Relationship Between Teachers' Interpersonal Style and Student Outcomes in Physical Education

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A thesis submitted in total fulfilment of the requirements for the degree of

Doctor of Philosophy

October 19, 2018

Dedicated to my beloved parents, my wife and our three children for their unconditional love, endless support, and encouragement

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Acknowledgements

This thesis would not have been possible without the financial support of the Brazilian National Council for Scientific and Technological Development (CNPq). I view this scholarship I was awarded to pursue my doctoral studies in Australia as a once in a lifetime opportunity. Thank you.

I would like to thank my principal supervisor, Professor Chris Lonsdale for your guidance, expertise, insight, and most importantly, for your support. Throughout my PhD candidature, you have taught me more than I could ever give him credit for here. I would also like to thank my co-supervisor, Associate Professor Philip Parker, for his guidance, expertise in statistics, and support. It has been a privilege to have had the opportunity to be a student of yours. Thank you.

Besides my supervisors, I would like to thank all the people involved in the iPLAY project since I became a member of the crew. A special thanks to the iPLAY postdoctoral researcher Dr. Taren Sanders, and to the iPLAY project officers that I have had the opportunity to work with, Anna Gonzalez, Kirsty Bergan, and Samuel Robinson. Thanks also to my PhD colleagues, Katherine Owen, Rhiannon White, Aidan Lester, Jane Lee, Devan Antczak, and Asghar Ahmadi for the friendship and constant support.

I would especially like to thank my family. My wife, Roberta has been extremely supportive of me throughout this entire journey and has made countless sacrificies to help me get to this point. Our children, Eduardo, Davi, and Augusto have continually provided the requisite breaks from studies and motivation to finish my degree with expediency. You four are my inspiration to achieve greatness. Without you, I would not be where I am today.

Finally, I would like to acknowledge the Institute for Positive Psychology and Education as a whole. I could not have chosen a better place to do my PhD.

Statement of Sources

This thesis contains no material published elsewhere or extracted in whole or in part from a thesis by which I have qualified for or been awarded another degree or diploma. No parts of this thesis have been submitted towards the award of any other degree or diploma in any other tertiary institution. No other person's work has been used without due acknowledgment in the main text of the thesis. All research procedures reported in the thesis received the approval of the relevant Ethics/Safety Committees (where required).

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19/10/2018

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Abbreviations

Abbreviation	Full term
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
CONSORT	Consolidated Standards of Reporting Trials
PE	Physical Education
PRISMA	Preferred Reported Items for Systematic Reviews and Meta-analysis
RMSEA	Root Mean Square Error of Apporximation
SDT	Self-determination theory
SES	Socioeconomic status
SEM	Structural Equation Modeling
SRMR	Standardized Root Mean Residual
TIDieR	Template for Intervention Description and Replication

Abstract

The overarching aim of this thesis was to investigate the effect of need support from the teacher on primary school students' enjoyment, effort, and cognitive outcomes in physical education. Study 1 was a systematic review and meta-analysis of 265 studies that investigated the evidence regarding the tenets of Self-determination theory (SDT) in the physical education context. With few exceptions, path analysis supported the relationships proposed by SDT. Teacher need support was a stronger predictor of student autonomy (ß = .54, 95% CI [.53, .55]) and competence (ß = .31, 95% CI [.29-.33]), compared with peer support (ß = .17, 95% CI [.16, .18] and ß = .15, 95% CI [.13, .16], respectively). Peer support (ß = .59, 95% CI [.58, .60]) was a stronger predictor of relatedness than teacher support (ß = .25, 95% CI [.24, .26]). Indirect effects of teacher support on adaptive (ß = .19) and maladaptive outcomes (ß = -.15) suggested needs satisfaction and motivation played mediating roles in these relationships. Study 2 investigated selected psychometric properties of the questionnaires used in the thesis, in which I measured students' perceptions of their teacher beahviour and students' perceptions of their in-class affective, behavioural, and cognitive experiences, using data from a sample of Year 3 and 4 students from Australian governament-funded primary schools. The fit indices, item loadings, and internal consistency estimates of scores derived from the measures supported the hypothesized factor structure of the questionnaires employed in this thesis. Study 3 investigated the effects of a teacher training intervention on students' experiences in physical education and school sport lessons. It also examined whether changes in teachers' interpersonal style were mediators of these relationships. Although no total effects of the intervention on student outcomes or teacher behaviour were found, students' perception of the teacher behaviour was found to be a predictor of students' enjoyment, effort, concentration, and use of learning strategies in physical education and school sport lessons.

Chapter 1: Introduction

Overview

This thesis focuses on primary school students' perceptions of their teacher's interpersonal style and how these perceptions can influence student outcomes. Chapter 1 (current chapter) provides a brief overview of the entire thesis and background information on the topic.

Chapter 2 is a systematic review and meta-analysis of 265 studies to examine the evidence regarding the tenets of self-determination theory (SDT; Deci & Ryan, 1985) in the context of school physical education. In addition to exploring the strength of the relationships, I compared the SDT-based motivational sequence with alternate models that have been proposed in the SDT literature. Also, I tested for moderators that could explain some of the heterogeneity found in the effect sizes. The findings from this study contribute significantly to the body of literature, as this was the first review within the physical education setting to test the SDT-based motivation sequence and apply meta-analysis to the data.

Given the lack of research on the relationships between teacher's interpersonal style and student outcomes in primary school students highlighted in the systematic review (Chapter 2), an important step to fill these gaps is to provide researchers with valid measures that produces reliable estimates of these variables. Chapter 3 analysed selected psychometric properties of the questionnaires that were used in this thesis. Data was collected in two schools for preliminary analysis; and then, at the baseline of an intervention involving a larger sample of Year 3 and 4 primary school students and their teachers, from New South Wales, Australia. Overall, the combination of item loadings and internal consistency

estimates of scores derived from the measures used in Chapter 3 supported the hypothesized factor structure of the questionnaire employed in this thesis.

Chapter 4 analysed the relationship between teacher's interpersonal style and students' enjoyment, effort, and cognitive outcomes in physical education. In this chapter, I looked at a randomized controlled trial intervention that trained teachers on needs support in order to support their ability to deliver physical education and school sport lesson. The main objective was to compare between groups changes in student outcomes and their perceptions of their teachers' needs support

Finally, Chapter 5 discussed the general findings of this thesis. In this chapter the three studies conducted are first briefly summarised, and then major points were examined with applied and practical implications for theory and research. Limitations and directions of future research were then discussed.

Background

Teaching practices and Student outcomes in Physical Education

Experiences during physical education and school sport lessons are the result of both environmental factors (e.g., teaching style and peer interactions) and student characteristics (e.g., motivation towards physical education, self-perceptions, and behaviours). Of these contextual factors, teachers are unique in their ability to influence a child's enjoyment, participation, and performance in physical activity. One important aspect of school physical education is the way it is delivered in schools. In hig-school, physical education lessons are delivered by specialist physical education teacher. In primary school, the classroom teacher is the person in charge of delivering physical education lessons along with all other lessons (Lynch & Soukup, 2017). Being responsible for preparing and delivering the physical

activity-related content, the teacher can optimize or inhibit students' in-class experiences depending on the teaching techniques they adopt. Some positive characteristics of the teaching practices are autonomy support, provision of structure during the lessons, and the way the teacher demonstrates involvement with the students.

One of the most influent theories for the understanding of human behaviour is self-determination theory (SDT; Ryan & Deci, 2017). Embedded within SDT, the basic psychological needs mini-theory states that for high quality motivation to develop and for individuals to achieve optimal functioning, three fundamental needs must be fulfilled – the need for autonomy, the need for competence, and the need for relatedness (Garn, McCaughtry, Martin, Shen, & Fahlman, 2012; Standage, Duda, & Ntoumanis, 2005; Taylor & Lonsdale, 2010; van Aart, Hartman, Elferink-Gemser, Mombarg, & Visscher, 2015). Autonomy can be defined as one's need to experience a sense of volition or willingness in one's actions. Competence refers to one's need to experience effectiveness in one's interactions with the world, while relatedness refers to a need for connectedness with significant others, satisfaction with the social world, and a feeling of being accepted (Ryan & Deci, 2017). If these needs are met, people are more likely to be well, and to be autonomously motivated. In contrast, when these needs are not met (or only partially fulfilled), individuals tend to regulate their behavior based on controlled reasons (McDavid, Cox, & McDonough, 2014; Mouratidis, Barkoukis, & Tsorbatzoudis, 2015; Ntoumanis, 2001; Standage et al., 2005). Importantly, basic needs theory points out that competence and relatedness are not expected to be perceived unless accompanied by feelings of autonomy.

SDT also postulates that individuals differ in both levels and types of motivation (Ryan & Deci, 2000a). Organismic Integration Theory (OIT) is the sub-theory within SDT that describes the six different types motivation, also called behavioural regulations. SDT goes beyond a binary conceptualisation of intrinsic/extrinsic motivation and outlines different types

of motivation under the broad category of extrinsic motivation. The six types of regulation are represented on what it is called the *self-determination continuum*, ranging from absolute lack of motivation (i.e., amotivation) to high quality motivation (i.e., intrinsic motivation) (Ntoumanis, 2001; Standage et al., 2005). When not intrinsically motivated, a person can still be motivated but will have their behaviour regulated by external rewards. The different types of extrinsic regulations vary in the amount of autonomy they represent. The most autonomous form of extrinsic motivation is integrated regulation (similar to intrinsic motivation, but there are still external elements such as goals to be achieved, other than the activity itself), followed by identified regulation (when the task is identified with personal values), introjected regulation (acting to avoid sense of guilt or anxiety) and external regulation (doing an activity for an outcome that is external to the individual [e.g., to avoid punishment by the teacher]). According to the degree of autonomy they represent, the different types of motivation have often been categorised as autonomous motivation (intrinsic motivation, integrated, and identified regulation; see for example Cheon, Reeve, & Moon, 2012; Haerens, Aelterman, Vansteenkiste, Soenens, & Van Petegem, 2015; Hagger et al., 2009; Shen, McCaughtry, Martin, & Fahlman, 2009; Yoo, 2015) and controlled motivation (introjected and external regulation; see for example Aelterman et al., 2012; De Meyer, Soenens, Vansteenkiste, et al., 2016; Gairns, Whipp, & Jackson, 2015; Karagiannidis, Barkoukis, Gourgoulis, Kosta, & Antoniou, 2015; Lodewyk & Pybus, 2013; Mouratidis et al., 2015; van Aart et al., 2015), expressing the quality of the motivation. In contrast, amotivation refers to lack of motivation and disinterest.

Along with the model of different types of motivation in OIT is the process of *internalization*, defined as the process by which a person would adopt more autonomous forms of motivation towards an activity. In the education context, for instance, internalization is considered one of the most challenging tasks in teaching, mostly because the contents

teacher wants to teach are not always perceived as enjoyable (i.e., intrinsically motivating) by the students (Deci et al., 1991).

When considered in the field of physical education, SDT proposes that social agents (e.g., teacher and peers) vary in terms of how much they support or thwart students' basic psychological need satisfaction. This directly influences students' need satisfaction and frustration, which in turn, predicts how autonomous or controlled students become in classrooms (Koka, 2013, 2014; Tessier, Sarrazin, & Ntoumanis, 2010; Van den Berghe, Cardon, Tallir, Kirk, & Haerens, 2016). Finally, more autonomous forms of student motivation are associated with more desirable cognitive, behavioral, and affective outcomes for students (Ntoumanis, 2001; Ntoumanis, Taylor, & Standage, 2010; Standage et al., 2005). In this motivational sequence proposed by SDT – adapted from Vallerand (1997), support from social agents is depicted as a direct predictor of students' perception of need satisfaction, and an indirect predictor of motivation and adaptive experiences and/or learning outcomes.

SDT suggests researchers should focus on contextual factors (e.g., teacher and peers) that influence students' outcomes in physical education. According to SDT, an autonomy-supportive social environment tends to facilitate positive affective, behavioural, and cognitive experiences in physical education (Standage et al., 2005). The provision of autonomy, structure, and involvement help support students' basic psychological needs of autonomy, competence, and relatedness. Research on the role of support in organised physical activities has shown that support from peers is an essential antecedent of need satisfaction in the physical education context, and can lead to more self-determined behaviour as well as to adaptive outcomes (Cox, Duncheon, & McDavid, 2009; Cox & Ullrich-French, 2010). For example, significant and positive effects of perceived autonomy support from peers on autonomous motivation in high-school physical education students (Gairns et al., 2015;

Hagger et al., 2009; Koka, 2014) and physical activity behaviour (Koka, 2013). Additionally, student perceptions of need support from the teacher has been found to be a significant predictor of student motivation in the physical education lesson context (Taylor & Ntoumanis, 2007).

Extensively studied with adolescents, *autonomy support* can be provided by the teacher by providing opportunities for choice, showing respect for their students' attitudes and ideas (e.g., they propose a different way to do one activity); providing rationale and emphasising relevance (e.g., explaining why a task is important and where/when it could be used); relying on non-controlling language; displaying patience to allow students the time they need for self-paced learning; and acknowledging and accepting students' expressions of negative affect (Reeve, 2009).

Less studied than autonomy support, *provision of structure* refers to the way the teacher organises and delivers the activities with coherency. Structure is a critical factor in supporting students competence needs (Taylor & Ntoumanis, 2007). Structure is evident when teachers provide clear expectations of the students (e.g., sticking to the rules they have set in the class); demonstrate consistent contingencies for behaviour (e.g., treating their students fairly); offer adequate help (e.g., showing different ways for the students to solve a problem); and monitor during the lesson (e.g., checking if students are ready before they go on) (Belmont, Skinner, Wellborn, & Connell, 1992).

Another teaching practice that is also understudied is *teacher involvement.* Teacher involvement helps support students need for relatedness (Taylor & Ntoumanis, 2007). This includes teachers taking time to express enjoyment in their interactions with students; showing affection (e.g., demonstrating that he/she cares about the students); displaying attunement (e.g., teacher showing that he/she knows the students well); being dependable

(e.g., being there for the students when needed); and dedicating resources (e.g., spending time and talking with the students).

When teachers do not support students psychological needs via autonomy support, provision of structure and involvement, teachers behaviour may be *controlling*. Controlling behaviour is where a teacher determines what and how a student should do an activity without any student input (Bartholomew et al., 2018; Reeve, 2009). Controlling teachers thwart their students' need for autonomy as they tend not to give the students a voice and pressure them to behave in certain ways (Shen, Li, Sun, & Rukavina, 2010; Van den Berghe, Cardon, Tallir, Kirk, & Haerens, 2016). Also, teachers can thwart student's need for competence by setting unrealistic goals, or simply by creating a chaotic learning environment when the rules and expectations are not made clear (De Meyer et al., 2014; Van den Berghe et al., 2013). Controlling teachers often do not listen to their students, or reject or exclude them during tasks, which can be detrimental for their need for relatedness (De Meyer et al., 2014; Gibbons, 2014; Shen et al., 2010). It is noteworthy that a lack of need support from the teacher does not imply in need thwarting (Cheon et al., 2019).

Students' individual experiences have been associated with their teachers' behaviour. Indeed, studies have demonstrated that perceived need support from the teacher is associated with students' needs fulfilment, which in turn leads to self-determined motivation and positive experiences in the physical education context (Cox & Williams, 2008; Ntoumanis, 2001, 2005; Standage, Duda, & Ntoumanis, 2003). Students whose teacher acts in an autonomy-supportive manner are expected to achieve positive outcomes in the class. For example, an experimental study of 1,158 physical education students by Cheon et al. (2012) found that students' autonomous motivation, amotivation, classroom engagement, skill development, future intentions to exercise, and academic achievement improved for students whose teachers were more supportive of their autonomy. Also, an empirical study by

Sanchez-Oliva, Sanchez-Miguel, Leo, Kinnafick, and García-Calvo (2014), with 1,692 Spanish students, found that competence support from the teacher predicted students' autonomous motivation, which in turn positively predicted students' enjoyment, perceived importance of physical education, and intentions to further participate in out of school physical activity. In addition, a study by Sparks, Lonsdale, Dimmock, and Jackson (2017) found teacher relatedness support predicted students' enjoyment, confidence in their teacher's ability, and their estimation of their peers' confidence in their ability. As a consequence, students demonstrating enjoyment and interest in learning and mastery a new skill in physical education tend to have better physical performance and motor skills development, physical fitness, concentration and attention in the lesson, and in-class participation (e.g., effort), as well as intentions to participate in leisure time physical activity (Standage et al., 2003). Teachers may also engage in controlling behavior, where they determine what students should do during the lesson without seeking students' input, rely on pressure-inducing language, and pressure students to think, feel, and behave in a specific way (Reeve, 2009). In the school physical education context, research has found that perceptions of controlling teaching predicted undesirable outcomes, such as poor quality student motivation, negative affect (Ntoumanis, 2005), anger and bullying (Hein, Koka, & Hagger, 2015a), fear of failure and boredom (Leptokaridou, Vlachopoulos, & Papaioannou, 2014), and less engagement (Bartholomew et al., 2018; De Meyer et al., 2016; De Meyer et al., 2014; Haerens et al., 2015; Van den Berghe et al., 2016).

In this thesis I investigated an intervention that involved training on needs support to help primary teachers deliver quality physical education and school sport lesson. The following section provides information of previous SDT-based intervention work that has been conducted within the physical education context.

SDT-based interventions in school physical education

SDT researchers have developed professional programs aiming specifically at promoting physical activity participation among physical education students. When conducting trials, researchers are often interested in: a) exploring the extent to which the application of SDT-based needs-supportive training can change teachers' interpersonal style; and b) whether these changes can effectively influence students' behaviour.

Apart from attempting to promote physical activity behaviour, most of the SDT school-based interventions have another common characteristic—they have been conducted with high school students (Aelterman, Vansteenkiste, Van Den Berghe, De Meyer, & Haerens, 2014; Chatzisarantis & Hagger, 2009; Cheon & Reeve, 2013, 2015b; Cheon et al., 2012; Ha, Lonsdale, Lubans, & Ng, 2017; Lonsdale et al., 2017b; Perlman, 2015; Rosenkranz et al., 2012; Sparks, Lonsdale, Dimmock, & Jackson, 2017; Tessier, Sarrazin, & Ntoumanis, 2008, 2010b). Few studies have investigated the efficacy of SDT-based interventions in primary school teachers and students (Cohen, Morgan, Plotnikoff, Callister, & Lubans, 2015; Escriva-Boulley, Tessier, Ntoumanis, & Sarrazin, 2018). These interventions have examined the impact of needs-supportive training on teacher behaviour, and also on other SDT constructs (i.e., needs satisfaction and motivation). Interventions have also investigated the effect these programs had on students' in-class affective and behavioural experiences, with little attention being paid to cognitive outcomes (e.g., Chatzisarantis & Hagger, 2009; Cheon et al., 2012; Sparks et al., 2017).

In this thesis I will investigate an intervention that is designed to influence primary teachers' need supportive behaviour. I will be particularly focused on the effect this has on students' psychological outcomes. The next three sections of this document provide definition and rationale for measuring these selected student outcomes in this thesis (i.e.,

enjoyment, effort, and cognitive outcomes); the relationship of each outcome with other SDT constructs; and evidence within physical education.

Enjoyment in Physical Education

Definition and rationale. Affective outcome in this thesis refers to students' level of enjoyment in the physical education lesson. I decided to investigate enjoyment experiences as a measure of student in-class affective outcome because enjoyment has been found to predict other learning outcomes, such as classroom engagement (Cheon et al., 2012; Pharez, 2016), perceived learning in physical education (Dupont, Carlier, Gérard, & Delens, 2009), and in-class physical activity behaviour (Cox, Smith, & Williams, 2008), for example.

Relationships involving enjoyment and SDT variables. According to SDT, positive affective outcomes such as enjoyment are influenced by need-supportive environments. These types of environments create situations in which students are likely to experience positive outcomes because they satisfy students' psychological needs and autonomous forms of motivation. When teachers use positive strategies, and avoid using controlling language to teach, they provide students with a sense of autonomy, competence, and relatedness in the tasks. Resulting from perceptions of need support and satisfaction, experience of enjoyment in the physical education lessons is important because it has positive associations with lesson-related outcomes such as perceived learning (Aelterman, Vansteenkiste, Soenens, & Haerens, 2016; Dupont et al., 2009; Shen et al., 2009), satisfaction (Bekiari, Kokaridas, & Sakellariou, 2006; Escartí & Gutiérrez, 2001), intentions to practice physical activity (Dupont et al., 2009; Sanchez-Oliva, Sanchez-Miguel, Leo, Kinnafick, & Garc¡a-Calvo, 2014), and leisure-time physical activity (Abarca-Sos, Bois, Zaragoza, Generelo, & Julian, 2013; Cox et al., 2008).

Evidence within physical education. SDT constructs have been investigated as antecedents of experiences of enjoyment in the physical education lesson context. For

instance, autonomous motivation was found to have a positive effect on enjoyment in physical education, whereas controlled motivation negatively predicted enjoyment (Cox et al., 2008; Sanchez-Oliva et al., 2014). Motivation is one mediator of the relationship between need satisfaction and enjoyment in physical education (Gråstén, Jaakkola, Liukkonen, Watt, & Yli-Piipari, 2012; Wang & Liu, 2007).

Need supportive environments are also expected to have a positive effect on students' enjoyment in physical education. Need support from the teacher provides consistent evidence on positive lesson-related outcomes. The effect of an autonomy-supportive learning context created by the teacher is mediated by needs satisfaction (Ntoumanis, 2001, 2005). A Sport Education intervention program, which among other things aimed to enhance perceptions of autonomy in physical education, increased high school students' enjoyment of sports (Wallhead & Ntoumanis, 2004). As proposed by SDT, autonomy-supportive contexts can predict affective responses in physical education through the satisfaction of inner motivational sources (e.g., psychological needs). However, most of the evidence in support autonomy support comes from the provision of choice only, and it is plausible that the implementation of strategies that address a broader number of the elements involved in supporting students' need for autonomy provides a better insight into how autonomy support may affect enjoyment of the lessons. Further, in some experiments the researchers were the ones delivering the intervention, which can have induced to biased results (e.g., Gillison, Standage, & Skevington, 2013).

Effort in Physical Education

Definition and rationale. Effort is defined in this thesis as the extent to which an individual exerts himself toward getting involved in a task. I have chosen effort as a student outcome to measure because effort has been found to be a central mechanism that explains student learning (Hopland & Nyhus, 2016; Malmberg, Walls, Martin, Little, & Lim, 2013).

Furthermore, it has also largely been studied as a measure of student in-class behavioural involvement (Cheon et al., 2012; Cox, Ullrich-French, & Sabiston, 2013).

Relationship between effort and SDT constructs. Self-determination theory posits that students' effort is influenced by inner sources of motivation, which can be enhanced when teachers support students' need satisfaction (i.e., needs for autonomy, competence, and relatedness) in the lesson context. Students employing more effort in the lessons present higher levels of physical activity in general (Cox & Ullrich-French, 2010; Ullrich-French & Cox, 2009), experience enjoyment in the lesson (Wallhead, Garn, & Vidoni, 2014), and show higher intentions to engage in physical activity (Ntoumanis, 2001; Papacharisis, Simou, & Goudas, 2003).

Evidence within physical education. Motivation plays an important role on intensity of effort students employ in physical education. Lonsdale, Sabiston, Raedeke, Ha, and Sum (2009) found that students with greater self-determined motivation spend more time being active during the lesson than their peers with lower self-determined motivation. Increasing students' physical activity levels during physical education can give them opportunities to experience the well documented physical and mental benefits associated with regular physical activity (Penedo & Dahn, 2005), as physical education is a mandatory subject in many schools. Physical activity levels have been considered as a synonym of effort in some studies. But this is a mistake. Some activities such as invasion games (e.g., soccer) expect more movement from the players than a high jump, for example. In both situations, the student can put a lot of effort in trying to do well, but the physical activity levels will be higher in the soccer game.

Perceived effort is also positively correlated with satisfaction of the psychological needs for autonomy, competence, and relatedness (Wallhead et al., 2014). This is, students display more effort in the classroom when they perceive that these needs are fulfilled. For

instance, moderate-to-strong positive associations have been found between effort and autonomy (Hein & Caune, 2014; Pan, Tsai, Chu, & Hsieh, 2011), competence (Fernandez-Rio, Méndez-Giménez, & Estrada, 2014; Marmeleira, Aldeias, & Medeira da Graça, 2012), and relatedness (Pan et al., 2011). Further, limited evidence has confirmed these relationships longitudinally Taylor, Ntoumanis, Standage, and Spray (2010), therefore longitudinal analysis of the relationship between need satisfaction and effort is an important gap in the literature.

Levels of intensity of effort in learning can also be influenced by the teaching strategies adopted by the teacher (Cheon & Reeve, 2015a; Cheon et al., 2012; Liukkonen, Barkoukis, Watt, & Jaakkola, 2010; Tessier, Sarrazin, & Ntoumanis, 2010a; Xiang, Chen, & Gao, 2013). Evidence showing the role of teachers' autonomy support in predicting students' effort is consistent (e.g., Gillison et al., 2013; Hein & Caune, 2014; Zhang, Solmon, & Gu, 2012), and this relationship can be mediated by students' needs satisfaction (e.g., Taylor & Lonsdale, 2010). Competence and relatedness support (concepts similar to provision of structure and involvement, respectively) have also been found to be predictors of effort in physical education (Leptokaridou et al., 2014). However, many of these studies have examined a composite measure of need support and the individual contribution of each need support construct in predicting students' effort remains unclear (e.g., García-Calvo, Sánchez-Oliva, Leo, Amado, & Pulido, 2016; Zhao & Li, 2016). Further, little is known about the influence of the support from primary school teachers on their students' effort, as most of the research examining this association in the physical education setting has been conducted with middle and high school students.

Cognitive outcomes in Physical Education

Definitions and rationale. In this thesis, students' cognitive outcomes represent a motivated behaviour associated with their levels of concentration and use of cognitive strategies when trying to learn physical education-related skills. Concentration and use of strategies to learn provide information about students' cognition at different levels. While concentration helps to understand cognition at a broader level, the use of cognitive learning strategies provides deeper insight about how students connect the lesson content to situations that occur out of the lesson context. For example, the use of learning strategies in physical education has been associated with intrinsic motivation for doing leisure-time physical activity (Pihu, Hein, Koka, & Hagger, 2008), suggesting that students that make use of such type of strategies in the physical education context are likely to engage in physical activity outside of school for intrinsic reasons (e.g., fun, pleasure, etc).

Relationships in SDT. SDT suggests that contexts that nurture students' psychological needs, and will consequently enhance self-determined motivation, can positively influence students' cognitive outcomes in physical education. As a consequence, higher levels of concentration in the lesson are positively associated with lesson-related outcomes such as persistence/effort (Zhang et al., 2012) and negatively associated with negative affect (Ntoumanis, 2005). The use of learning strategies is correlated with both participation and performance in physical education (Ulstad, Halvari, Sørebø, & Deci, 2016), and can be viewed as a significant predictor of students' in-class physical activity behaviour (Zhu & Chen, 2015).

Evidence within physical education. In the SDT literature, studies have found a link between SDT variables (i.e., need support, needs satisfaction, and motivation) and levels of concentration in the physical education class. For instance, Ntoumanis (2005) found that self-determined motivation positively predicted concentration in the physical education class.

Standage et al. (2005) showed that intrinsic motivation positively predicted concentration, whereas amotivation (i.e., lack of motivation) was a negative predictor of concentration. Another important SDT variable, relatedness, was found to be positively correlated with attention in physical education by Standage and Gillison (2007). That means, the more the students felt related or connected to one another and/or to the teacher, the more attentive they were during the lessons. Zhang et al. (2012) investigated the importance of a need-supportive environment created by the teacher on middle school student outcomes including concentration. This is one of the few studies that explored and reported on the individual needs support constructs. The authors found that the more supportive students perceived their teacher to be, the more they concentrated in their classes. Specifically, perceived autonomy support and competence support predicted concentration, β=.21 and β=.20, respectively.

Few studies have looked at the use of learning strategies in physical education from a SDT perspective. Classroom engagement was one of the outcomes investigated in middle and high school students by Cheon et al. (2012). Although the authors did not separate classroom engagement into its dimensions for analysis, cognitive engagement was measured through use of sophisticated strategies when learning physical education-related skills (e.g., "When learning a PE activity, I try to relate what I'm learning to what I already know"). In that study, the broad construct labelled classroom engagement significantly increased for students of teachers in the experimental condition (received training to be more autonomy-supportive), but not in the control condition. In a sample of middle and high school students, Xiang et al. (2013) found that the provision of instructional cognitive choice (β = .167), organizational choice (β = .021), and procedural choice (β = .221) to support student autonomy were predictors of a composite measure of behavioural and cognitive (use of self-regulation strategies – e.g., "I ask myself questions while practicing to monitor my performance") engagement.

A recent study among 8-10 graders in Norway showed a positive link between need satisfaction and the use of learning strategies, and this association was mediated by autonomous motivation (Ulstad et al., 2016). The learning strategies investigated by the authors were *effort regulation* (e.g., "Even when tasks in physical education are dull and uninteresting, I manage to keep working until I finish"; *peer learning* (e.g., "I try to work with other students from this class to complete the tasks and activities"; *help seeking* (e.g., "When I can't understand the tasks and exercises in physical education, I ask another student in this class for help"; and *absorption* (e.g., "In this PE class I am concentrated on fulfilling the tasks"). The authors found moderate-to-strong associations between a composite measure of learning strategies and autonomy support (r = .39), needs satisfaction (r = .68), and autonomous motivation (r = .65). In addition, the latent learning strategies was a predictor of student performance (ß = .43) in physical education.

Research problem

Investigating consequences of teacher need support is important, as this would help determine teaching strategies adopted by the teacher that facilitate students' learning-related outcomes. Moreover, the evidence presented in this Chapter also demonstrates that most of the evidence within the physical education comes from the provision of autonomy support from the teacher, therefore, there is lack of research exploring provision of structure (i.e., competence support) and teacher involvement (i.e., relatedness support) and its direct association with students' in-class experiences in physical education in primary school students. The evidence presented in this chapter leads to the following research question: what is the effect of primary school teacher need support on primary school students' enjoyment, effort, and cognitive outcomes in physical education?

Research aim

The overarching aim of this thesis was to examine the effect of need support from the teacher on primary school students' enjoyment, effort, and cognitive outcomes in physical education. To achieve this aim three distinct studies were conducted:

Study 1 systematically combined the evidence from research that applied the SDT tenets within the physical education context. In order to further explore the relationship between teacher need support and student outcomes in physical education, I applied meta-analysis to the data and I also tested the motivational sequence proposed by SDT (i.e., social context $\rightarrow$ needs satisfaction $\rightarrow$ motivation $\rightarrow$ outcomes). Study 1 identified a number of gaps in the literature, some of which directed Study 2 and Study 3.

In Study 2 and Study 3 I investigated an intervention on primary school teachers' need supportive behaviour. Study 2 tested selected psychometric properties of the questionnaires used in this thesis, which consisted of measures of primary school students' perceptions of their teacher behaviour as well as students' perceptions of enjoyment, effort, concentration, and use of learning strategies in physical education and school sport lesson.

Finally, in Study 3, I examined the effect the intervention had on teacher behaviour and these student outcomes, and the effect teacher behaviour had on the student outcomes under investigation in this thesis. The selected outcomes are in line with the national goals set by the Australian Curriculum for primary schools. During primary school in Australia, the curriculum not only supports students to be more physically active (thus the importance of examining effort), but also expect students to develop knowledge and understanding of opportunities in which they can engage to enhance their health and wellbeing, hence the need for investigating enjoyment, concentration, and learning strategies in physical education (Australian Curriculum, 2016).

Chapter 2: The Literature Review: Study 1 – Self-determination Theory Applied to Physical Education: A Systematic Review and Meta-analysis

Abstract

In this review, I examined the evidence regarding self-determination theory within the school physical education context. I applied a multi-level structural equation modelling approach to meta-analyse data from a systematic review that identified 265 relevant studies. With few exceptions, path analysis supported the relationships proposed by SDT. Teacher need support was a stronger predictor of student autonomy (ß = .54, 95% CI [.53, .55]) and competence (ß = .31, 95% CI [.29-.33]), compared with peer support (ß = .17, 95% CI [.16, .18] and ß = .15, 95% CI [.13, .16], respectively). Peer support (ß = .59, 95% CI [.58, .60]) was a stronger predictor of relatedness than teacher support (ß = .25, 95% CI [.24, .26]). Indirect effects of teacher support on adaptive (ß = .19) and maladaptive outcomes (ß = -.15) suggested needs satisfaction and motivation played mediating roles in these relationships. In sum, need-supportive teaching appears to motivate students towards adaptive outcomes in physical education through autonomy and competence, while peer influence on outcomes is more strongly associated with relatedness.

Keywords: classroom learning, physical education, motivation, meta-analysis

Introduction

A substantial body of motivational research in education has emerged over the past few decades (Dai, Moon, & Feldhusen, 1998; Deci, Vallerand, Pelletier, & Ryan, 1991; Rosenzweig & Wigfield, 2016; Schunk, 1991; Turner & Patrick, 2008). Self-determination theory (SDT; Deci & Ryan, 1985) has been one of the more prominent conceptual frameworks underpinning this research; however, in many areas of education, no comprehensive synthesis of the existing SDT literature has been completed. For example, SDT has emerged as one of the most popular theories of motivation employed in physical education research (Lindahl, Stenling, Lindwall, & Colliander, 2015), yet no systematic review of SDT-based research has been undertaken in this context, though Ryan and Deci (2017) have recently provided an extensive narrative review chapter. In this study, I systematically reviewed and meta-analysed evidence from SDT-based research applied to the context of school physical education.

Most children and adolescents globally are insufficiently physically active, placing them at increased risk of ill-health and ill-being (Boddy, Fairclough, Atkinson, & Stratton, 2012; Cohen et al., 2011; Ekelund, Luan, Sherar, & et al., 2012; Spittaels et al., 2012). Physical education presents an opportunity to not only help students be active during the school day, but also acquire the knowledge, skills, and motivation to be active outside school hours and in later life (Cohen et al., 2015; Gu & Solmon, 2015; Jaakkola & Washington, 2013; Lonsdale et al., 2017a; Shen, 2014). However, many students do not have positive experiences in physical education (Moreno-Murcia, Coll, & Pérez, 2009; Taylor & Ntoumanis, 2007), with poor quality motivation towards physical activity and low physical self-concept. Self-determination theory is potentially a viable framework from which to understand student experiences in physical education and develop interventions that could enhance student learning and motivation towards physical activity. This review focuses

specifically on physical education, rather than other educational contexts for a number of reasons. First, the nature of physical education lessons is that displays (and by extension evaluations) of competence are typically public, while in academic lessons these public displays are more often relatively covert. Second, many of the learning goals of physical education are qualitatively different from academic lessons, with healthy behaviours (e.g., physical activity outside school) a common focus of empirical investigations. As such, I limited my review to the physical education context and excluded research conducted on motivational processes and outcomes in other subjects.

I also sought to compare the motivational sequence outlined in SDT (i.e., social context → need satisfaction → motivation → outcomes) with an alternate model that has been proposed in the SDT literature, the dual-process model – where teacher support predicts the "bright" side of students' motivation and functioning, while controlling teaching style predicts the "dark" side. By understanding the potential effect social agents may have on students' outcomes, this review will be able to help delineate what teacher and peer focused interventions should focus on.

Theoretical Background

Self-determination theory (Deci & Ryan, 1985; Ryan & Deci, 2000a, 2017) describes the process through which motivation develops and how it influences human behaviour and wellbeing. Embedded within SDT, the basic psychological needs mini-theory states that for high quality motivation to develop and for individuals to achieve optimal functioning, three fundamental needs must be fulfilled – the need for autonomy, the need for competence, and the need for relatedness (Garn, McCaughtry, Martin, Shen, & Fahlman, 2012; Standage, Duda, & Ntoumanis, 2005; Taylor & Lonsdale, 2010; van Aart, Hartman, Elferink-Gemser, Mombarg, & Visscher, 2015). Autonomy can be defined as one's need to experience a sense of volition or willingness in one's actions. Competence refers to one's need to experience

effectiveness in one's interactions with the world, while relatedness refers to a need for connectedness with significant others, satisfaction with the social world, and a feeling of being accepted (Ryan & Deci, 2017). If these needs are met, people are more likely to be well, and to be autonomously motivated. In contrast, when these needs are not met (or only partially fulfilled), individuals tend to regulate their behaviour based on controlled reasons (McDavid, Cox, & McDonough, 2014; Mouratidis, Barkoukis, & Tsorbatzoudis, 2015; Ntoumanis, 2001; Standage et al., 2005).

SDT also postulates different types of motivation (Ryan & Deci, 2000a). Organismic integration theory is a sub-theory within SDT that describes these different types of motivation, known as behavioural regulations. SDT goes beyond a binary conceptualization of intrinsic and extrinsic motivation as it outlines four different types of motivation under the broad category of extrinsic motivation. Figure 1 depicts six types of regulation on what it is known as a *self-determination continuum*, ranging from a lack of motivation (i.e., amotivation) to the most autonomous forms of motivation (e.g., intrinsic motivation, identification) (Ntoumanis, 2001; Standage et al., 2005). There are four different types of extrinsic motivation which vary in their individual characteristics, as well as in the amount of autonomy they represent. The least autonomous form of extrinsic motivation is external regulation (doing an activity for contingent rewards or punishments controlled by others), followed by introjected regulation (acting to avoid sense of guilt or anxiety or to protect contingent self-worth), identified regulation (when the task is aligned with personal values), and integrated regulation (when activity is fully assimilated with individual's sense of self). Organismic integration theory describes these differences in terms of *internalization*, defined as the process by which a person adopts more autonomous forms of motivation towards an activity. Internalization is often considered one of the most challenging aims in teaching, because not all tasks students do will be intrinsically motivating (Deci et al., 1991). These

different types of motivation have been categorized in some analyses as autonomous motivations (intrinsic motivation, integrated, and identified regulation; see for example Cheon, Reeve, & Moon, 2012; Haerens, Aelterman, Vansteenkiste, Soenens, & Van Petegem, 2015; Hagger et al., 2009; Shen, McCaughtry, Martin, & Fahlman, 2009; Yoo, 2015) and controlled motivations (introjected and external regulation; see for example Aelterman et al., 2012; De Meyer et al., 2016; Gairns, Whipp, & Jackson, 2015; Karagiannidis, Barkoukis, Gourgoulis, Kosta, & Antoniou, 2015; Lodewyk & Pybus, 2013; Mouratidis et al., 2015; van Aart et al., 2015)..

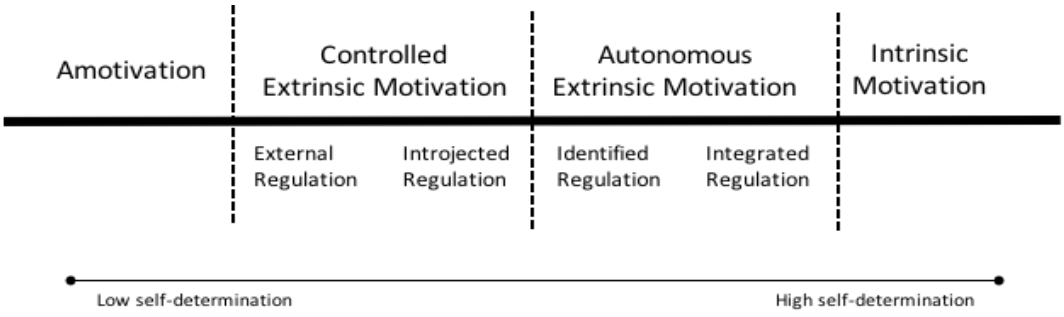


Figure 1. The Self-determination continuum

According to SDT, social agents (e.g., teacher and peers) vary in terms of how much they support or thwart students' basic psychological need satisfaction. This directly influences students' need satisfaction and frustration, which in turn, predicts how autonomous or controlled students become in classrooms (Koka, 2013, 2014; Tessier, Sarrazin, & Ntoumanis, 2010; Van den Berghe, Cardon, Tallir, Kirk, & Haerens, 2016). Finally, more autonomous forms of student motivation are associated with more desirable cognitive, behavioural, and affective outcomes for students (Ntoumanis, 2001; Ntoumanis, Taylor, & Standage, 2010; Standage et al., 2005). This sequence is illustrated in Figure 2 – adapted from (Vallerand, 1997), in which support from social agents is depicted as a direct

predictor of students' perception of need satisfaction, and an indirect predictor of motivation and adaptive experiences and/or learning outcomes.

