44.7% had engaged in a professional bachelor program in physical education at a university college. Of the participating teachers, 83.3% and 18.8% taught PE in mixed gender and single gender classes, respectively. In addition, 42.1% taught students in an academic track, 22.4% in a technical track, 15.8% in a vocational track, and 19.7% in a combination of different educational tracks.

4.2. Procedure

Coordinators of different pedagogical counseling services in Flanders were approached by email and telephone to explore their interest in an in-service CPD training on motivating teaching in the context of PE and to explain the purposes of the research and its timeline. All four contacted coordinators expressed an interest to participate. However, due to the timeline, only three counseling services were actually able to offer the training as a CPD program for PE teachers on a specific occasion within their region. In addition, one comparable counseling service in The Netherlands agreed to take part in the study. Ultimately, five different training days were organized, of which four trainings took place in three different regions of Flanders, and one training took place in The Netherlands. The administration of subscription happened entirely by the support of the pedagogical counseling services, who subsequently sent all contact information of the participants to the coordinating researcher of the study (i.e. first author). All five workshops were delivered by two trainers (i.e. different combinations of the first, second and/or fourth author), who had substantial expertise in delivering workshops and lectures for (PE) teachers about SDT and adopting a need-supportive approach while doing so.

Participants in the training were followed on three measurement occasions. First, approximately three weeks before the training, all teachers were invited by email to complete an online questionnaire tapping into their beliefs concerning a need-supportive teaching approach and into their in-class application of such an approach (i.e. pretest/baseline). Second, immediately following the training, teachers were presented with a paper-version questionnaire to obtain data on their beliefs concerning the effectiveness and feasibility of autonomy-supportive and structuring teaching strategies, their experiences during the training, and their intentions to apply the proposed teaching strategies in their own PE lessons (i.e. immediate post-training). Finally, about two to three weeks after the training, PE teachers were again invited to complete an online questionnaire as to report on their actual in-class application of autonomy-supportive and structuring teaching strategies at that moment in time (i.e. two weeks post-training). The study protocol was approved by the Ethical Committee of Ghent University.

4.3. CPD training on need-supportive teaching

The training involved a standardized one-day (i.e. 6 h) in-service CPD training on how to adopt a more need-supportive approach toward students. This workshop-like training was previously systematically developed and optimized for and in close collaboration with experienced secondary school PE teachers in a first study (Aelterman et al., 2013), and was found effective in changing PE teachers’ beliefs and teaching behaviors in a second study with a different sample of PE teachers (Aelterman et al., 2014).

The training consisted of three interactive parts. Part I (i.e. 1 h) involved an introduction of SDT as the theoretical framework. Through interactive exercises and discussions, teachers got acquainted with the concepts of motivation, need satisfaction, and need support. In addition, empirical evidence was provided to support the argument that when students feel supported in their basic psychological needs, they better enjoy PE and acknowledge the value and personal benefits associated with PE. Part II (i.e. 2.5 h) existed of an overview of, respectively, four and five specific instructional strategies to support students’ feelings of autonomy (i.e. autonomy support) and competence (i.e. structure) in PE, illustrated by authentic video images (i.e., as good and bad practices) and cases. With regard to autonomy support, (1) adopting an empathic attitude, (2) providing choice, (3) offering a meaningful rationale, and (4) integrating fun elements, were put forward. As for structure, PE teachers were provided with strategies such as (1) giving an overview of the forthcoming lesson, (2) communicating expectations, (3) avoiding the provision of unnecessary information by asking questions, (4) giving positive, informational feedback and (5) offering help when needed. To avoid an overload of information and because relatedness support often co-occurs with autonomy support and even structure, relatedness-supportive strategies were not presented as a separate category, but rather as

1 In Flanders, pedagogical counseling services are governmentally subsidized entities that provide advice to educational institutions such as schools as to support and strengthen the quality of education. Pedagogical counseling services work both demand- and supply-driven and the in-service CPD training that was offered as part of the present study especially fits within the supply-driven nature of their operation. Each pedagogical counseling service is responsible for a particular region in Flanders.
general basic teaching qualities that help support autonomy and provide structure (Reeve & Jang, 2006). Finally, in Part III (i.e. 2.5 h), PE teachers had the opportunity to practice the motivating strategies through microteaching and role-playing in the gym. In addition, several opportunities for (self-)reflection and peer feedback were created along this application exercise.

