The effect of an intervention to improve newly qualified teachers' interpersonal style, students motivation and psychological need satisfaction in sport-based physical education

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A B S T R A C T

Recent developments in self-determination theory research in the educational setting (e.g., Reeve, Deci, & Ryan, 2004), suggest that teachers' interpersonal style should be considered as consisting of three dimensions: autonomy support, structure and interpersonal involvement. Based on this theoretical proposition, the purpose of the present study was to test the effects of a training program for three physical education newly qualified teachers on the aforementioned teachers' overt behaviors and students' psychological needs satisfaction, self-determined motivation and engagement in sport-based physical education. After a baseline period of four lessons, the teachers attended an informational session on adaptive student motivation and how to support it. The training program also included individualized guidance during the last four lessons of the cycle. Results revealed that from pre- to post-intervention: (1) teachers managed to improve their teaching style in terms of all three dimensions, and (2) students were receptive to these changes, as shown by increases in their reported need satisfaction, self-determined motivation and engagement in the class.

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1. Introduction

A considerable amount of research in the last two decades has examined the implications of being intrinsically or extrinsically motivated in school settings (see Reeve et al., 2004 and Ryan & Deci, 2000, for reviews). Nevertheless, much of what we know about motivation in school environments comes from survey data. Several scholars (e.g., Patrick, Anderman, Ryan, Edelin, & Midgely, 2001; Urdan & Turner, 2005) have underlined the necessity to carry out studies that enable the examination of possible causal links in order to improve our understanding of the relationship between instructional practices and student motivation. To this effect, and based on self-determination theory (SDT; e.g., Deci & Ryan, 2002), the aim of this study was to test the effects of a multidimensional motivation-based training program for physical education teachers on their teaching behaviors and their students' motivation and psychological need satisfaction.

1.1. Self-determination theory

Over the last 20 years, SDT has been established as a heuristic theoretical framework to study individuals' motivated behaviors in several life contexts, including school settings (see Deci, Vallerand, Pelletier, & Ryan, 1991; Reeve, 2002; Reeve et al., 2004 and Ryan & Deci, 2000, for reviews). According to SDT, the central concept that could explain the relationship between students' motivation and their experiences in the classroom is the degree to which their behaviors are autonomous (i.e., fully volitional, freely pursued, and wholly endorsed by the self) as opposed to controlled (i.e., pursued and directed by external or internal forces leaving students feeling like they have very little or no choice). Research clearly supports the idea that individuals have different types of motivation, ranging from high (autonomous) to low (controlled) levels of self-determination. Students can be intrinsically motivated (when they engage in learning activities for their inherent appeal), extrinsically motivated (when they engage in activities for instrumental reasons), or amotivated (when they have no motivation toward an activity).

Intrinsic motivation represents the prototype of self-determination, because a person is motivated to act for the fun or challenge entailed in the behavior rather than because of external contingencies, such as pressures or rewards. In contrast extrinsic motivation embraces a variety of behavioral regulations that vary in their

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relative degree of self-determination. In an increasing degree of self-determination these regulations are: *external* (partaking in an activity because of external pressures or incentives, such as rewards, threats or punishment), *introjected* (doing an activity because of internal pressures such as guilt or shame), *identified* (pursuing an activity because one finds it important and useful) and *integrated*[1] (undertaking an activity because it is congruent with one's set of core goals and values). Finally, SDT also proposes *amotivation* which refers to the absence of both intrinsic and extrinsic motivation and represents a complete lack of self-determination and volition with respect to the target behavior (Deci & Ryan, 2000). Amotivation stems from lack competence, the belief that an activity is unimportant, and/or when an individual does not perceive contingencies between her/his behavior and desired outcome(s) (Ryan & Deci, 2000; Vallerand, 1997). In sum, intrinsic, integrated, and indentified regulations are self-determined, whereas amotivation, external and introjected regulations are non self-determined forms of motivation.

SDT-based research has shown that higher levels of self-determined motivation are related to several positive outcomes, such as student effort, academic achievement, engagement, quality of conceptual learning, preference for optimal challenge, creativity, and rates of retention (see Reeve, 2002; Ryan & Deci, 2000, for reviews). Among these outcomes, student engagement is critical for academic learning (Turner et al., 1998) and a useful concept to study from a SDT perspective in educational settings (Reeve, 2002). Referring to the behavioral intensity and emotional quality of a person's active involvement during a task (Connell, 1990; Connell & Wellborn, 1991; Reeve, Jang, Carrell, Jeon, & Barsh, 2004), engagement provides teachers with an observable manifestation of the quality of a student's motivation (Reeve, 2002). In physical education more specifically, engagement covers cognitive (i.e., students' degree of investment in learning and self-regulation), affective (i.e., students could be enthusiastic, half-hearted, or experience negative emotions such as boredom), and behavioral (i.e., students could be active *versus* passive during the lessons) aspects. Thus, engagement provides teachers with information they can more or less readily observe and monitor. Therefore, in the present study we utilized engagement as a manifest indicator of students' motivation, to complement student self-reports of their motivational regulations.

1.2. Determinants of motivation and engagement

According to Cognitive Evaluation Theory (CET; Deci & Ryan, 1985), a sub-theory within SDT that specifies factors that explain variability in intrinsic motivation, social-contextual events that foster feelings of competence and autonomy can enhance intrinsic motivation. A theoretical proposition of SDT (Deci & Ryan, 2002) is that socials factors – such as teachers' interpersonal style – can influence students' motivation and engagement by nurturing *versus* thwarting three basic psychological needs. These are the needs for autonomy (i.e., feeling the 'origin' as opposed to the 'pawn' of their actions), competence (i.e., feeling effective in their school-related interactions), and relatedness (i.e., feeling secured and meaningfully connected to others). Previous studies have conceptualized interpersonal style along a continuum that ranges from highly controlling to highly autonomy-supportive behaviors (e.g., Deci, Schwartz, Sheinman, & Ryan, 1981; see Reeve, 2002, for a review). However, recent studies (e.g., Reeve et al., 2004; Skinner & Belmont, 1993; Skinner & Edge, 2002) have expanded upon this unidimensional continuum by examining characteristics of the environment which satisfy or thwart each of the three psychological needs. In this line of work, researchers have labeled as "autonomy support", "structure" and "interpersonal involvement", the socials factors likely to nourish the needs for autonomy, competence and relatedness, respectively.

Autonomy support refers to behaviors by a person in position of authority that show respect, allow freedom of expression and action, and encourage subordinates to attend to, accept, and value their inner states, preferences, and desires (Deci & Ryan, 1987). Examples of autonomy-supportive behaviors are the provision of choice and meaningful rationale from teachers, the support of student volition and the acknowledgment of the students' perspective (Deci, Eghrari, Patrick, & Leone, 1994). The opposite of autonomy support is coercion. When teachers are coercive, pressuring, or controlling (e.g., by ushering commands and deadlines), then students' need for autonomy is threaten because they tend to experience themselves as "pawns" in the hands of teachers (Skinner & Edge, 2002).

Structure describes the extent to which a social context is structured, predictable, contingent, and consistent (Skinner & Edge, 2002). More specifically, when a teacher provides challenging tasks, negotiates clear and short-term goals, delivers contingent feedback related to students' endeavors, and encourages their effort and progress, he/she tends to nurture the students' need for competence and their self-determined motivation. This is especially the case if the components of structure are delivered in an autonomy supportive manner (Deci & Ryan, 1991). The opposite of structure is chaos. When contexts are noncontingent, uncontrollable, or chaotic, students will come to experience themselves as incompetent (Skinner & Edge, 2002).