A need supportive environment encompasses support for autonomy, competence and relatedness. In the education context, supporting students' *autonomy* means nurturing their inner motivational resources by respecting their attitudes and suggestions (e.g., proposing a different way to do an activity), providing rationales to attribute meaningfulness to learning (e.g., explaining why a task is important and where/when it could be used), relying on non-controlling language, providing opportunities for choice, displaying patience to allow students the time they need for self-paced learning to occur, and acknowledging and accepting expressions of negative affect (Reeve, 2009). *Competence* support refers to the way the teacher organizes and delivers the activities. Competence support (i.e., structure) is evident when teachers provide clear expectations of the students (e.g., sticking to the rules they have set in the class), demonstrate consistent contingencies for behaviour (e.g., not acting differently regardless of students' performance on a task), offer adequate help (e.g., showing different ways for the students to solve a problem), and monitor during the lesson (e.g., checking if students are ready before he/she goes on) (Belmont et al., 1992). *Relatedness* support (i.e., involvement) includes teachers taking time to express enjoyment in their interactions with students, showing affection (e.g., demonstrating that he/she cares about the students), displaying attunement (e.g., teacher showing that he/she knows the students well), being dependable (e.g., being there for the students when needed), and dedicating resources (e.g., spending time and talking with the students). Teachers may also engage in *controlling* behaviour, where they determine what students should do during the lesson without seeking students' input, rely on pressure-inducing language, and pressure students to think, feel, and behave in a specific way (Reeve, 2009).

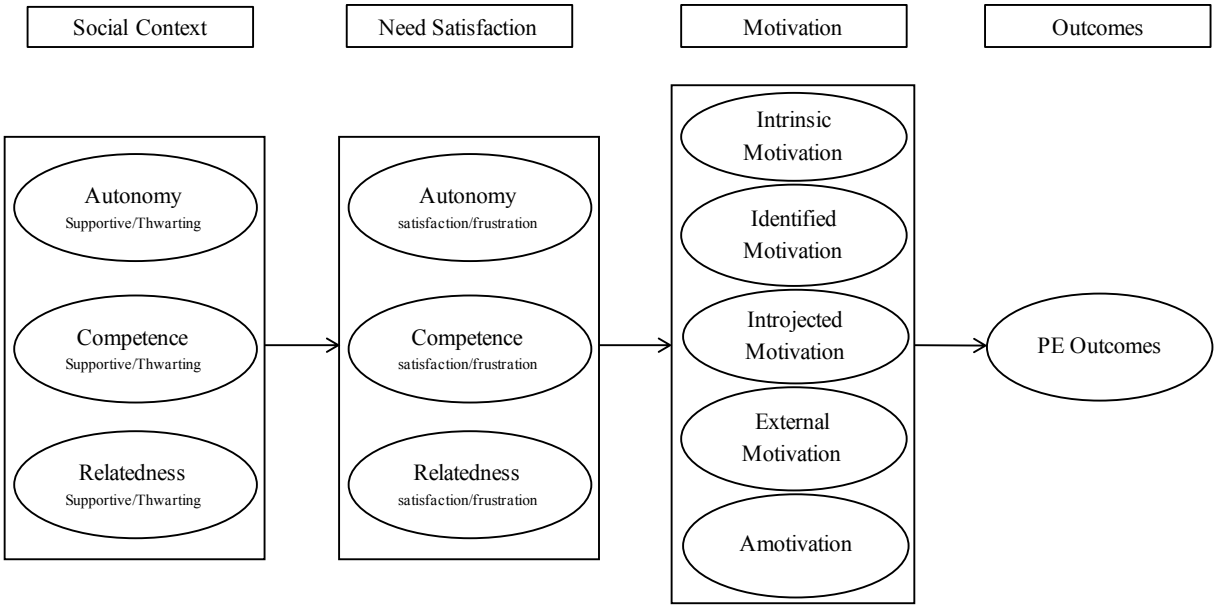


Figure 2. Model of motivational sequence in the context of school physical education, adapted from Vallerand (1997)

Previous Reviews

Researchers have reviewed some of the evidence involving SDT constructs and related consequences in the context of school physical education (e.g., Chatzisarantis, Hagger, Biddle, Smith, & Wang, 2003; Chen, Chen, & Zhu, 2012; Ntoumanis & Standage, 2009; Van den Berghe, Vansteenkiste, Cardon, Kirk, & Haerens, 2014). However, none of these reviews have applied a meta-analytic approach to examine the SDT-based double mediation model in physical education (Ryan & Deci, 2017; Vallerand, 1997). Meta-analysis offers the opportunity to critically evaluate and statistically combine results of comparable studies or trials. For example, Ntoumanis and Standage's (2009) review was narrative, rather than systematic, and Van den Berghe et al.'s (2014) systematic review did not include a meta-analysis. Other reviews included meta-analyses, but focused on a relatively narrow aspect of the model. For example, Chatzisarantis et al. (2003) examined the associations among perceived competence, self-determined motivation, and intentions towards physical activity in the exercise, sport, and physical education settings, while Chen et al. (2012) reviewed the association between motivation and competence-based outcomes. My review

includes a systematic approach designed to include all relevant literature and applies meta-analysis in order to:

1. quantify the mean associations and test the motivational sequence model,
2. explore moderating factors associated with heterogeneity in effect sizes among existing studies, and
3. identify promising avenues for intervention to improve students' experiences in physical education.

Purpose and Hypotheses

The overarching purpose of this review was to examine the evidence regarding the tenets of SDT within the physical education context. To achieve this aim, I first explored the strength of each of the associations proposed in SDT-based model summarized in Figure 2 – adapted from Vallerand (1997). Then, I examined potential demographic moderators of these associations (i.e., age, sex, culture – to test the SDT tenet that such associations are expected to be universal). SDT claims that the need for autonomy is a universal need. As such it should be related to positive functioning in all countries. However, culture may play a moderating role in the way in which basic needs are met (or not met) and the types of mechanisms by which they effect well-being. For example, Hofstede's (2001) classification of individualism and collectivism highlights that individual needs and goals are valued more in individualistic-oriented cultures, than it is in collectivistic-oriented societies. The differential influence of the relationship between social context and autonomy perceptions has yet not been tested in any synthesis of the SDT-physical education-based literature. Also, the different developmental stages between children and adolescents my affect the way they regulate their behaviour. Indeed, some research has found contrasting results when examining the relationship between extrinsic forms of motivation (e.g., introjection) and adaptive outcomes

in primary versus high school students (Chen & Hypnar, 2015). Differences between boys and girls may also play a moderating role in the SDT physical education-based literature. With regards to the different forms of motivation proposed by SDT, for example, some adolescents do not differentiate intrinsic motivation (i.e., what they enjoy) and identified regulation (i.e., what they value) (Lonsdale, Sabiston, Taylor, & Ntoumanis, 2011). Next, I conducted moderation analyses to examine the influence that methodological study characteristics (i.e., risk of bias) had on the effect sizes. Secondly, I tested the structural model outlined in Figure 2, which hypothesizes that need satisfaction and motivation are mediators of the effect social agents have on students' outcomes in physical education. I then compared the hypothesized model – which represents a double mediation SDT motivational sequence – with the dual-process model (Bartholomew et al., 2018; Haerens et al., 2015; Jang, Kim, & Reeve, 2016) in which teacher support is hypothesized to predict the "bright side" of students' motivation and functioning (i.e., needs satisfaction, autonomous motivation, and desirable outcomes), while teacher controlling behaviour is expected to predict the "dark side" of students' motivation and functioning (i.e., needs frustration, controlled forms of motivation and amotivation, and undesirable outcomes) (see Figure 3a). This alternate model is based on tenets from basic psychological needs theory, which is a mini-theory embedded within SDT.

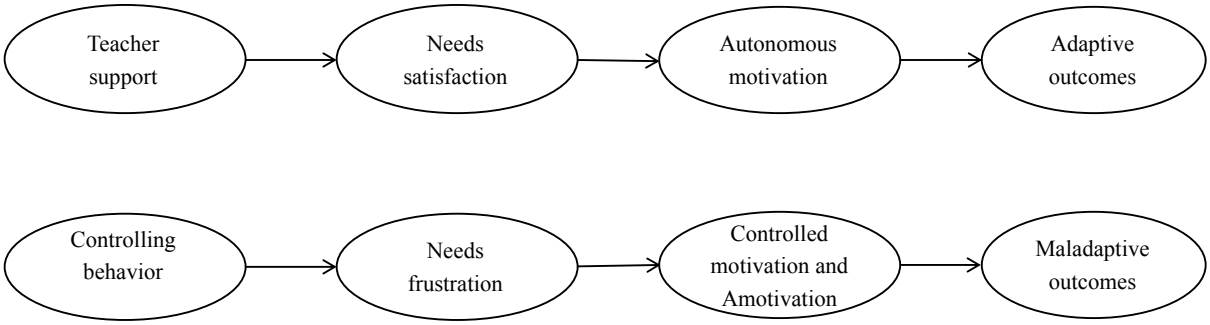


Figure 3a. Dual-process model of motivational sequence in the context of school physical education.

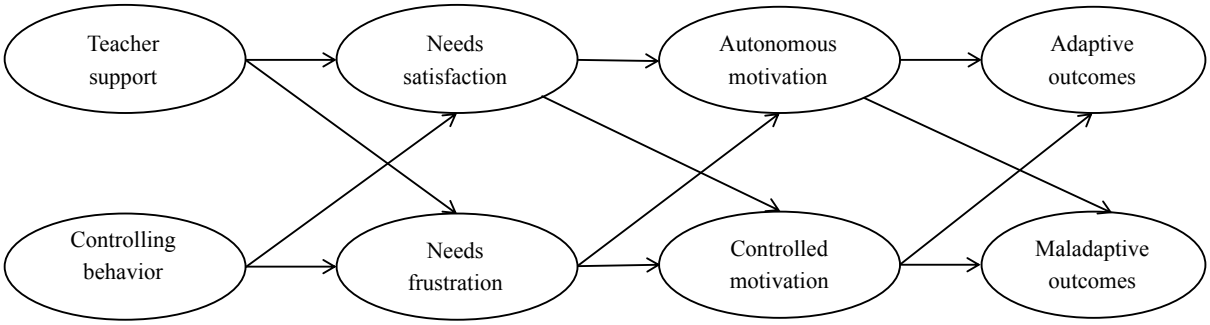


Figure 3b. an SDT motivational sequence model.

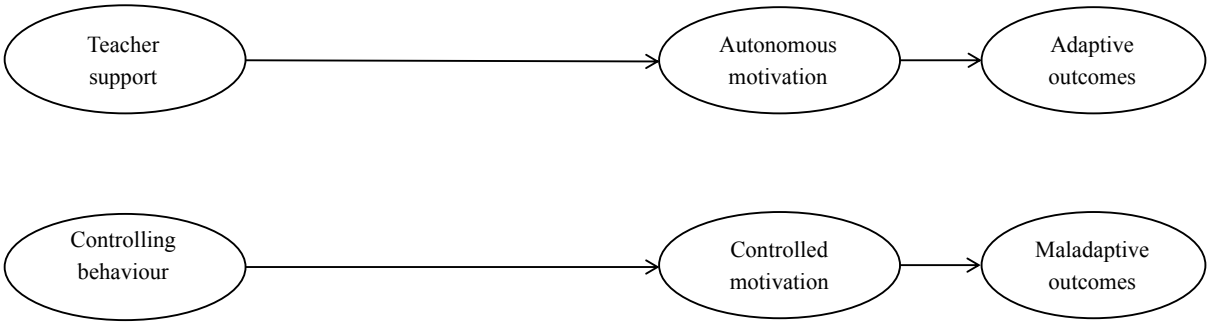


Figure 3c. revised dual-process model

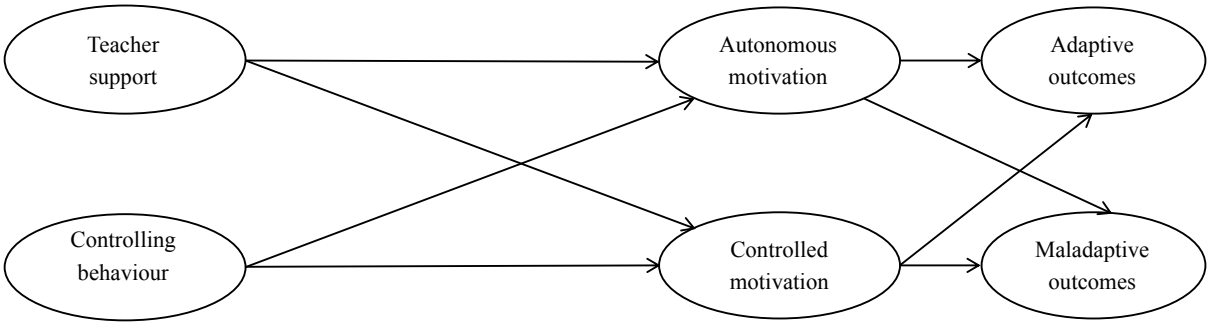


Figure 3d. revised SDT motivational model

Methods

Reporting in this review aligns with the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) statement (Moher, Liberati, Tetzlaff, & Altman, 2009).

Inclusion/Exclusion Criteria

This review is limited to studies meeting the following criteria: (a) written in English and published in peer-reviewed journals before January 2017; (b) included a sample of children or adolescents; (c) conducted in the physical education lesson context; (d) included quantitative assessment and statistical analysis of the relationship between at least two of the following constructs outlined in SDT: needs support (e.g., teacher support, peer support); needs satisfaction in physical education only (e.g., autonomy, competence, relatedness– studies in which need satisfaction in a different context, for example sports, was investigated were excluded); motivation (at least one form of motivation outlined in SDT); or cognitive, affective, or behavioural outcome related to physical education (e.g., experiences during physical education lessons or physical education learning outcomes). Qualitative studies that were identified in the search were kept aside for a separate review that is not reported here.

Information Sources

Studies were identified through four electronic databases PsychINFO, PubMed, Scopus, and SPORTDiscus. These are among the sources identified by Bramer, Rethlefsen, Kleijnen, and Franco (2017) for optimal database combination, and also exceed the minimum recommendation of three databases for a comprehensive review (Higgins, 2008; Lam & McDiarmid, 2016). Potential studies were searched by using different combinations of two groups of keywords.

Search

In December 2016, I conducted systematic searches of titles and abstracts to identify studies that related to at least one of the following three topics:

a) Social environment in physical education ("need* support" or "autonomy support" or "competence support" or "relatedness support" or structure or involvement or "control* teach*" or "motivational climate" or "motivational atmosphere" or "need* frustrat*" or "need* thwart*" or hostil* or chaos or impersonal) AND "physical education";
b) Needs satisfaction in physical education ("need* satisf*" or "need* fulfil*" or autonomy or competence or relatedness or "belonging*") AND "physical education";
c) Motivation in physical education ("self-determin*" or "intrinsic motivation" or "intrinsic interest" or "extrinsic motivation" or "autonomous motivation" or "controlled motivation" or amotivation or "perceived locus of causality") AND "physical education".

Study Selection

The screening process began after the deletion of duplicate studies identified in the initial search. The titles and abstracts were independently screened for eligibility by three researchers, DV, RC and TH, with two researchers screening each record. Three researchers, DV, KO and TH, carried out the full-text review of the potentially eligible studies. Once again, two researchers reviewed each article. I included a fourth researcher (CL) to discuss any discrepancies between the researchers with regards to inclusion until consensus was reached (see Figure 4).

Data Collection Process

The first author extracted all the data, which were independently checked by four researchers (TH and GA each completed 70% of the checking process, and JL and DA verified the remaining 30%). Discrepancies between the data extraction table and the original article were discussed and then resolved by further review by the first author. Extracted data included descriptive study information (e.g., publication year, study design, sample size, school stage, age range, mean and standard deviation, and country of publication), measures of need support, measures of need satisfaction, measures of behavioural regulations, and measures of physical education outcomes, and the results of statistical analysis that examined the relations between two variables (as illustrated in Figure 2).

Because this was a correlational meta-analysis, I followed Cheung's (2014) recommendation and only examined relationships among scores derived from measures at baseline. This analytical strategy allowed me to compare results from different study designs, including cross-sectional, longitudinal, and experimental (see for example, Owen et al., 2016; Tod & Edwards, 2015; White et al., 2017). The purpose of this meta-analysis was to examine SDT-based models regarding the influence of social agents (i.e., teachers and peers) on hypothesized mediators and outcomes in physical education (see Figures 2 and 3). While interventions are most certainly valuable, they are limited with respect to testing hypotheses outlined in these models. Indeed, interventions with teachers test an association between the intervention (i.e., control vs experimental group) and teacher behaviour construct(s) or the associations between the intervention and the mediators or outcomes, but interventions do not test any of the associations in the SDT sequence models I examined. Stated differently, analyses related to interventions test the effectiveness of the intervention, not the theoretical relationships in the models that were the focus of this meta-analysis. Additionally, I was not

able to test the hypothesized model using longitudinal data due to the lack of matrix coverage in the data used to run the path analysis. For the data I extracted, eight of the 55 correlations did not have data from longitudinal studies and a further five associations only had data from one longitudinal study.

Risk of Bias

Risk of bias was assessed using a tool that was based on items from two checklists: the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE; Von Elm et al., 2014) guide and the CONsolidated Standards of Reporting Trials (CONSORT) statement. Items included: a) description of eligibility criteria and/or sufficient description of the sample such that the population from which it was drawn can be determined; b) sampling procedures adequately described and appropriate (i.e., likely to generate a representative sample of the population described in criterion a); c) proportion (0 to 1) of variables that were measured using assessment tools with supportive reliability and validity evidence reported in the article); d) power calculation reported and study adequately powered to detect hypothesized relationships; e) analyses adjusted for covariates. Kappa statistic (K) was employed to test interrater reliability of percentage agreement (Cohen, 1968). Discrepancies were discussed until 100% consensus was reached. Studies were then classified with either low risk of bias (>50%) or high risk of bias (<50%).

Summary Measures and Synthesis of Results

Commonly used summary measures in the retrieved studies included the correlation coefficient (r), standardized regression analysis coefficient (β), and standardized mean difference (Cohen's d). All results were first converted into a correlation effect size (r). Rosenthal's (1994) formula was used to convert Cohen's d to r, while Peterson and Brown's (2005) formula allowed conversion from β to r. Although the combination of beta

coefficients with different metrics (e.g., correlations) may be a limitation – as the number of covariates accounted for in multivariate analysis generally vary across studies – a beta coefficient can still be converted to *r* if it ranges from -.50 to .50 (Bowman, 2012; Hunter & Schmidt, 2004; Peterson & Brown, 2005). I requested from the authors the correlations where they were not reported in the original paper. I was successful in many cases, and only worked with beta coefficients when I did not receive a response from the authors. Less than 0.4% effect sizes fell outside the required range (-.50 to .50) and these correlations were, therefore, excluded from the main analyses. I conducted sensitivity analyses to test whether the inclusion of these extreme effect sizes (by rounding extreme values up to -.50 or down to .50) would affect the results, and no important differences were found (contact the corresponding author for details). I then corrected the effect sizes for attenuation (Charles, 2005) by using reported internal consistency for each measure (e.g., Cronbach's alpha). If not reported, .70 was used as an estimate of reliability measure. Next, given that the variance depends strongly on the correlation (Borenstein, 2009), I *z*-transformed the adjusted effect sizes for analysis and reversed them back into *r* for presentation. I defined effect sizes as > 0.1 (weak), > 0.3 (moderate), and > 0.5 (strong) (Cohen, 1988).

Statistical Analysis

Meta-analysis. I conducted main analyses and moderator analyses using a multilevel structural equation modelling (SEM) approach (Cheung, 2014; Viswesvaran & Ones, 1995). The multilevel SEM approach handles assumption of dependence among the effect sizes in cases where multiple effect sizes are reported within a single study. In this review, the number of effect sizes within each paper ranged from 1 to 273. Using the meta3 function of the MetaSEM package (Cheung, 2015) in R version 3.3.2 (R Core Team, 2016), I employed three-level random-effects model to meta-analyse correlations in this study (Table 1–which

intends to show all the possible associations that have been examined within the physical education context). This technique allowed me to explore heterogeneity at the within-study level (Level 2) and between-study level (Level 3). I calculated heterogeneity in the effect sizes using the *Q* statistic, which represents the weighted sum of squared deviations. I also considered the I^2 statistic, which shows the proportion of the observed variance that reflects true difference in the effect sizes (Borenstein, 2009), to explore the proportion of variability in effect sizes due to true heterogeneity. For each effect size, I calculated 95% likelihood-based confidence intervals (CIs) (Cheung, 2014). Based on Higgins' et al (2003) recommendations, when I^2 values were above .25, I considered effect sizes to be moderately (between .25 and .50) or highly (above .75) heterogeneous, and I investigated potential moderators that could influence these associations. I carried out moderation analysis on meta-analysed correlations when there were at least two effect sizes in each subgroup (Borenstein & Higgins, 2013) using the meta3 function of the MetaSEM package in R. This approach takes into account the differences in sample size per effect size via the variance component, and allowed me to calculate the proportion of variance (R^2) in effect sizes that could be attributed to the inclusion of the moderator variable, as well the heterogeneity in effect sizes in each group (I^2). Potential moderators included demographic variables, such as age (children, mean age <10; preadolescents 10.1< to 14; adolescents, mean age >14), culture (individualistic or collectivistic; Hofstede, 2001) and sex, as well as methodological variables, such as risk of bias within studies (see Table 2).

Path Analysis. After completing the meta-analyses to determine the strength of relations between variables, I tested a structural model representing the motivational sequence outlined in SDT (i.e., Figure 2, social context → need satisfaction → motivation → outcomes). I estimated total, direct, and indirect effects via a structural equation modelling approach using the Lavaan package (Rosseel, 2012) in R (Cheung, 2014) with standard errors

given via the delta method (Dowd, Greene, & Norton, 2014). Following Viswesvaran and Ones' (1995) recommendation for calculating uncertainty estimates, I used the harmonic mean of the sample sizes across the different cells in the meta-analysed correlation matrix.

I attempted to compare a dual-process model (Figure 3a) with an SDT-based motivational sequence model (Figure 3b). Unfortunately, due to linear dependency caused by the strong correlation between teacher controlling behaviour and needs frustration (r = .80), I was not able to test needs satisfaction and frustration as separate mediators in the model. To address this issue, I modified the models by dropping the needs satisfaction and needs frustration latent variables and associated paths. I then used a log-likelihood ratio test to compare the fit of the revised dual-process model (Figure 3c) and the revised SDT motivational sequence model (Figure 3d).

The model's exogenous variables were two sources of social support in physical education, the physical education teacher and peers. I included an omnibus teacher relative need support variable (controlling behaviour effect sizes were reverse coded), as opposed to separate measures relating to support for each need because many of the autonomy support measures in the literature included items for competence and relatedness (e.g., Bagoien, Halvari, & Nesheim, 2010; Barkoukis, Hagger, Lambropoulos, & Tsorbatzoudis, 2010; Meng & Keng, 2016). In order to meaningfully compare autonomy support with other aspects of needs support, I would need to only examine those studies that included all three types of needs support, plus studies in which the autonomy support measure was specifically designed to measure autonomy support only and not competence or relatedness. The decision to collapse all three needs support constructs allowed me to maximize my sample size.

Although few studies have looked at peer support, I decided to include this construct in the model as it may be a source of support in physical education that is distinct from teacher influences (González-Cutre, Ferriz, et al., 2014; González-Cutre, Sicilia, Beas-

Jiménez, & Hagger, 2014; Koka, 2014). Next in the model, I analysed the needs for autonomy, competence, and relatedness separately. Then, I combined intrinsic motivation, integrated and identified regulation into *autonomous motivation* for three reasons: (a) in order to have a parsimonious model that could be feasibly estimated; (b) 32 studies (12.1%) included in my review combined the autonomous motivation constructs - I would not have been able to include these studies' data in my hypothesized model if I did not combine these motives across all studies, because these studies did not provide information that enabled me to test each regulation separately; and (c) due to the strong associations found among these motives (intrinsic motivation and integrated regulation r = .88, intrinsic motivation and identified regulation r = .88, integrated regulation and identified regulation r = .84; see Table 1). This decision was also supported by the findings from Howard, Gagné, and Bureau's (2017) meta-analysis, in which autonomous motivation constructs were more strongly inter-correlated than controlled motives. I treated introjected regulation, external regulation and amotivation as distinct constructs for analysis because their associations were not as strong (r = .530 to r = .576) as the associations among intrinsic motivation, integrated regulation and identified regulation. I examined the type of outcome as adaptive and maladaptive rather than affective, behavioural, and cognitive. The reason for this was that the associations involving this latter group of constructs were relatively similar. Due to the large number of different adaptive and maladaptive outcomes (defined based on how the original authors employed them in their studies) found in this study and the complexity of the model tested in this meta-analysis, it was not feasible to present results associated with each outcome. Instead, I present meta-analysed correlations for the nine most frequently examined outcome variables (three affective, three cognitive and three behavioural). For greater detail on the meta-analyses involving each of the outcomes, please see the full dataset in supplemental material. I focused my analysis of indirect effects on the influence teachers and peers could have on other

variables. I made this decision because these social agents represent constructs that could most directly be influenced in an intervention, as opposed to needs satisfaction and motivation which would be influenced indirectly.

Results

Study Selection

After duplicates were removed, 9,555 records remained for screening, of which 605 were retained for full-text review. Of these, 265 articles met the criteria to be included in the review (see Appendix A). I tried to contact the authors of the 13 articles that did not provide sufficient information to be included in the meta-analysis, but received no response (see Figure 4).

Study Characteristics

A table with all the data extracted from each study is available through Open Science Framework (https://tinyurl.com/y8vehmsr). Most the studies employed a cross-sectional design (k = 159), followed by experimental (k = 62) and longitudinal (k = 44) designs. Of these studies, 64.8% provided data from samples in Europe, 22.8% from North America, 8.2% from Asia, and 3.7% from Australia and Oceania. No studies from South America or Africa were identified. In total, data from 133,958 students aged 13.92 years (SD = 1.64 years) were included (see supplementary material for detailed study characteristics).

Risk of Bias Within Studies

Regarding risk of bias within individual studies, the kappa coefficient (K = 0.81) indicated strong initial agreement between the two raters (Cohen, 1968; McHugh, 2012). Nearly all studies (96.25%) exhibited low risk of bias. See supplementary material for details.

Synthesis of Results

Most research within physical education has involved older children and adolescents, with less attention paid to young children. As can be seen in Table 1, behavioural and affective outcomes of student participation in physical education have been studied extensively; comparatively, cognitive outcomes have been examined less frequently.

Most of the evidence regarding social context and SDT constructs examined teachers' provision of autonomy support. In fact, there were almost three times more effect sizes relating to teacher autonomy support, than competence support, relatedness support or controlling behaviour. Relatively few studies have looked at the association between peer support and constructs outlined in SDT (see Table 1).

In terms of the associations involving need satisfaction and motivation variables, competence has received substantially more empirical attention than autonomy or relatedness. Finally, the evidence involving the different forms of behaviour regulations and outcomes in physical education shows that intrinsic motivation has been studied most extensively, followed by amotivation, external regulation, identified regulation and introjected regulation. The most autonomous form of extrinsic motivation, integrated regulation, has rarely been studied in this context (see Table 1).

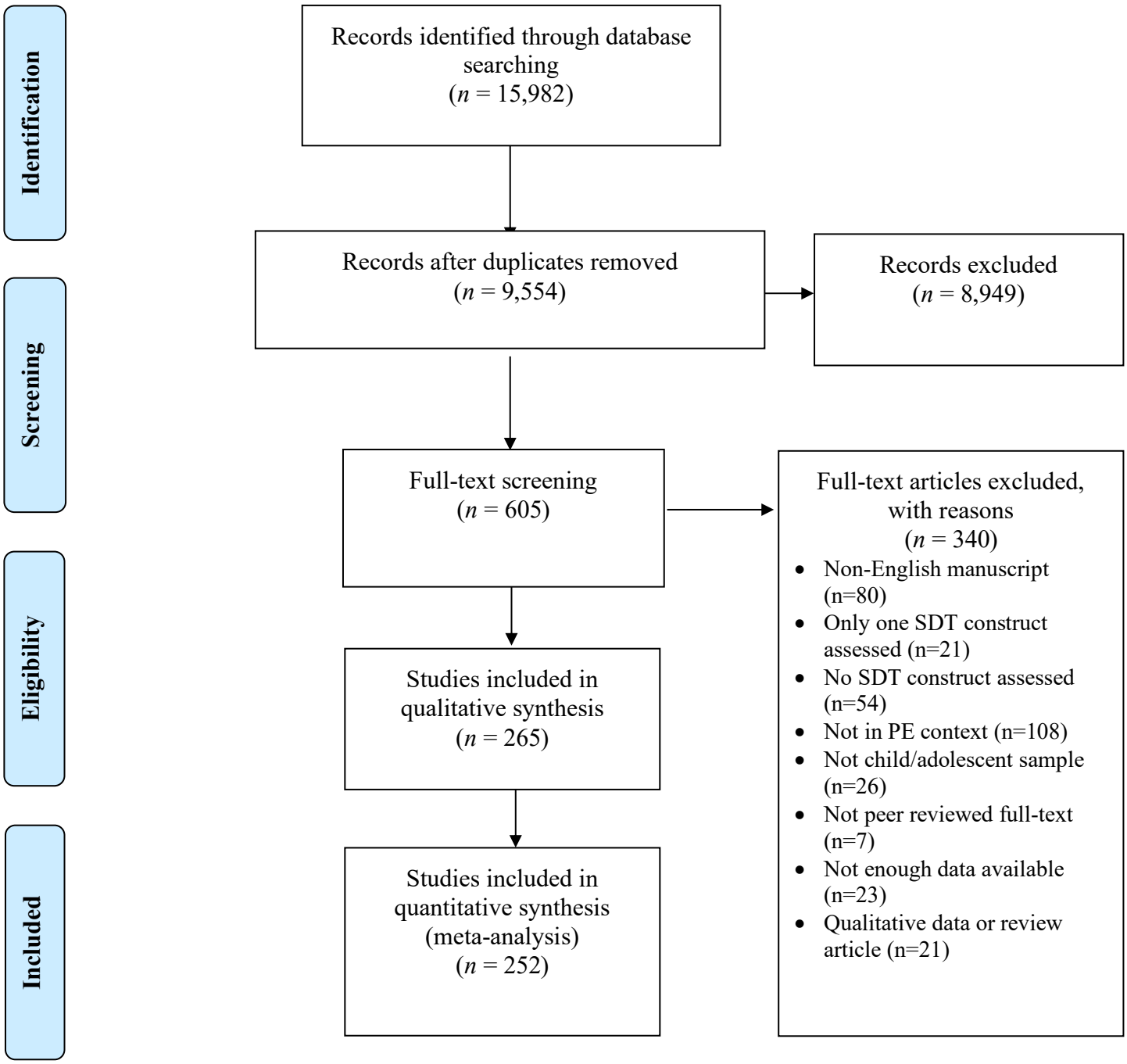


Figure 4. Flow diagram of literature search results

Meta-analyses. Table 1 shows the 319 meta-analytic correlations that emerged from the dataset, of which 57 were strong, 127 were moderate, 124 were weak, and 11 correlations were very weak (< .1). Associations involving teacher's relative need support were mostly in the expected direction. The correlations between needs support factors were strong – all above .75. In addition, it is important to note that "autonomy support" has often been conceptualized and measured as an omnibus term for "needs support" (which could include competence and relatedness items). As a result, comparisons between "teacher autonomy support" and other aspects of needs support can be difficult to make. Teacher's relative need support had a strong positive association with autonomy, and a moderate positive association with relatedness, and competence. While the correlation between teacher's relative need support and autonomous motivation was positive, perceptions of teacher's relative need support correlated negatively with external regulation and amotivation.

Although the number of studies investigating peer support was small (k = 5), the associations involving peer support followed a largely similar pattern to the correlations involving teacher's relative need support. Peer support was negatively correlated with amotivation and maladaptive outcomes, and positively associated with all other variables. Notably, these positive correlations included controlled forms of motivation – introjected regulation and external regulation.

The correlations between social context factors and outcomes in physical education ranged from -.35 to .39. Both teacher's relative need support and peer support in physical education were positively associated with adaptive outcomes, and negatively associated with maladaptive outcomes.

Autonomy, competence, and relatedness were strongly correlated with autonomous motivation, and not so strongly, but still positively correlated with introjected regulation.

Weak negative correlations were found between autonomy, competence, and relatedness and external regulation. Amotivation had moderate negative correlations with needs satisfaction.

Autonomous motivation was positively correlated with adaptive outcomes, and negatively correlated with maladaptive outcomes. External regulation had a weak negative association with adaptive outcomes and a weak-to-moderate positive association with maladaptive outcomes. In contrast, amotivation had a moderate relationship with adaptive outcomes, and a strong positive relationship with maladaptive outcomes. Introjected regulation was positively correlated with both adaptive and maladaptive outcomes, a finding expectable given its place as a partial internalization, still entailing inner conflict.

Inter-factor correlations among motivation constructs supported the presence of a continuous order of self-regulatory motives as proposed by SDT. I found strong correlations between intrinsic motivation and integrated regulation, intrinsic motivation and identified regulations, and between integrated regulation and identified regulation. In contrast, relatively weaker correlations among introjected regulation, external regulation, and amotivation indicated these constructs were more distant from one another on a continuum of motivation.

Table 1

Meta-Analysed Correlations Involving Teacher Support, Peer Support, Needs Satisfaction, Motivation, and Student Outcomes in the Physical Education Context

	Teacher Autonomy Support	Teacher Competence Support	Teacher Relatedness Support	Teacher Controlling Behaviour	Teachers' Relative Need Support	Peer Support	Autonomy	Competence	Relatedness	Total Needs Satisfaction	Total Needs Frustration
Teacher Competence Support	.76(12)										
Teacher Relatedness Support	.82(14)	.79(12)									
Teacher Controlling Behaviour	-.19(1)	(0)	(0)								
Teachers' Relative Need Support	.76(16)	.76(12)	.80(15)	-.40(2)							
Peer Support	.42(2)	.45(1)	.44(2)	(0)	.41(6)						
Autonomy	.70(29)	.60(7)	.65(9)	.16(2)	.61(47)	.39(4)					
Competence	.46(30)	.62(6)	.52(9)	.45(4)	.37(52)	.27(4)	.65(54)				
Relatedness	.53(27)	.61(6)	.67(12)	-.08(2)	.49(47)	.69(5)	.60(51)	.58(50)			
Total Needs Satisfaction	.57(36)	.61(7)	.62(14)	.37(5)	.48(63)	.51(5)	(0)	(0)			
Total Needs Frustration	-.16(2)	(0)	(0)	.80(2)	-.55(3)	(0)	(0)	(0)			
Intrinsic Motivation	.52(25)	.62(6)	.53(13)	.25(3)	.46(49)	.29(1)	.61(33)	.62(53)	.55(34)	.59(55)	-.45(1)
Integrated Regulation	(0)	(0)	(0)	(0)	(0)	(0)	.66(1)	.78(2)	.30(1)	.66(2)	(0)
Identified Regulation	.49(18)	.61(4)	.51(10)	-.19(1)	.48(33)	.41(1)	.54(27)	.60(38)	.52(30)	.56(40)	-.39(1)
Introjected Regulation	.20(17)	.32(4)	.24(10)	.28(1)	.19(28)	.32(1)	.35(28)	.27(39)	.27(30)	.29(41)	-.07(1)
External Regulation	-.11(18)	-.08(4)	-.15(9)	.41(1)	-.07(34)	.25(1)	-.13(29)	-.10(41)	-.07(32)	-.10(43)	-.13(1)
Amotivation	-.25(26)	-.35(7)	-.28(11)	.37(2)	-.24(39)	-.12(1)	-.29(26)	-.42(32)	-.30(28)	-.32(39)	.32(3)
Autonomous Motivation	.50(37)	.63(6)	.53(13)	.12(4)	.47(64)	.34(2)	.57(42)	.60(66)	.51(45)	.56(73)	-.13(3)
Controlled Motivation	.04(22)	.12(4)	.07(10)	.36(2)	.05(40)	.29(1)	.08(32)	.07(46)	.09(36)	.09(52)	.08(3)
Self-determination Index	.17(45)	.13(8)	.17(18)	.17(8)	.21(90)	.23(4)	.31(55)	.32(80)	.27(59)	.33(94)	-.10(3)
Outcomes within PE	.36(44)	.33(8)	.29(15)	.20(9)	.33(73)	.21(2)	.48(38)	.53(83)	.45(41)	.52(96)	.48(6)
Outcomes outside PE	.25(20)	.34(2)	.22(5)	(0)	.25(25)	.36(3)	.34(20)	.47(38)	.35(21)	.41(40)	(0)
Affective Outcomes	.45(40)	.23(5)	.27(12)	.38(5)	.34(60)	.42(3)	.48(38)	.56(70)	.47(42)	.54(78)	.48(3)
Behavioural Outcomes	.29(44)	.43(8)	.29(13)	.04(7)	.29(70)	.26(4)	.33(34)	.48(70)	.35(34)	.45(83)	.47(4)
Cognitive Outcomes	.28(31)	.30(6)	.26(10)	(0)	.26(36)	.55(1)	.40(19)	.50(34)	.39(19)	.46(36)	.41(1)
Adaptive Outcomes	.37(56)	.29(9)	.38(18)	-.27(7)	.39(89)	.33(5)	.44(50)	.52(105)	.43(53)	.51(117)	-.37(4)
Maladaptive Outcomes	-.02(13)	-.26(3)	-.14(9)	.45(3)	-.26(25)	-.35(1)	-.26(16)	-.27(31)	-.32(19)	-.26(37)	.53(5)
Outcomes (overall)	.33(58)	.34(9)	.33(18)	.20(9)	.31(92)	.31(5)	.43(50)	.51(107)	.41(53)	.49(120)	.48(6)

Meta-Analysed Correlations Involving Teacher Support, Peer Support, Needs Satisfaction, Motivation, and Student Outcomes in the Physical Education Context

Table 1

Continued

	Intrinsic Motivation	Integrated Regulation	Identified Regulation	Introjected Regulation	External Regulation	Amotivation	Autonomous Motivation	Controlled Motivation	Self-determination Index
Integrated Regulation	.88(4)								
Identified Regulation	.88(65)	.84(4)							
Introjected Regulation	.48(57)	.65(4)	.62(57)						
External Regulation	-.08(69)	.19(4)	-.02(64)	.56(56)					
Amotivation	-.47(57)	-.02(4)	-.38(52)	.05(44)	.58(52)				
Autonomous Motivation	.89(49)	.84(4)	.85(22)	.56(58)	-.03(69)	-.43(62)			
Controlled Motivation	.30(51)	.45(4)	.67(45)	.58(37)	.52(21)	.37(59)	.25(83)		
Outcomes in PE	.47(69)	-.54(1)	.42(47)	.24(39)	-.02(52)	-.20(58)	.44(83)	.09(62)	.47(107)
Outcomes out of PE	.42(31)	.48(1)	.38(22)	.25(18)	-.03(24)	-.26(20)	.42(43)	.10(27)	.38(54)
Affective Outcomes	.43(54)	-.25(2)	.35(38)	.22(34)	.04(44)	-.11(43)	.40(70)	.12(49)	.48(88)
Behavioural Outcomes	.48(52)	.59(1)	.40(40)	.21(34)	-.08(42)	-.27(40)	.44(68)	.05(49)	.39(93)
Cognitive Outcomes	.49(31)	.47(1)	.52(24)	.28(22)	-.05(23)	-.34(25)	.50(44)	.11(28)	.43(55)
Adaptive Outcomes	.57(84)	.48(1)	.53(60)	.26(51)	-.07(65)	-.37(63)	.54(105)	.06(75)	.44(139)
Maladaptive Outcomes	-.26(31)	-.54(1)	-.23(25)	.13(22)	.25(29)	.45(30)	-.25(38)	.20(35)	.37(45)
Outcomes (overall)	.54(86)	.50(2)	.50(61)	.29(52)	.27(66)	.40(67)	.51(108)	.27(77)	.43(142)

Note. Each data point represents the meta-analysed correlation, with the number of studies (*k*) listed in parentheses. A (0) shows an absence of studies examining that particular relationship. Composite measures displayed in the table are: Teachers' Relative Need Support (Autonomy Support, Competence Support, Relatedness Support, and Controlling Behaviour [multiplied by -1]). Total Needs Satisfaction (Autonomy, Competence, and Relatedness). Autonomous motivation (Intrinsic Motivation, Integrated Regulation, and Identified Regulation). Controlled motivation (Introjected Regulation and External Regulation). Self-determination Index (SDI) was calculated using the formula: SDI = 2(Intrinsic Motivation) + 1(average of Integrated Regulation and Identified Regulation) – 1(average of Introjected Regulation and External Regulation) – 2(Amotivation).