One central feature of the training (Aelterman et al., 2013) was that the trainers intended to act in accordance with the principles of need support that were conveyed (i.e. congruent teaching; Swennen et al., 2008). Specifically, they attempted to maximize PE teachers’ opportunities to have their basic psychological needs for autonomy, competence, and relatedness fulfilled during the training (Aelterman et al., 2013). It is important to note that the present study did not aim to explore the degree to which the trainers were actually need-supportive, but rather focused on teachers’ personal experiences during the training.

4.4. Measures

4.4.1. Teacher beliefs

To assess teacher beliefs we relied on a previously developed questionnaire as to directly tap into effectiveness and feasibility beliefs regarding the specific strategies that were presented during the training (Aelterman et al., 2014). Specifically, the PE teachers were provided with a 15-item list of autonomy-supportive (9 items; e.g., ‘I find it personally meaningful that teachers offer choice to all students during the PE lesson’) and structuring (6 items; e.g., ‘I find it personally meaningful that teachers give an overview of the content and structure of the PE lesson’) teaching strategies to be rated twice, that is, once in terms of effectiveness on a five-point Likert scale from 1 (totally disagree) to 5 (totally agree), and once in terms of feasibility with a score ranging from 1 (totally unfeasible) to 5 (totally feasible). All teacher beliefs scales had good internal consistencies with Cronbach’s alphas ranging between .73 and .80 at baseline and between .70 and .79 immediately after the training.

4.4.2. Psychological need satisfaction

To measure teachers’ psychological need experienced during the training, the Basic Psychological Need Satisfaction and Need Frustration Scale (BPNSF; Chen et al., 2015) was used. This recently developed and validated 24-item scale consists of six subscales pertaining to the satisfaction and frustration of the three needs identified in SDT, with each need being assessed by means of eight items, of which four tap into need satisfaction and four into need frustration. For the purposes of the present study, only the need satisfaction subscale was used. The stem of the scale was changed into ‘During this training...’ and the items were slightly adapted as to tap into teachers’ experiences of autonomy (e.g., ‘I felt a sense of choice and freedom in the things I thought and did’), competence (e.g., ‘I felt confident that I could apply the proposed teaching strategies well’), and relatedness (e.g., ‘I felt connected with the other participants’) satisfaction experienced during the training.

4.4.3. Intention to apply proposed strategies

Immediately after the training, teachers reported on their intention to apply the proposed teaching strategies in their practice, using the same set of 15 items applied to measure teachers’ beliefs. Specifically, teachers indicated on a five-point Likert scale from 1 (absolutely no intention) to 5 (definitely have the intention) to what extent they intended to apply the proposed autonomy-supportive (9 items; α = .76) and structuring (6 items; α = .74) teaching strategies in their current practice.

4.4.4. Application of proposed strategies

Prior to the training and about two weeks after the training, teachers reported online on their in-class application of autonomy-supportive and structuring teaching strategies, using the same set of 15 items applied to measure teachers’ beliefs and intentions. Specifically, teachers indicated on a five-point Likert scale from 1 (totally disagree) to 5 (totally agree) to what extent they applied autonomy-supportive (9 items) and structuring (6 items) teaching strategies at that moment in time. Internal consistencies were good with Cronbach’s alphas of .80 and .71 at the pretest and .82 and .71 two weeks after the training for autonomy support and structure, respectively.

4.5. Plan of analyses

Descriptive statistics, internal consistency coefficients and correlations among the study variables were computed using IBM SPSS Statistics 22.0. Possible associations between teacher characteristics (i.e. teacher sex, teacher age, years of teaching experience, diploma, and educational track they are teaching in) and study variables at baseline (i.e. teacher beliefs and in-class application of autonomy support and structure) were tested by means of MANOVAs and correlations for dichotomous and continuous background variables, respectively.