Finally, *interpersonal involvement* refers to individuals' opportunities to feel related and belonging when they interact within a social environment that offers affection, warmth, care, and nurturance (Skinner & Edge, 2002). In school, when teachers are sympathetic, warm and affectionate with their students, when they dedicate psychological resources, such as time, energy and affection (Deci & Ryan, 1991; Reeve et al., 2004), they tend to nurture their students' relatedness and self-determined motivation. The opposite of interpersonal involvement is hostility. When teachers are hostile or neglectful, students experience themselves as unlovable and the context as untrustworthy (Skinner & Edge, 2002).

Autonomy support, structure and interpersonal involvement are independent but complementary dimensions of a teacher's interpersonal style. Student motivation thrives under condition in which teachers find ways to provide optimal structure and high autonomy support (Skinner & Belmont, 1993), because structure facilitates students' intentions to act, while autonomy support allows those formulated intentions to be self-determined and aligned with their inner resources (Reeve et al., 2004). As far as interpersonal involvement is concerned, Skinner and Edge (2002) advance the idea that a high level of interpersonal involvement is needed to provide optimal structure and to support students' autonomy.

Past studies have consistently shown the benefits of an autonomy-supportive teacher style on students' motivation, emotion, learning, and performance (see Deci & Ryan, 1987; Deci et al., 1991 and Reeve, 2002, for reviews). However, many teachers tend to use controlling strategies (Newby, 1991), and physical education teachers are not the exception (Sarrazin, Tessier, Pelletier, Trouilloud, & Chanal, 2006; Taylor, Ntoumanis, & Smith, 2009). Empirical evidence in the school environment, and in particular in physical education classes, regarding structure and involvement is relatively scarce (for an exception, see Taylor & Ntoumanis, 2007). Thus, from an applied perspective, an important question to ask is whether it is possible to help teachers improve their existing

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[1] Integrated regulation was not assessed in the present study because often this regulation has not emerged as a perceived reason for participation in the physical domain (e.g., Pelletier et al., 1995).

teaching style to be more need-supportive and less need-thwarting.

1.3. Can teachers modify their interpersonal style to be more need-supportive?

Four studies, to our knowledge, have examined the question of whether it is possible to educate teachers to develop a more need-supportive interpersonal style (Chatzisarantis & Hagger, 2009; Reeve, 1998; Reeve, Jang, et al., 2004; Tessier, Sarrazin, & Ntoumanis, 2008). Reeve's (1998) study involved 114 females and 45 males pre-service teachers. The educational program entailed reading an instructional booklet for 45 min presenting one of three teaching styles: autonomy supportive, controlling, or neutral. Compared to those who read an instructional booklet on a controlling or neutral teaching style, pre-service teachers who read the autonomy supportive strategies booklet reported an increase in their autonomous orientation. However, a limitation of the study was that the teachers' actual behaviors were not assessed. A self-reported interpersonal style may not necessarily be manifested during classroom instruction.

This limitation was addressed by Reeve, Jang, et al. (2004). Involving 20 experienced teachers (i.e., nine women and 11 men teaching mathematics, economics, English and science), the authors developed an informational session on how teachers can be autonomy supportive toward students. Teachers' behaviors were subsequently coded by two trained raters over a series of three classroom observations. Results showed that teachers increased their use of autonomy-supportive behaviors compared to their baseline levels. Further, students' engagement (i.e., their active task involvement during instruction, and initiative in taking personal responsibility for their learning) was positively affected by increases in teachers' autonomy support. Nevertheless, the intervention did not attempt to increase the use of structure and interpersonal involvement by teachers and did not assess students' reports of their own motivation.

The Tessier et al. (2008) study involved five physical education teachers (i.e., three males and two females) randomly assigned to a control or an autonomy-supportive training group over an 8-week teaching cycle. To assess the effect of the teacher training, teacher–student interactions were videotaped and coded via an observational grid developed by Sarrazin et al. (2006), which distinguished between different categories of teacher communications. Results showed that compared to the teachers in the control group, those in the experimental group used an autonomy-supportive style with greater frequency. Nevertheless, this study had two limitations. First, although the two groups were matched in terms of important characteristics (i.e., teaching experience, student socio-economic status and motivation), the teachers' interpersonal style was not assessed prior to the teacher training. It is thus difficult to know if the observed post-training differences were related to the training itself or if they pre-existed. Secondly, the effects of the teacher training on students' engagement and motivation were not assessed. Thus, it is not possible to know if the students were receptive to the modifications of their teachers' style.

Involving 10 physical education teachers and 215 pupils, Chatzisarantis and Hagger (2009) developed a 10-week intervention program and examined its effects on students' physical activity intentions and self-reported leisure-time activity behavior. The study employed two conditions, an autonomy-supportive one in which teachers were trained to provide rationale, feedback, choice and acknowledge difficulties, and a less autonomy-supportive one in which teachers provided rationale and feedback only. Results indicated that students who were taught by more autonomy-supportive teachers reported stronger intentions to exercise during leisure time and participated more frequently in leisure-time physical activities than students taught by less autonomy-supportive teachers. This is the first study that demonstrates the usefulness of SDT for the development of school-based interventions to increase physical activity participation. Nevertheless, more studies are needed to test the effectiveness of others teachers' behaviors related to structure and interpersonal involvement, in addition to autonomy support. Further, it should be noted that Chatzisarantis and Hagger (2009) did not have a control condition with any autonomy support provided, and did not measure student motivation.

1.4. Aims and hypotheses

In sum, although initial evidence has emerged indicating that teachers can learn to better support students' psychological needs, further research is needed to address limitations in previous studies. Thus, the purpose of the present study was to test the effects of a multidimensional teacher training program, on overt behaviors of newly qualified teachers, students' self-reported need satisfaction, self-determined motivation and engagement in class. We hypothesized that the training program will increase teachers' provision of autonomy support, structure and involvement. Secondly, we hypothesized that students will be sensitive to the changes in their teachers' intrapersonal style by reporting greater satisfaction of all three psychological needs, more self-determined motivation and greater engagement in learning tasks.

2. Methods

2.1. Participants

Three physical education teachers (one male and two females, ranging in age from 24 to 28 years) and their 185 students (102 females and 83 males from 9th to 11th grade; *M* age = 16.56 years, *SD* = 1.38, age range = 14–18 years) from six classes of three senior high schools situated in the Northeast of France volunteered to participate in the study. Most of the students in this sample were of upper-middle socio-economic status. The ethnic distribution of the sample was as follows: 74% white (*n* = 137), 14% North African (*n* = 26), 3% from another European country (*n* = 5). Nine percent (*n* = 17) did not report their ethnicity. All three teachers were in their first year of teaching. Teacher 1 was a 24 years-old woman who taught badminton in classes 1 (student *n* = 30; 16 female *n* = 16; from 9th grade) and table tennis in class 2 (student *n* = 31; female *n* = 17; from 11th grade). Teacher 2 was a 28 years-old man who taught softball in classes 3 (student *n* = 27; female *n* = 16; from 11th grade) and basket-ball in class 4 (student *n* = 34; female *n* = 19; from 11th grade). Teacher 3 was a 26 years-old woman who taught badminton in classes 5 (student *n* = 30; female *n* = 16; from 11th grade) and table tennis in class 6 (student *n* = 33; female *n* = 18; from 11th grade).