Moderator Analyses. Moderator analyses were conducted on the 55 associations in the model (Figure 5) to investigate whether study characteristics influenced these effects. Due to an insufficient number of effect sizes (i.e., < two per sub-group) examining the relations between peer support and motivation variables, and between peer support and maladaptive outcomes, moderator analyses were not conducted on these associations. Significant moderator effects at both within-study (Level 2) and between-study (Level 3) levels are presented in Table 2. Results of all moderator analyses are available in the supplementary material. Significant moderation effects were found in eight of the 55 associations.

Sex. Sex accounted for a large portion of the within-study (Level 2) heterogeneity in studies that investigated the association between autonomy and competence (R^2 = .57, p < .001). Effect sizes were stronger in studies that reported combined results for boys and girls (r = .67, 95% CI [.60, 73]), than they were in studies reporting them separately for boys (r = .28, 95% CI [-.03, .54]) or girls (r = .38, 95% CI [.26, .50]). Sex also explained heterogeneity at the between-study level associations between introjected regulation and amotivation, and between introjected regulation and adaptive outcomes. Stronger effect sizes were found in studies that reported combined results for boys and girls than separate sexes between introjected regulation and amotivation. In contrast, effect sizes were found to be stronger for boys in the association between introjected regulation and adaptive outcomes than they were in studies that reported combined results for boys and girls, or girls only.

Age. In studies that investigated the association between introjected regulation and maladaptive outcomes, age explained 71% (p = .035) of the heterogeneity in effect sizes at the between-study level (Level 3). The effect sizes were stronger for preadolescents (r = .28, 95% CI [.11, .43]) than they were for adolescents (r = .04, 95% CI [-.09, .16]).

Culture. Culture accounted for significant and large portions of the heterogeneity in effect sizes at the between-study level (Level 3) in six associations (see Table 2). Effect sizes

were stronger for individualistic cultures regarding the negative relationships between: (a) autonomy and external regulation, and (b) relatedness and external regulation. Compared with individualistic-orientated countries, I found stronger positive effect sizes in collectivism-oriented countries for the associations between: (a) peer support and adaptive outcomes, (b) autonomy and competence, (c) introjected regulation and external regulation, and (d) introjected regulation and maladaptive outcomes. The analysis pertaining to introjected regulation and maladaptive outcomes revealed that introjected regulation was not associated with maladaptive outcomes for students from individualistic countries, whereas there was a significant positive relationship between introjection and maladaptive outcomes (r = .24) in collectivist countries.

Table 2

Summary of Significant Moderation Effects

	k	#ES	Sample size		Coefficient (*r*)	Lower 95% CI	Upper 95% CI	R^2_2	R^2_3	I^2_2	I^2_3	*Q* statistic
			Total	Harmonic Mean								
Peer support – Adaptive Outcomes	5	20	7467	265	.334	0.15	0.50			0.44	0.52	533.7074
Culture (*p*=.002)								0.12	1.00			
Individualistic	4	10	3467	198	.254	0.15	0.36			0.88	0.00	
Collectivistic	1	10	4000	400	.591	0.51	0.66			0.92	0.00	
Autonomy – Competence	54	66	32833	271	.651	0.58	0.71			0.08	0.91	5854.978
Culture (*p*<.001)								0.00	0.22			
Individualistic	32	39	17894	281	.543	0.44	0.63			0.04	0.94	
Collectivistic	21	26	14224	285	.779	0.70	0.84			0.15	0.84	
Sex (*p*<.001)								0.57	0.01			
Both	50	59	29969	295	.669	0.60	0.73			0.03	0.96	
Male	4	4	1482	191	.279	-0.03	0.54			0.48	0.48	
Female	3	3	1382	275	.383	0.26	0.50			0.40	0.40	
Autonomy – External Regulation	29	36	14082	220	-.131	-0.23	-0.03			0.13	0.84	912.3109
Culture (*p*=.012)								0.06	0.21			
Individualistic	18	23	9294	260	-.222	-0.32	-0.12			0.19	0.76	
Collectivistic	11	13	4788	164	.027	-0.13	0.18			0.09	0.86	
Relatedness – External Regulation	32	39	15192	223	-.074	-0.14	0.00			0.00	0.94	592.9022
Culture (*p*= .037)								0.01	0.11			
Individualistic	19	24	8928	250	-.135	-0.22	-0.05			0.14	0.79	
Collectivistic	13	15	6264	190	.016	-0.11	0.14			0.00	0.94	
Introjected Regulation – External Regulation	56	66	26196	228	.560	0.48	0.63			0.84	0.14	3777.35
Culture (*p*=.035)								0.00	0.51			
Individualistic	35	43	15788	224	.494	0.38	0.59			0.93	0.06	
Collectivistic	21	23	10408	235	.655	0.55	0.74			0.71	0.27	
Introjected Regulation – Amotivation	44	65	26437	255	.053	-0.03	0.14			0.40	0.58	1817.888
Sex (*p*<.001)								0.00	0.08			
Both	43	64	26337	247	.063	-0.02	0.15			0.41	0.56	
Male	1	1	100	100	-.388	0.54	-0.21			0.50	0.50	
Female	0	0	-	-	-	-	-			-	-	
Introjected Regulation – Adaptive Outcomes	51	125	49964	253	.256	0.18	0.31			0.37	0.59	2966.77
Sex (*p*=.017)								0.00	0.24			
Both	49	121	49321	262	.254	0.19	0.31			0.43	0.53	

Male	1	3	300	100	.657	0.58	0.72			0.16	0.00	
Female	1	1	343	343	-.207	-0.31	-0.10			0.50	0.50	
Introjected Regulation – Maladaptive Outcomes	22	31	11837	212	.129	0.01	0.24			0.69	0.28	1033.303
Culture (p=.049)								0.00	0.62			
Individualistic	14	19	6853	273	.054	-0.06	0.17			0.96	0.00	
Collectivistic	8	12	4984	156	.239	0.02	0.44			0.20	0.78	
Age (p=.035)								0.00	0.71			
Children	0	0	-	-	-	-	-			-	-	
Preadolescents	8	13	6663	215	.276	0.11	0.43			0.98	0.00	
Adolescents	14	18	5174	210	.036	-0.09	0.16			0.32	0.62	

Note. k = number of studies, #ES = number of effect sizes, r = population effect size, R^2_2 and R^2_3 = proportion of variance explained by the moderator variable at Level 2 (within study) and Level 3 (between study), respectively. I^2_2 and I^2_3 = proportion of variability in effect sizes at Level 2 and 3, respectively.

Risk of Bias Across Studies

Egger's tests revealed non-significant results, which indicated low asymmetry and suggested low risk of publication bias across the studies. For example, studies that examined the association between perceived competence and external regulation had a non-significant Egger's test (t = 0.8841, p = .381; please contact authors for details on other test results).

Additional Analysis

Path Analysis. I used 55 of the meta-analysed correlations from Table 1 to create an input matrix (Table 3) for path analyses. The model tested teacher's relative need support and peer support as predictors of students' outcomes in physical education, with students' needs satisfaction and motivation as mediators of this process. Given that moderators only influenced 14 out of 55 possible associations, and these effects were not consistent across associations, I decided to test a single path model (i.e., I did not test separate models divided according to levels of the moderators).

Support from the physical education teacher was found to be a stronger predictor of autonomy (ß = .54) and competence (ß = .31), compared with peer support (ß = .17 and ß = .15, respectively). On the other hand, peer support (ß = .59) was a stronger predictor of relatedness than teacher support (ß = .25).

Direct paths from needs satisfaction to motivation variables were all significant (p < .001). Among the needs satisfaction constructs, competence was the strongest predictor of both autonomous motivation (ß = .38) and amotivation (ß = -.38). Autonomy was the strongest predictor of introjected regulation (ß = .29) and relatedness was the strongest predictor of external regulation (ß = -.44).

The direct paths from social context factors (teacher, peer) to motivation indicated that external regulation was strongly predicted by peer support (ß = .60), and indirectly

predicted by needs satisfaction (ß = -.26). It should, however, be noted that these findings emanated from a single study. Furthermore, peer support still had a considerable direct effect on maladaptive outcomes (ß = -.35), even after accounting for the mediated effect.

There was little evidence of mediation between peer support and adaptive (indirect effect, ß = .05) and maladaptive outcomes and (indirect effect, ß = .07, respectively). As seen in Table 4, the proportion of the effect that was mediated (i.e., indirect effect/total effect) in these associations through the hypothesized mediators (needs satisfaction and motivation) was very low. The proportion of mediation found between peer support and adaptive outcomes was 21%, and 16% between peer support and maladaptive outcomes. Caution is needed when interpreting this finding because the number of studies that examined the associations involving peer support was limited (k = 5, see Table 3). On the other hand, there was a substantial indirect effect between teacher support and adaptive outcomes (ß = .19) and maladaptive outcomes (ß = -.15). The high proportion of mediation found (62% for adaptive outcomes, and 97% for maladaptive outcomes) suggests a mediating role of needs satisfaction and motivation on these relations. While there was a significant difference between the paths from teacher and peer support to adaptive outcomes ($\Delta = .09$; $p < .001$) and to maladaptive outcomes ($\Delta = .14$; $p < .001$), the difference in effect size was small.

Apart from synthesizing the evidence and quantifying the strength of SDT physical education-based research, another purpose of this review was to test an adapted model of SDT applied to the physical education context (see Figure 2). I then compared the hypothesized model with the dual-process model. I found that the data fit the double mediation model ($\Delta X^2 = 95717.165$, $\Delta df = 55$, CFI = 1.00, TLI = 1.00, RMSEA = .00, and SRMR = .00; $p < .001$) better than the dual process model ($\Delta X^2 = 68374.592$, $\Delta df = 49$, CFI = .86, TLI = .59, RMSEA = .24, and SRMR = .11; $p < .001$). In this regard, the motivational

sequence model predicted adaptive (R^2 = .42) and maladaptive (R^2 = .40) outcomes better than did the dual-process model (R^2 = .31 and R^2 = .36, respectively).

Table 3

Correlation Matrix for the Path Analysis

	1	2	3	4	5	6	7	8	9	10	11
1.Teacher's relative need support	-	6	47	52	47	64	28	34	39	89	25
2.Peer support	.410	-	4	4	5	2	1	1	1	5	1
3.Autonomy	.607	.389	-	54	51	42	28	29	26	50	16
4.Competence	.367	.272	.651	-	50	66	39	41	32	105	31
5.Relatedness	.493	.691	.596	.584	-	45	30	32	28	53	19
6.Autonomous Motivation	.467	.343	.565	.597	.511	-	58	69	62	105	38
7.Introjected Regulation	.190	.322	.346	.272	.269	.564	-	56	44	51	22
8.External Regulation	-.065	.251	-.131	-.104	-.074	-.025	.560	-	52	65	29
9.Amotivation	-.235	-.123	-.288	-.426	-.297	-.434	.053	.576	-	63	30
10.Adaptive Outcomes	.389	.334	.439	.524	.426	.540	.256	-.073	-.369	-	53
11.Maladaptive Outcomes	-.260	-.345	-.262	-.274	-.318	-.253	.129	.251	.450	-.212	-

Note. Lower diagonal = meta-analysed correlations. Upper diagonal = corresponding number of studies.

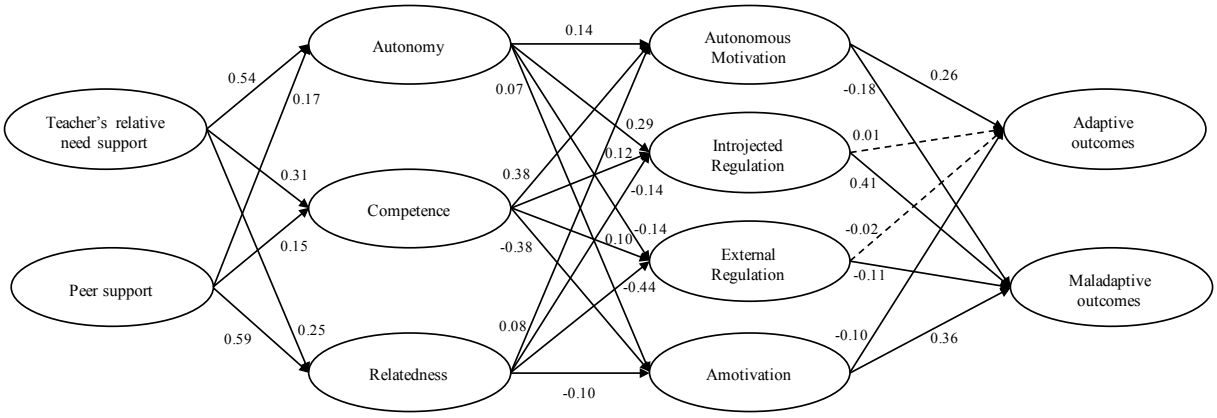


Figure 5. Motivational sequence as proposed by SDT applied to physical education (harmonic mean of the sample sizes, N = 15,555)

Note. Solid line indicates significant paths at $p < 0.001$. The dotted lines indicate a non-significant path between introjected regulation and adaptive outcomes ($p = .657$), and between external regulation and adaptive outcomes ($p = .156$).

Table 4

Path Analysis Direct and Indirect Effects

	Direct effect			Indirect Effect	
	Estimate	SE	*p* value	Estimate	SE
Adaptive outcomes					
Autonomous motivation	.261	.011	.000		
Introjected regulation	.005	.011	.657		
External regulation	-.017	.012	.156		
Amotivation	-.100	.010	.000		
Autonomy	-.022	.011	.039		
Competence	.290	.010	.000		
Relatedness	-.063	.012	.000		
Peer support	.165	.010	.000	.045	.008
Teacher's relative need support	.114	.009	.000	.189	.008
Maladaptive outcomes					
Autonomous motivation	-.178	.011	.000		
Introjected regulation	.407	.012	.000		
External regulation	-.108	.013	.000		
Amotivation	.355	.010	.000		
Autonomy	-.119	.011	.000		
Competence	-.014	.011	.179		
Relatedness	.081	.011	.000		
Peer support	-.352	.012	.000	.065	.008
Teacher's relative need support	-.004	.009	.673	-.139	.008
Autonomous motivation					
Autonomy	.140	.009	.000		
Competence	.379	.009	.000		
Relatedness	.077	.010	.000		
Peer support	.058	.009	.000		
Teacher's elative need support	.181	.008	.000		
Introjected regulation					
Autonomy	.285	.011	.000		
Competence	.116	.010	.000		
Relatedness	-.144	.013	.000		
Peer support	.313	.010	.000		
Teacher's relative need support	-.083	.009	.000		
External regulation					
Autonomy	-.136	.011	.000		
Competence	.096	.010	.000		
Relatedness	-.443	.012	.000		
Peer support	.603	.010	.000		
Teacher's relative need support	-.047	.009	.000		
Amotivation					
Autonomy	.065	.011	.000		
Competence	-.384	.010	.000		
Relatedness	-.111	.012	.000		
Peer support	.078	.010	.000		
Teacher's relative need support	-.111	.009	.000		
Autonomy					
Peer support	.168	.007	.000		
Teacher's relative need support	.538	.007	.000		
Competence					
Peer support	.146	.008	.000		
Teacher's relative need support	.307	.008	.000		
Relatedness					
Peer support	.588	.006	.000		
Teacher's relative need support	.252	.006	.000		

Discussion

Meta-Analysis and Path Analysis

Discussion of main findings. This review presents a meta-analytic synthesis of the evidence regarding the application of SDT in physical education. Overall, the findings of this review largely support theoretical postulates based on the motivational sequence proposed in SDT (Deci & Ryan, 1985; Ryan & Deci, 2017; Vallerand, 1997). SDT proposes that social environments can affect students' perceptions of psychological needs satisfaction. The evidence supported this postulate, and also found that teachers and peers likely have differential impact on these needs. Indeed, perceived teacher support appears more beneficial for autonomy and competence, while perceived peer support is more strongly associated with relatedness. The way teacher and peer support have been measured may help to explain this finding. For instance, measures of teacher behaviour often include controlling and need supportive behaviours, while peer behaviour measures in SDT research have focused exclusively on support. It could also be due to the items in the utilized questionnaires – given that in most of these studies the measure of autonomy support was largely focused on autonomy and less so on competence and relatedness. Also, it could be a function of how relatedness was measured, as in most cases relatedness was measured more broadly in relation to both teachers and peers, while in very few cases (some peer support studies) relatedness was measured in relation to peers only. This is issue is important as this measurement difference could have an impact on the correlations between both. The very uneven number of studies involving teachers and peers (see Table 3) could also partially explain this finding. Another possibility would be that the teacher is in control, so it is not surprising that autonomy for physical education activities is primarily influenced by teachers. Also, feedback comes from the teachers mainly, not peers, hence the effect from teachers on competence. Relatedness is perhaps most influenced by peers because they interact with their

peers throughout the day, not just during classroom time. Furthermore, teachers might not have much time to interact with each child, leading to a weaker relatedness effect. In addition, peer relatedness may not be related to adaptive participation in physical education insofar as some peer groups may not be constructively engaged even as they support each other socially. Lastly, the motivational sequence model proposed by SDT was found to be a better predictor of student's experiences in physical education lessons when compared to the dual-process model. I did not further explore the results from the latter because it omits important paths, for example, the implications of controlling teaching on student's motivation and on adaptive outcomes.

The findings in this study largely supported the existence of continuum of self-regulation motives in physical education. Yet students appear to have some difficulty in differentiating between autonomous forms of motivation (i.e., intrinsic motivation, integrated regulation, and identified regulation), as demonstrated by the strong inter-factor correlations. However, introjected regulation and external regulation, which are often combined into controlled motivation (Aelterman et al., 2016; De Meester et al., 2016; De Meyer, Soenens, Vansteenkiste, et al., 2016; Gairns et al., 2015), and amotivation, were all found to be distinct constructs. The simplex structure of different self-regulations has been tested in a recent meta-analysis by Howard et al. (2017), which showed results similar to ours across different domains, such as work, sport, exercise, education, and physical education. The proximity of autonomous forms of regulation, as well as the distance among introjected regulation, external regulation, and amotivation has also been confirmed in a meta-analysis in the health domain (Ng et al., 2012).

Introjected regulation, a self-regulatory way of engaging in behaviours by feelings of internal pressure and obligation, correlated with other variables in ways predicted by the theory, in that its effects lay somewhere between the relatively positive effects of intrinsic

motivation and identification, and the largely null or negative effects of external regulation and amotivation. Within SDT, introjection represents a "partial or incomplete" internalization that, on the positive side can foster behavioural compliance, as well as "certain forms of self-esteem, satisfaction, and feelings of pride about oneself" (Ryan & Deci, 2017, p. 185). Yet, because of its controlling elements it can also foster anxieties and self-criticism that negatively affect motivation, persistence and wellness.

In this review, introjected regulation was associated with both adaptive and maladaptive outcomes in physical education. In particular, introjection was positively associated with need satisfaction, suggesting that this partial internalization is facilitated by supports. Interesting too was that introjection was positively correlated with both teacher autonomy support and teacher control, suggesting that both elements contribute to this type of motivation.

Mixed correlations of introjected regulation with SDT constructs and different types of outcomes have been found in the exercise (Gillison, Osborn, Standage, & Skevington, 2009), education (Can, 2015), public health (Verloigne et al., 2011) and sport (Pelletier, Fortier, Vallerand, & Brière, 2001) settings. Introjected regulation can enhance behavioural outcomes, especially in the short term (e.g., promoting effort on a task). Yet, as a partial internalization, introjection may not sustain behaviour over time. For instance, Pelletier et al. (2001) found positive correlations of introjection with sport persistence at baseline, but these effects disappeared over time, whereas the effects of autonomous motives on persistence remained positive over time. Because this review is based on cross-sectional data, it does not address the potential for such maladaptive long-term outcomes.

Moderator analysis revealed substantial heterogeneity in some of the associations investigated; some of this heterogeneity could be explained by study characteristics. Sex, for example, moderated three out of 55 associations in this study – autonomy and competence,

introjected regulation and amotivation, and introjected regulation and adaptive outcomes. Even though boys tend to see sports activities as more important than girls do, the limited moderating effect of sex in the associations examined could be due to the fact that both boys and girls seem to be equally motivated when they perceive the learning situations to be interesting and attractive (Shen, Chen, Tolley, & Scrabis, 2003). Unfortunately, there were a small number of studies in which data were analysed separately for boys and girls (e.g., only four studies broke down by sex the relationship between autonomy and competence) precludes further exploration of this finding. Future physical education-based research should consider providing separate data on boys and girls, in order for sex differences to be accurately investigated within future integrative research.

Age was found to be a moderator of the association between introjected regulation and maladaptive outcomes in one of 55 associations. Results suggested that introjected reasons, such as to avoid punishment from the teacher or to avoid a sense of guilt, lead to undesired outcomes in students aged 10-14, but not for older adolescents. Indeed, this correlation was seven times stronger for preadolescents (r = .28) than it was for adolescents (r = .04). These results suggest that preadolescents and adolescents may not experience guilt/shame the same way. Ryan and Deci (2000b) pointed out that externally motivated behaviours (e.g., introjected regulated) are often performed in order to satisfy significant others (parents, teacher). This finding could, therefore, support previous research indicating that preadolescents are more affected by significant other's influence (parents, teacher) than adolescents (Chan, Lonsdale, & Fung, 2012; Horn & Weiss, 1991; McKiddie & Maynard, 1997). Some research has found age-related changes in motivation when looking at specific outcomes (e.g., physical activity), rather than a combination of a wide range of related but distinct outcomes as I did in this review. Taylor, Spray, and Pearson (2014), for example,

found that physical activity behaviour was more negatively affected during the primary-secondary school transition than perceptions of self-concept among 545 British children.

Lastly, the inclusion of Hofstede's classification of individualistic and collectivistic cultures provided insights to the SDT tenet of cross-cultural invariance. In individualistic cultures, individuals' needs are seen as more important than a group's needs. In the education context, it could therefore be argued that students from individualistic or collectivist countries could experience needs support from the teacher differently (Awang-Hashim, Thaliah, & Kaur, 2017). Yet, in my review culture was not found to moderate any relationship involving perceptions of teacher support. Thus, it appears that students from across cultures experience similar benefits from need supportive teaching. Also, filial piety feelings (e.g., endorsing parents' values) found in collectivistic-oriented countries could also explain why introjected regulation might be different for different cultures, as in collectivistic-oriented cultures individuals are likely to engage in behaviours because they think they should, and not because they want to (Hui, Sun, Chow, & Chu, 2011; Tam, 2016). In my review, the significant positive relationship found between introjected regulation and maladaptive outcomes indicated that introjected regulation likely has negative consequences for collectivistic students, but perhaps less so for individualistic cultures. Sources of these different effects warrant further study.

Overall Implications

With only a few exceptions discussed previously, the results of my meta-analysis supported the motivational processes proposed by SDT in the school physical education setting. Most of the effect sizes were moderate and in the expected direction. Teachers appear to have greater influence on students' perceptions of autonomy and competence, while peers seem to have more impact on students' feeling of relatedness. Among the basic needs,

perceptions of competence seem to be associated with students' self-determined motivation more so than autonomy and relatedness, suggesting that a sense of efficacy in physical education is particularly associated with more willing participation. Autonomous motivation and amotivation are the types of motivation that have the strongest associations with students' outcomes in physical education. Autonomously motivated students are more likely to demonstrate more positive experiences in physical education, whereas amotivated students are more likely to display negative experiences. In sum, support from a physical education teacher appears to motivate students to experience adaptive outcomes through perceptions of autonomy and competence, while feelings of relatedness are more strongly associated with peer support.

In terms of applied implications, this review could guide educators in their selection of classroom strategies to employ in order to effectively motivate students and enhance student outcomes. I sought to identify what teacher and peer focused interventions should focus on in order to foster an environment where students' needs are supported. The effect of supportive teaching on autonomy and competence highlights that these two needs can be influenced by certain strategies adopted by the teacher. According to (Reeve, 2009), students will experience autonomy when they perceive an environment where they can perform tasks without feeling pressured, where the teacher welcomes students' thoughts, feeling and actions, rely on non-controlling language, and where exploratory rationale is given so the content is seen as meaningful to their lives. In addition, a number of strategies can be implemented in order to support student's need for competence, such as planning and organizing activities according to the students' physical skills level, making it clear what is expected of the students, and praising and encouraging individual effort, instead of collective efforts (Belmont et al., 1992).

I found good support for the process model suggested by Ryan and Deci (2000). The question is, thus, whether the variables at the beginning of this process model (i.e., teacher and peer behaviours) are amenable to intervention. Su and Reeve's (2011) meta-analysis indicated that teachers' needs support increased following intervention (d = .63). To examine intervention effectiveness in studies from my review, I extracted 23 effect sizes from 16 intervention studies that attempted to modify teacher support (none focused on peers). I found interventions to be effective at increasing teacher needs support (d = .63) This is a large effect size and suggests training interventions can enhance teacher behaviours.

Peers likely have the greatest influence on each other's sense of relatedness in the classroom. Although the literature on how students can support each other's needs in physical education is limited – see Wallhead and Ntoumanis (2004) for an exception, there has been an increase in implementing peer-focused methods in other areas of education (e.g., Lee & Lim, 2012; Slavin, 1996; Thalluri, Flaherty, & Shepherd, 2014; Topping & Ehly, 2001). Some of the strategies proposed by the different methods involve both same level and higher-level students tutoring (Thalluri et al., 2014; Topping & Bryce, 2004; Topping, Peter, Stephen, & Whale, 2004), one-to-one (i.e., mentoring) and group situations (e.g., Nixon & Topping, 2001), and cooperative learning (Slavin, 1990, 1996). Teachers can also influence peer relatedness by organizing activities in small groups, in order to make peer support more prominent. Indeed, simple strategies that are easy to be applied, such as modified and small-sided games are features of two pedagogical models – Teaching Games for Understanding (TGfU; Bunker & Thorpe, 1982; Leary, 2014), and Sport Education (Siedentop, 1998) – that have been shown to have positive impact on students' motivation. The main idea behind such strategies is the promotion of a supportive learning environment through social interactions among students. Perhaps having peer support as a formalized intervention component would also lead to the satisfaction of other students' needs in physical education, other than

relatedness alone, in part by directing peer interactions toward activities consistent with physical education goals.

Strengths and Limitations

The key strength of this review is that it is first to meta-analyse the large body of SDT research within the physical education context. Apart from examining the strength and direction of the associations proposed by the theory in physical education, I used path analysis to test a full mediation model of the motivational sequence (see Figure 1). The number of studies included, the number of effect sizes analysed, and the total sample size are strengths of this review. This study, however, also presents the following limitations: The review is limited to peer-reviewed studies written in English, which could omit some important contributions published in other languages. Because of the complexity of the model indirect effects were reported as total indirect effects only (by subtracting the direct effect from the total effect). Future research that aims to explore a specific component of this overall model in more detail may want to decompose these total effects, when exploring a specific component of the SDT motivational sequence model, into specific indirect effects. I did not complete moderator analysis for all 319 relationships presented in Table 1. Instead, I investigated potential moderators on the 55 associations included in the path model I tested. Also, I did not have matrix coverage to examine my main hypothesis using longitudinal data.

Future Directions

This systematic review raises a number of opportunities for future research. Although there are many elements involved in supporting students' psychological needs, much of the existing evidence comes from the provision of autonomy support from the teacher (see Table 1). This is concerning and highlights the disparity in the way that support has been studied in

the physical education-based literature. Indeed, relatively few SDT-based studies have investigated the impact of competence (i.e., structure) and relatedness (i.e., involvement; Sparks et al., 2017) support from the teacher in physical education, and more research is needed to understand how these teacher behaviours influence students' experiences in physical education. My review also found a relative lack of objective social support variables in the literature, and research is needed to understand how observable teacher and peer behaviours influence motivational processes and outcomes.

Also, I found that peer support has been rarely studied in physical education, and further that it is associated with both positive and negative outcomes. Thus, another promising area for future interventions is the impact of need support from peers on students' motivational outcomes.

Moreover, given that most research has focus on older children and adolescents, additional research is needed with young children (<10 years of age) to better understand how the SDT model applies to physical education involving young children.

In addition, there is a dearth of research on integrated regulation. While this form of regulation may not be relevant in younger students, older adolescents whose sense of self is more developed, are more likely to be able to express the extent to which their behaviour is a good representation of their own personal values and beliefs (Deci et al., 1991). In these students, it may be important to investigate determinants and outcomes of integrated regulation in school physical education in order to understand how this form of motivation influences students' experiences.

Finally, I have also found that behavioural and affective outcomes have been extensively studied in physical education, but little attention has been paid to cognitive outcomes. Given that cognitive engagement would likely be a precursor of better learning in physical education, future research should also focus on how self-determined behaviours

influence cognitive variables, such as the use of learning strategies, metacognitive processes (i.e., knowledge about and regulation of one's cognition), and in-class concentration.

Conclusion

The overarching aim of this study was to synthesize results from studies underpinned by self-determination theory conducted in the school physical education context. Overall, the results of this meta-analytic review support theoretical postulates, suggesting that SDT is a useful theoretical framework to understand motivational process in physical education. SDT may provide the basis for effective interventions designed to improve in-class experiences as well as physical education learning outcomes.

Additional Results for Study 1

Meta-analysed Correlations Involving Teacher Support, Peer Support, Needs Satisfaction, Behavioural Regulations, and Student Outcomes in the Physical Education Context.

	k	#ES	Sample size		Coefficient	Lower	Upper	I^2_2	I^2_3	Q statistic
			Total	Harmonic Mean	(r)	95% CI	95% CI			
Teacher autonomy support and social context constructs										
Teacher autonomy support – Teacher competence support	12	13	6313	313	.757	0.62	0.85	0.75	0.03	1181.203
Teacher autonomy support – Teacher relatedness support	14	14	10487	327	.817	0.69	0.90	0.46	0.46	2362.787
Teacher autonomy support – Teacher controlling behaviour	1	1	499	499	-.188	-0.27	-0.10	0.46	0.46	0
Teacher autonomy support – Teacher's relative support	16	28	17299	324	.756	0.63	0.85	0.46	0.46	4182.156
Teacher autonomy support – Peer support	2	4	2347	562	.422	NA	NA	0.70	0.00	26.28821
Teacher autonomy support and psychological needs										
Teacher autonomy support – Autonomy	29	34	15919	227	.704	0.61	0.78	0.09	0.90	2458.197
Teacher autonomy support – Competence	30	35	15897	227	.458	0.38	0.53	0.00	0.96	695.8443
Teacher autonomy support – Relatedness	27	32	15524	256	.533	0.46	0.60	0.01	0.97	1011.23
Teacher autonomy support – Total needs satisfaction	36	105	50343	241	.568	0.49	0.64	0.50	0.49	7117.522
Teacher autonomy support – Total needs frustration	2	2	1516	670	-.160	-0.37	-0.07	0.47	0.47	36.27193
Teacher autonomy support and motivation										
Teacher autonomy support – Intrinsic Motivation	25	31	13625	234	.523	0.47	0.58	0.40	0.53	414.7777
Teacher autonomy support – Integrated Regulation	0	0	-	-	-	-	-	-	-	-
Teacher autonomy support – Identified Regulation	18	22	9625	242	.490	0.41	0.56	0.27	0.68	353.0336
Teacher autonomy support – Introjected Regulation	17	21	8336	231	.199	0.12	0.28	0.15	0.77	192.1669
Teacher autonomy support – External Regulation	18	22	9625	242	-.109	-0.22	0.00	0.40	0.56	825.4535
Teacher autonomy support – Amotivation	26	60	25164	266	-.247	-0.32	-0.18	0.27	0.67	1085.847
Teacher autonomy support – Autonomous motivation	37	68	28697	242	.501	0.45	0.55	0.16	0.78	1194.218
Teacher autonomy support – Controlled motivation	22	46	19367	243	.040	-0.12	0.20	0.97	0.00	1578.95
Teacher autonomy support – Self-determination Index	54	201	83475	242	.191	0.12	0.26	0.91	0.08	15580.0
Teacher autonomy support and student outcomes										
Teacher autonomy support – Affective outcomes	40	91	42318	218	.445	0.36	0.52	0.49	0.50	6426.868
Teacher autonomy support – Behavioural outcomes	44	84	25774	197	.294	0.25	0.38	0.43	0.52	1929.396
Teacher autonomy support – Cognitive outcomes	31	87	26856	170	.283	0.22	0.35	0.72	0.22	1624.485
Teacher autonomy support – In PE outcomes	44	105	51449	245	.359	0.26	0.45	0.44	0.55	7557.209
Teacher autonomy support – Out of PE outcomes	20	136	34005	157	.250	0.18	0.31	0.80	0.14	2073.121
Teacher autonomy support – Adaptive outcomes	56	241	87478	201	.374	0.32	0.44	0.42	0.55	8205.038
Teacher autonomy support – Maladaptive outcomes	13	21	7470	136	-.023	-0.16	0.08	0.97	0.00	412.7574
Teacher autonomy support – Outcomes (overall)	58	262	94948	193	.326	0.26	0.39	0.46	0.52	10349.31
Teacher competence support and social context constructs										
Teacher competence support – Teacher relatedness support	12	12	5749	302	.792	0.67	0.87	0.46	0.46	1499.346
Teacher competence support – Teacher's relative support	12	13	6313	313	.757	0.62	0.85	0.5	0.03	1818.203
Teacher competence support – Peer support	1	3	1947	649	.449	0.33	0.55	0.72	0.00	30.14666
Teacher competence support and psychological needs										
Teacher competence support – Autonomy	7	7	4391	422	.601	0.49	0.69	0.48	0.48	137.3371

Teacher competence support – Competence	6	6	4144	478	.616	0.50	0.71	0.48	0.48	135.0711
Teacher competence support – Relatedness	6	6	4144	478	.608	0.50	0.69	0.48	0.48	118.0848
Teacher competence support – Total needs satisfaction	7	19	12679	456	.608	0.53	0.68	0.58	0.38	390.968
Teacher competence support – Total needs frustration	0	0	-	-	-	-	-	-	-	-
Teacher competence support and motivation										
Teacher competence support – Intrinsic Motivation	6	6	4144	478	.623	0.55	0.68	0.45	0.45	58.67413
Teacher competence support – Integrated Regulation	0	0	-	-	-	-	-	-	-	-
Teacher competence support – Identified Regulation	4	4	2166	473	.608	0.50	0.70	0.46	0.46	55.04766
Teacher competence support – Introjected Regulation	4	4	2166	473	.317	0.19	0.43	0.45	0.45	49.37274
Teacher competence support – External Regulation	4	4	2166	473	-.080	-0.28	0.12	0.48	0.48	104.8497
Teacher competence support – Amotivation	7	14	6932	298	-.351	-0.44	-0.26	0.23	0.68	186.2875
Teacher competence support – Autonomous motivation	6	10	6310	476	.627	0.55	0.69	0.00	0.97	117.4986
Teacher competence support – Controlled motivation	4	8	4332	473	.123	-0.06	0.30	0.97	0.00	344.9873
Teacher competence support – Self-determination Index	8	33	18361	383	.133	-0.09	0.34	0.83	0.16	4613.904
Teacher competence support and student outcomes										
Teacher competence support – Affective outcomes	5	7	6333	466	.229	-0.34	0.71	0.99	0.00	1448.152
Teacher competence support – Behavioural outcomes	8	8	2811	306	.430	0.33	0.56	0.45	0.45	99.27441
Teacher competence support – Cognitive outcomes	6	8	4088	354	.304	0.18	0.42	0.91	0.00	109.4845
Teacher competence support – In PE outcomes	8	20	10826	349	.329	0.19	0.45	0.98	0.00	1643.388
Teacher competence support – Out of PE outcomes	2	2	2120	683	.342	.015	0.51	0.47	0.47	30.5602
Teacher competence support – Adaptive outcomes	9	20	10810	348	.285	0.05	0.49	0.21	0.78	1411.586
Teacher competence support – Maladaptive outcomes	3	3	2422	481	-.260	-0.41	-0.10	0.46	0.46	41.82589
Teacher competence support – Outcomes (overall)	9	23	13232	361	.335	0.22	0.45	0.98	0.00	1679.876
Teacher relatedness support and social context constructs										
Teacher relatedness support – Teacher's relative support	15	26	16236	315	.795	0.69	0.87	0.57	0.34	4248.902
Teacher relatedness support – Peer support	2	4	2321	548	.438	0.40	0.48	0.32	0.00	5.817272
Teacher relatedness support and psychological needs										
Teacher relatedness support – Autonomy	9	9	4994	384	.646	0.51	0.75	0.49	0.49	307.4592
Teacher relatedness support – Competence	9	9	5736	441	.522	0.37	0.65	0.49	0.49	320.7369
Teacher relatedness support – Relatedness	12	14	6767	328	.670	0.56	0.76	0.59	0.39	483.5638
Teacher relatedness support – Total needs satisfaction	14	32	17497	370	.620	0.54	0.69	0.98	0.00	1275.265
Teacher relatedness support – Total needs frustration	0	0	-	-	-	-	-	-	-	-
Teacher relatedness support and motivation										
Teacher relatedness support – Intrinsic Motivation	13	13	8786	366	.531	0.43	0.62	0.49	0.49	449.2365
Teacher relatedness support – Integrated Regulation	0	0	-	-	-	-	-	-	-	-
Teacher relatedness support – Identified Regulation	10	10	4640	323	.514	0.44	0.58	0.45	0.45	72.42099
Teacher relatedness support – Introjected Regulation	10	11	4806	298	.242	0.15	0.33	0.90	0.00	141.2983
Teacher relatedness support – External Regulation	9	10	4557	303	-.153	-0.31	0.01	0.00	0.96	309.8564
Teacher relatedness support – Amotivation	11	27	10549	258	-.281	-0.38	-0.17	0.16	0.78	414.1287
Teacher relatedness support – Autonomous motivation	13	25	13738	315	.527	0.44	0.60	0.05	0.90	534.5007
Teacher relatedness support – Controlled motivation	10	21	9363	300	.074	-0.05	0.20	0.97	0.00	860.793
Teacher relatedness support – Self-determination Index	18	76	35097	290	.165	0.06	0.27	0.91	0.08	6581.58
Teacher relatedness support and student outcomes										
Teacher relatedness support – Affective outcomes	12	22	15724	371	.270	0.13	0.40	0.99	0.00	1919.459
Teacher relatedness support – Behavioural outcomes	13	16	5313	360	.293	0.18	0.40	0.94	0.14	195.0896
Teacher relatedness support – Cognitive outcomes	10	15	9327	405	.261	0.15	0.37	0.97	0.00	669.5587
Teacher relatedness support – In PE outcomes	15	41	22063	322	.288	0.31	0.42	0.98	0.00	2247.577
Teacher relatedness support – Out of PE outcomes	5	10	7766	433	.220	0.07	0.36	0.98	0.00	581.6534