Multilevel modeling is considered the most appropriate method to analyze data that are hierarchically structured (Hox, 2010), as is the case in the present study with 80 PE teachers being nested within 55 schools. However, the number of teachers within schools ranged between one and five per school (for 39 out of the 55 schools, the number of teachers was n = 1), which is considered insufficient to obtain an accurate estimation at the school level (Maas & Hox, 2005). In addition, the estimation of intraclass correlation coefficients (ICCs) in a two-level model using the statistical program MLwin version 2.27 (Rasbash, Steele, Browne, & Goldstein, 2009) indicated that there was no significant variance at the school level (all $\chi^2(1) < .50$, $p = 1.00$). Therefore, we proceeded with single-level analyses.

Although replicating the intervention effects on teachers’ beliefs and behaviors was not the purpose of the present study (but see Aelterman et al., 2014), we preliminarily examined whether positive mean-level changes in teachers’ effectiveness and feasibility beliefs regarding autonomy supportive and structuring teaching strategies and teachers’ in-class application of these strategies could be observed. Relying on repeated measures ANOVAs with teachers’ beliefs or self-reported behaviors as the within-subject variables, analyses were performed in distinct models for the dimensions of autonomy support and structure separately.

In the next step, structural equation modeling was used to model associations between experienced need satisfaction during the training, changes in beliefs regarding autonomy support and structure, teachers’ intentions to apply the proposed strategies, and changes in self-reported in-class application of these strategies. Changes in beliefs and changes in self-reported behaviors were calculated by means of residual change scores. For example, a measure of change in effectiveness belief regarding autonomy support between pre- and posttest free of auto-correlated error was created by regressing the belief measure at the posttest onto the measure at baseline to compute the residualized belief change index (i.e. the difference between the predicted and observed belief score at the posttest). The resulting residualized scores, which can automatically be computed in SPSS, can be interpreted as the amount of increase or decrease in belief scores between baseline and posttest, taking into account the baseline scores. The same procedure was followed for all dependent variables (for an example of this procedure see Haerens, Vereecken, Maes, & De...
The relatively small sample size \((n < 100)\) precluded us from performing SEM with latent variables. Specifically, whereas 80 PE teachers filled out the baseline questionnaire, only 41 teachers participated in the online survey two weeks after the training. Hence, the structural model was tested through path analysis with manifest variables based on maximum likelihood estimation in Mplus (Muthén & Muthén, 2007). To evaluate the model fit, the Comparative Fit Index (CFI), the Root Mean Squared Error of Approximation (RMSEA) and the Standardized Root Means Square Residual (SRMR) were selected. According to Hu and Bentler (1999), combined cut-off values to .95 for CFI and close to .06 for RMSEA and .09 for SRMR indicate good fit.

5. Results

5.1. Preliminary analyses

5.1.1. Descriptive statistics

Means, standard deviations, and correlations among the study variables are presented in Table 1. Further, Pearson bivariate correlations indicated that teacher age was significantly positively related to effectiveness beliefs regarding structure \((r = .28, p < .05)\) and to the self-reported application of autonomy support \((r = .30, p < .01)\) and structure \((r = .42, p < .01)\) at baseline. Teachers’ teaching experience related only significantly positively to the application of structuring teaching strategies \((r = .34, p < .01)\). To examine whether the baseline measures differed according to teacher sex, diploma and educational track, three MANOVAs were conducted. The multivariate effects of teacher sex were not significant, Wilks’ Lambda = .91, \(F(6,73) = 1.26, p = .29, \eta^2 = .09\). However, a significant univariate effect was found for the application of autonomy support, \(F(1,78) = 4.87, p = .05, \eta^2 = .06\), with male \((M = 3.76 \pm .56)\), relative to female teachers \((M = 3.49 \pm .46)\), reporting to apply more autonomy-supportive teaching strategies. Multivariate effects of diploma, Wilks’ Lambda = .87, \(F(12,144) = .90, p = .55, \eta^2 = .07\), and educational track, Wilks’ Lambda = .72, \(F(24,245.11) = .99, p = .48, \eta^2 = .08\), were not significant, nor were the univariate effects. Based on these results, teacher sex \((0 = \text{male}, 1 = \text{female})\) was controlled for in the primary analyses. In addition, because teacher age and years of teaching experience were highly interrelated \((r = .93, p < .001)\), and because teacher age correlated with more study variables, only teacher age was included as a statistical control in the subsequent analyses.