We choose to work with newly qualified teachers because: (1) they have only 10 h of teaching a week, and thus have some time to reflect on their teaching, and (2) they possess a relatively malleable interpersonal style, and therefore are often interested in new teaching strategies as they have not established yet strong teaching habits (Hoy & Woolfolk, 1990). Our sample choice was constrained by: (a) timetabling (we had to ensure that we were able to film all the teachers each week), and (b) the activity taught (some activities took place in big open spaces – such as soccer, track and field – and thus were not conducive to video observation). These constrains determined the selection of the three teachers who participated to the study, among all those who volunteered. We chose to study students from senior high schools because adolescents who are 15 years or older often reduce their

physical activity involvement (Lubans, Foster, & Biddle, 2008). In fact, physical education teachers often report a decrease in student engagement in the lesson, an increase in medical certificates that exempt students from the lessons, and a decline in physical activity undertaken out of school. Informed consent was obtained from the Head Teachers of the schools, the teachers and the students' parents.

2.2. Procedure

In France, physical education is a compulsory subject for all high school students whose grade for the subject depends on their skillfulness and sport performance. Students attend physical education lessons once a week for 2 h. A physical education lesson is generally structured along three different parts – warm-up, learning, and formative assessment. These three parts are of different nature and involve different kind of teacher and student behaviors. We chose to focus our study on the middle part (representing about 50 min to 1h10), which is the longest and the one in which the most interactions about learning occur between the teacher and the students. Generally, the physical education curriculum comprises of 8-week sport units. The first and the eighth lessons, reserved for the initial and final assessments of students' motor skills, were not taken into account. Teachers' overt behaviors and students' engagement were videotaped during the remaining six physical education sessions using a digital camcorder. The camcorder had a large viewing angle which enabled the recording of all students and the physical education teacher simultaneously. All classes were filmed at least one lesson before the beginning of the data collection in order to reduce reactivity effects associated with the use of the camcorder.

The experimental procedure used in this study comprised of three parts. In the first part (i.e., lessons 2–4), the usual teaching behaviors and student engagement were videotaped at each lesson. At the end of lesson 2, students answered a questionnaire in order to assess their initial levels of psychological need satisfaction and self-determined motivation in the activity practiced. At this first part of the study, no reference was made to the teachers about their interpersonal style. Rather, they were told that the researchers were only interested in different types of student behavior exhibited during physical education courses. This was a precautionary measure taken to prevent a Hawthorne effect[2] (e.g., Adair, Sharpe, & Huynh, 1989).

In the second part of the experiment, between the 4th and the 5th lessons, the teachers were invited at the university to attend a half-day (i.e., about 4 h) informational session. This session began with a 1-h presentation of the basic tenets of SDT, including the different types of student motivation, the different teacher interpersonal styles (i.e., need-thwarting vs. needs-supportive), and their effects on students. Further, empirical evidence was presented – for about 1 h – to support the argument that students benefit when teachers support students' needs. Examples of a need-supportive teacher (e.g., offering choice and initiative taking, ensuring optimal challenge and learner-centered feedback, investing time and effort towards students) were specifically emphasized using video footage of other physical education teachers. The two major aims of the training workshop were: (1) to explain to teachers that using a reward–punishment system can be seriously detrimental to student motivation, and (2) to help teachers build their lessons by answering the question: How can I provide the conditions under which students can motivates themselves? Final-

ly, during the last 2 h of the session, teachers were invited to analyze their own interpersonal style based on video footage recorded during the first part of the study, and to plan the last lessons of the cycle (i.e., lessons 5–7) in a more need-supportive manner. This work aimed to discuss alterations in the planning of lessons by the teachers to provide more opportunities for need satisfaction (e.g., "in basket-ball, if I show two possible ways to shoot, and I propose to the students to try 10 times each position and then choose which one is best for them, do you think I am being need-supportive?").

Finally, in the third part of the cycle (i.e., lessons 5–7), teacher and student behaviors were again videotaped in each lesson. Using this video footage, an individualized guidance program for each teacher was developed. Specifically, after each lesson the experimenter and the teacher analyzed, for 15–30 min, the teacher's interpersonal style in order to help the teacher improve his/her capacity to motivate students. More specifically, this debriefing session aimed to find alternatives to reduce the frequency of directive commands, emphasized the transmission of technical feedback using non-controlling language, helped teachers to better understand the students' point of view, and emphasized the importance of downplaying social comparison. When the teachers did not manage to find alternatives by themselves, the experimenter offered some suggestions. In some cases, when a teacher thought that a need-supportive interpersonal style was not the best option (e.g., when reminding students about safety rules or restoring discipline in the classroom), the experimenter did not try to impose a new strategy. At the 7th lesson, students responded to a questionnaire assessing again their levels of need satisfaction and motivational regulations.

2.3. Measures

2.3.1. Students' self-determined motivation in physical education

Motivation toward the sport practiced in the teaching cycle (i.e., softball, table tennis, badminton and basket-ball) was assessed in the 2nd and the 7th lesson with the Echelle de Motivation pour l'Education Physique (EMEP; Physical Education Motivation Scale, Sarrazin et al., unpublished). Based on the Sport Motivation Scale (Pelletier et al., 1995) and the Academic Motivation Scale (Vallerand et al., 1992), EMEP was constructed in order to reflect both the sporting and educational aspects of physical education. The adaptation consisted of minor changes in the wording of some items to target the physical education context. is the scale comprises of 26 items and assesses the multifaceted motivational regulations proposed by SDT. The participants read the stem "I participate in this teaching cycle because...", and responded to items reflecting intrinsic motivation (IM) toward knowledge (IMK; e.g., "for the fun of discovering new skills/techniques"), IM toward accomplishment (IMA; e.g., "... for the satisfaction I experience while I am perfecting my abilities"), IM to experience stimulation (IMS; e.g., "... for the excitement I feel when I am really involved in the activity"), identified regulation (IDR; e.g., "... because what I learn in physical education will be useful later"), introjected regulation (INR; e.g., "... because I must do this teaching cycle to feel good about myself"), external regulation (EXR; e.g., "... because I will be assessed"), and amotivation (AM; e.g., "I don't know why I participate, if I could, I would get exempted"). Responses were made on a 7-point scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Previous studies have offered support concerning the factorial validity (e.g., Boiché, Sarrazin, Grouzet, Pelletier, & Chanal, 2008; Sarrazin et al., unpublished), predictive validity (e.g., Boiché et al., 2008; Chalabaev, Sarrazin, Trouilloud, & Jussim, 2009) and reliability of the EMEP (e.g., Boiché et al., 2008; Chalabaev et al., 2009; Sarrazin et al., 2006; Tessier et al., 2008). In this study, all sub-scales had adequate Cronbach alphas

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[2] The Hawthorne effect refers to the tendency of some people to work harder and perform better when they are participants in an experiment. These individuals may change their behavior due to the attention they receive from researchers rather than because of any experimental manipulation of independent variables.