Teacher relatedness support – Adaptive outcomes	18	41	23960	339	.383	0.32	0.44	0.96	0.00	1118.155
Teacher relatedness support – Maladaptive outcomes	9	12	6404	324	-.137	-0.25	-0.02	0.43	0.51	209.515
Teacher relatedness support – Outcomes (overall)	18	53	2120	336	.327	0.19	0.35	0.98	0.00	2941.327
Teacher controlling behaviour – Teacher's relative support	2	2	1999	749	-.399	-0.63	-0.10	0.45	0.45	78.83368
Teacher controlling behaviour and psychological needs										
Teacher controlling behaviour – Autonomy	2	2	127	60	.159	0.18	0.33	-	-	0
Teacher controlling behaviour – Competence	4	4	1693	111	.450	-0.09	0.78	0.50	0.50	165.488
Teacher controlling behaviour – Relatedness	2	2	127	60	-.077	-0.25	0.10	0.00	0.00	0
Teacher controlling behaviour – Total needs satisfaction	5	9	2446	86	.370	-0.09	0.70	0.05	0.94	792.4133
Teacher controlling behaviour – Total needs frustration	2	5	2907	578	.796	0.78	0.81	0.98	0.00	216.2175
Teacher controlling behaviour and motivation										
Teacher controlling behaviour – Intrinsic Motivation	3	4	3416	848	.245	-0.16	0.58	0.06	0.93	497.3077
Teacher controlling behaviour – Integrated Regulation	0	0	-	-	-	-	-	-	-	-
Teacher controlling behaviour – Identified Regulation	1	2	1850	925	-.188	-0.23	-0.14	0.0	0.00	1.6596
Teacher controlling behaviour – Introjected Regulation	1	2	1850	925	.282	0.08	0.46	0.95	0.00	41.8999
Teacher controlling behaviour – External Regulation	1	2	1850	925	.409	0.19	0.59	0.96	0.00	56.47248
Teacher controlling behaviour – Amotivation	2	3	2349	720	.374	0.31	0.44	0.81	0.00	16.53106
Teacher controlling behaviour – Autonomous motivation	4	7	5765	788	.123	-0.25	0.46	0.03	0.97	638.3512
Teacher controlling behaviour – Controlled motivation	2	5	4199	790	.356	0.23	0.47	0.95	0.00	118.334
Teacher controlling behaviour – Self-determination Index	8	20	13108	279	.173	0.06	0.28	0.98	0.00	1284.442
Teacher controlling behaviour and student outcomes										
Teacher controlling behaviour – Affective outcomes	5	9	4263	220	.377	-0.10	0.71	0.04	0.95	1068.469
Teacher controlling behaviour – Behavioural outcomes	7	15	8809	300	.039	-0.25	0.32	0.55	0.44	1713.516
Teacher controlling behaviour – Cognitive outcomes	0	0	-	-	-	-	-	-	-	-
Teacher controlling behaviour – In PE outcomes	9	24	13072	264	.198	-0.15	0.50	0.22	0.78	2784.0.51
Teacher controlling behaviour – Out of PE outcomes	0	0	-	-	-	-	-	-	-	-
Teacher controlling behaviour – Adaptive outcomes	7	14	6257	187	-.274	-0.60	0.13	0.23	0.76	1641.606
Teacher controlling behaviour – Maladaptive outcomes	3	10	6815	627	.448	0.24	0.62	0.17	0.80	140.4947
Teacher controlling behaviour – Outcomes (overall)	9	24	13072	264	.198	-0.15	0.50	0.22	0.78	2784.051
Teacher's relative support – Peer support	6	14	7731	364	.410	0.34	0.48	0.92	0.00	167.8989
Teacher's relative support and psychological needs										
Teacher's relative support – Autonomy	47	71	33650	214	.607	0.51	0.69	0.46	0.53	6731.532
Teacher's relative support – Competence	52	76	38527	227	.367	0.28	0.44	0.65	0.33	6177.197
Teacher's relative support – Relatedness	47	70	33593	222	.493	0.42	0.56	0.09	0.89	2667.486
Teacher's relative support – Total needs satisfaction	63	225	111129	226	.483	0.41	0.55	0.53	0.46	19841.71
Teacher's relative support – Total needs frustration	3	7	4423	602	-.546	-0.82	-0.06	0.27	0.72	1230.108
Teacher's relative support and motivation										
Teacher's relative support – Intrinsic Motivation	49	89	46107	281	.459	0.40	0.51	0.70	0.28	4851.444
Teacher's relative support – Integrated Regulation	0	0	-	-	-	-	-	-	-	-
Teacher's relative support – Identified Regulation	33	47	21876	257	.479	0.42	0.53	0.24	0.71	902.7806
Teacher's relative support – Introjected Regulation	28	43	19633	255	.190	0.12	0.26	0.15	0.79	944.1823
Teacher's relative support – External Regulation	34	49	22546	256	-.065	-0.18	0.05	0.16	0.82	2959.581
Teacher's relative support – Amotivation	39	113	48409	261	-.235	-0.29	-0.18	0.22	0.72	1917.356
Teacher's relative support – Autonomous motivation	64	157	77645	272	.467	0.42	0.51	0.48	0.49	6508.219
Teacher's relative support – Controlled motivation	40	97	44414	261	.049	0.02	0.12	0.83	0.15	5100.291
Teacher's relative support – Self-determination Index	90	411	186595	255	.206	0.15	0.26	0.86	0.13	36659.61
Teacher's relative support and student outcomes										
Teacher's relative support – Affective outcomes	60	157	79243	230	.340	0.25	0.42	0.46	0.53	13854.71

Teacher's relative support – Behavioural outcomes	70	155	62733	213	.291	0.23	0.35	0.54	0.44	7220.462
Teacher's relative support – Cognitive outcomes	36	122	47622	206	.264	0.21	0.32	0.64	0.31	2746.72
Teacher's relative support – In PE outcomes	73	252	131160	250	.332	0.26	0.40	0.52	0.47	21201
Teacher's relative support – Out of PE	25	153	45429	167	.253	0.20	0.31	0.82	0.13	2793.535
Teacher's relative support – Adaptive outcomes	89	382	161496	216	.389	0.34	0.43	0.44	0.54	12754.95
Teacher's relative support – Enjoyment	22	28	21540	182	.442	0.33	0.54	0.08	0.90	1112.061
Teacher's relative support – Intentions	18	28	13199	218	.229	0.17	0.29	0.03	0.85	379.3334
Teacher's relative support – Leisure-time physical activity	19	26	7622	189	.214	0.16	0.27	0.82	0.00	149.0411
Teacher's relative support – Maladaptive outcomes	25	52	28102	222	-.260	-0.32	-0.20	0.42	0.53	972.9953
Teacher's relative support – Boredom	6	10	7381	237	-.211	-0.35	-0.07	0.43	0.53	332.3978
Teacher's relative support – Negative affect	1	3	906	302	-.261	-0.32	-0.20	0.00	0.00	0.976733
Teacher's relative support – Pressure	0	0	-	-	-	-	-	-	-	-
Teacher's relative support – Outcomes (overall)	92	434	189598	217	.310	0.26	0.36	0.53	0.46	24493.09
Peer support and psychological needs										
Peer support – Autonomy	4	6	3398	537	.389	0.23	0.52	0.00	0.94	64.7373
Peer support – Competence	4	6	3398	537	.272	0.19	0.35	0.32	0.47	23.76874
Peer support – Relatedness	5	7	37772	505	.691	0.43	0.84	0.24	0.74	625.8202
Peer support – Total needs satisfaction	5	20	10942	514	.505	0.37	0.62	0.99	0.00	1567.282
Peer support – Total needs frustration	0	0	-	-	-	-	-	-	-	-
Peers support and motivation										
Peer support – Intrinsic Motivation	1	3	1947	649	.288	0.21	0.36	0.73	0.00	11.15426
Peer support – Integrated Regulation	0	0	-	-	-	-	-	-	-	-
Peer support – Identified Regulation	1	3	1947	649	.408	0.33	0.48	0.74	0.00	11.67106
Peer support – Introjected Regulation	1	3	1947	649	.322	0.26	0.38	0.48	0.00	5.727865
Peer support – External Regulation	1	3	1947	649	.251	0.21	0.29	0.00	0.00	0.3014666
Peer support – Amotivation	1	3	1947	649	-.123	-0.17	-0.08	0.00	0.00	1.205866
Peer support – Autonomous motivation	2	7	4550	650	.343	0.28	0.40	0.84	0.00	42.61461
Peer support – Controlled motivation	1	6	3894	649	.287	0.25	0.33	0.49	0.00	11.7249
Peer support – Self-determination Index	4	18	11186	607	.232	0.15	0.31	0.95	0.00	388.687
Peer support and student outcomes										
Peer support – Affective outcomes	3	10	3907	390	.417	0.10	0.66	0.58	0.40	620.8108
Peer support – Behavioural outcomes	4	8	2734	177	.257	0.11	0.39	0.01	0.86	80.27364
Peer support – Cognitive outcomes	1	3	1200	400	.551	0.51	0.59	0.00	0.00	2.1438
Peer support – In PE outcomes	2	6	1626	145	.214	-0.04	0.44	0.96	0.00	210.435
Peer support – Out of PE outcomes	3	12	5030	411	.362	0.05	0.61	0.36	0.61	349.2231
Peer support – Adaptive outcomes	5	20	7467	265	.334	0.15	0.50	0.44	0.52	533.7074
Peer support – Maladaptive outcomes	1	1	374	374	-.345	-0.43	-0.25	0.50	0.50	0
Peer support – Outcomes (overall)	5	21	7841	268	.313	0.11	0.49	0.56	0.41	786.5199
Autonomy – Competence	54	66	32833	285	.651	0.58	0.71	0.08	0.91	5864.978
Autonomy – Relatedness	51	62	30482	280	.596	0.54	0.65	0.60	0.38	2941.103
Autonomy and motivation										
Autonomy – Intrinsic Motivation	33	45	19637	246	.608	0.55	0.66	0.15	0.81	1433.764
Autonomy – Integrated Regulation	1	1	1035	1035	.658	0.62	0.69	0.50	0.50	0
Autonomy – Identified Regulation	27	34	13493	216	.539	0.47	0.60	0.09	0.87	964.3973
Autonomy – Introjected Regulation	28	35	12779	213	.346	0.26	0.42	0.22	0.73	809.4907
Autonomy – External Regulation	29	36	14082	220	-.131	-0.23	-0.03	0.13	0.84	912.3109
Autonomy – Amotivation	26	44	20058	288	-.288	-0.36	-0.20	0.34	0.62	1317.835
Autonomy – Autonomous motivation	42	91	39530	237	.565	0.52	0.61	0.19	0.77	2817.283

Autonomy – Controlled motivation	32	74	27572	215	.080	-0.01	0.17	0.98	0.00	3681.837
Autonomy – Self-determination Index	55	229	96239	242	.310	0.24	0.38	0.93	0.06	23141.9
Autonomy and student outcomes										
Autonomy – Affective outcomes	38	84	39478	263	.480	0.41	0.54	0.53	0.45	4452.615
Autonomy – Behavioural outcomes	34	64	22696	234	.329	0.27	0.39	0.26	0.68	882.8606
Autonomy – Cognitive outcomes	19	31	13093	297	.403	0.32	0.48	0.29	0.67	761.9699
Autonomy – In PE outcomes	38	96	41210	230	.478	0.42	0.53	0.56	0.42	4336.056
Autonomy – Out of PE outcomes	20	59	23389	273	.343	0.27	0.42	0.28	0.66	1074.389
Autonomy – Adaptive outcomes	50	157	64659	262	.439	0.35	0.49	0.27	0.71	7060.165
Autonomy – Enjoyment	13	14	5569	188	.626	0.55	0.69	0.01	0.93	328.5677
Autonomy – Intentions	13	13	5972	250	.412	0.32	0.50	0.47	0.47	255.796
Autonomy – Leisure-time physical activity	12	18	5451	216	.269	0.19	0.35	0.92	0.00	223.6504
Autonomy – Maladaptive outcomes	16	22	10608	226	-.262	-0.35	-0.17	0.56	0.40	597.3015
Autonomy – Boredom	6	6	3060	156	-.279	-0.47	-0.05	0.48	0.48	270.1471
Autonomy – Negative affect	4	4	1528	237	-.449	-0.49	-0.40	0.00	0.00	3.705079
Autonomy – Pressure	1	1	507	507	-	-	-	-	-	-
Autonomy – Outcomes (overall)	50	179	75267	257	.427	0.37	0.48	0.41	0.55	7081.651
Competence – Relatedness	50	62	29643	267	.584	0.54	0.62	0.41	0.55	1346.914
Competence and motivation										
Competence – Intrinsic Motivation	53	77	34717	278	.624	0.57	0.67	0.06	0.92	3999.749
Competence – Integrated Regulation	2	2	1155	215	.779	0.40	0.93	0.49	0.49	83.23875
Competence – Identified Regulation	38	46	19222	231	.600	0.53	0.67	0.05	0.93	2288.444
Competence – Introjected Regulation	39	46	18374	232	.272	0.19	0.34	0.11	0.85	1279.321
Competence – External Regulation	41	51	20863	237	-.104	-0.19	-0.01	0.21	0.76	1792.998
Competence – Amotivation	32	51	22444	276	-.426	-0.48	-0.35	0.40	0.55	1184.763
Competence – Autonomous motivation	66	140	61432	257	.597	0.55	0.64	0.16	0.81	7119.12
Competence – Controlled motivation	46	101	40225	232	.074	0.04	0.11	0.98	0.00	4985.708
Competence – Self-determination Index	82	319	138789	257	.320	0.26	0.38	0.95	0.04	41306.2
Competence and student outcomes										
Competence – Affective outcomes	70	151	79474	263	.560	0.51	0.60	0.77	0.21	10439.31
Competence – Behavioural outcomes	70	148	70641	269	.484	0.43	0.54	0.30	0.67	5327.355
Competence – Cognitive outcomes	34	62	32244	264	.498	0.43	0.56	0.70	0.27	2384.242
Competence – In PE outcomes	83	217	102554	234	.534	0.49	0.59	0.62	0.36	12750.56
Competence – Out of PE outcomes	38	103	58725	316	.465	0.41	0.52	0.59	0.39	4202.792
Competence – Adaptive outcomes	105	314	160710	278	.524	0.48	0.57	0.44	0.54	19172.39
Competence – Enjoyment	34	40	21363	202	.649	0.59	0.70	0.18	0.80	1557.954
Competence – Intentions	22	27	16422	289	.548	0.48	0.61	0.24	0.73	607.9957
Competence – Leisure-time physical activity	23	36	19452	302	.402	0.32	0.48	0.42	0.55	889.1627
Competence – Maladaptive outcomes	31	47	21649	204	-.274	-0.39	-0.15	0.69	0.30	3092.718
Competence – Boredom	7	7	3818	176	-.389	-0.66	-0.04	0.50	0.50	787.484
Competence – Negative affect	4	4	1528	237	-.397	-0.50	-0.28	0.33	0.33	30.48893
Competence – Pressure	8	8	4757	183	-.418	-0.68	-0.06	0.50	0.50	832.3137
Competence – Outcomes (overall)	107	361	182359	266	.513	0.47	0.55	0.55	0.43	19171.54
Relatedness and motivation										
Relatedness – Intrinsic Motivation	34	45	19739	245	.546	0.49	0.60	0.00	0.96	1200.911
Relatedness – Integrated Regulation	1	1	1035	1035	.300	0.24	0.36	0.50	0.50	0
Relatedness – Identified Regulation	30	37	14603	220	.513	0.46	0.57	0.06	0.88	710.084
Relatedness – Introjected Regulation	30	37	13598	215	.269	0.19	0.35	0.23	0.72	669.4537

Relatedness – External Regulation	32	39	15192	223	-.074	-0.14	0.00	0.00	0.94	592.9022
Relatedness – Amotivation	28	46	20974	290	-.297	-0.36	-0.23	0.17	0.77	593.4189
Relatedness – Autonomous motivation	45	97	41515	237	.511	0.46	0.56	0.06	0.89	2223.138
Relatedness – Controlled motivation	36	80	29875	218	.086	0.02	0.15	0.97	0.00	2360.506
Relatedness – Self-determination Index	59	244	101301	243	.271	0.21	0.33	0.88	0.10	17701.42
Relatedness and student outcomes										
Relatedness – Affective outcomes	42	96	43558	268	.470	0.42	0.51	0.70	0.26	3069.381
Relatedness – Behavioural outcomes	34	66	22454	227	.348	0.28	0.41	0.22	0.73	1337.632
Relatedness – Cognitive outcomes	19	31	13088	297	.387	0.30	0.46	0.17	0.77	603.6847
Relatedness – In PE outcomes	41	109	44974	231	.454	0.41	0.50	0.65	0.32	3341.281
Relatedness – Out of PE outcomes	21	60	23932	277	.348	0.28	0.42	0.38	0.56	1178.01
Relatedness – Adaptive outcomes	53	167	67415	262	.426	0.38	0.47	0.39	0.57	4849.132
Relatedness – Enjoyment	14	15	6149	202	.601	0.51	0.68	0.00	0.96	334.3802
Relatedness – Intentions	12	12	5886	296	.428	0.33	0.51	0.47	0.47	191.2753
Relatedness – Leisure-time physical activity	12	18	5722	226	.292	0.25	0.33	0.89	0.00	171.9011
Relatedness – Maladaptive outcomes	19	26	11685	224	-.318	-0.40	-0.24	0.41	0.54	565.2307
Relatedness – Boredom	5	5	2974	186	-.313	-0.45	0.16	0.46	0.46	113.3976
Relatedness – Negative affect	3	3	965	199	-.359	-0.41	-0.30	0.00	0.00	0.1413272
Relatedness – Pressure	1	1	507	507	-	-	-	-	-	-
Relatedness – Outcomes (overall)	53	193	79100	256	.414	0.37	0.46	0.49	0.47	5610.566
Total needs satisfaction and motivation										
Total needs satisfaction – Intrinsic Motivation	55	165	74785	270	.590	0.55	0.63	0.64	0.33	7079.43
Total needs satisfaction – Integrated Regulation	2	4	3225	356	.661	0.36	0.84	0.99	0.00	722.1565
Total needs satisfaction – Identified Regulation	40	115	48010	235	.561	0.52	0.61	0.66	0.31	4303.047
Total needs satisfaction – Introjected Regulation	41	116	45443	232	.288	0.22	0.35	0.20	0.76	2807.712
Total needs satisfaction – External Regulation	43	124	50829	239	-.101	-0.17	-0.02	0.18	0.79	3430.258
Total needs satisfaction – Amotivation	39	144	68087	306	-.315	-0.39	-0.23	0.24	0.74	5813.696
Total needs satisfaction – Autonomous motivation	73	329	147092	257	.562	0.53	0.60	0.59	0.39	13804.29
Total needs satisfaction – Controlled motivation	52	254	100800	234	.086	0.03	0.14	0.85	0.13	11465.61
Total needs satisfaction – Self-determination Index	94	793	348958	263	.330	0.28	0.38	0.89	0.10	89060.33
Total needs satisfaction and student outcomes										
Total needs satisfaction – Affective outcomes	78	332	165567	277	.537	0.49	0.58	0.60	0.38	20040.8
Total needs satisfaction – Behavioural outcomes	83	295	122822	249	.450	0.40	0.50	0.33	0.65	11700.11
Total needs satisfaction – Cognitive outcomes	36	126	62091	302	.461	0.41	0.51	0.57	0.40	4333.795
Total needs satisfaction – In PE outcomes	96	432	199157	243	.516	0.48	0.55	0.61	0.37	25055.88
Total needs satisfaction – Out of PE outcomes	40	228	108065	294	.407	0.36	0.46	0.57	0.39	7259.37
Total needs satisfaction – Adaptive outcomes	117	657	304399	276	.508	0.47	0.55	0.38	0.60	34950.67
Total needs satisfaction – Maladaptive outcomes	37	96	46081	230	-.262	-0.34	-0.18	0.54	0.44	4340.113
Total needs satisfaction – Outcomes (overall)	120	753	350480	269	.488	0.45	0.52	0.51	0.47	38140.38
Total needs frustration and motivation										
Total needs frustration – Intrinsic Motivation	1	3	258	86	-.449	-0.54	-0.34	0.00	0.00	1.150933
Total needs frustration – Integrated Regulation	0	0	-	-	-	-	-	-	-	-
Total needs frustration – Identified Regulation	1	3	258	86	-.388	-0.49	-0.28	0.00	0.00	-
Total needs frustration – Introjected Regulation	1	3	258	86	-.067	-0.19	0.06	0.00	0.00	0.171533
Total needs frustration – External Regulation	1	3	258	86	-.129	-0.25	-0.01	0.00	0.00	1.0126
Total needs frustration – Amotivation	3	5	1503	128	.319	0.01	0.57	0.00	0.94	77.74608
Total needs frustration – Autonomous motivation	3	8	1761	108	-.132	-0.37	0.12	0.00	0.89	83.35051
Total needs frustration – Controlled motivation	3	8	1761	108	.077	-0.04	0.20	0.00	0.69	26.79871

Total needs frustration – Self-determination Index	3	24	5283	108	-.100	NA	NA	0.97	0.00	420.3911
Total needs frustration and student outcomes										
Total needs frustration – Affective outcomes	3	15	5622	175	.484	0.43	0.54	0.87	0.00	133.2277
Total needs frustration – Behavioural outcomes	4	5	2758	459	.469	0.27	0.63	0.40	0.56	132.0665
Total needs frustration – Cognitive outcomes	1	3	258	86	.411	0.25	0.55	0.56	0.00	6.778333
Total needs frustration – In PE outcomes	6	23	8638	175	.481	0.42	0.54	0.91	0.00	273.5089
Total needs frustration – Out of PE outcomes	0	0	-	-	-	-	-	-	-	-
Total needs frustration – Adaptive outcomes	4	12	4105	148	-.371	-0.53	-0.18	0.85	0.12	465.0063
Total needs frustration – Maladaptive outcomes	5	11	4533	218	.531	0.42	0.63	0.61	0.33	170.7178
Total needs frustration – Outcomes (overall)	6	23	8638	175	.481	0.42	0.54	0.91	0.00	273.5089
Intrinsic motivation and motivation										
Intrinsic Motivation – Integrated Regulation	4	4	2019	239	.882	0.66	0.96	0.46	0.46	1017.219
Intrinsic Motivation – Identified Regulation	65	92	37946	232	.883	0.85	0.91	0.41	0.51	11366.15
Intrinsic Motivation – Introjected Regulation	57	80	31742	232	.479	0.36	0.58	0.38	0.53	11886.43
Intrinsic Motivation – External Regulation	69	96	41349	236	-.078	-0.19	0.04	0.12	0.70	14732.91
Intrinsic Motivation – Amotivation	57	95	42268	254	-.474	-0.56	-0.38	0.16	0.68	5130.822
Intrinsic Motivation – Autonomous motivation	49	103	43358	272	.885	0.85	0.91	0.53	0.39	13429.76
Intrinsic Motivation – Controlled motivation	51	131	55404	253	.299	0.16	0.42	0.57	0.33	27591.48
Intrinsic motivation and student outcomes										
Intrinsic Motivation – Affective outcomes	54	112	58885	271	.429	0.32	0.52	0.94	0.05	21708.38
Intrinsic Motivation – Behavioural outcomes	52	84	30667	204	.480	0.38	0.58	0.26	0.73	7555.852
Intrinsic Motivation – Cognitive outcomes	31	79	43415	384	.490	0.42	0.56	0.71	0.27	4519.694
Intrinsic Motivation – In PE outcomes	69	173	83679	253	.472	0.39	0.54	0.89	0.11	29654.8
Intrinsic Motivation – Out of PE outcomes	31	88	42885	284	.416	0.35	0.48	0.74	0.24	3490.895
Intrinsic Motivation – Adaptive outcomes	84	229	111861	275	.571	0.52	0.62	0.46	0.53	17111.82
Intrinsic Motivation – Enjoyment	22	27	11838	252	.774	0.70	0.83	0.12	0.87	1974.567
Intrinsic Motivation – Intentions	19	28	16015	308	.550	0.48	0.61	0.09	0.86	406.508
Intrinsic Motivation – Leisure-time physical activity	18	24	9541	200	.356	0.31	0.40	0.84	0.00	120.2721
Intrinsic Motivation – Maladaptive outcomes	31	46	21106	233	-.255	-0.38	-0.12	0.60	0.39	3073.88
Intrinsic Motivation – Boredom	9	9	5858	204	-.426	-.069	-0.07	0.50	0.50	810.1588
Intrinsic Motivation – Negative affect	3	3	787	189	-.434	-0.66	-0.14	0.47	0.47	40.06195
Intrinsic Motivation – Pressure	2	2	892	438	-.185	-0.41	0.06	0.46	0.46	26.61928
Intrinsic Motivation – Outcomes (overall)	86	275	132967	267	.542	0.49	0.59	0.54	0.45	20764.74
Integrated regulation and motivation										
Integrated Regulation – Identified Regulation	4	4	2019	239	.840	0.69	0.92	0.46	0.46	283.9688
Integrated Regulation – Introjected Regulation	4	4	2019	239	.651	0.36	0.83	0.46	0.46	141.6663
Integrated Regulation – External Regulation	4	4	2019	239	.188	-0.28	0.58	0.46	0.46	422.3235
Integrated Regulation – Amotivation	4	4	2019	239	-.022	-0.46	0.43	0.46	0.46	409.1117
Integrated Regulation – Autonomous motivation	4	4	2019	239	.840	0.69	0.92	0.46	0.46	283.9688
Integrated Regulation – Controlled motivation	4	8	4038	239	.448	0.11	0.69	0.76	0.00	1387.851
Integrated regulation and student outcomes										
Integrated Regulation – Affective outcomes	2	3	938	166	-.247	-0.18	0.13	0.99	0.00	234.1365
Integrated Regulation – Behavioural outcomes	1	1	698	698	.590	-	-	-	-	-
Integrated Regulation – Cognitive outcomes	1	2	1396	698	.474	0.43	0.51	0.00	0.00	0.31275
Integrated Regulation – In PE outcomes	1	2	240	120	-.544	-0.12	-0.06	0.95	0.00	37.44
Integrated Regulation – Out of PE outcomes	1	4	2792	698	.476	0.34	0.49	0.44	0.00	7.141125
Integrated Regulation – Adaptive outcomes	1	4	2792	698	.476	0.44	0.51	0.44	0.00	7.141125
Integrated Regulation – Enjoyment	0	0	-	-	-	-	-	-	-	-

Integrated Regulation – Intentions	1	1	698	698	-	-	-	-	-	-
Integrated Regulation – Leisure-time physical activity	0	0	-	-	-	-	-	-	-	-
Integrated Regulation – Maladaptive outcomes	1	2	240	120	-.544	-0.82	-0.06	0.95	0.00	37.44
Integrated Regulation – Boredom	0	0	-	-	-	-	-	-	-	-
Integrated Regulation – Negative affect	0	0	-	-	-	-	-	-	-	-
Integrated Regulation – Pressure	0	0	-	-	-	-	-	-	-	-
Integrated Regulation – Outcomes (overall)	2	6	3032	268	.497	0.36	0.61	0.95	0.00	46.42784
Identified regulation and motivation										
Identified Regulation – Introjected Regulation	57	66	26114	219	.621	0.50	0.72	0.06	0.73	14300.94
Identified Regulation – External Regulation	64	76	31058	215	-.022	-0.15	0.11	0.18	0.67	8632.913
Identified Regulation – Amotivation	52	75	31120	234	-.383	-0.50	-0.25	0.09	0.72	8843.167
Identified Regulation – Autonomous motivation	22	26	9675	191	.854	0.79	0.90	0.18	0.67	2702.405
Identified Regulation – Controlled motivation	45	94	38650	230	.670	0.26	0.52	0.73	0.07	26777.84
Identified regulation and student outcomes										
Identified Regulation – Affective outcomes	38	69	31074	237	.352	0.21	0.45	0.99	0.00	8510.556
Identified Regulation – Behavioural outcomes	40	60	21550	198	.403	0.31	0.53	0.33	0.66	3050.027
Identified Regulation – Cognitive outcomes	24	52	24852	316	.522	0.39	0.63	0.67	0.32	5114.727
Identified Regulation – In PE outcomes	47	108	45333	227	.420	0.32	0.51	0.99	0.01	14352.04
Identified Regulation – Out of PE outcomes	22	60	26292	242	.382	0.30	0.46	0.92	0.05	2483.569
Identified Regulation – Adaptive outcomes	60	147	64175	245	.525	0.47	0.59	0.55	0.44	9512.899
Identified Regulation – Enjoyment	16	16	5019	193	.653	0.56	0.73	0.48	0.48	412.91
Identified Regulation – Intentions	13	14	6198	203	.570	0.51	0.63	0.00	0.91	118.1467
Identified Regulation – Leisure-time physical activity	14	19	7338	182	.336	0.27	0.40	0.89	0.00	126.3854
Identified Regulation – Maladaptive outcomes	25	34	13301	215	-.233	-0.36	-0.11	0.50	0.48	1801.857
Identified Regulation – Boredom	7	7	2164	163	-.566	-0.69	-0.42	0.47	0.47	176.0817
Identified Regulation – Negative affect	2	2	402	150	-.461	-0.60	-0.30	0.31	0.31	5.339189
Identified Regulation – Pressure	1	1	507	507	-	-	-	-	-	-
Identified Regulation – Outcomes (overall)	61	180	77476	238	.501	0.45	0.55	0.58	0.40	9667.51
Introjected regulation and motivation										
Introjected Regulation – External Regulation	56	66	26196	228	.560	0.48	0.63	0.84	0.14	3777.35
Introjected Regulation – Amotivation	44	65	26437	255	.053	-0.03	0.14	0.40	0.58	1817.888
Introjected Regulation – Autonomous motivation	58	152	60837	234	.564	0.47	0.65	0.31	0.68	26889.27
Introjected Regulation – Controlled motivation	37	44	17200	229	.576	0.47	0.68	0.68	0.16	3204.795
Introjected regulation and student outcomes										
Introjected Regulation – Affective outcomes	34	61	23019	226	.220	0.15	0.29	0.97	0.00	1714.272
Introjected Regulation – Behavioural outcomes	34	48	17693	221	.214	0.14	0.27	0.58	0.36	837.2092
Introjected Regulation – Cognitive outcomes	22	47	21089	307	.275	0.20	0.34	0.97	0.00	1387.55
Introjected Regulation – In PE outcomes	39	92	35551	227	.238	0.18	0.29	0.97	0.00	2531.136
Introjected Regulation – Out of PE outcomes	18	54	21181	252	.253	0.18	0.33	0.87	0.09	1375.673
Introjected Regulation – Adaptive outcomes	51	125	49964	253	.256	0.18	0.31	0.37	0.59	2966.77
Introjected Regulation – Enjoyment	15	15	4624	193	.350	0.18	0.50	0.49	0.49	477.1424
Introjected Regulation – Intentions	12	13	3861	186	.302	0.16	0.43	0.33	0.62	221.3374
Introjected Regulation – Leisure-time physical activity	10	15	4698	194	.209	0.08	0.33	0.06	0.86	179.2521
Introjected Regulation – Maladaptive outcomes	22	31	11837	212	.129	0.01	0.24	0.69	0.28	1033.303
Introjected Regulation – Boredom	7	7	2164	163	.002	-0.18	0.22	0.48	0.48	161.4044
Introjected Regulation – Negative affect	2	2	402	150	-.107	-0.45	0.26	0.45	0.45	21.35675
Introjected Regulation – Pressure	1	1	507	507	-	-	-	-	-	-
Introjected Regulation – Outcomes (overall)	52	156	61801	243	.291	0.26	0.33	0.77	0.16	2318.506

External regulation and motivation										
External Regulation – Amotivation	52	81	35238	250	.576	0.50	0.65	0.23	0.76	5116.771
External Regulation – Autonomous motivation	69	177	75060	235	-.025	-0.14	0.09	0.15	0.85	23818.91
External Regulation – Controlled motivation	21	24	9184	194	.522	0.41	0.62	0.75	0.00	581.1321
External regulation and student outcomes										
External Regulation – Affective outcomes	44	83	39522	258	.040	-0.04	0.13	0.88	0.11	6484.886
External Regulation – Behavioural outcomes	42	63	22760	201	-.079	-0.16	-0.02	0.26	0.69	1172.345
External Regulation – Cognitive outcomes	23	50	24257	317	-.054	-0.17	0.06	0.54	0.39	2567.219
External Regulation – In PE outcomes	52	122	53737	241	-.018	-0.09	0.05	0.87	0.11	8473.384
External Regulation – Out of PE outcomes	24	63	27589	245	-.028	-0.12	0.07	0.59	0.38	1997.2
External Regulation – Adaptive outcomes	65	157	69410	251	-.073	-0.15	0.01	0.13	0.85	8237.723
External Regulation – Enjoyment	19	20	6980	217	-.127	-0.30	0.06	0.00	0.98	1245.393
External Regulation – Intentions	13	14	6198	203	-.152	-0.27	-0.03	0.10	0.85	284.8654
External Regulation – Leisure-time physical activity	15	21	8250	190	-.035	-0.14	0.07	0.00	0.93	283.5236
External Regulation – Maladaptive outcomes	29	39	17129	231	.251	0.17	0.33	0.62	0.34	1443.061
External Regulation – Boredom	9	9	4924	201	.236	-0.01	0.45	0.49	0.49	786.2404
External Regulation – Negative affect	3	3	787	189	.294	0.06	0.50	0.45	0.45	35.63957
External Regulation – Pressure	2	2	892	438	.264	0.18	0.35	0.23	0.23	3.672374
External Regulation – Outcomes (overall)	66	196	86539	247	.269	0.24	0.31	0.49	0.45	3374.201
Amotivation and motivation										
Amotivation – Autonomous motivation	62	179	77805	256	-.434	-0.52	-0.34	0.29	0.70	14807.1
Amotivation – Controlled motivation	59	148	62203	242	.367	0.30	0.43	0.76	0.00	11987.65
Amotivation and student outcomes										
Amotivation – Affective outcomes	43	107	57361	296	-.106	-0.22	0.02	0.89	0.10	15704.09
Amotivation – Behavioural outcomes	40	72	30835	241	-.272	-0.37	-0.17	0.76	0.22	5411.252
Amotivation – Cognitive outcomes	25	54	26277	298	-.344	-0.43	-0.25	0.79	0.19	2754.312
Amotivation – In PE outcomes	58	188	91124	278	-.201	-0.28	-0.11	0.87	0.12	23338.78
Amotivation – Out of PE outcomes	20	33	17703	244	-.264	-0.37	-0.15	0.82	0.16	1449.627
Amotivation – Adaptive outcomes	63	187	91785	280	-.369	-0.42	-0.31	0.62	0.36	7598.631
Amotivation – Enjoyment	14	14	5575	183	-.519	-0.63	0.38	0.49	0.49	622.9599
Amotivation – Intentions	14	18	10381	251	-.425	-0.52	-0.31	0.41	0.57	661.2996
Amotivation – Leisure-time physical activity	10	10	4826	186	-.279	-0.35	-0.21	0.41	0.41	39.61912
Amotivation – Maladaptive outcomes	30	46	22688	266	.450	0.34	0.55	0.27	0.71	2211.101
Amotivation – Boredom	11	11	7374	236	.630	0.52	0.72	0.49	0.49	609.5242
Amotivation – Negative affect	3	3	787	189	.570	0.38	0.72	0.46	0.46	21.86706
Amotivation – Pressure	3	3	1195	381	.406	0.29	0.51	0.40	0.40	15.30845
Amotivation – Outcomes (overall)	67	233	114473	277	.400	0.35	0.44	0.56	0.42	8207.346
Autonomous motivation – Controlled motivation	83	345	140467	228	.254	0.16	0.35	0.57	0.33	69505.48
Autonomous motivation and student outcomes										
Autonomous motivation – Affective outcomes	70	220	102856	255	.400	0.30	0.48	0.75	0.24	33913.89
Autonomous motivation – Behavioural outcomes	68	188	64361	204	.438	0.35	0.53	0.18	0.80	14815.22
Autonomous motivation – Cognitive outcomes	44	166	79943	320	.502	0.44	0.56	0.59	0.40	10202.63
Autonomous motivation – In PE outcomes	83	826	147716	246	.440	0.36	0.51	0.77	0.22	51382.88
Autonomous motivation – Out of PE outcomes	43	215	85344	243	.416	0.36	0.47	0.69	0.27	6805.421
Autonomous motivation – Adaptive outcomes	105	480	207584	254	.540	0.50	0.58	0.44	0.54	31860.15
Autonomous motivation – Enjoyment	24	46	18083	232	.733	0.66	0.79	0.38	0.60	2566.034
Autonomous motivation – Intentions	28	54	26636	259	.511	0.45	0.57	0.03	0.93	779.6465
Autonomous motivation – Leisure-time physical activity	26	54	19538	197	.337	0.29	0.39	0.27	0.61	327.7702