5.1.2. Mean-level changes in teacher beliefs and behaviors

Table 2 summarizes the results of the repeated measures ANOVA analyses indicating that, after controlling for teacher sex and age, mean-level increases were statistically significant for effectiveness and feasibility beliefs regarding the dimension of autonomy support, but not with respect to the dimension of structure. In addition, significant mean-level increases were obtained for teachers’ self-reported application of autonomy-supportive, but not structuring teaching strategies.

### Table 2

Mean-level changes in teachers’ effectiveness and feasibility beliefs and in-class application of proposed strategies.

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>After training</th>
<th>(F)</th>
<th>(\eta^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Effectiveness belief</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Autonomy support</td>
<td>4.06 ± .44</td>
<td>4.23 ± .44</td>
<td>7.51**</td>
<td>.09</td>
</tr>
<tr>
<td>Structure</td>
<td>4.18 ± .50</td>
<td>4.24 ± .45</td>
<td>3.52</td>
<td>.05</td>
</tr>
<tr>
<td>Feasibility belief</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Autonomy support</td>
<td>3.50 ± .47</td>
<td>3.63 ± .46</td>
<td>6.07*</td>
<td>.08</td>
</tr>
<tr>
<td>Structure</td>
<td>3.81 ± .50</td>
<td>3.90 ± .47</td>
<td>.93</td>
<td>.01</td>
</tr>
<tr>
<td><strong>In-class application</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Autonomy support</td>
<td>3.65 ± .56</td>
<td>3.77 ± .54</td>
<td>5.35*</td>
<td>.13</td>
</tr>
<tr>
<td>Structure</td>
<td>3.68 ± .50</td>
<td>3.77 ± .57</td>
<td>.54</td>
<td>.01</td>
</tr>
</tbody>
</table>

Note. *\(p < .05\); **\(p < .01\).
All associations remained statistically significant after controlling for teacher sex and age.

6. Discussion

Given that CPD programs for teachers are likely to be more successful when teachers fully accept and endorse the proposed change (e.g., Assor et al., 2009; Baard et al., 2004; Deci, 2009), it is critical that teachers have their basic psychological needs for autonomy, competence, and relatedness fulfilled during these programs (e.g., Aelterman et al., 2013; Assor et al., 2009; Roth et al., 2007). However, the role of psychological need satisfaction in processes of change during CPD has only scarcely been studied so far (but see Feinberg et al., 2005). The present study aimed at contributing to this literature by examining the role of experienced psychological need satisfaction during the training in predicting changes in PE teachers' beliefs regarding autonomy support and structure, as well as PE teachers' intentions to apply the proposed strategies in their lessons and subsequent changes in their self-reported application of these strategies.

6.1. Changing beliefs underlying need-supportive teaching strategies

Recent intervention research using a pretest-posttest control group design in the PE context provided evidence that CPD on need-supportive teaching leads to positive changes in effectiveness and feasibility beliefs regarding autonomy support and structure, and that these changes are related to changes in teacher-reported behavior (Aelterman et al., 2014). Although replicating these intervention effects was not the purpose of the present study, the results largely align with this previously conducted intervention study (Aelterman et al., 2014), by showing that, also in a new sample of PE teachers participating in the same training, teachers' effectiveness and feasibility beliefs regarding autonomy support, but not structure, increased at the mean-level. These findings appear to confirm previous findings (Aelterman et al., 2014) suggesting that, despite the ingrained teaching repertoire that teachers have built up, there is still room to change and/or innovate teachers' beliefs regarding current and alternative ways of teaching. The positive changes in beliefs regarding autonomy support, rather than structure, are in line with prior literature showing that teachers find the concept of autonomy support more innovative, presumably because they are less familiar with it (Aelterman et al., 2013; Reeve, 1998). As a result there is a greater opportunity for change in the perceived effectiveness and feasibility of autonomy support. Alternatively, the CPD providers might have been biased toward a stronger emphasis on autonomy support when delivering the training. Although the allotted time and the number of proposed strategies was fairly balanced between autonomy support and structure, when presenting the proposed structuring strategies, it is possible that the trainers at times shifted the attention away from the content of structure to how structure can be delivered (i.e. in an autonomy-supportive fashion). In this respect, it would be useful for future research to videotape the workshops as to quantify the amount of time spent to each dimension and to verify whether a predominant shift towards autonomy support was actually the case.