Rater :_____   School :_____
Teacher :_____   Classroom :_____

| | Thwarts needs satisfaction | 1 2 3 **4** 5 6 7 | Nurtures the basic psychological needs |
| | Disaffected behaviors | | High level of engagement |

Teacher's Autonomy Support
Instructions given to the whole class
Organizational instructions:
Uses commands and   1 2 3 **4** 5 6 7   Gives choices and options
directives, imposes   (e.g., groups, tasks)
everything
Rationales:
Imposes rules and limits 1 2 3 **4** 5 6 7 Explains rules and limits
Doesn't give rationales   Gives rationales
Interaction teacher –individual students
Teacher's guidance:
Controlling feedback   1 2 3 **4** 5 6 7   Gives feedback in an informational way
                                             Asks students' point of view
                                             about learning

Rationales:
Imposes rules and limits 1 2 3 **4** 5 6 7 Explains rules and limits
Doesn't give rationales   Gives rationales

Teacher's Structure
Instructions given to the whole class
Task structure:
Same task   1 2 3 **4** 5 6 7   Differentiated and
for all students   challenging tasks
Interaction teacher – student
Structure of the student's activity:
No feedback, vague goals 1 2 3 **4** 5 6 7 Contingent feedback,
confusing, unclear   short term goals
Encouragement:
No encouragement   1 2 3 **4** 5 6 7   Encourages students' effort
                                          and progress

Teacher's Interpersonal involvement
During task instructions to the whole class
Cold, distant,   1 2 3 **4** 5 6 7   Sympathetic, warm,
offers strict feedback,   humorous
sarcastic learning
Interaction teacher – student
Cold, distant   1 2 3 **4** 5 6 7   Sympathetic, warm,
strict, sarcastic,   uses humor with each student,
rigid, inflexible   listens, understands students,
limits time   invests time and energy

Students' collective Engagement
Cognitive engagement
Practise to let "steam off" 1 2 3 **4** 5 6 7 Listen carefully to teacher
Do not try to understand   Ask questions about

Behavioral engagement
Passive, Minimal effort   1 2 3 **4** 5 6 7   Active, intense effort
                                                 Persevere when faced with
                                                 difficulties
Affective engagement
Bored, disinterested,   1 2 3 **4** 5 6 7   Joyful, interested,
Lethargic   energetic, full of fun

Fig. 1. Observer's rating sheet to score teachers' interpersonal style and students' engagement (adapted from Reeve et al. (2004)).

pre- and post-training (IMS pre/post: .88/.86; IMA pre/post: .82/.85; IMK pre/post: .80/.77; IDR pre/post: .80/.89; INR pre/post: .74/.80; EXR pre/post: .73/.78; AM pre/post: .92/.90). Thus the average of the items on each sub-scale was used for our analysis.

2.3.2. Psychological need satisfaction

The needs for autonomy, competence and relatedness were assessed in the 2nd and 7th lessons of the cycle with an adapted version for physical education of the Basic Psychological Needs Scale (BNSC; Deci et al., 2001). This is a 21-item questionnaire that taps perception of competence (six items; e.g., "I have been able to learn interesting new skills in physical education"), relatedness (eight items; e.g., "I feel like my physical education teacher listen to me"[3]), and autonomy need satisfaction (seven items; e.g., "I feel like I can make a lot of inputs to deciding what to do in physical education"). All items were measured on 7-points scales (1 = *not at all true*; 7 = *very true*). Ntoumanis (2005) has provided evidence for the validity and reliability of the English version of this scale. The items were translated into French following the standard translation and back-translation process recommended by Brislin (1970). In our study, each sub-scale possessed adequate Cronbach alphas (i.e., competence pre/post: .84/.83; autonomy pre/post: .69/.70; relatedness pre/post: .87/.84).

2.3.3. Overt teacher and student behaviors

Each class was videotaped during the six targeted lessons. The teachers' interpersonal style and the students' collective (i.e., class) engagement were coded with an adapted version for physical education (see Fig. 1) of an observation rating scale developed by Reeve, Jang, et al. (2004). Our observation grid also included additional behaviors selected after an extensive review of the extant literature (Deci & Ryan, 1991; Deci et al., 1994; Reeve, 1996, 1998; Reeve & Jang, 2006; Reeve et al., 2004). In order to better capture teachers' interactions within a class, we coded separately the communications addressed to the whole class and those aimed to a single student. The dimension *autonomy support* appears in the

upper left quadrant and contains four items: organizational instructions given to the whole class, rationale about learning tasks given to the whole class, teacher's guidance given to a single student and rationale about learning tasks given to a single student. The dimension *structure* appears in the upper right quadrant and contains three items: structure of the learning tasks for the whole class, structure of individual student activity, and student encouragement. The dimension *interpersonal involvement* appears in the lower left quadrant and contains two items: instructions given to the whole class and interactions with students. Each of the items was anchored by bipolar descriptors situated on a 7-point scale ranging from (1) "*behaviors that thwart needs satisfaction*" to (7) "*behaviors that nurture the basic psychological needs*".

Finally, students' *collective engagement* appears in the lower right quadrant and contains three items: cognitive, affective and behavioral engagement. The cognitive engagement refers to the levels of psychological investment in learning and self-regulation. The affective engagement refers to the degree of enthusiasm in the lesson. Lastly, the behavioral engagement refers to the level of intensity of effort and persistence in learning manifested by students.[4] Following earlier studies (e.g., Reeve, Jang, et al., 2004), we combined the three ratings into one overall engagement score (α = .76 and .72 for the pre-test and post-test periods, respectively) capturing students' collective engagement.

Each teacher behavior and student engagement item was rated on a continuum ranging from 1 (i.e., teacher behavior thwarts needs satisfaction/high levels of student disaffection) to 7 (i.e., teacher behavior nurtures the basic psychological needs/high levels of student engagement). For the coercion *versus* autonomy support dimension, number 1 refers to controlling communications such as using commands and directives, imposing rules and limits or delivering controlling feedback (e.g., "extend your arm after the shot, I have told you that 10 times!"). In contrast, number 7 refers to autonomy supportive communications such as giving choices and options, explaining rules and limits or delivering feedback in

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[3] In order to be more aligned with the aims of our study, the items pertaining to the relatedness dimension focused specifically on the physical education teacher and not the classmates.

[4] This conceptualization has two limitations: (1) the measurement of cognitive engagement is highly inferential (Appleton, Christenson, Kim, & Reschly, 2006), and (2) in reality the components of engagement are dynamically embedded within a single individual and are not isolated processes (Fredericks, Blumenfeld, & Paris, 2004).

an informational way (e.g., "maybe you could try different kinds of shoots and then choose the best"). For the chaos *versus* structure dimension, number 1 refers to vague goals, no feedback neither encouragement, and to a learning system which is uniform for all students, whereas number 7 refers to teachers' behaviors which create a context (i.e., tasks, goals, feedback, and encouragement) that encourages students to take responsibilities, and to take ownership of their own learning. For the hostility *versus* interpersonal involvement dimension, number 7 refers to a teacher who is warm, sympathetic, humorous, listening and investing time and energy for students. In contrast, number 1 refers to a teacher who is cold, distant, sarcastic, and inflexible with students.

With regard to the students' collective engagement, number 1 on the cognitive engagement scale refers to students who ignore their teacher's instructions (e.g., they chat) and who do not produce the expected work. In contrast, number 7 refers to students who are invested in understanding their actions (e.g., they solicit attention from the teacher; they ask him/her questions when they do not understand instructions). For affective engagement, number 1 refers to students who are disinterested, bored, and lethargic, whereas number 7 refers to students who are joyful, interested, energetic, full of fun whatever they are asked to play or learn. As for behavioral engagement, being partly a function of the physical activity practiced, we assessed intensity of effort and perseverance for each physical activity. For instance in basket-ball, number 1 refers to students who walk on the play ground, get rid of the ball, do not shake off the marker, do not defend. In contrast, number 7 refers to students who put a lot of effort in playing both offensive and defensive roles.[5]

2.4. Coding reliability

Four researchers, specialists in both the psychology of education and SDT, coded the 36 lessons recorded for the study. To prevent rating artifacts, such as inadvertently inflating the association between teachers' behaviors and students' engagement, two raters coded the teachers' interpersonal style and two others coded students' engagement. Also, we randomized the order of viewing so that no coders knew from which period (pre-test or post-test) the video footage came from. Only the central part of the lesson devoted to learning was videotaped.