Autonomous motivation – Maladaptive outcomes	38	94	39576	229	-.253	-0.35	-0.15	0.46	0.52	5162.495
Autonomous motivation – Boredom	10	17	8652	192	-.494	-0.65	-0.29	0.80	0.19	1057.537
Autonomous motivation – Negative affect	3	5	1189	171	-.410	-0.61	-0.16	0.00	0.92	48.73911
Autonomous motivation – Pressure	2	3	1399	459	-.169	-0.36	0.04	0.13	0.78	27.45168
Autonomous motivation – Outcomes (overall)	108	573	247160	249	.513	0.47	0.55	0.50	0.48	35849.44
Controlled motivation and student outcomes										
Controlled motivation – Affective outcomes	49	154	67122	250	.116	0.06	0.17	0.98	0.00	9021.281
Controlled motivation – Behavioural outcomes	49	125	44831	210	.045	-0.01	0.09	0.96	0.00	2992.218
Controlled motivation – Cognitive outcomes	28	101	47530	316	.111	0.03	0.19	0.86	0.12	5035.653
Controlled motivation – In PE outcomes	62	239	99503	240	.088	0.04	0.13	0.94	0.04	12945.75
Controlled motivation – Out of PE outcomes	27	119	49421	249	.100	0.03	0.17	0.86	0.11	4045.843
Controlled motivation – Adaptive outcomes	75	302	126476	252	.064	0.00	0.12	0.66	0.32	14174.08
Controlled motivation – Enjoyment	20	36	12234	210	.098	0.05	0.24	0.97	0.02	2323.391
Controlled motivation – Intentions	15	28	10689	199	.072	-0.04	0.18	0.97	0.00	1013.077
Controlled motivation – Leisure-time physical activity	17	38	13599	196	.064	-.0.01	0.14	0.94	0.00	574.8757
Controlled motivation – Maladaptive outcomes	35	78	33007	234	.198	0.13	0.27	0.75	0.22	2740.874
Controlled motivation – Boredom	10	17	7718	190	.130	-0.05	0.30	0.98	0.00	958.1592
Controlled motivation – Negative affect	3	5	1189	171	.136	-0.13	0.39	0.95	0.00	80.83133
Controlled motivation – Pressure	2	3	1399	459	.248	0.20	0.30	0.35	0.00	4.60743
Controlled motivation – Outcomes (overall)	77	380	159483	248	.272	0.25	0.30	0.78	0.15	6027.292
Self-determination Index and student outcomes										
Self-determination Index – Affective outcomes	88	527	245454	261	.481	0.44	0.52	0.75	0.24	30046.44
Self-determination Index – Behavioural outcomes	93	469	168998	206	.390	0.34	0.44	0.42	0.55	20000.56
Self-determination Index – Cognitive outcomes	55	350	166640	295	.431	0.39	0.47	0.71	0.26	14320.47
Self-determination Index – In PE outcomes	107	828	360971	245	.469	0.43	0.50	0.68	0.30	49706.11
Self-determination Index – Out of PE outcomes	54	435	183276	231	.376	0.33	0.42	0.67	0.29	11601.55
Self-determination Index – Adaptive outcomes	139	1120	482168	247	.444	0.41	0.47	0.68	0.30	57605.89
Self-determination Index – Enjoyment	31	108	39984	220	.771	0.70	0.83	0.99	0.00	29320.68
Self-determination Index – Intentions	15	28	10689	199	.271	0.21	0.34	0.92	0.00	333.9236
Self-determination Index – Leisure-time physical activity	17	38	13599	196	.185	0.14	0.23	0.85	0.00	224.612
Self-determination Index – Maladaptive outcomes	45	226	98924	238	.369	0.31	0.42	0.65	0.32	7113.6
Self-determination Index – Boredom	10	17	7718	190	.315	0.24	0.39	0.79	0.13	171.5209
Self-determination Index – Negative affect	3	5	1189	171	.279	0.13	0.42	0.87	0.00	43.0516
Self-determination Index – Pressure	2	3	1399	459	.248	0.20	0.30	0.35	0.00	4.60743
Self-determination Index – Outcomes (overall)	142	1346	581092	245	.431	0.40	0.46	0.68	0.30	65455.3
Between student outcomes										
Adaptive outcomes – Maladaptive outcomes	53	231	109262	302	-.212	-0.33	-0.09	0.43	0.56	22247.34

Moderation Analysis on Each Association Included in the Model.

	k	#ES	Sample size		Coefficient	Lower	Upper	R^2_2	R^2_3	I^2_2	I^2_3	Q statistic
			Total	Harmonic Mean	(r)	95% CI	95% CI					
Teacher's relative support – Peer support	6	14	7731	364	.410	0.34	0.48			0.92	0.00	167.8989
Culture								0.00	1.00			
Individualistic	5	13	7331	361	.434	0.39	0.48			0.88	0.00	
Collectivistic	1	1	400	400	.080	-0.02	0.18			0.50	0.50	
Sex								0.03	0.00			
Both	5	13	7357	363	.378	0.21	0.53			0.20	0.76	
Male	1	1	374	374	.470	0.39	0.55			0.50	0.50	
Female	0	0	-	-	-	-	-			-	-	
Age								0.05	0.00			
Children	0	0	-	-	-	-	-			-	-	
Preadolescents	5	13	7666	563	.410	0.25	0.55			0.22	0.74	
Adolescents	1	1	65	65	.273	0.03	0.49			0.50	0.50	
Risk of Bias								0	0			
Low Risk of Bias	6	14	7731	364	.410	0.34	0.48			0.92	0.00	
High Risk of Bias	0	0	-	-	-	-	-			-	-	
Teacher's relative support– Autonomy	47	71	33650	214	.607	0.51	0.69			0.46	0.53	6731.532
Culture								0.03	0.00			
Individualistic	29	44	18895	200	.614	0.47	0.72			0.48	0.51	
Collectivistic	16	24	13226	228	.589	0.46	0.69			0.35	0.63	
Sex								0.03	0.00			
Both	43	64	31697	232	.616	0.51	0.70			0.38	0.61	
Male	4	4	1002	105	.601	0.53	0.67			0.27	0.27	
Female	3	3	951	162	.444	0.01	0.74			0.49	0.49	
Age								0.00	0.00			
Children	0	0	0	0								
Preadolescents	28	43	23477	288	.627	0.51	0.72			0.26	0.73	
Adolescents	21	28	10173	153	.585	0.42	0.71			0.72	0.27	
Risk of Bias								0.00	0.00			
Low Risk of Bias	47	71	33650	214	.607	0.51	0.69			0.46	0.53	
High Risk of Bias	0	0	-	-	-	-	-			-	-	
Teacher's relative support – Competence	52	76	38527	227	.367	0.28	0.44			0.65	0.33	6177.197
Culture								0.00	0.00			
Individualistic	33	50	22251	214	.346	0.23	0.45			0.72	0.27	
Collectivistic	18	25	15561	250	.378	0.26	0.48			0.00	0.98	
Sex								0.00	0.02			
Both	48	69	36574	248	.375	0.29	0.46			0.68	0.31	
Male	4	4	1002	105	.259	0.03	0.46			0.45	0.45	
Female	3	3	951	162	.194	-0.10	0.46			0.47	0.47	
Age								0.01	0.02			
Children	0	0	-	-	-	-	-			-	-	
Preadolescents	33	48	28804	320	.340	0.23	0.44			0.82	0.17	
Adolescents	21	28	9723	151	.428	0.31	0.54			0.01	0.96	
Risk of Bias								0.00	0.00			
Low Risk of Bias	52	76	38527	227	.367	0.28	0.44			0.65	0.33	

High Risk of Bias	0	0	-	-	-	-	-			-	-	
Teacher's relative support – Relatedness	47	71	33967	224	.493	0.42	0.56			0.17	0.71	2758.357
Culture								0.00	0.00			
Individualistic	31	48	20393	218	.514	0.43	0.59			0.18	0.80	
Collectivistic	15	21	12485	225	.398	0.25	0.53			0.03	0.95	
Sex								0.01	0.00			
Both	44	65	21131	232	.496	0.42	0.57			0.09	0.89	
Male	2	2	544	125	.395	0.20	0.56			0.31	0.31	
Female	3	4	1292	187	.525	0.14	0.77			0.97	0.00	
Age								0.00	0.00			
Children	0	0	-	-	-	-	-			-	-	
Preadolescents	31	46	25288	302	.512	0.42	0.59			0.12	0.87	
Adolescents	18	25	8679	151	.456	0.35	0.55			0.58	0.39	
Risk of Bias								0.00	0.00			
Low Risk of Bias	47	71	33967	224	.493	0.42	0.56			0.17	0.71	
High Risk of Bias	0	0	-	-	-	-	-			-	-	
Teacher's relative support – Autonomous Motivation	49	137	68149	271	.456	0.40	0.51			0.47	0.51	5836.797
Culture								0.01	0.00			
Individualistic	29	93	46383	345	.469	0.40	0.54			0.53	0.44	
Collectivistic	20	44	21766	186	.422	0.33	0.50			0.13	0.83	
Sex								0.01	0.00			
Both	46	131	64971	278	.461	0.41	0.52			0.46	0.51	
Male	2	2	479	122	.338	0.31	0.36			0.00	0.00	
Female	3	4	2699	220	.281	-0.10	0.59			0.02	0.96	
Age								0.00	0.00			
Children	0	0	-	-	-	-	-			-	-	
Preadolescents	33	85	44454	271	.446	0.38	0.51			0.47	0.51	
Adolescents	18	52	23695	270	.490	0.41	0.56			0.50	0.46	
Risk of Bias								0.00	0.00			
Low Risk of Bias	49	137	68149	271	.456	0.40	0.51			0.47	0.51	
High Risk of Bias	0	0	-	-	-	-	-			-	-	
Teacher's relative support – Introjected Regulation	28	43	19438	235	.190	0.12	0.26			0.15	0.79	942.5579
Culture								0.01	0.06			
Individualistic	18	29	14515	381	.221	0.13	0.31			0.14	0.82	
Collectivistic	10	14	5118	152	.137	0.05	0.22			0.48	0.32	
Sex								0.00	0.00			
Both	28	43	19438	235	.190	0.12	0.26			0.15	0.79	
Male	0	0	-	-	-	-	-			-	-	
Female	0	0	-	-	-	-	-			-	-	
Age								0.17	0.00			
Children	0	0	-	-	-	-	-			-	-	
Preadolescents	20	28	12724	225	.195	0.11	0.28			0.06	0.88	
Adolescents	10	15	6714	257	.192	0.07	0.31			0.20	0.75	
Risk of Bias								0.00	0.00			
Low Risk of Bias	28	43	19438	235	.190	0.12	0.26			0.15	0.79	
High Risk of Bias	0	0	-	-	-	-	-			-	-	
Teacher's relative support – External Regulation	34	49	22546	256	-.065	-0.18	0.05			0.16	0.82	2959.581
Culture								0.00	0.01			

Individualistic	20	31	15986	380	-.101	-0.21	0.01			0.27	0.71	
Collectivistic	14	18	6560	164	-.016	-0.25	0.22			0.11	0.88	
Sex								0.00	0.12			
Both	33	48	21436	252	-.086	-0.20	0.03			0.18	0.80	
Male	0	0	-	-	-	-	-			-	-	
Female	1	1	1110	1110	.501	0.46	0.54			0.50	0.50	
Age								0.17	0.00			
Children	0	0	-	-	-	-	-			-	-	
Preadolescents	24	32	15537	269	-.052	-0.21	0.11			0.03	0.96	
Adolescents	12	17	7009	234	-.165	-0.28	-0.04			0.94	0.00	
Risk of Bias								0.00	0.00			
Low Risk of Bias	34	49	22546	256	-.065	-0.18	0.05			0.16	0.82	
High Risk of Bias	0	0	-	-	-	-	-			-	-	
Teacher's relative support – Amotivation	39	113	48409	261	-.235	-0.29	-0.18			0.22	0.72	1917.356
Culture								0.02	0.19			
Individualistic	22	70	27147	261	-.306	-0.38	-0.23			0.20	0.73	
Collectivistic	17	43	21262	261	-.143	-0.23	-0.06			0.32	0.62	
Sex								0.08	0.00			
Both	36	89	43533	306	-.232	-0.30	-0.16			0.20	0.76	
Male	2	19	3138	165	-.209	-0.38	-0.02			0.27	0.53	
Female	2	5	1738	190	-.300	NA	NA			0.57	0.00	
Age								0.00	0.00			
Children	0	0	-	-	-	-	-			-	-	
Preadolescents	25	65	28545	248	-.237	-0.31	-0.16			0.26	0.69	
Adolescents	16	48	19864	282	-.248	-0.34	-0.15			0.16	0.78	
Risk of Bias								0.00	0.00			
Low Risk of Bias	39	113	48409	261	-.235	-0.29	-0.18			0.22	0.72	
High Risk of Bias	0	0	-	-	-	-	-			-	-	
Teacher's relative support – Adaptive Outcomes	89	382	161496	216	.389	0.34	0.43			0.44	0.54	12754.95
Culture								0.00	0.00			
Individualistic	60	264	101307	227	.359	0.32	0.40			0.73	0.23	
Collectivistic	28	114	58515	194	.431	0.32	0.54			0.17	0.82	
Sex								0.00	0.00			
Both	81	352	155318	229	.385	0.34	0.43			0.44	0.54	
Male	6	15	2490	107	.491	0.18	0.71			0.51	0.47	
Female	6	15	3688	164	.377	0.20	0.53			0.96	0.00	
Age								0.00	0.00			
Children	1	1	485	485	.226	0.14	0.31			0.50	0.50	
Preadolescents	54	234	101459	223	.387	0.33	0.44			0.35	0.63	
Adolescents	39	147	59552	204	.393	0.32	0.46			0.57	0.50	
Risk of Bias								0.00	0.00			
Low Risk of Bias	88	378	161076	218	.379	0.33	0.42			0.49	0.48	
High Risk of Bias	1	4	420	105	.864	0.77	0.91			0.81	0.00	
Teacher's relative support – Maladaptive Outcomes	25	52	28102	222	-.260	-0.32	-0.20			0.42	0.53	972.9953
Culture								0.00	0.05			
Individualistic	18	40	21610	358	-.280	-0.37	-0.19			0.36	0.60	
Collectivistic	7	12	6492	98	-.199	-0.28	-0.11			0.52	0.31	
Sex								0.00	0.00			

Both	24	51	27728	220	-.263	-0.33	-0.19			0.40	0.55	
Male	0	0	-	-	-	-	-			-	-	
Female	1	1	374	374	-.207	-0.31	-0.11			0.50	0.50	
Age								0.08	0.00			
Children	0	0	-	-	-	-	-			-	-	
Preadolescents	15	34	18569	207	-.210	-0.27	-0.15			0.40	0.50	
Adolescents	10	18	9533	256	-.329	-0.45	-0.19			0.73	0.24	
Risk of Bias								0.00	0.00			
Low Risk of Bias	25	52	28102	222	-.260	-0.32	-0.20			0.42	0.53	
High Risk of Bias	-	-	-	-	-	-	-			-	-	
Peer support– Autonomy	4	6	3398	537	.389	0.23	0.52			0.00	0.94	64.7373
Culture								0.00	0.74			
Individualistic	3	5	2998	576	.458	0.36	0.55			0.00	0.86	
Collectivistic	1	1	400	400	-	-	-			-	-	
Sex								0.02	0.00			
Both	4	6	3398	537	.389	0.23	0.52			0.00	0.94	
Male	0	0	-	-	-	-	-			-	-	
Female	0	0	-	-	-	-	-			-	-	
Age								0.02	0.00			
Children	0	0	-	-	-	-	-			-	-	
Preadolescents	4	6	3398	537	.389	0.23	0.52			0.00	0.94	
Adolescents	0	0	-	-	-	-	-			-	-	
Risk of Bias								0.00	0.00			
Low Risk of Bias	4	6	3398	537	.389	0.23	0.52			0.00	0.94	
High Risk of Bias	0	0	-	-	-	-	-			-	-	
Peer support – Competence	4	6	3398	537	.272	0.19	0.35			0.32	0.47	23.76874
Culture								0.51	1.00			
Individualistic	3	5	2998	576	.304	0.27	0.34			0.52	0.00	
Collectivistic	1	1	400	400	-	-	-			-	-	
Sex								0.00	0.00			
Both	4	6	3398	534	.272	0.19	0.35			0.32	0.47	
Male	0	0	-	-	-	-	-			-	-	
Female	0	0	-	-	-	-	-			-	-	
Age								0.39	0.00			
Children	0	0	-	-	-	-	-			-	-	
Preadolescents	4	6	3398	536	.272	0.19	0.35			0.32	0.47	
Adolescents	0	0	-	-	-	-	-			-	-	
Risk of Bias								0.00	0.00			
Low Risk of Bias	4	6	3398	537	.272	0.19	0.35			0.32	0.47	
High Risk of Bias	0	0	-	-	-	-	-			-	-	
Peer support – Relatedness	5	7	3772	505	.716	0.45	0.86			0.04	0.95	557.161
Culture								0.00	0.75			
Individualistic	4	6	3372	529	.799	0.68	0.88			0.11	0.86	
Collectivistic	1	1	400	400	-	-	-			-	-	
Sex								0.11	0.00			
Both	4	6	3398	537	.700	0.34	0.88			0.03	0.96	
Male	0	0	-	-	-	-	-			-	-	
Female	1	2	748	374	.647	0.40	0.81			0.96	0.00	

Age								0.11	0.00			
Children	0	0	-	-	-	-	-			-	-	
Preadolescents	5	8	4146	484	.691	0.43	0.84			0.25	0.73	
Adolescents	0	0	-	-	-	-	-			-	-	
Risk of Bias								0.00	0.00			
Low Risk of Bias	5	8	4146	484	.691	0.43	0.84			0.24	0.74	
High Risk of Bias	0	0	-	-	-	-	-			-	-	
Peer support – Autonomous Motivation	1	6	3894	649	.3450	0.28	0.42			0.84	0.00	40.92409
Peer support – Introjected Regulation	1	3	1947	649	.322	0.26	0.38			0.48	0.00	5.727865
Peer support – External Regulation	1	3	1947	649	.251	0.21	0.29			0.00	0.00	0.3014666
Peer support – Amotivation	1	3	1947	649	-.123	-0.17	-0.08			0.00	0.00	1.205866
Peer support – Adaptive Outcomes	5	20	7467	265	.334	0.15	0.50			0.44	0.52	533.7074
Culture* **(p=0.002)**								0.12	1.00			
Individualistic	4	10	3467	198	.254	0.15	0.36			0.88	0.00	
Collectivistic	1	10	4000	400	.591	0.51	0.66			0.92	0.00	
Sex								0.00	0.00			
Both	4	16	5971	247	.321	0.09	0.52			0.32	0.62	
Male	0	0	-	-	-	-	-			-	-	
Female	1	4	1496	374	.345	0.16	0.51			0.93	0.00	
Age								0.00	0.00			
Children	0	0	-	-	-	-	-			-	-	
Preadolescents	4	18	7337	402	.367	0.17	0.54			0.46	0.50	
Adolescents	1	2	130	65	.164	-0.01	0.33			0.00	0.00	
Risk of Bias								0.00	0.00			
Low Risk of Bias	5	20	1947	649	.251	0.21	0.29			0.44	0.52	
High Risk of Bias	0	0	-	-	-	-	-			-	-	
Peer support – Maladaptive Outcomes	1	1	374	374	-.345	-0.43	-0.25			0.50	0.50	0
Autonomy – Competence	54	66	32833	284	.651	0.58	0.71			0.08	0.91	5864.978
Culture* **(p<0.001)**								0.00	0.22			
Individualistic	32	39	17894	281	.543	0.44	0.63			0.04	0.94	
Collectivistic	21	26	14224	285	.779	0.70	0.84			0.15	0.84	
Sex* **(p<0.001)**								0.57	0.01			
Both	50	59	29969	295	.669	0.60	0.73			0.03	0.96	
Male	4	4	1482	191	.279	-0.03	0.54			0.48	0.48	
Female	3	3	1382	275	.383	0.26	0.50			0.40	0.40	
Age								0.00	0.00			
Children	1	1	1073	1073	.422	0.37	0.47			0.50	0.50	
Preadolescents	29	38	18253	261	.591	0.50	0.67			0.05	0.93	
Adolescents	26	27	13507	317	.719	0.62	0.80			0.37	0.62	
Risk of Bias								0.00	0.02			
Low Risk of Bias	53	65	32540	285	.656	0.58	0.72			0.08	0.91	
High Risk of Bias	1	1	293	293	-	-	-			-	-	
Autonomy – Relatedness	51	62	30482	280	.594	0.53	0.65			0.60	0.37	2941.103
Culture								0.00	0.00			
Individualistic	30	37	16357	277	.565	0.49	0.63			0.76	0.21	
Collectivistic	21	26	14224	285	.779	0.70	0.84			0.15	0.84	
Sex								0.00	100.0			
Both	549	59	30106	300	.605	0.55	0.66			0.89	0.09	

Male	2	3	376	122	.506	NA	NA			0.93	0.00	
Female	1	2	276	138	.296	-0.12	0.62			0.92	0.00	
Age								0.00	0.00			
Children	1	1	1073	1073	.635	0.60	0.67			0.50	0.50	
Preadolescents	29	40	17353	241	.583	0.51	0.65			0.82	0.15	
Adolescents	23	23	12332	332	.611	0.51	0.69			0.49	0.49	
Risk of Bias								0.01	0.02			
Low Risk of Bias	50	63	30465	271	.600	0.54	0.65			0.77	0.21	
High Risk of Bias	1	1	293	293	-	-	-			-	-	
Autonomy – Autonomous Motivation	33	80	34165	235	.565	0.50	0.63			0.13	0.84	2696.958
Culture								0.00	0.03			
Individualistic	18	46	18988	262	.536	0.45	0.62			0.19	0.78	
Collectivistic	15	34	15177	186	.599	0.49	0.69			0.09	0.89	
Sex								0.00	0.00			
Both	31	76	33151	240	.564	0.49	0.63			0.12	0.85	
Male	2	3	607	134	.534	0.48	0.59			0.00	0.28	
Female	1	1	400	400	-	-	-			-	-	
Age								0.00	0.00			
Children	1	2	2146	1073	.414	0.38	0.45			0.00	0.00	
Preadolescents	15	40	13542	200	.647	0.59	0.70			0.23	0.69	
Adolescents	18	38	18477	273	.503	0.38	0.61			0.14	0.84	
Risk of Bias								0.00	0.01			
Low Risk of Bias	32	78	33579	233	.569	0.50	0.63			0.13	0.84	
High Risk of Bias	1	2	586	293	.450	0.36	0.53			0.39	0.00	
Autonomy – Introjected Regulation	28	35	12779	213	.346	0.26	0.42			0.22	0.73	809.4907
Culture								0.01	0.01			
Individualistic	17	22	7991	248	.325	0.22	0.42			0.00	0.95	
Collectivistic	11	13	4788	152	.359	0.19	0.51			0.42	0.54	
Sex								0.00	0.01			
Both	27	34	12679	221	.342	0.25	0.43			0.22	0.74	
Male	1	1	100	100	.446	0.27	0.59			0.50	0.50	
Female	0	0	-	-	-	-	-			-	-	
Age								100.0	0.00			
Children	2	2	1364	458	.545	0.13	0.78			0.49	0.49	
Preadolescents	14	20	6110	198	.307	0.22	0.39			0.00	0.88	
Adolescents	13	13	5305	221	.352	0.20	0.48			0.49	0.49	
Risk of Bias								0.00	0.17			
Low Risk of Bias	27	34	12486	212	.361	0.28	0.44			0.25	0.71	
High Risk of Bias	1	1	293	293	-	-	-			-	-	
Autonomy – External Regulation	29	36	14082	220	-.131	-0.23	-0.03			0.13	0.84	912.3109
Culture								0.06	0.21			
Individualistic	18	23	9294	260	-.222	-0.32	-0.12			0.19	0.76	
Collectivistic	11	13	4788	164	.027	-0.13	0.18			0.09	0.86	
Sex								0.00	0.03			
Both	28	35	13982	227	-.139	-0.24	-0.04			0.13	0.84	
Male	1	1	100	100	.110	-0.09	0.30			0.50	0.50	
Female	0	0	-	-	-	-	-			-	-	
Age								0.45	0.00			

Children	2	2	1364	458	-.047	-0.27	0.18			0.46	0.46	
Preadolescents	13	19	5782	194	-.224	-0.36	-0.08			0.11	0.84	
Adolescents	15	15	6936	244	-.077	-0.21	0.06			0.48	0.48	
Risk of Bias								0.00	0.00			
Low Risk of Bias	28	35	13789	218	-.130	-0.23	-0.03			0.12	0.84	
High Risk of Bias	1	1	293	293	-	-	-			-	-	
Autonomy – Amotivation	26	44	20058	288	-.288	-0.36	-0.20			0.34	0.62	1317.835
Culture								0.02	0.01			
Individualistic	14	14	7042	375	-.319	-0.43	-0.20			0.48	0.48	
Collectivistic	12	30	13016	261	-.252	-0.37	-0.13			0.35	0.61	
Sex								0.00	0.00			
Both	25	43	19958	302	-.287	-0.37	-0.20			0.33	0.63	
Male	1	1	100	100	-.310	-0.48	-0.12			0.50	0.50	
Female	0	0	-	-	-	-	-			-	-	
Age								0.40	0.00			
Children	2	2	1364	458	-.246	-0.65	0.26			0.49	0.49	
Preadolescents	11	24	10954	314	-.288	-0.42	-0.14			0.13	0.84	
Adolescents	14	18	7740	250	-.312	-0.41	-0.21			0.47	0.47	
Risk of Bias								0.00	0.01			
Low Risk of Bias	25	43	19765	288	-.292	-0.38	-0.20			0.33	0.63	
High Risk of Bias	1	1	293	293	-	-	-			-	-	
Autonomy – Adaptive Outcomes	48	154	63924	268	.443	0.38	0.50			0.32	0.65	6549.014
Culture								0.00	0.07			
Individualistic	27	86	31418	284	.348	0.28	0.41			0.50	0.45	
Collectivistic	19	64	30262	243	.555	0.46	0.64			0.26	0.71	
Sex								0.00	0.00			
Both	45	143	61982	288	.452	0.39	0.51			0.33	0.64	
Male	3	7	1121	129	.348	0.12	0.54			0.02	0.85	
Female	2	4	821	165	.229	NA	NA			0.65	0.00	
Age								0.00	0.00			
Children	1	1	1073	1073	.422	0.37	0.47			0.50	0.50	
Preadolescents	24	80	30623	256	.464	0.36	0.55			0.21	0.76	
Adolescents	25	73	32228	280	.455	0.39	0.52			0.51	0.46	
Risk of Bias								0.00	0.01			
Low Risk of Bias	47	153	63631	268	.445	0.38	0.50			0.32	0.65	
High Risk of Bias	1	1	293	293	-	-	-			-	-	
Autonomy – Maladaptive Outcomes	14	20	9959	238	-.262	-0.31	-0.13			0.67	0.28	500.6509
Culture								0.00	0.09			
Individualistic	7	9	3438	359	-.192	-0.31	-0.06			0.90	0.00	
Collectivistic	7	11	6521	187	-.249	-0.40	-0.09			0.22	0.74	
Sex								0.00	0.10			
Both	13	19	9859	257	-.218	-0.31	-0.12			0.67	0.28	
Male	1	1	100	100	-.354	-0.52	-0.17			0.50	0.50	
Female	0	0	-	-	-	-	-			-	-	
Age								0.04	0.00			
Children	0	0	-	-	-	-	-			-	-	
Preadolescents	6	9	4480	173	-.192	-0.36	-0.02			0.97	0.00	
Adolescents	8	11	5479	345	-.250	-0.34	-0.15			0.41	0.50	

Risk of Bias								0.00	0.07			
Low Risk of Bias	13	19	9666	236	-.220	-0.31	-0.12			0.66	0.28	
High Risk of Bias	1	1	293	293	-	-	-			-	-	
Competence – Relatedness	50	60	29367	274	.584	0.54	0.62			0.44	0.52	1346.914
Culture								0.00	0.00			
Individualistic	30	36	16324	273	.524	0.48	0.57			0.94	0.00	
Collectivistic	19	23	12328	269	.661	0.60	0.71			0.24	0.72	
Sex								0.06	0.00			
Both	48	57	28991	293	.587	0.54	0.63			0.48	0.49	
Male	2	2	238	116	.542	0.44	0.63			0.00	0.00	
Female	1	1	138	138	-	-	-			-	-	
Age								0.00	0.00			
Children	1	1	1073	1073	-	-	-			-	-	
Preadolescents	27	35	16204	249	.554	0.50	0.60			0.77	0.18	
Adolescents	24	24	12090	311	.620	0.56	0.68			0.48	0.48	
Risk of Bias								0.00	0.01			
Low Risk of Bias	49	59	29074	274	.587	0.55	0.63			0.43	0.63	
High Risk of Bias	1	1	293	293	-	-	-			-	-	
Competence – Autonomous Motivation	52	123	54922	266	.597	0.56	0.66			0.15	0.83	6858.848
Culture								0.00	0.00			
Individualistic	27	65	27247	269	.630	0.56	0.69			0.18	0.80	
Collectivistic	24	56	26861	186	.595	0.50	0.68			0.12	0.86	
Sex								0.00	0.00			
Both	47	113	51842	270	.617	0.56	0.67			0.15	0.83	
Male	4	5	1297	173	.553	0.36	0.70			0.25	0.68	
Female	4	5	1783	340	.479	0.35	0.59			0.00	0.89	
Age								0.00	0.00			
Children	2	3	2662	789	.454	0.13	0.69			0.07	0.91	
Preadolescents	30	72	28372	242	.588	0.53	0.64			0.19	0.77	
Adolescents	21	48	23888	299	.655	0.55	0.74			0.14	0.85	
Risk of Bias								0.00	0.02			
Low Risk of Bias	51	121	54336	266	.608	0.55	0.66			0.15	0.83	
High Risk of Bias	1	2	586	293	.776	0.74	0.81			0.00	0.00	
Competence – Introjected Regulation	38	45	18288	241	.277	0.20	0.35			0.11	0.85	1273.223
Culture								0.00	0.00			
Individualistic	20	25	9162	246	.281	0.17	0.39			0.14	0.83	
Collectivistic	18	20	9126	234	.274	0.16	0.38			0.07	0.89	
Sex								0.00	0.06			
Both	36	43	17845	247	.279	0.20	0.36			0.11	0.86	
Male	1	1	100	100	.485	0.32	0.62			0.50	0.50	
Female	1	1	343	343	.000	-0.11	0.11			0.50	0.50	
Age								0.41	0.00			
Children	2	2	1364	458	.497	0.21	0.71			0.49	0.49	
Preadolescents	22	28	10298	228	.255	0.17	0.33			0.15	0.79	
Adolescents	15	15	6626	251	.276	0.13	0.41			0.49	0.49	
Risk of Bias								0.00	0.12			
Low Risk of Bias	37	44	17995	240	.290	0.21	0.36			0.12	0.84	
High Risk of Bias	1	1	293	293	-	-	-			-	-	

Competence – External Regulation	40	50	20777	245	-.108	-0.20	-0.02			0.21	0.76	1788.883
Culture								0.02	0.02			
Individualistic	22	29	11517	261	-.156	-0.26	-0.05			0.08	0.89	
Collectivistic	18	21	9260	226	-.055	-0.20	0.10			0.49	0.49	
Sex								0.00	0.06			
Both	36	44	18954	247	-.112	-0.21	-0.03			0.26	0.71	
Male	3	3	790	183	.211	0.03	0.38			0.41	0.41	
Female	3	3	1033	321	-.013	-0.44	0.42			0.49	0.49	
Age								0.45	0.00			
Children	2	2	1364	548	-.042	-0.26	0.18			0.46	0.46	
Preadolescents	22	31	11156	226	-.071	-0.19	0.05			0.12	0.84	
Adolescents	17	17	8257	272	-.182	-0.32	-0.03			0.49	0.49	
Risk of Bias								0.00	0.01			
Low Risk of Bias	39	49	20484	244	-.104	-0.20	-0.01			0.21	0.77	
High Risk of Bias	1	1	293	293	-	-	-			-	-	
Competence – Amotivation	31	50	22358	289	-.418	-0.48	-0.35			0.42	0.54	1171.727
Culture								0.00	0.18			
Individualistic	16	16	7490	328	-.466	-0.54	-0.38			0.47	0.47	
Collectivistic	15	34	14868	273	-.368	-0.46	-0.27			0.41	0.54	
Sex								0.00	0.04			
Both	30	49	22258	300	-.413	-0.48	-0.35			0.42	0.54	
Male	1	1	100	100	-.565	-0.69	-0.39			0.50	0.50	
Female	0	0	-	-	-	-	-			-	-	
Age								0.76	0.00			
Children	2	2	1364	458	-.167	-0.40	0.09			0.47	0.47	
Preadolescents	16	30	13220	299	-.375	-0.46	-0.28			0.14	0.82	
Adolescents	14	18	7774	262	-.503	-0.57	-0.43			0.03	0.90	
Risk of Bias								0.00	0.04			
Low Risk of Bias	30	49	22065	288	-.414	-0.48	-0.35			0.41	0.54	
High Risk of Bias	1	1	293	293	-	-	-			-	-	
Competence – Adaptive Outcomes	103	311	159975	282	.525	0.48	0.57			0.44	0.55	19165.75
Culture								0.00	0.00			
Individualistic	59	169	77351	266	.497	0.43	0.56			0.35	0.63	
Collectivistic	42	138	80380	300	.545	0.48	0.61			0.57	0.41	
Sex								0.00	0.00			
Both	93	276	138724	294	.532	0.48	0.58			0.45	0.53	
Male	9	18	10254	190	.471	0.34	0.59			0.30	0.68	
Female	10	17	10997	246	.413	0.29	0.52			0.26	0.71	
Age								0.00	0.00			
Children	3	4	5671	261	.591	NA	NA			0.54	0.00	
Preadolescents	64	189	88575	273	.503	0.44	0.57			0.32	0.66	
Adolescents	40	118	65729	298	.560	0.50	0.62			0.64	0.34	
Risk of Bias								0.00	0.00			
Low Risk of Bias	99	301	154452	284	.528	0.48	0.57			0.42	0.57	
High Risk of Bias	4	10	5523	234	.468	0.30	0.61			0.98	0.00	
Competence – Maladaptive Outcomes	29	45	21000	208	-.255	-0.38	-0.13			0.69	0.30	2974.374
Culture								0.05	0.00			
Individualistic	13	19	8101	253	-.342	-0.49	-0.17			0.51	0.47	

Collectivistic	16	26	12899	184	-.194	-0.38	0.00			0.68	0.31	
Sex								0.00	0.00			
Both	27	43	20218	210	-.251	-0.38	-0.11			0.68	0.30	
Male	2	2	782	174	-.331	-0.62	0.03			0.46	0.46	
Female	0	0	-	-	-	-	-			-	-	
Age								0.00	0.00			
Children	1	1	74	74	.319	0.10	0.51			0.50	0.50	
Preadolescents	14	21	10503	204	-.249	-0.39	-0.10			0.74	0.24	
Adolescents	16	23	10423	230	-.269	-0.46	-0.06			0.85	0.14	
Risk of Bias								0.00	0.45			
Low Risk of Bias	26	40	19424	221	-.309	-0.41	-0.17			0.85	0.14	
High Risk of Bias	3	5	1576	140	-.031	-0.40	0.34			0.02	0.94	
Relatedness – Autonomous Motivation	33	81	35205	246	.511	0.48	0.59			0.06	0.89	1990.033
Culture								0.00	0.09			
Individualistic	18	47	18062	253	.575	0.50	0.64			0.05	0.90	
Collectivistic	15	34	17143	236	.483	0.40	0.56			0.09	0.86	
Sex								0.00	0.00			
Both	32	79	35005	255	.535	0.48	0.59			0.06	0.90	
Male	1	2	200	100	.561	0.46	0.65			0.00	0.00	
Female	0	0	-	-	-	-	-			-	-	
Age								0.00	0.00			
Children	1	2	2146	1073	.561	0.53	0.59			0.00	0.00	
Preadolescents	17	44	15470	211	.586	0.51	0.65			0.07	0.88	
Adolescents	16	35	17589	293	.467	0.40	0.53			0.07	0.86	
Risk of Bias								0.00	0.00			
Low Risk of Bias	32	79	34619	245	.535	0.48	0.59			0.06	0.90	
High Risk of Bias	1	2	586	293	.561	0.50	0.62			0.00	0.00	
Relatedness – Introjected Regulation	29	36	13512	225	.269	0.19	0.35			0.23	0.72	669.4537
Culture								0.00	0.03			
Individualistic	18	23	8416	245	.293	0.18	0.40			0.28	0.67	
Collectivistic	11	13	5096	196	.245	0.12	0.37			0.14	0.80	
Sex								0.00	0.02			
Both	28	35	13412	233	.269	0.18	0.35			0.23	0.73	
Male	1	1	100	100	.446	0.27	0.59			0.50	0.50	
Female	0	0	-	-	-	-	-			-	-	
Age								0.00	0.00			
Children	1	1	1073	1073	.336	0.28	0.39			0.50	0.50	
Preadolescents	16	22	7074	209	.291	0.19	0.39			0.29	0.65	
Adolescents	13	13	5365	241	.240	0.10	0.37			0.48	0.48	
Risk of Bias								0.08	0.30			
Low Risk of Bias	28	35	13219	223	.269	0.22	0.36			0.27	0.67	
High Risk of Bias	1	1	293	293	-	-	-			-	-	
Relatedness – External Regulation	31	38	15106	233	-.078	-0.15	0.00			0.00	0.94	590.1877
Culture								0.01	0.11			
Individualistic	19	24	8928	250	-.135	-0.22	-0.05			0.14	0.79	
Collectivistic	12	14	6178	210	.016	-0.11	0.14			0.00	0.95	
Sex								0.01	0.04			
Both	30	37	15006	241	-.085	-0.16	-0.01			0.00	0.94	

Male	1	1	100	100	-.168	-0.03	0.35			0.50	0.50	
Female	0	0	-	-	-	-	-			-	-	
Age								0.00	0.00			
Children	2	2	1364	458	.083	-0.06	0.22			0.39	0.39	
Preadolescents	15	21	6746	205	-.118	-0.22	-0.01			0.03	0.89	
Adolescents	15	15	6996	264	-.071	-0.18	0.04			0.48	0.48	
Risk of Bias								0.00	0.03			
Low Risk of Bias	30	37	14813	231	-.071	-0.14	0.01			0.00	0.94	
High Risk of Bias	1	1	293	293	-	-	-			-	-	
Relatedness – Amotivation	28	46	20974	290	-.297	-0.36	-0.23			0.17	0.77	593.4189
Culture												
Individualistic												
Collectivistic												
Sex								0.00	0.00			
Both	27	45	20874	303	-.296	-0.36	-0.23			0.16	0.78	
Male	1	1	100	100	-.319	-0.49	-0.13			0.50	0.50	
Female	0	0	-	-	-	-	-			-	-	
Age								0.00	0.00			
Children	2	2	1364	458	-.215	-0.44	0.04			0.47	0.47	
Preadolescents	13	26	11918	322	-.281	-0.38	-0.18			0.21	0.73	
Adolescents	14	18	7692	245	-.323	-0.40	-0.24			0.00	0.90	
Risk of Bias								0.00	0.09			
Low Risk of Bias	27	45	20681	290	-.288	-0.35	-0.22			0.17	0.77	
High Risk of Bias	1	1	293	293	-	-	-			-	-	
Relatedness – Adaptive Outcomes	53	167	67415	262	.426	0.38	0.47			0.39	0.57	4849.132
Culture												
Individualistic												
Collectivistic												
Sex								0.00	0.00			
Both	50	154	64791	278	.433	0.38	0.48			0.40	0.56	
Male	2	6	714	116	.253	-0.10	0.55			0.25	0.65	
Female	2	7	1910	216	.249	0.01	0.47			0.51	0.42	
Age								0.00	0.00			
Children	1	1	1073	1073	.558	0.52	0.60			0.50	0.50	
Preadolescents	27	86	33690	265	.389	0.31	0.46			0.35	0.61	
Adolescents	27	80	32652	256	.461	0.40	0.52			0.50	0.46	
Risk of Bias								0.00	0.00			
Low Risk of Bias	52	166	67122	262	.427	0.38	0.48			0.39	0.58	
High Risk of Bias	1	1	293	293	-	-	-			-	-	
Relatedness – Maladaptive Outcomes	20	26	11685	224	-.318	-0.40	-0.24			0.21	0.54	565.2307
Culture												
Individualistic												
Collectivistic												
Sex								0.00	0.03			
Both	17	24	11211	232	-.312	-0.40	-0.22			0.41	0.54	
Male	1	1	100	100	-.380	-0.54	-0.20			0.50	0.50	
Female	1	1	374	374	-.388	-0.47	-0.30			0.50	0.50	
Age								0.00	0.00			