Examining the impact of CPD on teachers' beliefs is of added value because these beliefs are indicative of teachers' acceptance or internalization of the proposed alternative way of teaching (Reeve, 1998; Reeve et al., 2014). Indeed, in line with previous studies claiming that teachers' beliefs underlie their in-class teaching behavior (Pajares, 1992; Tsangaridou, 2006), the present study showed that a change in teachers' effectiveness and feasibility beliefs is associated with teachers' intentions to apply the proposed strategies, especially with respect to autonomy support. These findings suggest that to foster teachers' intentions to apply the proposed teaching approach in their daily practice, it is important for CPD providers to inform teachers on the benefits of applying these strategies and at the same time indicate how teachers can apply the recommended strategies in a feasible way.
6.2. The role of psychological need satisfaction

More central to the present study was to investigate the role of psychological need satisfaction in predicting changes in teachers' beliefs, their intentions immediately after the training and changes in their self-reported behaviors. Results of the path analyses indicated that the more PE teachers reported their psychological needs for autonomy, competence, and relatedness to be fulfilled during the training, the larger the change in their effectiveness and feasibility beliefs regarding both the proposed autonomy-supportive and structuring strategies. Although we did not investigate associations of the three basic needs independently, these results show that if PE teachers experience a sense of Initiative, volition, and ownership during the change process (i.e. autonomy), feel capable to implement the proposed change (i.e. competence), and feel comfortable during the training (i.e. relatedness) altogether, they are more likely to change their perceived effectiveness and feasibility of the proposed alternative way of teaching, which may be indicative of a fuller acceptance and endorsement of the importance and value of the proposed change (Assor et al., 2009; Baard et al., 2004; Deci, 2009). Presumably, if CPD providers manage to successfully offer need-fulfilling opportunities for teachers during the training, they may increase teachers' receptivity and openness to reflect on their current teaching practice and may reduce any defensiveness and resistance against the proposed change (Hodgins & Knee, 2002; Vansteenkiste & Ryan, 2013).

Interestingly, experienced need satisfaction did not only relate to a change in teachers' beliefs, but also was directly associated with teachers' intentions to apply the proposed teaching strategies. These findings largely confirm our hypotheses and are in accordance with prior work pointing to the facilitating role of psychological need satisfaction in processes of change during CPD (Assor et al., 2009; Feinberg et al., 2005). A possible explanation may be that experiencing a sense of autonomy, competence, and relatedness during the training has a directly energizing effect on teachers' intentions to apply the proposed teaching approach, irrespective of the cognitive processes that need satisfaction engenders (i.e. change in perceived effectiveness and feasibility). Alternatively, since we did not control for social desirability, it is also possible that if teachers had a positive, need satisfying experience during the training, they had a desire to please the trainer and thus indicated to carry out the proposed teaching approach, regardless of their personal beliefs.