Before the first coding, a two-hour meeting was organized to explain the grid to the raters and how to assign a number to an observed behavior. Coding took place in twelve meetings lasting 3 h each (i.e., 36 h). The raters of teachers' behaviors were instructed that the scores on the different teaching dimensions should reflect behaviors most frequently used by the teacher (i.e., his/her dominant teaching profile) during the lesson. The raters of students' collective engagement were told to consider both the percentage of students enacting each behavior, and the intensity of students' expressions of these behaviors. So a high score on an engagement indicator indicates that most or almost all of the students expressed the behavior and to a high level of intensity. The video footages were watched without interruption; the raters were free to fill in the grid whenever they wanted and to modify their assessments when and if necessary.

Following Bakeman and Gottman (1997) recommendations, the inter- and intra-rater reliabilities were estimated using the Cohen's kappa coefficients. The inter-rater reliability was estimated on the basis of the 36 lessons of the study, whereas the intra-rater reliability was estimated from five lessons randomly selected. The coders rated again this sample of five lessons 2 weeks later. The

analysis revealed good inter- and intra-rater reliabilities pertaining to the three intrapersonal teaching style variables (between .72 and .91; M_{intra} = .84; M_{inter} = .80) and that of student engagement (between .74 and .95; M_{intra} = .86; M_{inter} = .81). As the inter-rater reliability was satisfactory, we averaged the scores for each pair of raters into one overall score for each variable per lesson.

2.5. Data analysis

Given that the sample size of teachers (n = 3) is extremely small for any type of statistical analysis (parametric or non parametric test), we employed methodology used in single-subject designs studies (e.g., Hanton & Jones, 1999; Shambrook, Bull, & Douglas, 1994; Swain & Jones, 1995) to test our first hypothesis concerning the effects of the training on the teachers' interpersonal style. Specifically, we plotted on a graph the data points related to teachers' behaviors before and after the experimental intervention. To do so, we averaged the pre-training data (from lessons 2 to 4) and the post-training data (from lessons 5 to 7). In brief, nine graphs were created presenting changes from before to after the intervention, for each of the nine teachers' behaviors (i.e., organizational instructions, rationale given to the whole class, teacher's guidance, rationale give, to a single student, structure of the learning tasks, structure of the students' activity, encouragement and praise, instructions given to the whole class and interaction with students) observed in the six classes. The steepness of the slope of the line joining the data points indicates the extent of the impact of the change of the variable under examination. Despite the subjective nature of visual inspection, there are available criteria and guidelines (e.g., Horner et al., 2005) when examining the impact of such treatment effects. The main issue is to decide what the threshold is for inferring that any observed changes are not a reflection of intra-teacher variability but the effect of the experimental intervention. Following suggestions by Horner et al. for visual analysis in single-subject designs, we considered that a change over 0.7 of a unit could be used as such a threshold. This is because 0.7 represents 10% of the range of the scale, which seems a high degree of change given that the pre-test and the post-test values are averages of three lessons, and such averages tend to reduce the effect of the intra-teacher variability. Further, we also took into account the scale midpoint (i.e., 4) as the threshold distinguishing teacher's behaviors being more need-supportive than need-threatening (see Fig. 1).

To test the effects of teacher training on students' collective (i.e., class) engagement, we also plotted the data on a graph. To test the effects of the teacher training on individual students' motivational regulations and psychological need satisfaction, we performed repeated measures multivariate analysis of variance (MANOVAs), as at the individual student level the sample size was adequate (n = 185).

3. Results

3.1. Did Teachers' interpersonal style change?

3.1.1. Autonomy support
Fig. 2 illustrates the changes in teachers' autonomy-supportive behaviors, separately for each class. Concerning the organizational instruction given to the whole class, Fig. 2a shows an increase of this behavior after the teachers' training only for classes 1 (C1) and 2 (C2) (i.e., from 2 to 5.75 and from 3.22 to 5.67 for C1 and C2, respectively). These two classes were taught by the same teacher (i.e., teacher 1). The scores for classes C3, C4, C5 and C6 remained stable, changing at maximum 0.7 units. Inspection of the post-training scores shows that scores for three classes were above the midpoint of the scale (i.e., 4), indicating more choices and op-

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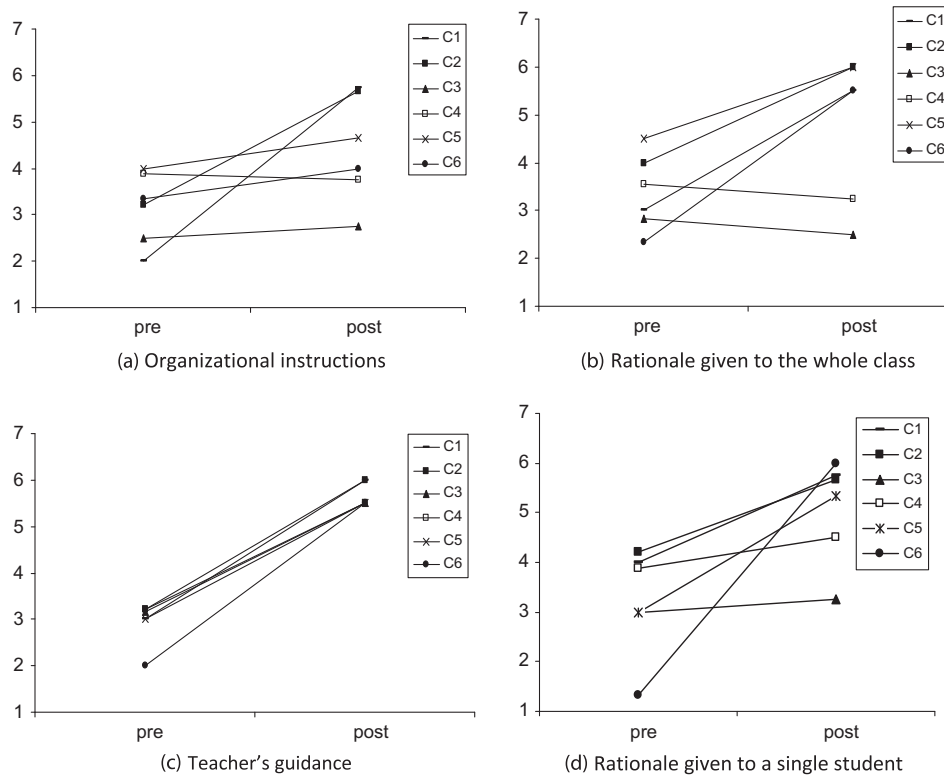[5] More details about any aspect of the observation grid can be obtained from the first author.

Fig. 2. Autonomy-supportive teachers' behaviors for each class (C1 and C2 were taught by teacher 1, C3 and C4 were taught by teacher 2, and C5 and C6 were taught by teacher 3).

tions were given than commands and impositions (see the rating scale in Fig. 1).

Concerning the use of rationale given to the whole class, Fig. 2b shows an appreciable increase for teacher 1 (i.e., from 3 to 5.5 for C1 and from 4 to 6 for C2) and for teacher 3 (i.e., from 4.5 to 6 for C5 and from 2.33 to 5.5 for C6), and a stable trend for teacher 2 (i.e., from 2.83 to 2.5 for C3 and from 3.56 to 3.25 for C4). As a result, scores for four of the six classes were above the scale midpoint, indicating that teachers from these classes used more rational than imposing rules and limits (see rating scale in Fig. 1).

Concerning teacher guidance, Fig. 2c shows a considerable and uniform increase (about 2.5 units on average in the six classes) after the teachers' training. This indicates that the teachers were able to give feedback in an informational rather than controlling way in all classes.