Children	0	0	-	-	-	-	-			-	-	
Preadolescents	9	12	5828	204	-.321	-0.42	-0.21			0.47	0.46	
Adolescents	10	14	5857	245	-.314	-0.43	-0.19			0.39	0.56	
Risk of Bias								0.01	0.00			
Low Risk of Bias	18	25	11392	222	-.322	-0.40	-0.24			0.40	0.54	
High Risk of Bias	1	1	293	293	-	-	-			-	-	
Autonomous Motivation – Introjected Regulation	58	152	60837	237	.565	0.47	0.65			0.31	0.68	26889.27
Culture												
Individualistic												
Collectivistic												
Sex								0.00	0.03			
Both	56	148	59951	240	.569	0.47	0.66			0.32	0.68	
Male	1	2	200	100	.714	0.64	0.78			0.00	0.00	
Female	1	2	686	343	.000	-0.17	0.17			0.80	0.00	
Age								0.01	0.00			
Children	1	2	2146	1073	.530	0.40	0.64			0.94	0.00	
Preadolescents	34	94	34676	223	.571	0.44	0.68			0.21	0.78	
Adolescents	24	56	24015	256	.557	0.39	0.69			0.46	0.53	
Risk of Bias								0.00	0.10			
Low Risk of Bias	57	150	60251	236	.575	0.48	0.66			0.32	0.67	
High Risk of Bias	1	2	586	293	-.240	-0.34	-0.14			0.39	0.00	
Autonomous Motivation – External Regulation	69	177	75060	235	-.025	-0.14	0.09			0.15	0.85	23818.91
Culture												
Individualistic												
Collectivistic												
Sex								0.00	0.00			
Both	64	165	72306	242	-.042	-0.16	0.08			0.15	0.84	
Male	3	4	890	151	.444	0.14	0.67			0.00	0.94	
Female	4	8	1864	178	.224	-0.39	0.70			0.16	0.83	
Age								0.01	0.00			
Children	1	2	2146	1073	.235	0.17	0.30			0.62	0.00	
Preadolescents	39	108	37889	211	-.024	-0.18	0.13			0.18	0.81	
Adolescents	30	67	35025	278	-.051	-0.23	0.13			0..08	0.91	
Risk of Bias								0.00	0.01			
Low Risk of Bias	68	175	74474	234	-.020	-0.14	0.10			0.15	0.85	
High Risk of Bias	1	2	586	293	-.384	-0.46	-0.31			0.18	0.00	
Autonomous Motivation – Amotivation	62	179	77805	256	-.434	-0.52	-0.34			0.29	0.70	14807.1
Culture												
Individualistic												
Collectivistic												
Sex								0.00	0.01			
Both	60	173	77117	268	-.435	-0.52	-0.34			0.29	0.70	
Male	1	2	200	100	-.582	-0.67	-0.48			0.00	0.00	
Female	1	4	488	122	-.219	-0.31	-0.12			0.19	0.00	
Age								0.00	0.00			
Children	1	2	2146	1073	-.245	-0.59	0.17			0.00	0.00	
Preadolescents	33	108	41204	241	-.367	-0.49	-0.23			0.36	0.63	
Adolescents	29	69	34455	277	-.520	-0.63	-0.40			0.11	0.88	

Risk of Bias								0.00	0.01			
Low Risk of Bias	60	176	76868	256	-.429	-0.52	-0.33			0.29	0.70	
High Risk of Bias	2	3	937	310	-.605	-0.69	-0.51			0.26	0.44	
Autonomous Motivation – Adaptive Outcomes	105	480	207584	254	.540	0.50	0.58			0.44	0.54	31860.15
Culture												
Individualistic												
Collectivistic												
Sex								0.00	0.00			
Both	93	441	192195	269	.548	0.50	0.59			0.46	0.53	
Male	9	20	6597	113	.427	0.20	0.61			0.40	0.57	
Female	10	19	8882	244	.434	0.19	0.63			0.41	0.57	
Age								0.00	0.00			
Children	3	5	3469	545	.541	0.40	0.66			0.94	0.03	
Preadolescents	55	234	92511	244	.519	0.45	0.58			0.45	0.54	
Adolescents	50	241	111604	261	.570	0.51	0.62			0.43	0.55	
Risk of Bias								0.00	0.00			
Low Risk of Bias	103	477	205943	253	.541	0.49	0.58			0.44	0.54	
High Risk of Bias	2	3	1641	386	.457	0.03	0.74			0.00	0.98	
Autonomous Motivation – Maladaptive Outcomes	38	94	39576	229	-.253	-0.35	-0.15			0.46	0.52	5162.495
Culture												
Individualistic												
Collectivistic												
Sex								0.00	0.20			
Both	35	87	38358	240	-.220	-0.32	-0.12			0.40	0.59	
Male	2	4	532	125	-.659	-0.82	-0.39			0.95	0.00	
Female	2	3	686	194	-.573	-0.85	-0.06			0.98	0.00	
Age								0.00	0.00			
Children	0	0	-	-	-	-	-			-	-	
Preadolescents	15	42	21325	241	-.182	-0.33	-0.02			0.56	0.42	
Adolescents	23	52	18251	221	-.297	-0.42	-0.16			0.38	0.60	
Risk of Bias								0.00	0.03			
Low Risk of Bias	37	92	38990	228	-.244	-0.35	-0.14			0.46	052	
High Risk of Bias	1	2	586	293	-.523	-0.60	-0.44			0.46	0.00	
Introjected Regulation – External Regulation	56	66	26196	228	.560	0.48	0.63			0.84	0.14	3777.35
Culture												
Individualistic												
Collectivistic												
Sex								0.00	0.00			
Both	54	64	25753	231	.563	0.48	0.64			0.84	0.15	
Male	1	1	100	100	.217	0.02	0.40			0.50	0.50	
Female	1	1	343	343	.623	0.55	0.68			0.50	0.50	
Age								0.00	0.00			
Children	1	1	1073	1073	.834	0.81	0.85			0.50	0.50	
Preadolescents	32	41	14858	212	.492	0.39	0.59			0.93	0.05	
Adolescents	24	24	10625	252	.627	0.51	0.72			0.49	0.49	
Risk of Bias								0.01	0.13			
Low Risk of Bias	55	65	25903	227	.552	0.47	0.62			0.85	0.13	
High Risk of Bias	1	1	293	293	-	-	-			-	-	

Introjected Regulation – Amotivation	44	65	26437	255	.053	-0.03	0.14			0.40	0.58	1817.888
Culture												
Individualistic												
Collectivistic												
Sex***(p<0.001)**								0.00	0.08			
Both	43	64	26337	261	.063	-0.02	0.15			0.41	0.56	
Male	1	1	100	100	-.388	0.54	-0.21			0.50	0.50	
Female	0	0	-	-	-	-	-			-	-	
Age								0.07	0.02			
Children	1	1	1073	1073	.537	0.49	0.58			0.50	0.50	
Preadolescents	26	42	16369	255	.011	-0.09	0.11			0.33	0.64	
Adolescents	18	22	8995	246	.084	-0.05	0.22			0.14	0.83	
Risk of Bias								0.00	0.08			
Low Risk of Bias	43	64	26144	254	.044	-0.04	0.13			0.41	0.56	
High Risk of Bias	1	1	293	293	-	-	-			-	-	
Introjected Regulation – Adaptive Outcomes	51	125	49964	253	.256	0.18	0.31			0.37	0.59	2966.77
Culture												
Individualistic												
Collectivistic												
Sex* **(*p*=0.017)**								0.00	0.24			
Both	49	121	49321	262	.254	0.19	0.31			0.43	0.53	
Male	1	3	300	100	.657	0.58	0.72			0.16	0.00	
Female	1	1	343	343	-.207	-0.31	-0.10			0.50	0.50	
Age								0.05	0.00			
Children	2	2	1364	458	.405	0.09	0.65			0.48	0.48	
Preadolescents	29	70	28145	254	.206	0.13	0.28			0.56	0.40	
Adolescents	22	53	20455	247	.316	0.21	0.41			0.18	0.79	
Risk of Bias								0.01	0.11			
Low Risk of Bias	50	124	49671	253	.265	0.20	0.33			0.39	0.57	
High Risk of Bias	1	1	293	-	-	-	-			-	-	
Introjected Regulation – Maladaptive Outcomes	22	31	11837	212	.129	0.01	0.24			0.69	0.28	1033.303
Culture												
Individualistic												
Collectivistic												
Sex								0.05	0.21			
Both	21	30	11737	220	.149	0.04	0.26			0.72	0.25	
Male	1	1	100	100	-.371	-0.53	-0.19			0.50	0.50	
Female	0	0	-	-	-	-	-			-	-	
Age* **(*p*=0.035)**								0.00	0.71			
Children	0	0	-	-	-	-	-			-	-	
Preadolescents	8	13	6663	215	.276	0.11	0.43			0.98	0.00	
Adolescents	14	18	5174	210	.036	-0.09	0.16			0.32	0.62	
Risk of Bias								0.00	0.00			
Low Risk of Bias	21	30	11544	210	.129	0.01	0.25			0.69	0.29	
High Risk of Bias	1	1	293	293	-	-	-			-	-	
External Regulation – Amotivation	52	81	35238	250	.576	0.50	0.65			0.23	0.76	5116.771
Culture												
Individualistic												

Collectivistic												
Sex								0.00	0.07			
Both	50	78	34894	262	.588	0.51	0.66			0.24	0.75	
Male	1	1	100	100	.254	0.54	0.43			0.50	0.50	
Female	1	2	244	122	.168	0.03	0.30			0.16	0.00	
Age								0.00	0.00			
Children	1	1	1073	1073	.711	0.68	0.74			0.50	0.50	
Preadolescents	28	52	18869	235	.571	0.46	0.66			0.24	0.74	
Adolescents	24	28	15296	276	.579	0.46	0.68			0.25	0.74	
Risk of Bias								0.00	0.00			
Low Risk of Bias	51	80	34945	250	.578	0.50	0.65			0.23	0.76	
High Risk of Bias	1	1	293	293	-	-	-			-	-	
External Regulation – Adaptive Outcomes	65	157	69410	251	-.073	-0.15	0.01			0.13	0.85	8237.723
Culture												
Individualistic												
Collectivistic												
Sex								0.00	0.00			
Both	60	147	67265	269	-.073	-0.15	0.01			0.14	0.84	
Male	4	7	1112	101	.089	-0.13	0.30			0.00	0.85	
Female	3	3	1033	321	-.054	-0.57	0.50			0.49	0.49	
Age								0.03	0.00			
Children	2	2	1364	458	-.138	-0.39	0.13			0.47	0.47	
Preadolescents	34	84	32199	244	-.113	-0.21	-0.02			0.12	0.85	
Adolescents	31	71	35847	258	-.048	-0.18	0.08			0.13	0.86	
Risk of Bias								0.00	0.01			
Low Risk of Bias	64	156	69117	251	-.069	-0.15	0.01			0.13	0.85	
High Risk of Bias	1	1	293	293	-	-	-			-	-	
External Regulation – Maladaptive Outcomes	29	39	17129	231	.251	0.17	0.33			0.62	0.34	1443.061
Culture												
Individualistic												
Collectivistic												
Sex								0.00	0.01			
Both	28	38	17029	240	.254	0.17	0.33			0.61	0.35	
Male	1	1	100	100	.149	-0.45	0.34			0.50	0.50	
Female	0	0	-	-	-	-	-			-	-	
Age								0.27	0.00			
Children	0	0	-	-	-	-	-			-	-	
Preadolescents	10	15	7176	218	.299	0.20	0.40			0.95	0.00	
Adolescents	19	24	9953	241	.231	0.11	0.35			0.00	0.97	
Risk of Bias								0.00	0.00			
Low Risk of Bias	28	38	16836	230	.250	0.17	0.33			0.60	0.36	
High Risk of Bias	1	1	293	293	-	-	-			-	-	
Amotivation – Adaptive Outcomes	63	187	91785	280	-.369	-0.42	-0.31			0.62	0.36	7598.631
Culture												
Individualistic												
Collectivistic												
Sex								0.00	0.00			
Both	60	173	88025	311	-.364	-0.42	-0.31			0.59	0.38	

Male	4	10	3132	116	-.480	-0.67	-0.23			0.91	0.00	
Female	1	4	628	157	-.300	-0.37	-0.23			0.00	0.00	
Age								0.05	0.00			
Children	2	2	1364	458	-.240	-0.52	0.09			0.48	0.48	
Preadolescents	29	92	44776	303	-.327	-0.39	-0.26			0.97	0.00	
Adolescents	34	93	45645	258	-.427	-0.50	-0.34			0.36	0.62	
Risk of Bias								0.00	0.01			
Low Risk of Bias	62	186	91492	280	-.366	-0.42	-0.31			0.62	0.36	
High Risk of Bias	1	1	293	293	-	-	-			-	-	
Amotivation – Maladaptive Outcomes	30	46	22688	266	.450	0.34	0.55			0.27	0.71	2211.101
Culture												
Individualistic												
Collectivistic												
Sex								0.00	0.08			
Both	29	45	22588	276	.438	0.33	0.53			0.28	0.70	
Male	1	1	100	100	.757	0.66	0.83			0.50	0.50	
Female	0	0	-	-	-	-	-			-	-	
Age								0.09	0.00			
Children	0	0	-	-	-	-	-			-	-	
Preadolescent	10	22	12041	286	.380	0.13	0.59			0.18	0.81	
Adolescents	20	24	10647	250	.481	0.38	0.58			0.35	0.62	
Risk of Bias								0.00	0.00			
Low Risk of Bias	29	45	22395	266	.450	0.34	0.55			0.26	0.72	
High Risk of Bias	1	1	293	293	-	-	-			-	-	
Adaptive Outcomes – Maladaptive Outcomes	53	231	109262	302	-.212	-0.33	-0.09			0.43	0.56	22247.34
Culture												
Individualistic												
Collectivistic												
Sex								0.00	0.00			
Both	49	219	106140	313	-.202	-0.33	-0.07			0.42	0.57	
Male	3	6	1314	138	-.388	-0.67	-0.01			0.63	0.32	
Female	2	6	1808	255	-.290	-0.37	-0.21			0.73	0.00	
Age								0.00	0.00			
Children	0	0	-	-	-	-	-			-	-	
Preadolescents	26	126	61254	325	-.191	-0.32	-0.06			0.46	0.53	
Adolescents	27	105	48008	278	-.230	-0.42	-0.02			0.43	0.56	
Risk of Bias								0.00	0.00			
Low Risk of Bias	51	226	105069	298	-.212	-0.33	-0.09			0.43	0.56	
High Risk of Bias	2	5	4193	665	-.269	-0.64	-0.20			0.02	0.97	

Chapter 3: Study 2: Measuring Teacher Interpersonal Style and Affective, Behavioural and Cognitive Outcomes in Physical Education with Primary School Students

Introduction

As highlighted in the systematic review and meta-analysis (Chapter 2), I found important gaps in the SDT-based literature with regards to students' outcomes in physical education. For instance, I found that the SDT physical education-based literature has largely been conducted with adolescents, and less attention has been paid to young children. Also, cognitive outcomes of student participation in physical education have been studied much less than affective and behavioural outcomes within the school physical education context. Thus, an important step to fill these gaps is to provide researchers with valid measures that are able to generate reliable scores (Messick, 1995) to be employed with primary school-aged children.

As shown in the studies included in the systematic review (Chapter 2), perceptions of need-supportive teaching style in the primary school setting have often been examined using items from the Teacher as Social Climate Questionnaire (TASC; Belmont et al., 1992) and items from adapted versions to physical education of the Health Care Climate Questionnaire (Williams & Deci, 1996). These measures include items tapping autonomy support, structure (competence support), involvement (relatedness support), and controlling behaviour. Reliability, structural validity (item-factor loadings above .30), and discriminat validity (factor corrlations below .85) of these measures have been supported in previous work conducted with young students (see Mouratidis, Vansteenkiste, Sideridis, & Lens, 2011; Rutten, Boen, & Seghers, 2012; Taylor et al., 2014; Vlachopoulos, Katartzi, & Kontou, 2011; Vlachopoulos, Katartzi, & Kontou, 2013). Also, internal consistency of the subscales reported in all these studies were satisfactory–describing results that are acceptable, but

maybe not great (alpha values above .60). Other measures such as the Motivational Climate in Physical Education Questionnaire (Liukkonen et al., 2010), the Psychological Sense of School Membership (Goodenow, 1993) and an adapted version of the Sport Climate Questionnaire (Williams & Deci, 1996) have been less used to assess support for students' autonomy (e.g., Jaakkola, Yli-Piipari, Barkoukis, & Liukkonen, 2015), relatedness (e.g., Cox & Williams, 2008), and competence (e.g., Mouratidis et al., 2011) in physical education, respectively. While physical education students' perceptions of their teacher's controlling behaviour has been studied according to its dimensions (De Meyer, Soenens, Aelterman, De Bourdeaudhuij, & Haerens, 2016) in high school, this has not been the case in primary school. The few studiesd that focsed only on controlling behaviour in young children examined the construct based on the amount of choice students perceive from their teacher (e.g., "I believe I had some choice about doing this activity") (Erwin, Stellino, Beets, Beighle, & Johnson, 2013; Khalkhali & Golestaneh, 2011).

In line with the overarching aim of this thesis, the purpose of this study was to investigate selected psychometric properties of the scores derived from measures of primary school students' perceptions of teacher interpersonal style and students' affective, behavioural, and cognitive outcomes in physical education and school sport. These were some of the measures employed in the "Internet-based Professional Learning to help teachers support Activity in Youth" study (iPLAY; Lonsdale, Sanders, Cohen, Parker, Noetel, Hartwig, Vasconcellos, Kirwan, Morgan, Salmon, Moodie, McKay, Bennie, Plotnikoff, Cinelli, Greene, et al., 2016). The iPLAY program was a multicomponent professional learning program aimed at promoting physical activity participation and enhancing fundamental movement skills acquisition in primary school students. In line with the aim of this thesis, in this study I only looked at the "Quality PE and school sport" intervention curricular component. This component helped teachers deliver better physical education and

school sport lessons through the implementation of the SAAFE teaching principles (Lubans et al., 2017). Supportive, Active, Autonomous, Fair, and Enjoyable (SAAFE) teaching is grounded in SDT and is designed to support student's needs satisfaction during physically active lessons that provide health benefits. Detailed information about the iPLAY intervention is presented in the methods section of Study 3 (Chapter 4).

Because this is the first of two studies in which I use iPLAY data, it is important to make clear my role in the iPLAY study. Since the beginning of my candidature, I have been involved in many different research activities within iPLAY. These activities included helping design the intervention itself; with recruiting schools (e.g., delivering information sessions at schools); weekly meetings with the ACU iPALY team, and monthly meetings with iPLAY investigators from other universities; pilot testing the operational procedures in two schools for the main data collection; data collection in 22 schools, with approximately 1,200 students for the randomised controlled trial component of iPLAY; training research assistants for data collection; data cleaning and processing. In addition to the activities mentioned, my involvement in the iPLAY project has also given me opportunity to be included as a co-author in the study protocol (published in BMC Public Health, in 2016 – see Study 3 for more details) and the Physical Activity tracker validation study (published in the Scandinavian Journal of Medicine & Science in Sports, in 2019). I contributed to the latter study with data collection, data cleaning and processing.

In this study, it was hypothesized that students would be able to identify five related but distinct constructs (Figure 6). As shown in the systematic review (Chapter 2), age and sex did not moderate the relationships between need support and student outcomes, thus, it was also hypothesized that the structure of the questionanire used in this thesis would be invariant across age and sex.

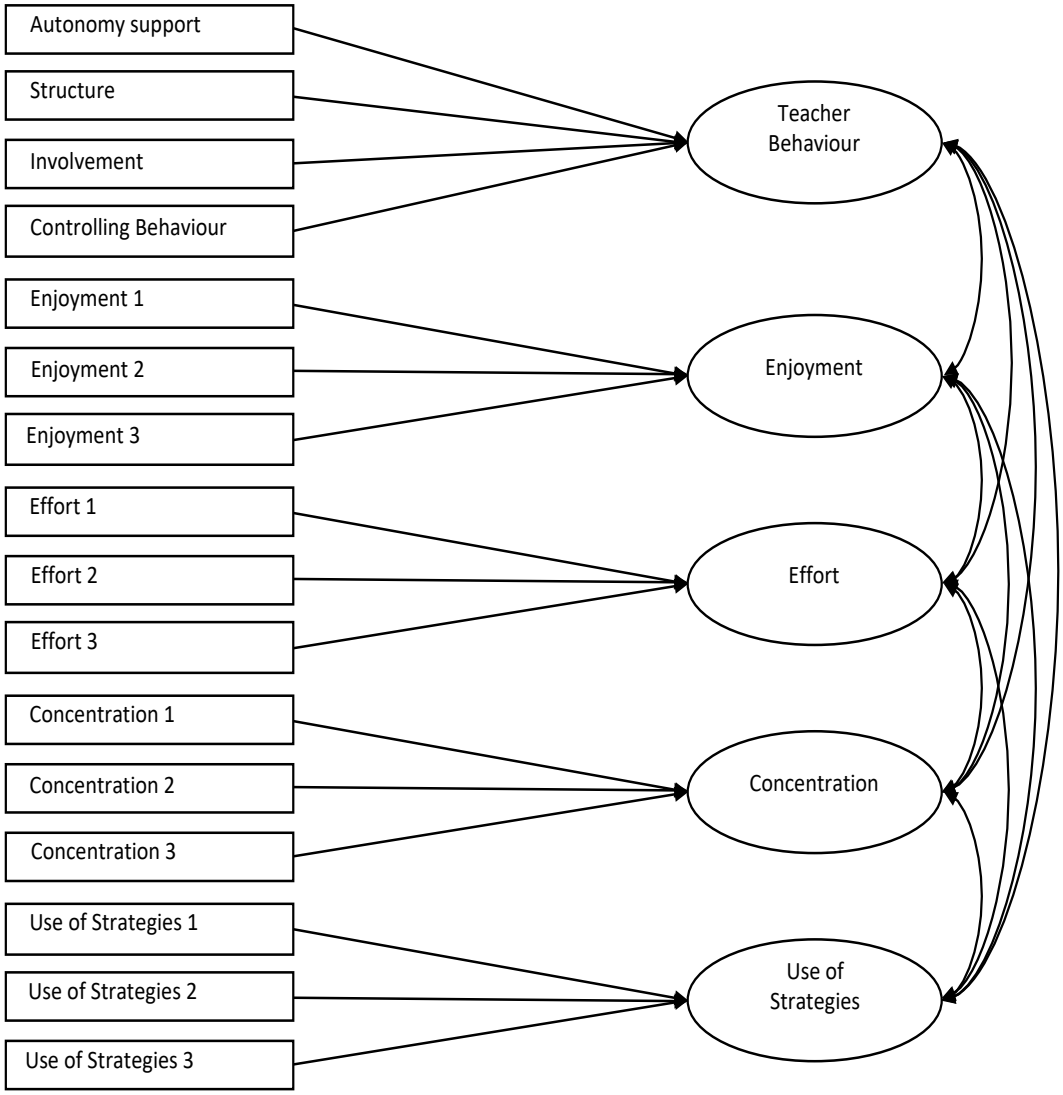


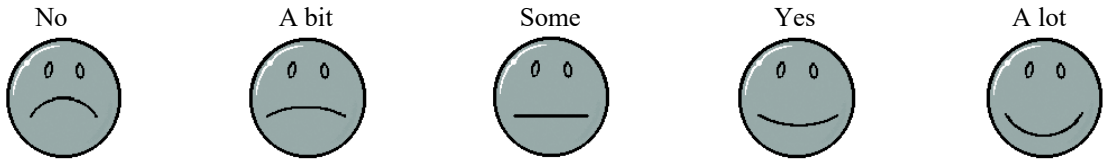
Figure 6. Hypothesised Measurement Structure.

Methods

Overview

The questionnaires employed in this study consisted of students' self-report measures of their teacher interpersonal style and students' outcomes in physical education and school sport. The low number of items in each scale was set to minimize participant burden.

Some research has highlighted the limited ability young children have in responding to questions that are presented to them in a Likert scale format with text (Mellor & Moore, 2014). To avoid this problem, in this study students answered each question in a 5-point Likert scale using smiley faces to help with reading comprehension of the response options (1= no, 2= a bit, 3= some, 4= yes, and 5= a lot) (see Appendix B).



Scales with pictures (e.g., smiley faces) have demonstrated satisfactory validity findings in classroom (Holt, Chee, Ng, & Bossler, 2013; Kear, Coffman, McKenna, & Ambrosio, 2000; Reynolds-Keefer, Johnson, Dickenson, & McFadden, 2009) and health care research with young children (Chambers & Craig, 1998; Soetenga, Frank, & Pellino, 1999).

In this study, I investigated students' perceptions of their teacher interpersonal style from a self-determination theory (SDT; Deci & Ryan, 1985; Ryan & Deci, 2000a, 2017) perspective. This is, I focused on the extent to which students perceive their teachers to be supportive of their autonomy, competence and relatedness, and the degree to which engage in controlling behaviour during the lessons.

With regards to students' outcomes in physical education and school sport lessons, I examined affective (i.e., enjoyment), behavioural (i.e., effort), and cognitive (i.e., concentration and use of learning strategies) outcomes. As shown in the systematic review

(Chapter 2), the different types of student outcomes have been studied unequally within the physical education context with less attention given to cognitive outcomes. For this reason, I include two different cognitive constructs as opposed to one each for behavioural and affective outcomes.

Sample

Year 3 and 4 students (N = 1,189) aged 7 to 11 years (8.82 ± 0.76) involved in the randomized controlled trial (RCT) component of iPLAY (hereafter referred to as the empirical study) were surveyed. Students in this study attended 22 public primary schools in New South Wales, Australia, that were match-paired according to their (a) size (e.g., number of students), (b) average scores on national standardised academic achievement tests (NAPLAN), (c) socioeconomic status (SES) as measured by the school's Index of Community Socio-Educational Advantages (high SES ≥ ICSEA of 1000 ≥ low SES), and (d) participation in the Live Life Well @ School program, which was a physical activity and nutrition program that was delivered in New South Wales schools between 2008 to 2015.

Procedures

Three cohorts provided data in Term 3 of 2016 (Cohort 1), Term 2 of 2017 (Cohort 2) and Term 4 of 2017 (Cohort 3). Data collection in this study followed the Standard Operations Procedures (SOP) manual for iPLAY (Lonsdale, Sanders, Cohen, Parker, Noetel, Hartwig, Vasconcellos, Kirwan, Morgan, Salmon, Moodie, McKay, Bennie, Plotnikoff, Cinelli, & Greene, 2016). Students responded to questionnaires in their own classroom. One member of the data collection team read the questions out loud. The other data collection team members and the teacher assisted with answering questions when needed. To avoid bias

in students' responses, teachers were asked to not help students answering any of the questions related to students' feeling towards physical education and school sport.

The measures used in this thesis were pilot tested in a sample of Year 3 and 4 public school students (N = 125) in New South Wales, Australia, in Term 1 of 2016. No adjustments were made to the items based on the pilot study. The scores derived from the five constructs investigated showed to be reliable as demonstrated by their satisfactory internal consistency estimates: teacher behaviour (subscale omega = .70); enjoyment (subscale omega = .85); effort (subscale omega = .84); concentration (subscale omega = .86); and use of strategies (subscale omega = .82). The iPLAY trial involved the measurement of many outcome variables that are not the focus of this thesis (e.g., cardiorespiratory fitness, fundamental movement skills), which did not allow the inclusion of a more comprehensive questionnaire. Thus, the research team decided to survey students with the most imperative items: 4-items on students' perceptions of their teacher behaviour (one item per need support construct), and, three items for each construct assessing student outcomes (i.e., enjoyment, effort, concentration, and use of learning strategies).

Measures

Teacher behaviour. The 4-item scale used to assess students' perceptions of their teacher's interpersonal style included two items from the Teacher as Social Context questionnaire (Belmont et al., 1992), one item from the Health Care Climate Questionnaire (Vlachopoulos et al., 2013), and one item from the Controlling Teacher Scale (Jang, Reeve, Ryan, & Kim, 2009). All items were adapted to suit the physical education context. The items from the Teacher as Social Context questionnaire were intended to tap structure (i.e., competence support; "In PE and school sport, the teacher makes it clear what he/she expects of me") and involvement (i.e., relatedness support; "In PE and school sport my teacher shows

that he/she likes me"). The item chosen from the Health Care Climate Questionnaire is designed to measure autonomy support ("I feel that my PE and school sport teacher provides me choices and options"). The item selected from the Controlling Teacher Scale to assess teacher's controlling behaviour was "In PE and school sport my teacher puts a lot of pressure on me". An overall experience of need support measure was calculated by averaging the four items (controlling behaviour was reverse-coded).

Enjoyment. I assessed enjoyment using three items adapted to physical education and school sport from the Student Engagement in School questionnaire (Lam et al., 2014). These items were "I enjoy PE and school sport lessons", "I like my PE and school sport lessons", and "PE and school sport is fun". The mean of the three items is intended to indicate levels of positive affective experience in the lesson.

Effort. I selected effort as a behavioural experience of student participation in physical education and school sport. I assessed effort through three items, including two items from Lam et al. (2014) ("I try hard in PE and school sport" and "I work as hard as I can in PE and school sport"), and one item from the effort subscale of the Intrinsic Motivation Inventory (IMI; McAuley, Duncan, & Tammen, 1989) ("I put a lot of effort into PE and school sport lessons").

I investigated *cognitive outcomes* through the assessment of elements of cognitive processes during physical education and school sport lessons. I chose 'Concentration' and 'Use of strategies to learn' in physical education and school sport because they provide a global and a more specific measure, respectively, of how students learn from teaching. Given that cognition relies on a certain level of understanding of what it means, the use of its global elements such as concentration seem to be appropriate when studying cognitive responses in young children. In addition, the use of learning strategies is one way to examine specific cognitive components students employ when learning. Furthermore, the items tapping these

variables could be worded in a non-sophisticated way to be used with primary school-aged children.

Concentration. Three items from the six employed by Standage et al. (2005) to assess students' self-report *concentration* in the lessons were selected. These items were "In PE and school sport I really concentrate on the skills and tasks I do", "I pay attention in my PE and school sport lessons", and "In PE and school sport I think carefully about the skills and tasks I am doing".

Use of learning strategies. I employed three items from the 5-item *use of strategies* subscale of the Cognitive Processes Questionnaire in Physical Education (CPQPE; Solmon & Lee, 1997) to measure strategies the students employ when trying to learn in physical education and school sport. Example items are "At home, I think about the right way to perform the skills I learn in PE and school sport", "When I am learning a new skill in PE and school sport, I try to think how it is like something I already know", "In PE and school sport, I talk to myself during practice to help me do better". Concentration and use of strategies measures are scored by averaging the items in each subscale.

Statistical Analyses

In order to increase transparency and ensure completeness, reporting in this section is in line with the COnsensus-based Standards for the selection of health Measurement INstruments (COSMIN) Risk of Bias Checklist (Mokkink et al., 2010).

Structural Validity. Validity indicators of the scales examined in this study have already been reported with older populations in the education (Jang et al., 2009; Lam et al., 2014; Solmon & Lee, 1997; Standage et al., 2005), and in the sport context (McAuley et al., 1989). I verified the selected psychometric properties of each instrument via factor analyses and reliability indicators. Confirmatory factor analysis (CFA) was employed to test the factor

structure of the data (Clarke, 2008). In the CFA, items were only allowed to load on the hypothesized factor and factors were allowed to correlate. I followed Hu and Bentler's (1999) cut-off criteria to test how the model fit the data (CFI and TLI ≥ .95, RMSEA ≤ .06, SRMR ≤ .08). In order for an item to be kept in its corresponding factor without being altered or excluded, I considered .30 as a minimum for standardized loadings as suggested by Hair, Black, Babin, and Anderson (2014). I calculated cluster robust standard errors due to the clustered nature of the data (students within teachers). I then established the discriminant validity of the factors by analysing the inter-factor correlations. Correlations of .85 or stronger indicate poor discriminant validity, meaning that the factors do not measure different constructs (Clark & Watson, 1995; Henseler, Ringle, & Sarstedt, 2015; Kline, 2011).

Measurement Invariance. I tested for factor structure invariance separately across sex (boys and girls) and age (Year 3 and Year 4 students) by employing the multi-group CFA procedures described by Byrne, Shavelson, and Muthén (1989). The baseline multi-group model involved no parameter constraints (configural invariance), the second model constrained factor loadings to be equal between groups (metric invariance), the third model constrained factor loadings and intercepts (scalar invariance) to be equal across groups, and the fourth model constrained factor loadings, intercepts, and uniqueness terms. I assessed measurement invariance by comparing the fit statistics of the models to the baseline model, and changes in CFI greater than .01 from one model to the next suggests that the more constrained model is not invariant (Cheung & Rensvold, 2002b).

Internal Consistency. Internal consistency of the scores derived from each scale was estimated by the omega coefficient (McDonald, 1999; Trizano-Hermosilla & Alvarado, 2016). All analyses were conducted in R statistical software version 3.3.2 2016.

Results

A total of 1,189 Year 3 and 4 students aged 7 to 11 years (8.82 ± 0.76) participated in this study, including 598 boys (8.82 ± 0.76 years) and 591 girls (8.81 ± 0.74 years).

The data showed satisfactory fit to the hypothesized model (items loading onto their respective latent), with CFI = .98, TLI = .98, RMSEA = .05, and SRMR = .04. Standardized item-factor loadings and robust standard variance errors associated with each item in the questionnaire are presented in Table 5. Overall, items demonstrated acceptable loadings (>.30), and the combination of fit and loadings suggest that the selected items were good indicators of the latent variables. The lowest item-factor loading was found for item 16 ('In PE and school sport my teacher puts a lot of pressure on me'), suggesting some students may have experienced difficulty in responding to this question. Researchers have pointed that young children are less able to respond to negatively worded items than positively worded items and this is expected to negatively affect the factor structure of a scale (Benson & Hocevar, 1985; Marsh, 1986; Mellor & Moore, 2014; Salazar, 2015). I tested whether the exclusion of the negatively worded item would improve the fit of the hypothesized factor structure. Results suggest the fit was not considerably better with the removal of this item (Cheung & Rensvold, 2002a). Therefore, I kept the negatively worded item in the scale. This was justified as the negatively worded item still met the minimum established value for factor loadings (.30; Hair et al., 2014). When considering factorial validity across age and sex, there was evidence of configural, metric, scalar and uniqueness invariance as all $\Delta\chi^2$ were non-significant ($p > .05$) and all ΔCFI were < .01.

Table 5

Standardized Item-Factor Loadings, Robust Standard Errors, and Uniqueness.

	Item-factor loadings	Standard Error	Uniqueness
Teacher behaviour			
I feel that my PE and school sport teacher provides me choices and options	.73	.06	.47
In PE and school sport, the teacher makes it clear what he/she expects of me	.74	.03	.45
In PE and school sport my teacher shows that he/she likes me	.69	.04	.53
In PE and school sport my teacher puts a lot of pressure on me	.30	.12	.93
Sub-scale Omega = .72			
Enjoyment			
I enjoy PE and school sport lessons	.88	.03	.23
I like my PE and school sport lessons	.91	.02	.17
PE and school sport is fun	.93	.02	.15
Sub-scale Omega = .93			
Effort			
I try hard in PE and school sport	.81	.02	.33
I put a lot of effort into PE and school sport lessons	.89	.02	.21
I work as hard as I can in PE and school sport	.89	.02	.21
Sub-scale Omega = .90			
Concentration			
In PE and school sport I really concentrate on the skills and tasks I do	.81	.02	.34
I pay attention in my PE and school sport lessons	.81	.03	.35
In PE and school sport I think carefully about the skills and tasks I am doing	.80	.03	.36
Sub-scale Omega = .85			
Use of Learning Strategies			
At home, I think about the right way to perform the skills I learn in PE and school sport	.76	.05	.42
When I am learning a new skill in PE and school sport, I try to think how it is like something I already know	.74	.05	.46
In PE and school sport, I talk to myself during practice to help me do better	.57	.07	.67
Sub-scale Omega = .73			

Internal consistency estimates showed the scores derived from the measures to be reliable indicators of students' perceptions of teacher behaviour, as well as affective, behavioural, and cognitive outcomes of student participation in physical education and school sport lessons. As shown in Table 5, omega values ranged from .72 to .93.

As it can be seen in Table 6, factor correlations were in the range and direction expected (factor correlation range = .64 to .93), with moderate to strong positive correlations found. Overall, the data largely supported discriminant construct validity of each measure, as nine of the ten possible correlations among constructs were below the .85 cut-off (Henseler et

al., 2015; Kline, 2011) established for determining poor discriminant construct validity in this study. The only exception was the factor correlation of .93 between concentration and effort, indicating that students in this study may have had problems in differentiating the items in these subscales. Given that these variables were to be outcomes rather than predictors in the subsequent study, I decided to retain both variables.

Table 6

Descriptive Statistics and Factor Correlations Among Teacher Behaviour, Enjoyment, Effort, Concentration, and Use of Learning Strategies in Physical Education and School Sport.

	Range	M (SD)	1	2	3	4	5
1.Teacher behaviour	1 – 5	4.10 (.72)	-	.528	.456	.536	.405
2.Enjoyment	1 – 5	4.58 (.71)	.790	-	.564	.560	.432
3.Effort	1 – 5	4.61 (.59)	.731	.739	-	.716	.487
4.Concentration	1 – 5	4.48 (.62)	.833	.751	.933	-	.559
5.Use of strategies	1 – 5	3.94 (.85)	.761	.642	.741	.835	-

Note: Teacher behaviour was calculated by averaging the items tapping autonomy support, competence support, relatedness support, and controlling behaviour (multiplied by -1). Bi-variate correlations above the diagonal.

Discussion

The aim of this study was to investigate the selected psychometric properties of the questionnaire employed in Study 3—the randomized control trial intervention on teacher behaviour. The questionnaire consisted of measures of primary school students' perceptions of teacher interpersonal style and students' outcomes during physical education and school sport lessons. Overall, the data largely supported the hypothesized factor structure of the questionnaire according to the item-factor loadings and internal consistency estimates found. The scores derived from the measures were also invariant across age and sex. Discriminant validity was also generally supported based on the factor correlations yielded.

With respect to factor loadings, items were found to strongly load onto their latent, with the exception of item 16 ('In PE and school sport my teacher puts a lot of pressure on me'). This result is in accordance with the literature, as research has shown items tapping pressure-related teaching behaviours to present low factor loadings (<.30) within the school physical education context (Hein, Koka, & Hagger, 2015b). Moreover, the low item loading for this item could be a function of the way the item was presented to the students, that is, the item was negatively worded while the others were positively worded. For this reason, answers to item 16 were in reverse order, and the response option "yes" (e.g., indicating total agreement with the statement) was associated with the sad/frowny face, instead of being associated with the smiley/happy face. Research has drawn the attention to the fact that young children may not respond well to negatively worded items (Benson & Hocevar, 1985; Marsh, 1986; Mellor & Moore, 2014; Salazar, 2015). In contrast, few problems have been found in studies grounded in self-determination theory when including this type of questions to investigate perceptions of teaching behaviours in the physical education-based research with adolescents (De Meyer, Soenens, Aelterman, et al., 2016; De Meyer et al., 2014).

Discriminant validity was generally supported as students perceived five related but distinct factors. The exception to this general finding was the strong relationship between concentration and effort. This indicated the students were not able to distinguish these two factors very well. This finding could be partially explained by the students' age. At young ages students might think of concentration as a type of effort (mental effort). Zhang et al. (2012), for instance, used the same items for concentration and very similar ones for effort and found a moderate association (r = .56) between these constructs in preadolescents, confirming the natural development in cognition as students get older. In contrast, students in this study did appear to distinguish the other cognitive outcome–use of learning strategies–from other outcome variables.

The reliability coefficients found for each construct exceeded the minimum accepted for research contexts (McDonald, 1999; Trizano-Hermosilla & Alvarado, 2016), showing the scores derived from the sub-scales to be reliable. However, caution is needed when interpreting the reliability score of the teacher support composite measure. Although the items selected in this study represent the core of each need support construct, there are many elements involved in supporting students' needs.