Teachers' intentions to apply the proposed strategies immediately after receiving the training were then found to relate to a change in teachers' self-reported application of structure, but not autonomy support. So, even though PE teachers had higher intentions to apply autonomy-supportive and structuring strategies when they had their basic needs more fulfilled, these intentions did not get translated into an increase of the application of autonomy-supportive strategies two weeks after the training. Notably, at the mean-level teachers only reported a significant increase in their application of autonomy support, but not structure. Thus, although the training did not produce mean-level increases in self-reported structure, those teachers who intended to apply the proposed structuring teaching strategies (as reported immediately following the training) said that they had increased the application of these strategies from pre-to post-training. As for autonomy support, the opposite pattern emerged, with self-reported autonomy-supportive strategies increasing on average but not being predicted by teacher intentions at the end of the training. A potential explanation for these inconsistent findings is that teachers who intended to implement the autonomy-supportive strategies found out that it was more difficult than expected to implement these strategies into their daily practice. Alternatively, although teachers with low intentions may have been skeptical to apply the strategies they may have found out that doing so is easier or brings more benefits than anticipated. In this respect, it would be useful for future research to include multiple follow-up moments assessing both (changes in) beliefs and (changes in) behaviors (Clarke & Hollingsworth, 2002) and to measure more directly PE teachers' reasons for intending or not intending and applying or not applying certain strategies.

Overall, whereas previous research argued that changing teachers' beliefs can be considered a primary proximal target of CPD (Aelterman et al., 2014; Pajares, 1992), the present findings might suggest that fostering experiences of psychological need satisfaction during the training represents an equally critical target. Future research can shed light on the degree to which the CPD providers actually acted in a need-supportive way. According to SDT, teachers are more likely to feel satisfied in their basic needs when the CPD providers adopt an autonomy-supportive (e.g., rationale provision; acceptance of resistance), structuring (e.g., overview; positive feedback; experiential learning provision) and warm (e.g., involvement and dedication; expression of respect) style (Assor et al., 2009; Baard et al., 2004; Reeve, 2009). It is important to note that many of these need-supportive strategies are very similar to strategies used within CPD more generally, even when there is not a specific focus on need support. For example, making time for teachers to share ideas and experiences (i.e., participation), listening to and discussing teachers' tensions and disagreements and creating experiential learning opportunities that are close to teachers' daily practice are strategies that have frequently been recommended for the design and delivery of CPD (O’Sullivan & Deglau, 2006). However, we suggest that, apart from its content, also the way CPD providers implement such strategies (i.e., ‘how’) might determine whether they lead to enhanced feelings of psychological need satisfaction during the training (Aelterman et al., 2013), an issue that warrants further investigation.

Although, the present study was conducted in the specific context of physical education, its topic might be of interest and value for research and practice within the broader CPD literature as well as to the sport-coaching context. Having provided evidence for the role of psychological need satisfaction during CPD to get teachers to actually experiment with the proposed teaching strategies, it is critical to help CPD providers to adopt an instructional approach that is supportive of teachers’ or coaches’ basic needs ('train the trainer'; Loughran, 2006). In addition, offering CPD that concurs well with what teachers and coaches expect from effective CPD both in terms of content and method of delivery (Aelterman et al., 2013; O’Sullivan & Deglau, 2006) can help CPD providers overcome the recurrent problem of the predictable failure of reform (Assor et al., 2009; Deci, 2009). This is particularly important because CPD has the purpose of supporting PE teachers and coaches in providing good quality instruction for students and athletes (Opfer & Pedder, 2011).

6.3. Teacher characteristics

When studying behavior change processes during CPD, the inclusion of key characteristics of teachers is critical as to explain why some teachers are open to change and others rather hold on to their current teaching behavior. In the present study, some interesting associations between the included teacher characteristics and outcomes at baseline emerged. Specifically, male teachers tended to apply more autonomy-supportive teaching strategies. In addition, older teachers reported to perceive structure as more effective and said to engage more frequently in both autonomy-supportive and structuring teaching behaviors. Although older teachers may be more comfortable with traditional teacher-centered approaches
The present findings contrast such a portrayal of older teachers. Perhaps, older teachers have gradually adapted their style over the years and evolved along with a change of attitude among students, presumably because they found out that teaching in need-supportive ways entails more benefits, both for their students (Cheon, Reeve, & Moon, 2012) and themselves (Cheon, Reeve, Yu, & Jang, 2014).