Finally concerning the use of rationale given to individual students, Fig. 2d shows a noticeable increase for teacher 1 (i.e., from 4 to 5.25 for C1 and from 4.2 to 5.67 for C2) and for teacher 3 (i.e., from 3 to 5.33 for C5 and from 1.33 to 6 for C6), and a stable trend for teacher 2 (i.e., from 3 to 3.25 for C3 and from 3.89 to 4.5 for C4). The scores for five classes were above the scale midpoint, indicating that when teachers from these classes interacted individually with a student, they tended to explain rules and limits rather than impose them.

3.1.2. Provision of structure

Fig. 3 illustrates the change in teachers' behaviors scores related to structure, separately for each class. Concerning the teachers' capacity to structure learning tasks, Fig. 3a shows a noticeable and uniform increase (about 2 units on average in the six classes) after their training. In all classes, teachers used varied and challenging tasks as opposed to uniform ones.

Concerning the teachers' capacity to structure students' activity, Fig. 3b shows an increase of 2 units on average in the six classes.

The figure also reveals a noticeable inter-class variability; the average level of structure in C3 and C6 is about 2 units lower than that for C1 and C2. As a whole, five classes have scores above the scale midpoint, indicating that their teachers gave contingent feedback and clearer goals.

Finally, Fig. 3c shows an increase in teacher use of encouragements for student effort and progress for all classes, with more substantial increases for C1, C4, C5, C6 (about 2.5 units on average) than for C2 and C3 (1 unit and 0.7 unit, respectively). The graph also displays a noticeable inter-class variability (e.g., in C2 the teacher encouraged her students two times more than the teacher in C3 did).

3.1.3. Interpersonal involvement

Fig. 4 illustrates teachers' scores related to interpersonal involvement for each class, before and after their training. Concerning the whole class, Fig. 4a reveals a noticeable (about 1.5 units) and uniform increase for all classes. C6 has a steeper slope than those for the other classes (about 2.5 units). All teachers exhibited more sympathetic and affectionate behaviors, than cold and distant ones.

Concerning the teacher–individual student interaction, Fig. 4b shows that after training teacher 1 (i.e., from 3.5 to 4.75 for C1 and from 3.27 to 5.33 for C2) and teacher 3 (i.e., from 4.5 to 5.42 for C5 and from 4.75 to 6 for C6) interacted in a more sympathetic and affectionate manner with their students. A stable trend was observed for teacher 2 (i.e., from 4.08 to 4.37 for C3 and from 3.88 to 4.12 for C4).

3.2. Were students receptive to the effects of their teachers' training?

3.2.1. Students' collective engagement in class

Fig. 5 illustrates students' behaviors related to collective engagement for each class, before and after the teachers' training.
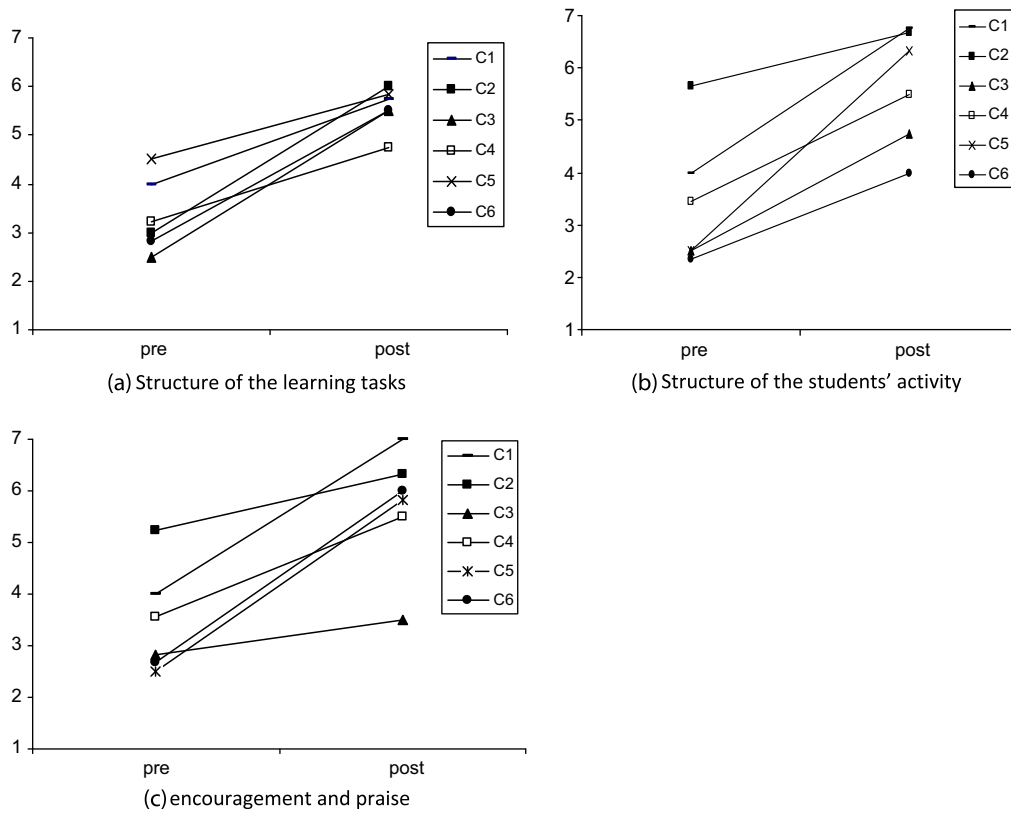
Fig. 3. Teachers' behaviors scores related to structure for each class (C1 and C2 were taught by teacher 1, C3 and C4 were taught by teacher 2, and C5 and C6 were taught by teacher 3).
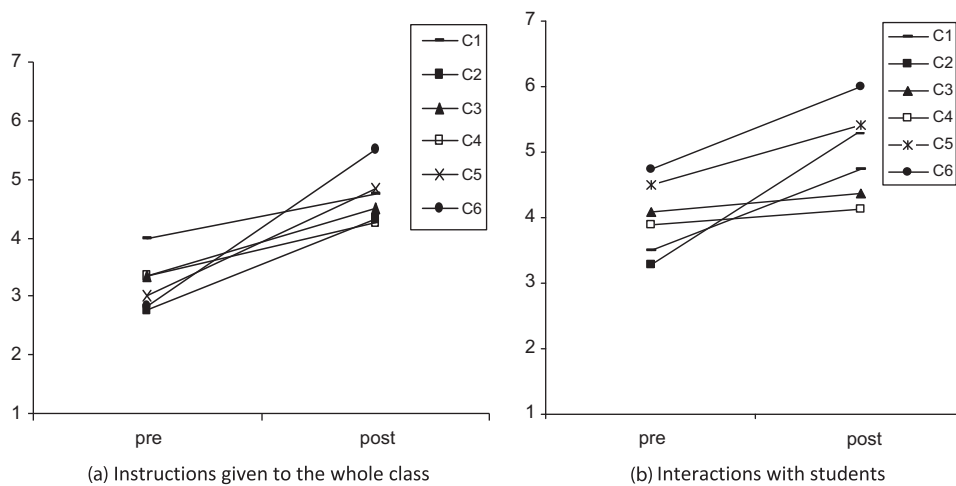

Fig. 4. Teachers' behaviors scores related to interpersonal involvement for each class (C1 and C2 were taught by teacher 1, C3 and C4 were taught by teacher 2, and C5 and C6 were taught by teacher 3).

Except for C3 in which students' collective engagement remained stable (i.e., from 4.27 to 4.3), the increases (about 1 unit) are evident and uniform in all other classes. In fact, for all classes the post-training scores are above the scale midpoint.

3.2.2. Students' self-determined motivation

We performed a repeated measure MANOVA to test the effect of the training on each of the motivational regulations. The results show a significant multivariate effect [Wilks lambda = 0.49; $F(7, 137) = 19.93$, $p < .001$]. Follow-up ANOVA's were significant for only two motivational regulations (see Table 1). More specifically, students reported being less externally regulated [$F(1, 144) = 10.33$, $p < .01$] and less amotivated [$F(1, 144) = 6.94$, $p < .01$] after their teachers' training.