Strengths and limitations

Apart from examining selected psychometric properties of measures used in this thesis, this study also addressed some of the gaps identified in the systematic review (Chapter 2), by providing estimates of correlations that have been understudied in the physical education SDT-based literature. The large sample of primary school students, and the examination of students' global and specific components of cognition are also strengths of this study. Another strength of this study is the cross validation sample enabling age and sex invariance to be confirmed. Despite these strengths, this study also had some limitations. While support constructs are comprised of multiple elements, these constructs were measured using single-item scales, which might have influenced across items stability (i.e., internal consistency). As mentioned previously, I did not have space to measure multiple components because data colletion for the iPLAY trial involved other variables that are not under investigation in this thesis. Another limitation was the reverse-coded need thwarting measure. This item did not load well, and this could be due to the fact that the item was negatively worded, which was done in order to maintain consistency with the other items in the teacher behaviour scale. The other three items measure behaviours that the teacher "does" in order to support students' needs, instead of behaviours that the teacher does not do. The low number of outcome variables within each category may represent limited information about students'

lesson-related emotions, behaviour, and cognition. Also, there were not a sufficient number of schools to confirm multilevel construct validity in this study.

Implications and future directions

This study highlights some opportunities for future research in primary school aged-children. While students in this study were able to identify the five constructs examined separately, concentration was strongly associated with effort. More research is needed to further investigate at what stage students are able to differentiate global aspects of cognition (e.g., concentration) from behaviour (e.g., effort) more clearly in physical education and school sport. For example, researchers could replicate the sub-scales used in this study in longitudinal studies to further explore the impact of age on the understanding of cognitive-related outcomes in physical education and school sport lessons.

Conclusion

Overall, the hypothesized factor structure of the questionnaire used in this thesis showed to be satisfactory. The combination of item loadings and internal consistency estimates of scores derived from the five constructs assessed represent an appropriate way of investigating primary school children perceptions of teacher interpersonal style and students' affective, behavioural, and cognitive outcomes in physical education and school sport lessons.

Chapter 4: Study 3: Effects of the "Internet-based Professional Learning to help teachers support Activity in Youth (iPLAY)" intervention on students' affective, behavioural, and cognitive experiences in physical education and school sport

Introduction

Promoting participation in physical activity is one the goals of school physical education (Australian Curriculum, Assessment and Reporting Authority, 2016). While schools provide an important venue to promote physical activity behaviour (Cohen et al., 2015; Lonsdale et al., 2017a; Lonsdale et al., 2013), many children and adolescents do not meet recommended physical activity guidelines (Boddy et al., 2012; Cohen et al., 2011; Ekelund et al., 2012; Spittaels et al., 2012). Physical education presents an opportunity to provide students with the knowledge, skills, and motivation to be active outside school hours and in later life (Cohen et al., 2015; Gu & Solmon, 2015; Jaakkola & Washington, 2013; Lonsdale et al., 2017a; Shen, 2014). Understanding the processes concerning motivation is crucial to engage students in activities from which they can physiologically and psychologically benefit. Self-determination theory (SDT; Deci & Ryan, 1985; Ryan & Deci, 2000a, 2017) is one theory that aims to explain the motivational process and has been one of the more prominent conceptual frameworks underpinning research in the school physical education context (Lindahl et al., 2015).

The Role of Teacher Interpersonal Style in Promoting Positive Experiences in Class

According to SDT, a need-supportive teaching style tends to facilitate positive affective, behavioural, and cognitive experiences in physical education (Standage et al., 2005). Among the contextual factors, the physical education teacher plays a key role influencing students' experiences in the class. Being responsible for preparing and delivering the content, the teacher can optimise or inhibit students' in-class experiences depending on

the teaching techniques he/she adopts. Some positive characteristics of the teaching practices are autonomy support, provision of structure during the lessons, and the way the teacher demonstrates involvement with the students.

Extensively studied in the SDT literature, mainly with adolescents, *autonomy support* can be offered by the teacher by providing students with opportunities for choice; showing respect for their attitudes and ideas (e.g., they propose a different way to do one activity); providing an explanatory rationale for learning (e.g., explaining why a task is important and where/when it could be used); relying on non-controlling language; displaying patience to allow students the time they need for self-paced learning; and acknowledging and accepting students' expressions of negative affect (Reeve, 2009). *Provision of structure* supports students' sense of competence and refers to the way the teacher organises and delivers the activities with coherence. Structure is evident when teachers provide clear expectations of the students (e.g., sticking to the rules they have set in the class), demonstrate consistent contingencies for behaviour (e.g., treating their students fairly), offer adequate help (e.g., showing different ways for the students to solve a problem), and monitor during the lesson (e.g., checking if students are ready before he/she goes on) (Belmont et al., 1992). *Teacher involvement* supports students' need for relatedness and includes teachers taking time to express enjoyment in their interactions with students, showing affection (e.g., demonstrating that he/she cares about the students), displaying attunement (e.g., teacher showing that he/she knows the students well), being dependable (e.g., being there for the students when needed), and dedicating resources (e.g., spending time and talking with the students). In contrast, when not supporting students' psychological needs, teachers may engage in *controlling behaviour*, where they determine what and how students should do the activities and exercises, and are not usually open to dialogue (Reeve, 2009).

Teaching Style and Student Outcomes in Physical Education

Students' individual in-class experiences have been associated with their teachers' behaviour. Indeed, as shown in the systematic review chapter of this thesis (Chapter 2), studies have demonstrated that perceived need support from the teacher is associated with students' needs fulfilment, which in turn leads to self-determined motivation and a wide range of positive experiences in the physical education context (Cox & Williams, 2008; Ntoumanis, 2001, 2005; Standage et al., 2003). Students whose teacher acts in an autonomy-supportive manner are expected to achieve positive outcomes in the class. For example, students demonstrating enjoyment and interest in learning and mastery a new skill in physical education tend to have better physical performance and motor skills development, physical fitness, concentration and attention in the lesson, and in-class participation (e.g., effort), as well as intentions to participate in leisure time physical activity (Standage et al., 2003). In contrast, perception of less need supportive behaviour is associated with negative outcomes such as negative affect (Ntoumanis, 2005), anger and bullying (Hein et al., 2015a), fear of failure and boredom (Leptokaridou et al., 2014).

Enjoyment in physical education. In this study, the affective outcome under investigation was students' level of enjoyment in the physical education lesson. As proposed by SDT, needs-supportive contexts can predict affective responses (e.g., enjoyment) in physical education through the satisfaction of inner motivational demands (e.g., psychological needs; Ntoumanis, 2001, 2005). For example, an intervention program that aimed to enhance perceptions of autonomy in physical education, increased high school students' enjoyment along the program (Wallhead & Ntoumanis, 2004).

Effort in physical education. Effort is defined in this study as the extent to which an individual exerts himself towards a given task. SDT posits that students' effort is influenced by internal motivation, which can be enhanced when teachers support students' need

satisfaction (i.e., needs for autonomy, competence, and relatedness). Evidence showing the role of teachers' autonomy support in predicting students' effort is consistent (e.g., Gillison et al., 2013; Hein & Caune, 2014; Zhang et al., 2012), and this relationship may be mediated by students' needs satisfaction (e.g., Taylor & Lonsdale, 2010). Competence and relatedness support (concepts similar to provision of structure and involvement, respectively) have also been positively correlated with students' effort in physical education (Leptokaridou et al., 2014).

Cognitive outcomes in physical education. In this study, students' cognitive outcomes investigated represent a motivated behaviour associated with their levels of concentration and use of cognitive strategies when trying to learn physical education-related skills. In the SDT literature, studies have found a link between SDT constructs (i.e., needs support, needs satisfaction, and motivation) and levels of concentration in the physical education class. For instance, Ntoumanis (2005) found that self-determined motivation positively predicted concentration in physical education lessons in a sample of secondary students. Standage et al. (2005) also showed that, among students 11-15 years old, intrinsic motivation positively predicted concentration, whereas amotivation (i.e., lack of motivation) was a negative predictor of concentration. Another important SDT variable, relatedness, was found to be positively correlated with attention in physical education by Standage and Gillison (2007). Zhang et al. (2012) also investigated the importance of a need-supportive environment created by the teacher on middle school student outcomes including concentration. The authors found that autonomy support and competence support were positive predictors of students' concentration.

Few studies have looked at the use of learning strategies as a measure of students' cognition in physical education from a SDT perspective. Classroom engagement (including affective, behavioural, agentic, and cognitive engagement) was one of the outcomes

investigated in middle and high school students by Cheon et al. (2012). Cognitive engagement was measured through use of sophisticated strategies while trying to learn physical education-related skills (e.g., "When learning a PE activity, I try to relate what I'm learning to what I already know"). In that study, although the authors did not separate classroom engagement into its dimensions for analysis, the broad construct labelled classroom engagement significantly increased for students of teachers in the experimental condition (received training to be more autonomy-supportive), but not in the control condition. Xiang et al. (2013) also found that autonomy supportive strategies such as provision of instructional cognitive choice, organizational choice, and procedural choice were predictors of a composite measure of behavioural and cognitive (use of self-regulation strategies – e.g., "I ask myself questions while practicing to monitor my performance") engagement in a sample of middle and high school physical education students.

Intervention Work Grounded in SDT

In conducting SDT-based experiments in the school setting, researchers are often interested in: a) exploring the extent to which an intervention can change teacher behaviour by making teachers to be more supportive of their students' needs and engage in less controlling forms of teaching; and b) how these expected changes in teacher behaviour influence students' experiences in the class.

Although the SDT physical education-based literature is extensive, only a few studies have focused on primary school teachers and students (Cohen et al., 2015; Escriva-Boulley et al., 2018). Most studies have focused on high school physical education (Aelterman et al., 2014; Chatzisarantis & Hagger, 2009; Cheon & Reeve, 2013, 2015b; Cheon et al., 2012; Ha et al., 2017; Lonsdale et al., 2017b; Perlman, 2015; Rosenkranz et al., 2012; Sparks et al., 2017; Tessier et al., 2008, 2010b). These studies have examined the effects of interventions

that involved training on needs support had on teacher behaviour and also on other SDT variables (i.e., needs satisfaction and motivation), as well as on a range of different lesson-related outcomes in physical education. In general, the interventions employing specific professional learning programs have shown that teachers can learn how to be more supportive of their students' needs. Interventions have also focused on investigating students' affective (e.g., enjoyment) and behavioural (e.g., physical activity) outcomes in the lesson, and little attention has been paid to cognitive outcomes (e.g., Chatzisarantis & Hagger, 2009; Cheon et al., 2012; Sparks et al., 2017). Furthermore, none of the research conducted to date has attempted to deliver a needs supportive physical education teaching intervention at scale (i.e., acrros a large number of schools). One possible way to address this issue is by adopting an internet-based approach. Learning can take place whenever and wherever on internet-delivered programs, as opposed to more traditional methods (e.g., classroom workshops). Essentially, learning occurs at the learner's convinience. This approach has been used in some SDT-focused work for promoting physical activity in adult populations (e.g., Friederichs, Bolman, Oenema, Verboon, & Lechner, 2016), and for school-based sex education (e.g., Schutte et al., 2018), for example. Among the aforementioned school physical education SDT intervention studies, only Lonsdale et al. (2017a) delivered an internet-based training to the teachers. In sum, the potential benefits of online learning include flexibility, novelty, and scalability of knowledge transfer. To date, researchers have delivered the training intervention to a relatively small number of teachers, perhaps because in most cases the researchers were the ones responsible for delivering the intervention contents.

My study extended these previous studies in several important ways: a) is focused on intervening in primary schools; b) focusing on cognitive outcomes with two different cognitive constructs examined; and c) looking at an internet-based teacher-focused

intervention that is currently being delivered at scale (approx. 100 schools; the majority of which are part of a dissemination study while the studies focused on here are part of a cluster randomized control trial).

The present study

The aim of this study was to investigate the effects of the 'Internet-based Professional Learning to help teachers support Activity in Youth' (iPLAY; Lonsdale, Sanders, Cohen, Parker, Noetel, Hartwig, Vasconcellos, Kirwan, Morgan, Salmon, Moodie, McKay, Bennie, Plotnikoff, Cinelli, & Greene, 2016) intervention on students' experiences in physical education and school sport lessons; and whether changes in teachers' interpersonal style were mediators of these relationships. Detailed information about the iPLAY intervention is presented in the methods section. The iPLAY intervention was a multicomponent professional learning program aimed at promoting physical activity participation and enhancing fundamental movement skills acquisition in primary school students. In line with the overarching aim of this thesis, in this study I only looked at the "Quality PE and school sport" intervention curricular component. This component helped teachers deliver better physical education and school sport lessons through the implementation of the SAAFE teaching principles (Lubans et al., 2017). Supportive, Active, Autonomous, Fair, and Enjoyable (SAAFE) teaching is grounded in SDT and is designed to support student's needs satisfaction during physically active lessons that provide health benefits.

In this study, it was hypothesised that: (a) students in the intervention condition would have better in-class affective, behavioural, and cognitive experiences when compared to students in the control condition; (b) that students in the intervention condition would perceive their physical education and school sport teacher more supportive of their needs, as compared to students in the control condition; and (c) that changes in students' perceptions of

their teacher interpersonal style would mediate the relationship between the intervention and students' outcomes.

Methods

The iPLAY program is a large-scale professional teacher learning program that is currently being delivered in 98 primary public schools in New South Wales, Australia. The randomized controlled trial component of the program examined the effects of the program on selected Year 3 and 4 student outcomes, and involved 22 schools separated in three cohorts, each starting the intervention at different times between 2016 and 2017. As per the study protocol (Lonsdale, Sanders, Cohen, Parker, Noetel, Hartwig, Vasconcellos, Kirwan, Morgan, Salmon, Moodie, McKay, Bennie, Plotnikoff, Cinelli, & Greene, 2016), the estimated sample size for the entire randomized controlled trial was 1,080 students. However, in this study I analysed data collected from the 16 schools and 714 students in Cohorts 1 and 2. Cohort 3 schools are not included in this thesis because they have not yet completed data collection and Cohorts 1 and 2 provided sufficient data for my planned analyses – see power analysis described in a subsequent section.

Reporting of this trial aligns with the Consolidated Standards of Reporting Trials statement for cluster randomised trials (CONSORT; Schulz, Altman, & Moher, 2010). To ensure completeness and transparency reporting also followed the Template for Intervention Description and Replication (TIDieR) checklist (Hoffmann et al., 2014).

Participants

To be eligible to participate in the study students were required to be in Year 3 and 4 of government-funded primary schools in New South Wales, Australia. Schools for Specific Purposes (i.e., schools for students who have special learning needs) and schools that

participated in the SCORES intervention (a precursor of iPLAY; Cohen et al., 2015) were not eligible for this study.

This study was a cluster randomized controlled trial with an allocation ratio of 1:1 (intervention : attention control). Sixteen schools consented to participate in this study, and were match-paired according to their (a) size (e.g., number of students), (b) average scores on national standardised academic achievement tests (NAPLAN), (c) socioeconomic status (SES) as measured by the school's Index of Community Socio-Educational Advantages (high SES ≥ ICSEA of 1000 ≥ low SES), and (d) participation in the Live Life Well @ School program, which was a physical activity and nutrition program that was delivered in New South Wales schools between 2008 to 2015. After baseline data collection, one school from each pair was randomly assigned to the intervention and the other school to the control condition.

For the outcome measures in this study, I used GPower 3.1 to calculate an estimated sample size to detect an effect of $d = .40$, with power of .80 and significance level set at 0.05. The sample size estimated was 59 students. This effect size and the expected Intraclass Correlation Coefficient (ICC) of .13, were estimated based on other need support teacher-training interventions studies (e.g., Cheon & Reeve, 2015a; Yli-Piipari, Wang, & Liukkonen, 2012). I then accounted for the cluster design by multiplying the sample size by a design effect of $1 + [(m - 1) \times ICC]$ where m is the number of students per class (Moher et al., 2010). With an estimated class size of 18 students and an ICC of .13 for this study's outcomes, the design effect was 3.6 (i.e., 59 x (1 + [(17 x .13)]. Calculations indicated that 189 participants would provide the estimated power of .80. While 189 students would to appear to provide an adequate sample, I decided to use data from participants at the first 16 schools (N = 714) enrolled in the main iPLAY trial because: (a) in previous studies the researchers were the ones conducting the training intervention with teachers (e.g., Cheon & Reeve, 2015a; Yli-

Piipari et al., 2012), but iPLAY employed a train-the-trainer type of program and, thus, a smaller intervention effect was likely; and (b) a sample of 189 students could be drawn from just 4 schools from the iPLAY trial and such a small number of clusters would increase the chances of unbalanced sampling at baseline between the intervention and control participants.

Procedures

Students responded to questionnaires in their own classroom. One member of the data collection team read the questions out loud and paced the students. The other data collection team members and the teacher helped students who were struggling to understand any of the instructions or questions. To avoid bias in students' responses, teachers were asked to not help students answer any of the questions related to students' feeling towards physical education and school sport, including questions about their teacher's behaviour during physical education and school sport lessons.

Students were blinded to allocation conditions (i.e., intervention vs. control), but teachers were aware of their allocation. At follow-up, data collectors were not informed of each school's allocation; however, the chances of keeping data collectors blinded to allocation conditions were reduced due to iPLAY promotional and content materials displayed at intervention schools.

Baseline data was collected from two cohorts in Term 3 of 2016 (Cohort 1, $N = 6$ schools) and Term 2 of 2017 (Cohort 2, $N = 10$ schools). Following baseline data collection, schools were randomly assigned by a statistician who was not part of the research team using a computer-generated algorithm from within each pair to the intervention or control arm of the cluster randomised controlled trial. Post-intervention data was collected 12-14 months after baseline in Term 3 of 2017 (Cohort 1) and in Term 2 of 2018 (Cohort 2). Data collection followed a set of standard operating procedures. Apart from being an important tool used to

train data collectors, this operations manual (and an associated checklist that was completed each session) ensured consistent and accurate data procedures were utilised when collecting data in schools.

Intervention

iPLAY is a multicomponent professional learning program aimed at increasing physical activity participation and improving fundamental movement skills competency in primary school-aged children. The iPLAY program uses a whole-school approach involving non-curricular and curricular components.

Non-curricular components included: a) active playgrounds that enable children to be physically active during recess and lunch breaks; b) engaging parents through regular newsletters and multimedia provided by the project team; and c) encouraging children to participate in community sport and recreation by linking schools and local organisations. Curricular activities included: a) quality PE and school sport; b) physically active homework; and c) classroom energisers (see Table 7 for intervention components and associated implementation strategies).

Within each school, up to three teachers – known as iPLAY leaders – shared responsibility for delivering the non-curricular components of the program. This study does not focus on these aspects of the iPLAY intervention. Rather the current investigation examines the quality physical education and school sport component. To learn the curricular components, including quality physical education and school sport, the teachers attended a workshop and completed a series of eight online learning modules. Modules were designed to help teachers plan and deliver lessons that adhered to the 'Supportive, Active, Autonomous, Fair, and Enjoyable' teaching principles (SAAFE; Lubans et al., 2017). Modules centred on multimedia presentation of key concepts, provided teachers with opportunities to reflect on

good and poor practice videos, and prompted teachers to reflect on their own practice and set action plans for their teaching in the future.

Each participating teacher also received a mentoring session from the school's iPLAY mentor, a peer observation with a colleague from their school, and a small group meeting with other teachers in their stage. After completing the professional learning program, teachers were credited with 14 New South Wales (NSW) Board of Studies Teaching and Educational Standards professional learning hours at 'proficient' standard.

The iPLAY mentors were current or recently retired teachers recruited, trained, and employed by the research team. Mentors were required to hold NSW Board of Studies Teaching and Educational Standards specialist accreditation in Health and Physical Education. Mentors received two 7-hour face-to-face training sessions led by the project team.

Table 7

Description of the "Quality PE and school sport" Intervention Component and Associated Implementation Strategies Used in iPLAY

Curricular component	Description	Implementation measure
Quality PE and school sport	• Teachers will deliver 150 minutes of planned PE or school sport each week.	• Classroom teachers will self-report delivery of PE and School Sport on eight occasions during the intervention at the start of each online learning module.
	• Lessons will be delivered according to the SAAFE principles (Supportive, Active, Autonomous, Fair and Enjoyable).	• Mentors will observe and rate each teacher's delivery using the SAAFE checklist once during the intervention.

Note: Adapted from the study protocol (Lonsdale, Sanders, Cohen, Parker, Noetel, Hartwig, Vasconcellos, Kirwan, Morgan, Salmon, Moodie, McKay, Bennie, Plotnikoff, Cinelli, & Greene, 2016).

Measures

The measures used to collect data from students have been fully described in Chapter 3 of this thesis. For the examiner's convenience, I have included a full description of each measure in this section.

Teacher behaviour. The 4-item scale used to assess students' perceptions of their teacher's interpersonal style included two items from the Teacher as Social Context questionnaire (Belmont et al., 1992), one item from the Health Care Climate Questionnaire (Vlachopoulos et al., 2013), and one item from the Controlling Teacher Scale (Jang et al., 2009). All items were adapted to suit the physical education context. The items from the Teacher as Social Context questionnaire were intended to tap structure (i.e., competence support; "In PE and school sport, the teacher makes it clear what he/she expects of me") and involvement (i.e., relatedness support; "In PE and school sport my teacher shows that he/she likes me"). The item chosen from the Health Care Climate Questionnaire is designed to measure autonomy support ("I feel that my PE and school sport teacher provides me choices and options"). These behaviours were addressed in the intervention as follows: a) structure – modules 1, 2, 3, 4, 5, 6 and 8; involvement – modules 1 and 8; and autonomy support – modules 1, 2 and 7. The item selected from the Controlling Teacher Scale to assess teacher's controlling behaviour was "In PE and school sport my teacher puts a lot of pressure on me". I selected these four items because they represent the core of each construct assessed, and showed satisfactory reliability (subscale omega $\geq .70$) when pilot tested in a sample of Year 3 and 4 public school students ($N = 125$) in New South Wales, Australia. Also, I could not include many measures because this was part of a larget project in which numerous constructs needed to be measured. An overall experience of need support measure was calculated by averaging the four items (controlling behaviour was reverse-coded).

Enjoyment. I assessed enjoyment using three items adapted to physical education and school sport from the Student Engagement in School questionnaire (Lam et al., 2014). These items were “I enjoy PE and school sport lessons”, “I like my PE and school sport lessons”, and “PE and school sport is fun”. The mean of the three items is intended to indicate levels of positive affective experience in the lesson.

Effort. I selected effort as a behavioural experience of student participation in physical education and school sport. I assessed effort through three items, including two items from Lam et al. (2014) (“I try hard in PE and school sport” and “I work as hard as I can in PE and school sport”), and one item from the effort subscale of the Intrinsic Motivation Inventory (IMI; McAuley et al., 1989) (“I put a lot of effort into PE and school sport lessons”).

I investigated *cognitive outcomes* through the assessment of elements of cognitive processes during physical education and school sport lessons. I chose ‘Concentration’ and ‘Use of strategies to learn’ in physical education and school sport because they provide a global and a more specific, respectively, measure of how students learn from teaching. Given that cognition relies on a certain level of understanding of what it means, the use of its global elements such as concentration seem to be appropriate when studying cognitive responses in young children. In addition, the use of learning strategies is one way to examine specific cognitive components students employ when learning. Furthermore, the items tapping these variables could be worded in a non-sophisticated way to be used with primary school-aged children.

Concentration. Three items from the six employed by Standage et al. (2005) to assess students’ self-report *concentration* in the lessons were selected. These items were “In PE and school sport I really concentrate on the skills and tasks I do”, “I pay attention in my

PE and school sport lessons", and "In PE and school sport I think carefully about the skills and tasks I am doing".

Use of learning strategies. I employed three items from the 5-item *use of strategies* subscale of the Cognitive Processes Questionnaire in Physical Education (CPQPE; Solmon & Lee, 1997) to measure strategies the students employ when trying to learn in physical education and school sport. Example items are "At home, I think about the right way to perform the skills I learn in PE and school sport", "When I am learning a new skill in PE and school sport, I try to think how it is like something I already know", "In PE and school sport, I talk to myself during practice to help me do better". Concentration and use of strategies measures are scored by averaging the items in each subscale.

Intervention fidelity

Intervention fidelity was measured through: a) intervention adoption and b) implementation rates. *Intervention adoption* refers to the amount of the intervention the 23 teachers in the intervention group completed. The training consisted of a 120-min workshop (teachers were given the opportunity to attend this in person at school, or complete a version online if they could not attend the workshop); a series of eight 30-min online modules focusing on need support; and three 30-min meeting modules with the school's iPLAY mentor as well as with other teachers. Together, the workshop, the online modules, and the meeting modules would require 450 minutes to be completed. Teacher adoption is described in terms of the number of minutes completed. *Intervention implementation* was examined through observed and teacher-reported measures. The school's iPLAY mentor conducted observations and, using a SAAFE checklist, rated one 30-min physical education or sport lesson of each teacher in the intervention condition on a 5-point scale. The 15-item checklist included: four items rating *Supportive* (e.g., teacher provided individual skill specific

feedback); three items rating *Active* (e.g., transitions between activities were efficient with minimal time wasted); three items rating *Autonomous* (e.g., students were involved in creating the rules/modifying the activities); two items rating *Fair* (e.g., teacher ensured that students were evenly matched in activities); and three items rating *Enjoyable* (e.g., lesson included a variety of activities). This checklist is not validated, and it has been used in iPLAY more as a prompt for mentors and teachers rather than a measurement tool. An overall observer rating was calculated by averaging the average scores of each principle.

Teachers also rated their own implementation of the SAAFE teaching principles during their lessons on a 5-point scale, after the completion of each module. This means, teachers rated their implementation of the strategies learned in module 1 (Fast Start – 2 ratings) in the subsequent module (module 2; Circuits and Physical Activity Monitoring – 2 ratings). Because of this dynamic, teachers were able to rate their implementation of the SAAFE principles across modules 3 (Small-sided and Modified Games – 2 ratings), 4 (Effective Feedback – 3 ratings), 5 (Fair and Enjoyable – 3 ratings), 6 (Positive Social Climate – 3 ratings), and 7 (Choice and Rationales – 2 ratings), but not the strategies taught in the last module (differentiation and empathy). An overall self-report rating was calculated by averaging the average scores of each module. Both the observed and self-report measures are presented descriptively.

Statistical analysis

I examined between-group changes using linear mixed models with standard errors corrected for clustering (i.e., teachers) in R version 3.5.0 (R Core Team, 2018) using the Mediation package (Dustin, Teppei, Kentaro, Luke, & Kosuke, 2014). I also followed intention-to-treat principles and used the multiple imputations method for missing/incomplete data, meaning that all 714 students who provided valid data at baseline were included in all

analyses. I employed multilevel models with student experiences in physical education and school sport as outcome, adjusting for student demographics, baseline scores, as well as clustering.

First, I calculated the regression coefficients for the effect the iPLAY intervention on students' affective, behavioural, and cognitive experiences, (e.g., iPLAY → enjoyment). Next, I examined the effects the intervention had on a latent composite measure of the teacher interpersonal style (i.e., autonomy supportive, competence support, relatedness support, and controlling behaviour). I also calculated the effect of the teacher interpersonal style as a direct predictor of students' experiences in physical education and school sport (e.g., teachers' style → enjoyment). As fixed effects, I entered students' demographic variables (i.e., sex and age), as well as their baseline scores on the mediator and outcome variable in each model. Then, as random effects, I examined variations in the outcome variables as a function of each student's teacher.

Additionally, I tested four different single mediation models (see Figure 7) in which students' experiences in physical education and school sports were predicted by the iPLAY intervention (path c'), mediated by changes in students' perception of their teachers' interpersonal style (path ab). Students' demographics (i.e., sex and age), as well as mediator and outcome scores at baseline were included as covariates in analyses. I defined effect sizes as > 0.1 (weak), > 0.3 (moderate), and > 0.5 (strong) (Cohen, 1988).

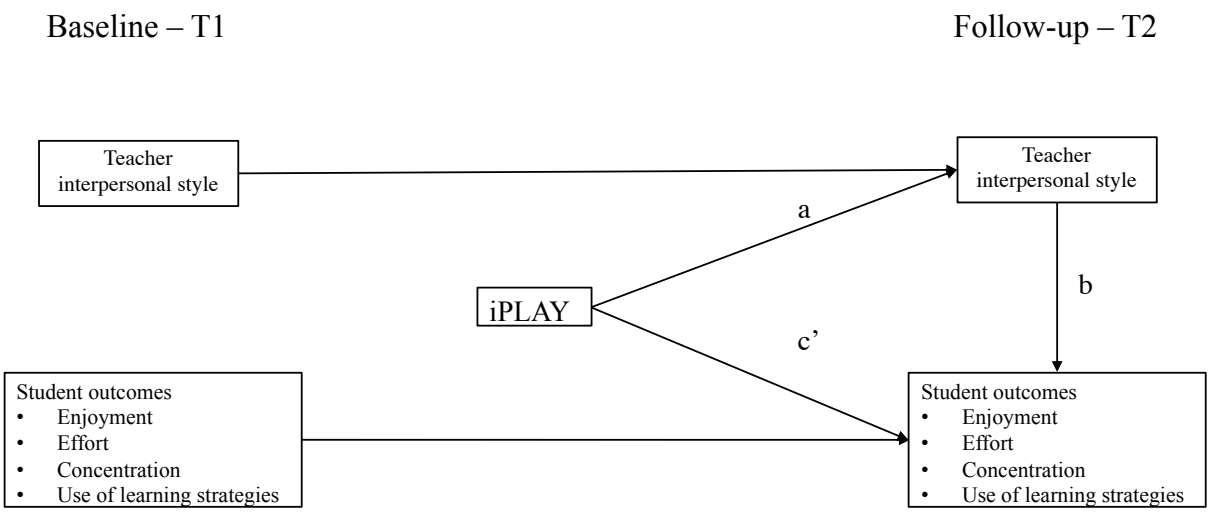


Figure 7. Model of hypothesised relationships in iPLAY.

Preliminary examination of histograms showed some variables were highly skewed, with large proportions of the sample scoring at or near the maximum value at baseline on the teacher interpersonal style and student outcome variables. This suggested potential ceiling effects that would limit the ability of the analysis to show positive change of the intervention. For example, 69.9% of the sample scored above 4.67 for enjoyment of physical education and school sport at baseline (Table 8). As a result, I conducted exploratory analyses to determine if the iPLAY intervention had effects in the subsample of students whose baseline scores did not approach these ceiling values.

Results

Year 3 and 4 students (N = 714; n = 361 in intervention condition and n = 353 in control condition) from 9 High SES (n = 232) and 7 Low SES (n = 482) NSW public schools were assessed at baseline, including 370 boys (mean [SD] = 8.74 [0.72] years) and 340 girls (mean [SD] = 8.71 [0.74] years). The majority of the students were born in Australia (88.5%) and most spoke English at home (89.8%).

Path Analysis

Total effects of the intervention on student outcomes (path ab + c'). As seen in Table 8, the total effect of the intervention on students' enjoyment, effort, concentration, and use of learning strategies was weak, with beta coefficients ranging from .02 to .08. No significant effect was found, as 95% confidence intervals in all these relationships encompassed zero.

Intervention effects on mediator (path a). Estimates of intervention effects on the mediator (i.e., teachers' interpersonal style) can be viewed in Table 8. No significant effect was found ($p > .05$).

Direct effect of the mediator on student outcomes (path b). Following adjustment for individual demographics (i.e., sex and age) and baseline scores, students' perceptions of the teacher interpersonal style at follow-up was found to be a moderate significant predictor of students' enjoyment ($b = 0.47$ [0.36, 0.59]), effort ($b = 0.31$ [0.23, 0.38]), concentration ($b = 0.36$ [0.28, 0.43]), and use of learning strategies ($b = 0.37$ [0.27, 0.48]) at follow-up.

Direct effect of intervention on student outcomes (path c'). As seen in Table 8, no significant direct effects were found between the intervention and students' outcomes at post-intervention (i.e., enjoyment ($b = 0.04$, $p = .320$); effort ($b = 0.08$, $p = .117$), concentration ($b = 0.03$, $p = .300$), or learning strategies ($b = 0.07$, $p = .151$).

Mediating effect of teacher interpersonal style on student outcomes (path ab). Among the overall sample, changes in student outcomes at follow-up were not mediated through changes in perceptions of the teacher interpersonal style (p values ranged from .532 to .551). As shown in Table 8, the proportion of the effect that was mediated (i.e., indirect effect/total effect) in these associations through the hypothesized mediator (teacher interpersonal style) was very low (< 1%).

Table 8

Direct Effect of Intervention on Teacher Interpersonal Style and Direct, Indirect, and Total Effect of Intervention on Students' Experiences in Physical Education and School Sport

	Intervention on mediator (path a)		Intervention on study outcomes (patch c')		Mediator on study outcomes (path b)		Mediated effect (path ab)		Total effect		ICC at T2	% of total effect mediated (indirect/total effect)
	b	95% CI	*b*	95% CI	*b*	95 % CI	*b*	95% CI	*b*	95% CI		%
Teacher interpersonal style	-0.01	-0.15 to 0.14									0.21	
Enjoyment			0.04	-0.11 to 0.14	0.47*	0.36 to 0.59	-0.03	-0.07 to 0.06	0.04	-0.09 to 0.16	0.01	< 1%
Effort			0.08	-0.02 to 0.19	0.31*	0.23 to 0.38	-0.02	-0.04 to 0.04	0.08	-0.02 to 0.19	0.01	< 1%
Concentration			0.03	-0.08 to 0.13	0.36*	0.28 to 0.43	-0.00	-0.05 to 0.04	0.02	-0.09 to 0.13	0.03	< 1%
Use of strategies			0.07	-0.07 to 0.21	0.37*	0.27 to 0.48	-0.00	-0.05 to 0.05	0.07	-0.07 to 0.21	0.02	< 1%

Note: Path a: unstandardized regression coefficients (*b*) of the intervention on mediator; Path b: unstandardized regression coefficients (*b*) of mediator on student outcomes; Path c': unstandardized regression coefficients (*b*) of the intervention on student outcomes; Path ab: unstandardized regression coefficients (*b*) of the intervention on student outcomes; 95% CI: 95% Confidence Interval. Significant effect ($p < .05$). ICC: Teacher level intra-class correlation at follow-up.

Mean scores for baseline and follow-up assessments of students' perceptions of their teacher behaviour and students' outcome variables are displayed in Table 9. Among the overall sample, students in the intervention condition had lower scores at follow-up in all variables under investigation compared to their baseline data. Students in the control group presented a similar trend in results, with lower mean scores at follow-up than at baseline. However, as shown in Table 9, the intervention-control adjusted mean difference at follow-up was not significant for perceptions of teacher behaviour (95% CI -0.92 to 0.51), enjoyment (95% CI -0.06 to 0.16), effort (95% CI -0.04 to 0.18), concentration (95% CI -0.06 to 0.14), or use of learning strategies (95% CI -0.05 to 0.23).

Subsample analyses. As noted, a large portion of students started the intervention with high scores on the variables under investigation. As such, I examined separately students that did not score at or near the maximum value at baseline. Regardless of the students' allocation condition (intervention or control), changes between baseline and follow-up scores were positive for students in the subsample, but not among the overall sample. Although increases were observed at follow-up in all outcome variables, no intervention effects were found on this subsample of students (Table 9). In all these relationships 95% CI's encompassed zero (point of no difference).

Table 9

Changes in Outcome Variables from Baseline to Follow-Up

	Intervention		Control		Intervention-control adjusted mean difference at Follow-Up	
	Baseline mean (SD)	Follow-up mean (SD)	Baseline mean (SD)	Follow-up mean (SD)	Estimate	95% CI
Teacher interpersonal style						
Overall sample	4.09 (0.72)	4.02 (0.69)	4.05 (0.74)	4.00 (0.72)	-0.02	-0.92 to 0.51
Subsample	3.45 (0.76)	3.84 (1.33)	3.48 (0.76)	3.78 (1.14)	-0.01	-0.14 to 0.12
Enjoyment						
Overall sample	4.57 (0.74)	4.51 (0.78)	4.53 (0.71)	4.52 (0.75)	0.05	-0.06 to 0.16
Subsample	3.88 (1.22)	4.11 (1.57)	4.01 (1.04)	4.25 (1.39)	0.04	-0.08 to 0.17
Effort						
Overall sample	4.61 (0.58)	4.52 (0.69)	4.59 (0.60)	4.58 (0.60)	0.07	-0.04 to 0.18
Subsample	4.13 (0.90)	4.24 (1.26)	4.12 (0.90)	4.36 (1.08)	0.07	-0.04 to 0.17
Concentration						
Overall sample	4.42 (0.62)	4.37 (0.69)	4.50 (0.61)	4.43 (0.64)	0.04	-0.06 to 0.14
Subsample	3.87 (0.70)	4.07 (1.06)	3.89 (0.70)	4.15 (1.23)	0.02	-0.08 to 0.12
Use of learning strategies						
Overall sample	3.84 (0.91)	3.67 (0.94)	4.01 (0.80)	3.82 (0.81)	0.09	-0.05 to 0.23
Subsample	3.04 (0.85)	3.35 (1.53)	3.15 (1.02)	3.51 (1.36)	0.07	-0.07 to 0.22

Note: Subsample = students that did not score at or near the maximum value at baseline.

Correlations pre and post-intervention. Correlations among study variables demonstrated similar trends at the two timepoints (Table 10). For example, students' perceptions of their teacher behaviour (i.e., needs support) was strongly associated ($r > .50$) with enjoyment and concentration at both baseline and at follow-up, while teacher behaviour was moderately ($r > .30$) associated with effort and use of strategies at baseline and follow-up. Moderate to strong inter-correlations (range = .37 to .77) among student outcomes were found at both baseline and follow-up. Intra-correlations between the constructs revealed enjoyment ($r = .50$) and concentration ($r = .49$) to be the most stable of the outcome variables over time, and teacher interpersonal style the least stable ($r = .35$) – which is logical because most students had a different teacher at baseline compared with post-intervention.

Table 10

Bivariate Correlations Among Study Variables at Baseline and Follow-Up.

	α	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Teacher interpersonal style T1	.60																	
2. Teacher autonomy support T1		.68																
3. Teacher competence support T1		.67	.35															
4. Teacher relatedness support T1		.74	.38	.49														
5. Teacher controlling behaviour T1		-.63	-.19	-.15	-.20													
6. Enjoyment T1	.86	.53	.23	.38	.39	-.16												
7. Effort T1	.82	.45	.26	.44	.33	-.12	.54											
8. Concentration T1	.75	.52	.33	.44	.42	-.17	.52	.72										
9. Use of strategies T1	.63	.35	.15	.33	.33	.00	.45	.46	.56									
10. Teacher interpersonal style T2	.60	.35	.23	.27	.27	-.19	.23	.26	.33	.15								
11. Teacher autonomy support T2		.31	.22	.26	.23	-.14	.30	.26	.29	.24	.69							
12. Teacher competence support T2		.19	.13	.24	.15	-.04	.12	.18	.21	.11	.66	.35						
13. Teacher relatedness support T2		.29	.23	.22	.32	-.06	.18	.14	.20	.15	.70	.36	.36					
14. Teacher controlling behaviour T2		-.16	-.05	-.05	-.03	.24	-.04	-.13	-.20	.05	-.65	-.18	-.24	-.17				
15. Enjoyment T2	.88	.33	.33	.24	.20	-.14	.50	.33	.34	.28	.51	.54	.32	.32	-.21			
16. Effort T2	.86	.24	.28	.44	.12	-.08	.39	.43	.43	.28	.40	.37	.33	.25	-.15	.70		
17. Concentration T2	.80	.26	.24	.19	.19	-.12	.31	.39	.49	.30	.50	.41	.42	.34	-.20	.60	.77	
18. Use of strategies T2	.65	.27	.24	.23	.21	-.09	.29	.30	.39	.43	.34	.32	.29	.37	-.01	.37	.47	.61

Note: Teacher interpersonal style was calculated by averaging the items tapping autonomy support, competence support, relatedness support, and controlling behaviour (multiplied by -1). α indicates internal consistency estimates of each subscale. Internal consistency for single-item measures (i.e., teacher autonomy support, competence support, relatedness support, and controlling behaviour) are not relevant.