### 6.4. Limitations and future directions

Several limitations are noteworthy when interpreting the present findings. First, a major methodological limitation of the study is that no control group was included, not all variables (e.g., intentions to apply the proposed strategies) were measured at baseline, and social desirable responding was not controlled for, which may have violated the internal validity of the results. Although a previous intervention study provided evidence for the positive effects of the training on PE teachers' beliefs and teaching behaviors (Aelterman et al., 2014) and the present study aimed at looking into underlying mechanisms in a unique sample of PE teachers rather than replicating these findings, the design precluded us from concluding that the favorable changes in teachers' effectiveness and feasibility beliefs and in in-class teaching behaviors were actually due to the training, rather than to other confounding variables. Future studies aimed at gaining insight in experienced psychological need satisfaction during the training as an underlying mechanism in changing teachers' beliefs are recommended to rely on a pretest-posttest control group design to draw more valid conclusions.

A second limitation relates to the measurements that were used. As for the beliefs questionnaire, teachers were asked to rate every single item on a list of need-supportive teaching strategies (e.g., 'I find it personally meaningful that teachers offer choice to all students during the PE lesson') in terms of both effectiveness and feasibility. This similar set of items was also used to assess teachers' intentions and application of the proposed strategies. Future research could include multiple items for effectiveness and feasibility beliefs separately. For example, to assess feasibility beliefs, questions could be 'How easy is providing choice to all students during the PE lesson?' or 'Does providing choice to all students during the PE lesson take much effort or class time?'. In addition, although we considered positive changes in teachers' beliefs and higher intentions to apply the proposed teaching strategies as indicative of a fuller acceptance and endorsement of the importance and value of the proposed change, it would be interesting for future research to actually include a measurement of internalization (i.e., types of regulation; Deci & Ryan, 2000) to examine whether experienced need satisfaction during the training relates to higher internalization of the proposed change. Further, the present study relied exclusively on teachers' self-reports to assess teachers' in-class application of the proposed teaching strategies. Although self-reported data are valuable, they are often subject to overestimation, social desirability, and influenced by teachers' previous experiences. Future studies could therefore complement these self-reports with more objective methods to map out teachers' actual in-class application of the proposed teaching strategies. For example, PE lessons can be videotaped and rated by external observers using a coding scheme of need-supportive teaching behaviors, as the one that was recently developed by Haerens et al. (2013).

Future studies can also elaborate on the current study by providing objective information regarding the quality and consistency of intervention implementation, not only in terms of what CPD providers deliver, but also in how they deliver the training. Therefore, it could be useful to make videotapes of the different workshops as to obtain external ratings of the degree to which the training is need-supportive (i.e., fidelity check), as to investigate whether the degree to which the trainer acts in a need-supportive way relates to participants' experiences of need satisfaction during the training. Such observations could also help to permanently revise and optimize both the 'what' and 'how' of the training.

Further, it would be interesting for future studies to investigate whether the obtained structural model applies to teachers with different personal characteristics. Specifically, it might be useful to address teachers' general motivational orientation as well as potential reasons for resistance against the training message to explore whether control- and autonomy-oriented teachers would differ in their receptivity toward the proposed change (e.g., Reeve, 2009), and would hence require a different approach to meet their basic psychological needs. Such information might be helpful to better attune the training to teachers with a different general motivational orientation.

Finally, it is important to acknowledge that generalizability of our findings to a broader audience of PE teachers is limited by the relatively small (n < 100) sample size and by potential selection bias stemming from the use of teachers who voluntarily subscribed for the CPD program offered by the pedagogical counseling service in their region. Although the present findings are promising in illustrating the critical role of fostering psychological need satisfaction during CPD, future research is needed to replicate these results on a larger scale in order to gather stronger evidence for this claim in the broader educational context.

### 7. Conclusion

Although CPD is aimed at providing PE teachers with new knowledge, skills, and expertise, teachers often express reservations against the proposed change because they believe the proposed strategies are not effective or feasible. Fostering satisfaction of the psychological needs for autonomy, competence, and relatedness can produce greater receptivity toward change, so that PE teachers come to fully accept and endorse the proposed change. Greater attention on 'how' CPD providers can maximize teachers' opportunities to have their basic psychological needs met during training could help to increase the likelihood that teachers change their beliefs regarding the proposed teaching strategies and become inclined to apply these strategies in their practice.

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### References