3.2.3. Students' psychological need satisfaction

Similar to the analysis for motivational regulations, we tested the effect of teacher training on each need using a repeated measure MANOVA. The results showed a significant multivariate effect [Wilks lambda = 0.33; $F(3, 124) = 84.80$, $p < .001$]. Follow-up ANO-
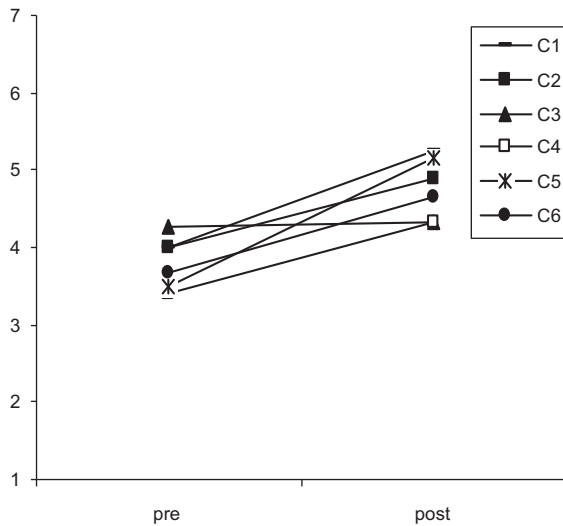
Fig. 5. Students' collective engagement scores for each class (C1 and C2 were taught by teacher 1, C3 and C4 were taught by teacher 2, and C5 and C6 were taught by teacher 3).

Table 1
Results of repeated measures ANOVA's on motivational regulations and psychological needs.

Variable	$M_{\text{pre-training}}$	$M_{\text{post-training}}$	F (1, 144)
Motivational regulations			
IMS	3.66	3.97	2.37
IMA	3.91	3.88	0.40
IMK	3.74	3.63	3.19
IDR	3.22	3.98	1.72
INR	2.71	2.60	0.21
EXR	3.78	3.17	10.33[**]
AM	3.09	2.53	6.95[**]
Psychological needs			
Autonomy	3.21	3.09	1.78
Competence	4.92	4.89	0.20
Relatedness	4.54	4.85	9.19[**]

IMS = intrinsic motivation to experience stimulation, IMA = intrinsic motivation toward accomplishment, IMK = intrinsic motivation toward knowledge, IDR = identified regulation, INR = introjected regulation, EXR = external regulation, AM = amotivation.
[*] $p < .05$.
[**] $p < .01$.
[***] $p < .001$.

VA's were significant only for the need of relatedness (see Table 1). After the teachers' training, students reported a greater satisfaction of this need [$F(1, 126) = 9.19$, $p < .01$].

4. Discussion

Grounded on the SDT framework (e.g., Deci & Ryan, 2002), the purpose of this study was to test the efficacy of a training for physical education teachers aimed to support students' psychological needs, self-determined motivation, and engagement in the class. Two questions guided this work: (1) Drawing from a multidimensional approach (e.g., Reeve et al., 2004; Skinner & Belmont, 1993; Skinner & Edge, 2002) on teachers' interpersonal style, could the training increase teachers' autonomy support, structure and interpersonal involvement? (2) Would the students be receptive to these changes in their teachers' interpersonal style by reporting greater psychological need satisfaction, self-determined motiva-

tion and engagement in learning tasks? Results are discussed in light of these two questions.

4.1. Changes in teachers' interpersonal style

In accordance with our hypothesis, results showed that teachers' participation to an informational session, followed by an individualized guidance program during the last lessons of the cycle, fostered positive changes in the teachers' interpersonal style. For example, in table tennis, teacher 1 organized for C2 a "Davis cup" type tournament (i.e., singles and doubles matches) in which one of the organizational instructions was "you can choose the teammate with who you want to play". In basket-ball with C4, teacher 2 showed a student who performed poorly two possibilities to shoot (i.e., aim at the black rectangle at the back of the ring or moving to one side and then shoot). He subsequently said to the student "maybe you could try 10 times each position and then choose the best". In badminton, to better adapt the learning tasks to the diversity of her students' physical skills in C5, teacher 3 developed for the less-skilled students a game in which they could score only in 2-m zones situated at the front and at the back of the court. For the more skilled students, she developed a game in which they could only score when the shuttlecock fell on the ground without having been touched by the opponent. Whatever the sport, the three teachers tried to give more encouragements such as: "now you're getting the hang of it, let's go". To better affiliate with the students, they used more empathic statements such as "I can see that you are starting to get tired, you can have a break if you want".

On the whole, teachers used need supportive behaviors more frequently after the informational session, except for one autonomy supportive behavior (i.e., organizational instructions) whose frequency of use remained stable in four out of six classes. The latter result is in alignment with those reported in Tessier et al.'s (2008) study, in which a similar behavior was not affected by the educational program. Providing organizational instructions to the whole class in an autonomy-supportive way is certainly one of the most difficult behaviors to adopt for teachers, especially newly qualified ones. Indeed, giving choices to students within a group necessitates experience in class management. In addition, choices are often constrained by the nature of the activity taught or the availability of equipment in the gym.

Our findings expand those by Reeve et al. (2004) and Chatzisarantis and Hagger (2009) by showing that, not only autonomy support, but all three dimensions of teachers' interpersonal style are malleable. In relation to the provision of structure, the collaborative exercises organized during the training session gave the opportunity to the teachers to share with other teachers their instructional methods and the indicators they employ to assess students' performance. It is plausible that enriched by this brainstorming of information, the teachers were subsequently able to give more technical advice and facilitate students' improvement. As far as teacher interpersonal involvement is concerned, the analysis of their own interpersonal style via the video footage and the opportunity to role play the recommended teaching behaviors might have helped the teachers to provide more perspective-talking statements and to gain a greater capacity to acknowledge and accept the negative feelings associated with engaging in physically-demanding activities.

The results also reveal that teacher 2 (C3 and C4) did not manage to change his behaviors as much as the other two teachers did. Three autonomy-supportive behaviors (i.e., organizational instructions, rationales given to the whole class or to a single student) and one behavior related to interpersonal involvement (i.e., interactions with students) remained stable after the informational session. These inter-individual differences among teachers may be due to

personality characteristics. Deci (1995) argued that one's motivating style is partly due to personality. Providing empirical support for this argument, Reeve (1998) showed that prior beliefs of pre-service teachers about the nature of motivation (i.e., their causality orientation) strongly affected how willing they were to accept the merits of an autonomy-supportive style. Reeve showed that pre-service teachers used more autonomy-supportive behaviors following an informational training only to the extent that they saw autonomy support as a superior alternative to their pre-existing strategies. Therefore, the weak effects of the training on teacher 2's behaviors may be due to conceptual resistance from this teacher. Empirical literature discusses the influence of teachers' beliefs on their interpersonal style. For example, previous studies have shown that the rejection of a "liberal" conception of education was linked to an authoritarian predisposition (e.g., Nachtscheim & Hoy, 1976). Also, more recent research on value orientations[6] has demonstrated the influence of these variables on the teachers' choices regarding curriculum content and the nature of their instructional and assessment decisions (e.g., Ennis & Chen, 1995). Thus, it is possible that certain beliefs and values of teacher 2 might have attenuated the effects of the intervention on his teaching behaviors.