Intervention Fidelity

Intervention adoption. As seen in Figure 8 below, among the 23 teachers in the intervention group, intervention adoption was very high for almost half of the teachers and very low for the others (range = 0 - 100% complete). In terms of workshop and online learning modules completion, 11 teachers completed all aspects of the intervention, which included a 120-min workshop and eight 30-min online modules, while 12 teachers had low adoption completing 120 minutes or less (Figure 8).

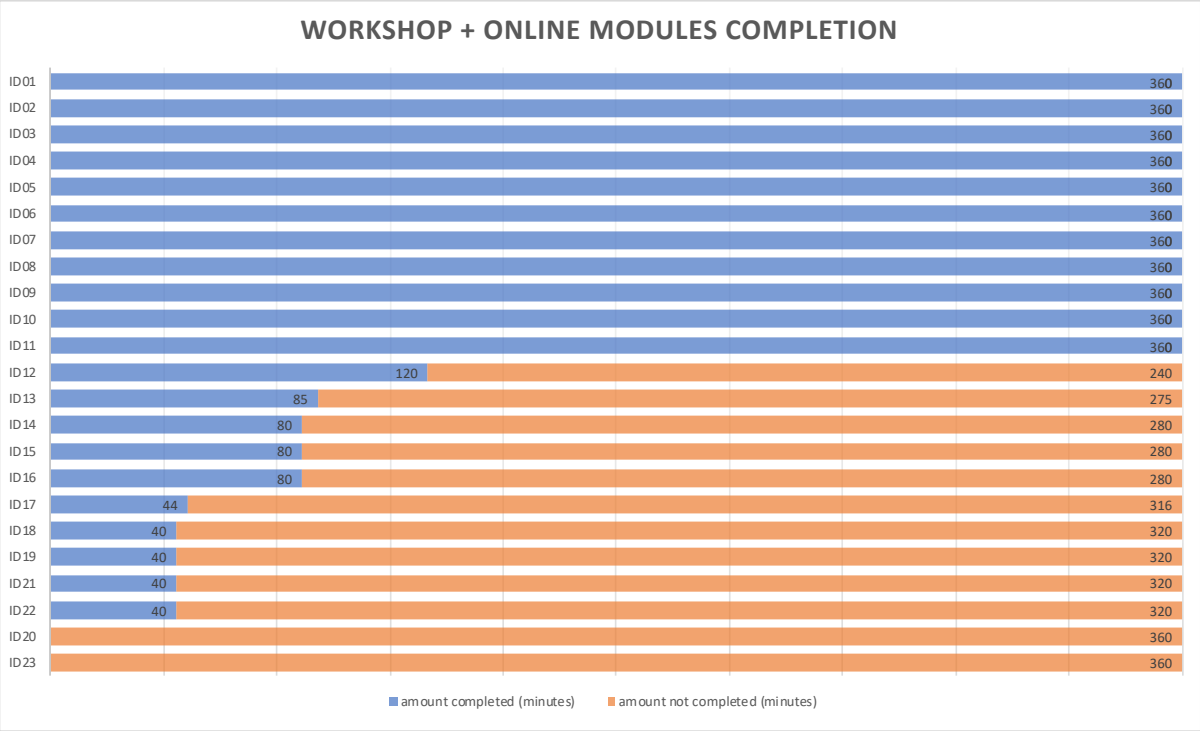


Figure 8. Individual teacher completion of the workshop (120-min) and the eight online modules (30-min each) for each of the 23 teachers in the intervention condition.

The final three modules of the training involved meetings with the school's mentor as well as with the other teachers, and were fully completed (90 minutes in total) by nine teachers (Figure 9). Four teachers had low engagement (15 to 60 min) in completing these modules, while the remaining 10 teachers had no involvement (0 min) with this part of the intervention.

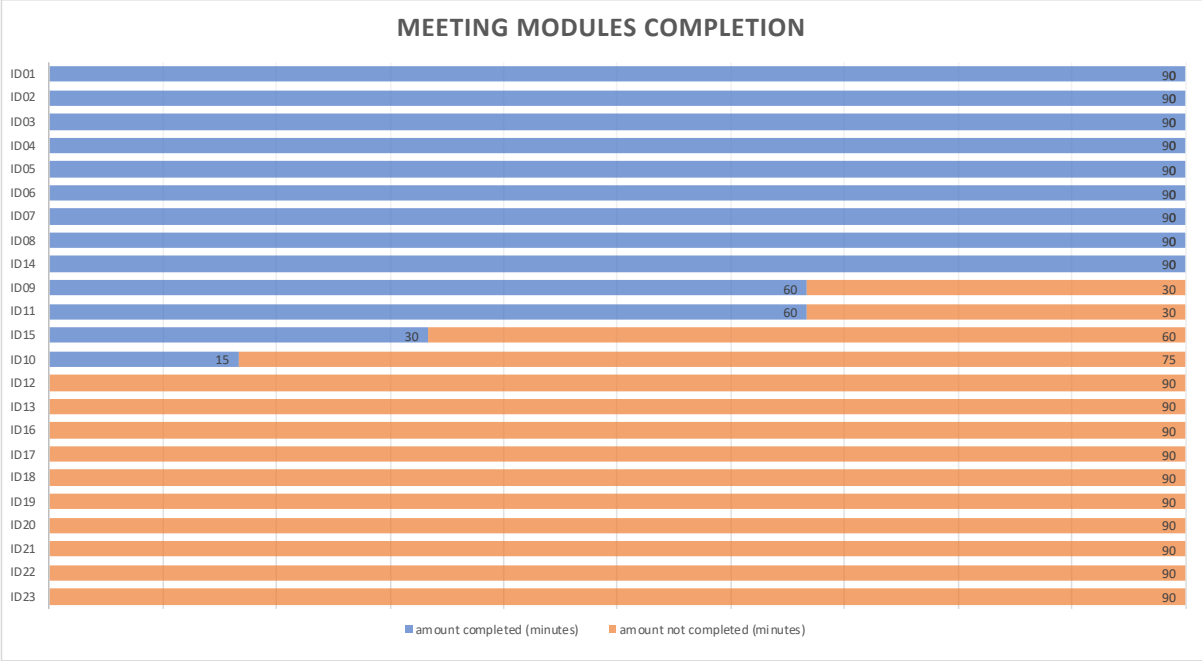


Figure 9. Individual teacher completion of the three meeting modules (30-min each) for each of the 23 teachers in the intervention condition.

Although no moderation analysis was conducted due to limited information, teachers' module completion appeared to have a negative impact on the study outcomes. Students whose teacher completed all/nearly all the intervention showed a decrease over time in all outcome variables. This was observed among both the overall sample and the subsample of students that scored lower than the median at baseline (Table 11). Contrary to the decreases observed among the overall sample, increases in all variables were observed at follow-up on the subsample of students whose teacher completed some aspects of the intervention. With two exceptions (teacher behaviour and concentration), mean scores increased at follow-up among students from the two teachers who did not even attempted to do intervention.

Table 11

Changes in Outcome Variables from Baseline to Follow-Up According to the Amount of the Intervention Teachers Completed

	All/nearly all (teachers completed 80%-100% of the intervention; n = 11 teachers)		Some (1%-79%; n = 10 teachers)		Did not attempt (0%; n = 2 teachers)	
	Baseline mean (SD)	Follow-up mean (SD)	Baseline mean (SD)	Follow-up mean (SD)	Baseline mean (SD)	Follow-up mean (SD)
Teacher interpersonal style						
Overall sample	4.18 (0.67)	4.06 (0.65)	4.00 (0.78)	3.95 (0.79)	3.78 (0.83)	4.01 (0.71)
Subsample	3.99 (0.74)	3.97 (0.74)	3.70 (0.74)	3.88 (0.93)	3.55 (0.76)	3.86 (1.11)
Enjoyment						
Overall sample	4.61 (0.73)	4.61 (0.67)	4.54 (0.73)	4.44 (0.85)	4.44 (0.73)	4.31 (1.1)
Subsample	4.47 (0.87)	4.45 (0.90)	4.17 (1.04)	4.24 (1.22)	4.04 (1.08)	4.16 (1.26)
Effort						
Overall sample	4.66 (0.55)	4.57 (0.62)	4.53 (0.58)	4.51 (0.82)	4.46 (0.75)	4.42 (0.85)
Subsample	4.53 (0.54)	4.47 (0.72)	4.30 (0.74)	4.33 (0.90)	4.21 (0.72)	4.29 (0.88)
Concentration						
Overall sample	4.46 (0.61)	4.41 (0.63)	4.43 (0.64)	4.34 (0.79)	4.34 (0.68)	4.37 (0.88)
Subsample	4.33 (0.53)	4.30 (0.70)	4.05 (0.88)	4.15 (0.90)	3.98 (0.71)	4.12 (0.90)
Use of learning strategies						
Overall sample	3.85 (0.94)	3.72 (0.94)	3.81 (0.84)	3.61 (0.97)	3.81 (0.92)	3.81 (1.08)
Subsample	3.70 (0.85)	3.59 (1.19)	3.35 (0.85)	3.42 (1.21)	3.21 (1.02)	3.41 (1.36)

Note: Subsample = students that scored lower than the median at baseline. Percentage completion represents the overall intervention module completion by the teachers (i.e., workshop, online modules, and meeting modules).

Intervention implementation. Teachers rated their implementation of SAAFE principles based on questions they answered after the completion of each of the online modules. Mentors rated teachers' implementation of the strategies through an observation of a physical education lesson. Self-reports of the teachers' own implementation across the modules (3.75; in a 5-point scale) and observations made by the mentors (3.68) were strongly associated (r = .533, p = .113). When analysing modules that focused on need support separately, teachers rated their implementation as 4.00 on average. Ten out of the 11 teachers that completed the modules arranged a lesson observation with a mentor.

Differences between self-reported ratings and obverse ratings on teacher behaviour and student outcomes can be seen in Table 12. Exploratory analysis showed similar results in the outcome variables regardless of the source of rating (teachers or external observers). With a few exceptions, follow-up scores slightly decreased from baseline in both groups of teachers with low and high implementation rates made by themselves or by the mentors.

Due to limited information available (< 50% of the teachers in the intervention condition), moderation analysis to examine the effect of both observed and self-reported teachers' implementation of the intervention had on changes in student outcomes and changes in teacher behaviour was not conducted.

Table 12

Students' Perceptions of Their Teachers' Behaviour and Students' Affective, Behavioural, and Cognitive Outcomes at Baseline and Follow-Up Based on Teacher-Reported Ratings and Observer Ratings

	Low implementers				High implementers			
	Teachers' report (n = 3 teachers)		Mentors report (n = 4 teachers)		Teachers report (n = 8 teachers)		Mentors report (n = 7 teachers)	
	Baseline	Follow-up	Baseline	Follow-up	Baseline	Follow-up	Baseline	Follow-up
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Teacher interpersonal style	4.33 (0.72)	4.03 (0.74)	4.03 (0.69)	4.14 (0.65)	4.13 (0.65)	4.04 (0.65)	4.24 (0.67)	3.88 (0.75)
Enjoyment	4.69 (0.71)	4.54 (0.82)	4.56 (0.88)	4.57 (0.79)	4.58 (0.73)	4.63 (0.59)	4.59 (0.68)	4.51 (0.74)
Effort	4.79 (0.35)	4.52 (0.74)	4.63 (0.60)	4.40 (0.76)	4.60 (0.65)	4.62 (0.53)	4.63 (0.59)	4.62 (0.64)
Concentration	4.64 (0.54)	4.45 (0.72)	4.45 (0.62)	4.31 (0.75)	4.47 (0.57)	4.41 (0.54)	4.48 (0.61)	4.41 (0.63)
Use of learning strategies	3.92 (1.07)	3.96 (0.89)	3.79 (0.99)	3.64 (0.93)	3.94 (0.81)	3.65 (0.84)	3.98 (0.89)	3.72 (0.89)

Note: Median scores of each source of rating were used to form the two groups (Low implementers and High implementers). Low implementers according to external observations made by the mentors were teachers rated below 3.6 (median). Low implementers based on teacher self-reports were teachers that rated themselves below 4.0 (median).

Discussion

Discussion of Main Findings

The aim of this study was to investigate the effects of the iPLAY intervention on students' experiences in physical education and school sport lessons; and whether changes in teachers' interpersonal style mediated these. Overall, no significant intervention effect on students' affective, behavioural, or cognitive outcomes in physical education and school sport lessons was found. These relationships were also not mediated by changes in perceptions of the teacher behaviour. However, teacher interpersonal style predicted all outcome measures (i.e., enjoyment, effort, concentration, and use of strategies) at follow-up.

The fact that no intervention effects were found on any of the study outcome variables could be explained by a number of reasons. First, it could be due a ceiling effect where participants started the intervention with high scores on the outcome variables. In this study, large proportions of students had high scores at baseline on all variables that were measured, meaning that an intervention effect would unlikely be observed at follow-up. Ceiling effects were found not only for students' in-class affective, behavioural, and cognitive experiences, but also for perceptions of their teacher's behaviour. In addition to the ceiling effects found, some research has highlighted the limited ability students have in rating teacher behaviour. For example, Haerens et al. (2013) found substantial discrepancies between independently-observed and student-perceived teacher behaviour in physical education in a sample of high school students. Also, Lonsdale et al. (2017b) found significant intervention effects on observed teacher behaviour, but not on high school students' perceptions of their teachers' behaviour.

Lack of intervention effects on students' outcomes could also be a function of teacher adoption (i.e., the extent to which teachers completed the iPLAY program) (RE-AIM framework; Glasgow, Vogt, & Boles, 1999). In a recent trial, Lonsdale et al. (2017b) found

significant intervention effects when the majority of the teachers completed all modules in their training. Teachers might have different interests in what they want or need to improve, thus giving more focus to aspects of their teaching not related to physical education and sport. As schools' standardised test scores are publicly available, pressures on teachers about numeracy and literacy have increased, which may had led teachers to complete only specific modules rather than the entire program.

Poor intervention implementation could also be a possible explanation for no intervention effects being found. In terms of implementation, observed ratings made by the mentors (3.68; in a 5-point scale) were similar to teachers' self-report of the implementation of the strategies (3.75), meaning that even after the intervention, teachers were not employing teaching that rated highly according to the SAAFE checklist. It was expected that students would benefit more from high implementer teachers as opposed to low implementers (Lonsdale et al., 2017b). However, exploratory analysis revealed similar results in the outcome measures, as well as in perceived teacher behaviour, over time in both groups of low and high implementers. It was also expected that teachers that completed more of the training would have higher implementation rates. However, because the completion percentage was around only 50%, and the number of teachers that were assessed by mentors and/or reported on their own implementation was low (11 teachers out of 23), it was not possible to make any type of comparison in this regard.

Although the hypothesised mediation model was not supported (i.e., teacher behaviour did not mediate the relationship between the intervention and students' outcomes at post-intervention), I found that students' rating of their teachers was a moderate/strong predictor of students' enjoyment, effort, concentration, and use of strategies in physical education and school sport lessons at follow-up. These findings are consistent with SDT school physical education-based research (Cohen et al., 2015; Cox & Williams, 2008;

Lonsdale et al., 2017b; Sparks et al., 2017; Standage et al., 2005) and highlight the importance of the physical education/sports teacher behaviour as a predictor of students' in-class experiences. This is particularly important in terms of cognitive outcomes, given that exercise works with the physiology of the brain to improve behaviour. Indeed, exercise causes the release of neurotransmitters that activate the attention system, improve mood, decrease anti-social behaviour, and increase pro-social behaviour. This increases the opportunities to access executive functioning (i.e. problem solving, planning, sequencing, etc.) necessary for learning.

Overall Implications

The hypothesised mediation model was not supported, and I did not find evidence that the intervention changed teacher behaviour or student experiences in physical education at post-intervention. Yet, the paths from teacher behaviour to students' in-class experiences was significant. In terms of theoretical implications, this finding supports SDT postulates that student perceptions of supportive social contexts (i.e., teacher support) lead to positive consequences. Research has shown that supportive teaching has a positive impact on students' affective (Almolda-Tomás et al., 2014; Gillison et al., 2013; Khalkhali & Golestaneh, 2011; Leptokaridou et al., 2014; Mouratidis et al., 2011; Sparks et al., 2017), behavioural (Bronikowski, Bronikowska, & Glapa, 2016; Cheon et al., 2012; Cheon, Reeve, & Song, 2016; Cohen et al., 2015; Erwin et al., 2013; Lonsdale et al., 2017b; Lonsdale et al., 2013; Perlman, 2012; Smith et al., 2015), and cognitive (Chatzipanteli, Digelidis, & Papaioannou, 2015; Cheon et al., 2012; Wallhead et al., 2014) experiences in school-based physical education.

As evidenced by the meta-analysis from Su and Reeve (2011), teachers can learn how to be more supportive towards their students. Contrary to the studies identified in that meta-

analysis and other physical education-based interventions (e.g., Aelterman et al., 2014; Cheon & Reeve, 2015b), iPLAY employed a train-the-trainer type of program and, thus, a smaller intervention effect was likely. Also, comparing the iPLAY intervention with other studies can be challenging as the SAAFE teaching principles have just recently began to be tested in the physical education setting (Cohen et al., 2015). Recently, the NEAT and ATLAS programs (Lubans et al., 2016) employed the SAAFE teaching principles in fitness lessons (not physical education or school sport) in secondary schools. More research is needed to test the effect of the strategies outlined in the SAAFE teaching principles in promoting better students' experiences and learning outcomes in physical education.

Strengths and Limitations

This study helps address some of the gaps in the literature highlighted in the systematic review (Chapter 2), by investigating and providing estimates of associations that have been studied less in the self-determination theory physical education-based literature. For example, cognitive outcomes have been less studied than affective and behavioural outcomes in physical education. In this regard, this study focused on further investigating lesson-related cognitive outcomes by examining two different cognitive constructs that represent both global aspects (concentration) and specific (use of learning strategies) components of cognition. Another strength of this study is that this is one of the few studies (Cohen et al., 2015) that examined the SAAFE principles in primary school.

Although this study has a number of strengths, it also presented limitations. Despite needs support constructs are comprised of multiple elements, these constructs were measured using self-reported single-item scales, which might have influenced across items stability (i.e., internal consistency) and limited students' ability to distinguish among them. Also, the low number of outcome variables within each category may represent limited information about

students' lesson-related emotions, behaviour, and cognition. Lack of observed teacher behaviour and lack of objective student behaviour measure in lessons are also limitations of this study.

Future Directions

Young students may not be able to accurately rate their teachers' behaviour (Mellor & Moore, 2014). Researchers may wish to conduct longitudinal studies to further explore the impact of age on students' ability to evaluate supportive teaching in physical education and school sport lessons. The use of observed measures of teacher behaviour in conjunction with self-report measures is also something that researchers should consider for future research in order to provide more accurate estimates of supportive teaching.

Conclusions

The present study aimed to provide primary school teachers with an approach to help them deliver better quality physical education and school sport lessons. Although no intervention effects were observed on teacher behaviour or students' experiences in class, teacher behaviour was found to be a predictor of students' experiences. This finding highlights the importance of a need-supportive environment created by the teacher and emphasises self-determination theory as valuable framework to consider in further physical education teacher training programs.

Chapter 5: General Discussion and Conclusion

The overarching aim of this thesis was to examine the relationship between teacher interpersonal style and students' affective, behavioural, and cognitive experiences in physical education. To achieve this aim, three studies were conducted.

Study 1 (Chapter 2) was a systematic review and meta-analysis of the evidence regarding the tenets of self-determination theory within the physical education context.

Summary of evidence: In regards to social context and SDT constructs, the 265 included studies highlighted that most of the evidence regarding teacher behaviour within the physical education context has examined the provision of autonomy support. Structure (competence support), involvement (relatedness support), and controlling teaching behaviour have been studied less. Relatively few studies have investigated the association of peer support and the constructs proposed by SDT. Regarding outcomes of student participation in physical education, affective and behavioural variables have gained more attention than cognitive outcomes. Also, the tenets of SDT have been tested largely with older children and adolescents and less attention has been paid to young children.

Meta-analyses: Among the 319 associations examined, 57 were strong, 127 were moderate, 124 were weak, and 11 correlations were very weak (< .1). The majority of these associations were in the expected direction. Inter-factor correlations among motivation constructs supported the presence of a continuous order of self-regulatory motives as proposed by SDT. *Moderator analysis*: Study characteristics (i.e., age, sex, culture, and risk of bias) were tested as moderators and explained some of the heterogeneity in some of the 55 correlations in the model, however, none of the variables consistently moderated these relationships.

Path analysis: The SDT motivation sequence (i.e., social context → needs satisfaction → motivation → outcomes) was tested and moderate to strong links were found

between teacher need support and student autonomy (ß = .54) and competence (ß = .31), compared with peer support (ß = .17 and ß = .15, respectively). Peer support (ß = .59) was a stronger predictor of relatedness than teacher support (ß = .25). Indirect effects of teacher support on adaptive (ß = .19) and maladaptive outcomes (ß = -.15) suggested needs satisfaction and motivation played mediating roles in these relationships. This review concluded that supportive teaching appears to facilitate adaptive outcomes in physical education through satisfaction of autonomy and competence, while peer influence on outcomes is more associated with relatedness.

Study 2 (Chapter 3) aimed to investigate selected psychometric properties of the questionnaire used in this thesis. The 16-item questionnaire consisted of measures of primary school students' perceptions of teacher interpersonal style (four items; one item tapping each need support construct) and students' perceptions of enjoyment (three items), effort (three items), concentration (three items), and use of learning strategies (three items) during physical education and school sport lessons. Overall, items demonstrated strong loadings (>.30), and the combination of fit and loadings suggest that the selected items were good indicators of the variables. Internal consistency estimates showed the scores derived from the sub-scales to be reliable indicators of students' perceptions of teacher behaviour, as well as affective, behavioural, and cognitive outcomes of student participation in physical education and school sport lessons (omega values ranged from .72 to .93). In addition, the SDT tenet that the associations between need support and outcomes are expected to be universal was confirmed as the scores from the measures used in this thesis were invariant across age and sex. Finally, discriminant validity was generally supported through the factor correlations found, as students perceived five related but distinct constructs. The only exception was the strong factor correlation between concentration and effort (.93) indicating that students in this study may have had problems in differentiating the items in these subscales. Results from

Study 2 indicated that the combination of fit indices, item loadings, and internal consistency estimates of scores derived from the measures supported the hypothesized factor structure of the questionnaires employed in this thesis.

Study 3 (Chapter 4) investigated the effects of a teacher training intervention on students' experiences in physical education and school sport lessons. It also examined whether changes in students' perceptions of their teachers' behaviour were mediators of these relationships. Although no total effects of the intervention on student outcomes or perceptions of teacher behaviour were found, students' perceptions of their teacher's behaviour predicted changes from baseline to post-intervention in students' enjoyment (b = .47), effort (b = .31), concentration (b = .36), and use of learning strategies (b = .37) in physical education and school sport lessons. Intervention adoption among the 23 teachers in the intervention was either very high or very low, which resulted in an average completion of 56%. Implementation rates provided by external observers and the teachers themselves were consistent (r = .543). Exploratory analyses showed that students whose teacher was a high implementer presented similar results as those students from low implementers.

Teacher interpersonal style and students' experiences in physical education

Students' experiences in physical education are influenced by how students feel their teacher supports their psychological needs in the class. Study 1 showed that the different instructional behaviours adopted by the teachers can lead to motivational outcomes through the support of students' autonomy and competence, while peer support is more associated with relatedness. However, only a few studies have examined the influence of perceived relatedness on the relationship between peer support and outcomes in physical education. Similar to Study 1, the findings from Study 3 also showed that a composite measure of teacher support predicted changes in students' in-class experiences in physical education.

The affective, behavioural, and cognitive outcomes variables investigated in this thesis (i.e., enjoyment, effort, concentration, and use of strategies to learn) are important in the education context as they all are associated with academic-related outcomes. For example, positive affective experiences, like enjoyment, can foster student engagement (e.g., Lin, Hong, & Huang, 2012). Research in the education setting (Owen et al., 2016; Rasberry et al., 2011) also shows that being more physically active at school can increase students time on task in academic lessons. Exercise works with the physiology of the brain to improve behaviour as it causes the release of neurotransmitters that activate the attention system, improve mood, decrease anti-social behaviour, and increase pro-social behaviour. This increases the opportunities to access executive functioning (i.e. problem solving, planning, sequencing, etc.) necessary for learning (Gomez-Pinilla & Hillman, 2013; Thomas, Dennis, Bandettini, & Johansen-Berg, 2012).

The findings from this thesis go beyond previous research as it was one of the few SDT-based intervention studies conducted with children (Cohen et al., 2015; Escriva-Boulley et al., 2018), and the first to examine data from a large-scale intervention program with primary school teachers. It also investigated the use of a new teaching approach (i.e., SAAFE principles). While the main purpose of the iPLAY program is to promote physical activity levels among young students, this thesis also further extended the knowledge by reporting on a number of student in-class outcomes, with special attention to cognitive outcomes in physical education. Although iPLAY is a high quality design program, no intervention effects were found on teacher behaviour or student outcome variables (i.e., enjoyment, effort, concentration, and use of learning strategies). One important aspect to consider when interpreting these findings is that the program was delivered to classroom teachers, not to physical education teachers (as seen in high schools). Due to the increasing pressure on increasing academic performance scores, classroom teachers may give more attention to

numeracy and literacy subjects and perceive them as more beneficial to academic performancerather as opposed to physical activity content, which might have negatively affect teachers' adoption and implementation of the interevention strategies. In contrast, interventions with high school physical education often reveal high levels of adoption and implementation (e.g., Aelterman et al., 2014; Lonsdale et al., 2017b).

Applied implications

Previous research has established that needs supportive programs can influence teaching strategies adopted by teachers, and it has been shown to be effective in promoting physical activity behaviour (e.g., Chatzisarantis & Hagger, 2009; Escriva-Boulley et al., 2018; Lonsdale et al., 2017b). This thesis, however, did not investigate physical activity levels among students, but examined self-reports of affective, behavioural, and cognitive lesson-related experiences instead.

Evidence found in this thesis (Study 3) highlighted that teacher behaviour seems to be an important social factor in promoting students' in class experiences. Using this evidence, primary school teachers can motivate their students by creating a lesson environment that foster the satisfaction of their students' psychological needs. In addition, this can be more easily achieved (planning and delivery of physical education lessons) by primary school teachers as opposed to high school teachers, in the sense that perceptions of the learning environment, as well as motivation towards physical education, is less affected by differences between boys and girls at younger ages (Study 2). Support for autonomy, for example, can be provided when teachers give students a voice during the lesson, offer rationale to the content so that it is meaningful to their lives, allow expressions of negative feelings during the lesson, and avoid the use of pressuring language. Competence support can be perceived when teachers offer adequate help for the tasks proposed, make it clear what they expect of their

students, treat students fairly. Teachers can also adopt a number of strategies in order to support students' need for relatedness, such as showing affection, spending time and talking with the students, and caring for the students, for example.

Interventions in the future should also consider including a component that involves peer support, as feelings of relatedness have been shown to be more associated with psychological support from the peers, and not show much from the teachers as highlighted in Study 1. While there is limited research on how students can support their peers' needs in physical education (see Wallhead & Ntoumanis, 2004 for an exception), there has been an increase in implementing school-based peer-led programs in other areas of education (Lee & Lim, 2012; Michael et al., 2018; Slavin, 1996; Thalluri et al., 2014; Topping & Ehly, 2001). These programs have implemented a number of strategies such as both same level and higher level students tutoring (Thalluri et al., 2014; Topping & Bryce, 2004; Topping et al., 2004), cooperative learning (Slavin, 1990, 1996), and one-to-one (i.e., mentoring) and group situations (Nixon & Topping, 2001).

Limitations and future directions

Intervention fidelity was measured through teacher adoption and implementation of intervention contents. Low adoption was evidenced by the fact that only about half of the teachers (11 out of 23) completed all or nearly all the of the intervention training. This limited information, however, did not allow further investigation whether self-reported ratings and observer ratings could have been moderators of intervention effects.

Another limitation of this thesis could be the use of self-report measures to investigate intervention effects. Self-report methods are not ideal because they rely on factors such as: honesty of the respondents, their understanding of the questions, and the type of rating scales presented to them, for example. To avoid response bias and help students with reading

comprehension of the questions, students answered each question using smiley faces, however, some of the factors presented may have led to ceiling effects found in Study 3 (Chapter 4). Study 2 (Chapter 3) examined selected psychometric properties of the measures employed in this thesis; however, I did not test for ceiling effects in Study 2. One important aspect to consider in regard to students' "honesty" in responding to the questionnaires is that all questionnaires are subject to perceptions of social desirability (Boyle, 2015; Edwards, 1957; Miller et al., 2015). In this thesis, children's social desirability may have had an impact on how students rated their own behaviour (i.e., questions that were directed to them), and also when rating their teachers' behaviour. For example, when asked if they put a lot of effort into physical education and school sport lesson, some students may have responded in ways so they over-report socially acceptable behaviour and under-report negative behaviours, rather than providing their real answer. Although some research has shown that young children may have limited ability to responds to Likert-type scales, I added smiley faces to help students understand the questions.

Despite the limitations presented, the use of subjective measures was the only viable way to collect data from an intervention that is currently being delivered at scale. As mentioned previously, iPLAY is currently being delivered in 100 schools and the 16 in this study are just a sub-sample. Future research could address this issue by making use of both observed and self-reported measures of student experiences in class. This could be done, for example, by having at least two sources of information that could then be compared to provide more consistent estimates of a given measure. An example in this case could be measuring students' effort by self-reports of the students themselves and self-reports from the teacher, or videoing a lesson and having external people rating the behaviour under investigation, with a clear pre-established definition of the construct.

This thesis raises a number of opportunities for future research. For example, the small number of SDT-based interventions with young children makes it unclear the extent to which age could had impact on students' responses. Young students' limited ability to rate their own feelings as well as other people's behaviour (e.g., teacher) can be critical, especially when examining intervention effects based on subjective measures. Thus, future research could focus on further exploring the effects of age on primary school students' perceptions of teacher behaviour and students' in-class experiences longitudinally.

Moreover, the different categories of student outcomes have been studied unequally in physical education, with less attention been paid to cognitive outcomes in comparison with affective and behavioural outcomes. While a wide range of behavioural outcomes has been studied in school physical education, motor learning outcomes should also be given more attention in the field as they are among the most critical outcomes in physical education. Future research should continue to investigate motivational mechanisms and its associations with cognitive variables in physical education, as cognitive processes are associated with outcomes that are needed for learning (e.g., working memory, inhibition).

Conclusion

This thesis has added to the literature on teacher need support and student experiences in physical education. Study 1 gathered information from a large number of studies and concluded, among other things, that students benefit more from autonomy and competence support coming from the teacher, while feelings of relatedness are more associated with perceived support from peers. Study 1 also highlighted important areas that have been understudied in the SDT physical education-based literature, some of which were then addressed in Study 2 and Study 3. Study 2 examined selected psychometric qualities of the questionnaires employed in this thesis and, as an outcome, offers reliable measures to

investigate perceptions of teacher behaviour, enjoyment, effort, concentration, and use of learning strategies in primary school physical education students. The findings from Study 3 showed no intervention effects on teacher behaviour or student outcomes; however, teacher behaviour was associated with students' affective, behavioural, and cognitive outcomes at post-intervention. In summary, teacher behaviour is one important social factor that can help enhance student experiences in the physical education context.

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Appendices

Appendix A: List of all Studies Included in The Review

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Appendix B: Questionnaire used in the thesis.

The next questions ask about your feelings towards PE and School Sport. You can choose a face that is most like how you feel!

1. I feel that my PE and School Sport teacher provides me choices and options.

No A bit Some Yes A lot

2. I enjoy PE and School Sport lessons.

No A bit Some Yes A lot

3. I try hard in PE and School Sport.

No A bit Some Yes A lot

4. In PE and School Sport I really concentrate on the skills and tasks I do.

No A bit Some Yes A lot

5. At home, I think about the right way to perform the skills I learn in PE and School Sport.

No A bit Some Yes A lot

6. In PE and School Sport, the teacher makes it clear what he/she expects of me.

No A bit Some Yes A lot

7. I like my PE and School Sport lessons.

No A bit Some Yes A lot

8. I put a lot of effort into PE and School Sport lessons.

No A bit Some Yes A lot

9. I pay attention in my PE and School Sport lessons.

No A bit Some Yes A lot

10. When I am learning a new skill in PE and School Sport, I try to think how it is like something I already know.

No A bit Some Yes A lot

11. In PE and School Sport my teacher shows he/she likes me.

No A bit Some Yes A lot

12. PE and School Sport is fun.

No A bit Some Yes A lot

13. I work as hard as I can in PE and School Sport.

No A bit Some Yes A lot

14. In PE and School Sport I think carefully about the skills and tasks I am doing.

No A bit Some Yes A lot

15. In PE and School Sport, I talk to myself during practice to help me do better.

No A bit Some Yes A lot

16. In PE and School Sport my teacher puts a lot of pressure on me.

No A bit Some Yes A lot

Appendix C: CONSORT checklist for Study 3

Topic	Checklist item	Reported on page No.
Trial design	3a. Description of trial design (such as parallel, factorial) including allocation ratio	125
	3b. Important changes to methods after trial commencement (such as eligibility criteria), with reasons	N/A
Participants	4a. Eligibility criteria for participants	124
	4b. Settings and locations where data were collected	126
Interventions	5. The interventions for each group with sufficient details to allow replication, including how and when they were actually administered	127
Outcomes	6a. Completely defined pre-specified primary and secondary outcome measures, including how and where they were assessed	129
	6b. Any changes to trial outcomes after the trial commenced, with reasons	N/A
Sample size	7a. How sample size was determined	125
	7b. When applicable, explanation of any interim analyses and stopping guidelines	N/A
Randomisation:		
Sequence generation	8a. Method used to generate the random allocation sequence	126
	8b. Type of randomisation; details of any restriction (such as blocking and block size)	N/A
Allocation concealment mechanism	9. Mechanism used to implement the random allocation sequence (such as sequentially numbered containers), describing any steps taken to conceal the sequence until interventions were assigned	126
Implementation	10. Who generated the random allocation sequence, who enrolled participants, and who assigned participants to interventions	126
Blinding	11a. If done, who was blinded after assignment to interventions (for example, participants, care providers, those assessing outcomes) and how	127
	11b. If relevant, description of the similarity of interventions	N/A
Statistical methods	12a. Statistical methods used to compare groups for primary and secondary outcomes	132 and 133
	12b. Methods for additional analyses, such as subgroup analyses and adjusted analyses	132 and 133

Appendix D: TIDieR checklist for Study 3

TIDieR
Template for Intervention Description and Replication

The TIDieR (Template for Intervention Description and Replication) Checklist*:
Information to include when describing an intervention and the location of the information

Item number	Item	Where located **	
		Primary paper (page or appendix number)	Other † (details)
	BRIEF NAME		
1.	Provide the name or a phrase that describes the intervention.	127	_____
	WHY		
2.	Describe any rationale, theory, or goal of the elements essential to the intervention.	N/A	_____
	WHAT		
3.	Materials: Describe any physical or informational materials used in the intervention, including those provided to participants or used in intervention delivery or in training of intervention providers. Provide information on where the materials can be accessed (e.g. online appendix, URL).	127	_____
4.	Procedures: Describe each of the procedures, activities, and/or processes used in the intervention, including any enabling or support activities.	127	_____
	WHO PROVIDED		
5.	For each category of intervention provider (e.g. psychologist, nursing assistant), describe their expertise, background and any specific training given.	128	_____
	HOW		

6.	Describe the modes of delivery (e.g. face-to-face or by some other mechanism, such as internet or telephone) of the intervention and whether it was provided individually or in a group.	128 and 129	_____
	WHERE		
7.	Describe the type(s) of location(s) where the intervention occurred, including any necessary infrastructure or relevant features.	128	_____
	WHEN and HOW MUCH		
8.	Describe the number of times the intervention was delivered and over what period of time including the number of sessions, their schedule, and their duration, intensity or dose.	128	_____
	TAILORING		
9.	If the intervention was planned to be personalised, titrated or adapted, then describe what, why, when, and how.	N/A	_____
	MODIFICATIONS		
10.‡	If the intervention was modified during the course of the study, describe the changes (what, why, when, and how).	N/A	_____
	HOW WELL		
11.	Planned: If intervention adherence or fidelity was assessed, describe how and by whom, and if any strategies were used to maintain or improve fidelity, describe them.	131 and 132	_____
12.‡	Actual: If intervention adherence or fidelity was assessed, describe the extent to which the intervention was delivered as planned.	131 and 132	_____

** **Authors** - use N/A if an item is not applicable for the intervention being described. **Reviewers** – use '?' if information about the element is not reported/not sufficiently reported.

† If the information is not provided in the primary paper, give details of where this information is available. This may include locations such as a published protocol or other published papers (provide citation details) or a website (provide the URL).

‡ If completing the TIDieR checklist for a protocol, these items are not relevant to the protocol and cannot be described until the study is complete.

* We strongly recommend using this checklist in conjunction with the TIDieR guide (see *BMJ* 2014;348:g1687) which contains an explanation and elaboration for each item.
* The focus of TIDieR is on reporting details of the intervention elements (and where relevant, comparison elements) of a study. Other elements and methodological features of studies are covered by other reporting statements and checklists and have not been duplicated as part of the TIDieR checklist. When a **randomised trial** is being reported, the TIDieR checklist should be used in conjunction with the CONSORT statement (see www.consort-statement.org) as an extension of **Item 5 of the CONSORT 2010 Statement.** When a **clinical trial protocol** is being reported, the TIDieR checklist should be used in conjunction with the SPIRIT statement as an extension of **Item 11 of the SPIRIT 2013 Statement** (see www.spirit-statement.org). For alternate study designs, TIDieR can be used in conjunction with the appropriate checklist for that study design (see www.equator-network.org)

Appendix E: Publications

Submitted

Vasconcellos, D., Parker, P., Hilland, T., Cinelli, R., Owen, K., Kpsal, N., Ntoumanis, N., Ryan, R., Lonsdale, C., (submitted) Self-determination Theory Applied to Physical Education: A Systematic Review and Meta-Analysis. *Journal of Educational Psychology.*

Appendix F: Statement of Contribution of Others

Statement of Contribution for Study 1

Study 1 – Self-determination Theory Applied to Physical Education: A Systematic Review and Meta-Analysis.

I, Diego Vasconcellos, conducted this study and acknowledge that my contribution to the above study is 70%.

Signature: 

This study was done in collaboration with Professor Chris Lonsdale, Professor Philip D. Parker, Dr. Toni Hilland, Dr. Renata Cinelli, Dr. Katherine B. Owen, Nathanial Kapsal, Professor Nikos Ntoumanis, and Professor Richard M. Ryan. These collaborators have contributed their expertise to the above study and acknowledge their contributions range from 3 to 10 percent of the study.

Signatures:

Professor Chris Lonsdale 

Professor Philip D. Parker 

Dr. Toni Hilland 

Dr. Renata Cinelli 

Dr. Katherine B. Owen 

Nathanial Kapsal 

Professor Nikos Ntoumanis 

Professor Richard M. Ryan