4.2. Changes in student need satisfaction, motivation and engagement

The main goal of this study was to promote students' psychological needs satisfaction, self-determined motivation and engagement in physical education lessons by manipulating experimentally the interpersonal style of their physical education teachers. Concerning need satisfaction, students reported a significant increase in relatedness, but no changes in autonomy and competence. It is possible that the positive changes in teachers' behaviors may have been interpreted by the students as a mark of interest in them, increasing their feeling of relatedness. Perhaps the time span was too small to see any meaningful changes in competence. To experience substantial learning in a sport takes time; six lessons in which only 50 min to 1h10 were devoted to learning are maybe too short to make students feel significantly more competent. Also, despite the substantial change in teachers' autonomy-support behaviors, this may be not enough to compensate students' feeling of control emanating from being in a school setting, and in turn improve their feeling of autonomy. According to Brophy (1999), from the students' point of view the school setting is a controlling one because school attendance is compulsory, curriculum content and learning activities are not fun, and student work is graded.

With regard to motivational regulations, the results partially confirm our hypothesis. The improvements in teachers' interpersonal style contributed to reductions in students' non/low self-determined motivation (i.e., amotivation and external regulation), however they did not result in any increases in self-determined motivation (i.e., intrinsic motivation and indentified regulation). These results are not aligned with previous work, which has shown a positive link between autonomy supportive teacher's behaviors and student's self-determined motivation in physical education (e.g., Ntoumanis, 2001, 2005; Standage, Duda, & Ntoumanis, 2005; Taylor & Ntoumanis, 2007). Nevertheless, almost all previous

studies used cross-sectional designs. It is important to take into account the length of time of the post-intervention period in our study. Indeed, it is plausible that three lessons of 2 h each is a rather short period to produce substantial changes in student self-determined motivation (i.e., intrinsic motivation and indentified regulation). Increasing self-determined motivation takes time and requires incorporating in the self the reasons to engage in a behavior (La Guardia & Ryan, 2002). Further, as discussed earlier, it was difficult for the teachers to fully incorporate into their interpersonal style each need supportive behavior. In each teacher and class, some behaviors did not significantly increase as a result of the training program. Thus, it is possible that changes in the teachers' behaviors had not been sufficiently large and consistent to foster a greater degree of internalization of low self-determined motivations into more self-determined ones (Ryan & Deci, 2000).

The findings pertaining to student engagement, with the exception of class 3, confirm our hypothesis, and are aligned with Reeve et al.'s (2004) results. Post-intervention, students were more engaged (physically, cognitively and affectively) than in the pre-intervention period. Teachers seem to have learnt more how to organize and communicate the content of their lessons to facilitate student engagement. Thus, the fact that teachers developed learning tasks that they were more adapted to the diversity of their students' physical skills, gave feedback more frequently, praised and encouraged more individual effort and progress, would have probably increased the actual learning time within a lesson. Further, the fact that they were more involved with their students, listened to them more and offered more empathic statements, must have reduced any apprehensions related to engaging in practicing new motor skills. Finally, the fact that the teachers offered greater support for their students' autonomy by suggesting different possibilities and enhancing initiative taking, must have stimulated students' cognitive activity and learning. In the same vein, the difficulties of teacher 2 to increase the usage of all targeted behaviors (he was able to increase teacher's guidance, structure of the learning tasks, structure of the students' activity, encouragements and praise, instruction given to the whole class) could explain why his students in class 3 did not increase their engagement in lessons. This finding brings up two questions that have implications for the nature of the interplay among the three dimensions of a teacher's interpersonal style. The first question is whether or when the lack of effects from any dimension cannot be compensated by the positive effects of the others? The second question is, when such null findings are observed, are these indicative of one of the dimensions having more weight than the others in terms of predicting students' engagement? Answering such questions by examining the interaction effects of a teacher's interpersonal style dimensions on students' engagement could help to explain why one of the classes (i.e., C3) did not show increased student collective engagement.

It is also interesting to note that the informational session had no effect on students' self-determined motivation (i.e., intrinsic motivation and identified regulation), but had a positive effect on their engagement. This direct relation between teachers' behaviors and students' engagement has also been found in previous research in physical education (e.g., Chatzisarantis & Hagger, 2009; Hagger, Chatzisarantis, Barkoukis, Wang, & Baranowski, 2005; Hagger, Chatzisarantis, Culverhouse, & Biddle, 2003). Future intervention studies are needed to test and explain such direct effects.

4.3. Limitations and future directions

A limitation of this study is that it is unknown whether our results could be generalized to participants from different backgrounds. Our work involved newly qualified teachers interested in experimenting with new teaching strategies and possessing a relatively malleable interpersonal style (Hoy & Woolfolk, 1990).

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[6] Five different orientations have been proposed by Jewett, Bain, and Ennis (1995): disciplinary mastery (the teacher focuses on the mastery of the subject matter, the content of fundamental movement skills, sports and physical activity skills, and fitness-related activities), learning process (the teacher puts the idea of learning how to learn in the center of physical education content), self-actualization (the curriculum goals are dealing with the students' needs and interests), the social responsibility (teacher is concerned about developing positive interpersonal relationships among their students), and the ecological integration (teacher emphasizes a balanced curriculum between the needs of the learner, the subject matter, the educational context and social concerns).

Further, the students came from predominantly well-off families. It would be interesting if future research repeated this study with more experienced teachers with established teaching routines and with students from less privileged backgrounds. It would be also interesting to test whether our teacher training can help teachers in lessons involving less inherently interesting activities (e.g., endurance running).

Another limitation of this study is the lack of control group. One might argue that changes in teachers and students' behaviors and self-reports might have been due to other school contextual variables that were not controlled for in this study (e.g., expectations from school authorities or parents). Although this argument cannot be entirely dismissed, we think that it is unlikely to explain the observed changes. This is because the positive changes appeared over a short period of only 3 weeks (between the fourth and the seventh lesson). Further, as far as teachers' behaviors are concerned, the school context places several demands on the teachers – such as expectations from school authorities or parents – that tend to steer their interpersonal style toward student control than psychological need-support (Brophy, 1999; Pelletier, Séguin-Lévesque, & Legault, 2002). As far as students' responses are concerned, available longitudinal evidence in the literature indicates time-related decline in indices of adaptive motivation during the school year (e.g., Ntoumanis, Barkoukis, & Thøgersen, 2009). Given these considerations, we suggest that our pattern of findings probably reflect the positive influences of our intervention on the teachers and students' behaviors than the influence of any unmeasured contextual effects.

Future intervention studies on teachers' interpersonal style aiming to increase students' self-determined motivation and psychological need satisfaction should utilize a control group and longer time frames (e.g., several months or even an entire school year). In addition, follow-ups are needed to test the durability of the intervention effects. It would also be important to monitor the time required for novice teachers to fully understand the strategies and learn to plan lessons that implemented the target behaviors independently, without a researcher's assistance. Furthermore, the relation between each dimension of the interpersonal style and the satisfaction of students' needs should be tested with many more classes than those sampled in this study to allow for multilevel analysis. Finally, it should be interesting to refine the observational grid in order to measure more comprehensively the effect of teacher behaviors on student engagement. Assessing engagement at the class level certainly produces a loss of information compared to an assessment at the individual level. Also, the cognitive engagement scale would benefit from expansion to include additional deeper level cognitive categories (e.g., problem solving, socio-cognitive conflict, experimentation of multiple solutions), that can provide a broader range of types of cognitive engagement found in the physical education classes.

In summary, the present study replicates and expands upon previous SDT-based intervention studies in school settings (Chatzisarantis & Hagger, 2009; Reeve, 1998; Reeve, Jang, et al., 2004; Tessier et al., 2008). Our findings reinforce the usefulness of the three-dimensional approach in understanding teachers' interpersonal style and its effects on student motivation.

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