Development and feasibility of a multi-component intervention to promote children's physical activity in schools

(SOKKA Schools)

Matthew Stuart Domville

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Abstract

Physical activity (PA) promotion and sedentary behaviour (SB) reduction in childhood are important as PA and SB are independently associated with individual and clustered cardiometabolic risk factors. Primary schools are a key setting for child PA promotion, yet even with the provision of PA opportunities and the supporting role of physical education (PE) co-ordinators, few school-based United Kingdom (UK) PA interventions have been effective. While various reasons for this exist, it is suggested that many-school based PA interventions skip the critical development and feasibility/piloting stages of multi-component intervention design. Consequently, the overarching aims of the thesis were to design, develop, implement and evaluate a multi-component primary school-based PA intervention.

Study one used interviews to explore the barriers and facilitators of children's school-based PA from the perspective of headteachers, PE-coordinators and a deputy headteacher. At an organisational level headteachers were the predominant driving force in the promotion of PA opportunities, yet institutional barriers including low priority for PA and PE were perceived to negate delivery. At an interpersonal level, strategies to increase the delivery of school-based PA were developed, however poor teacher-coach relationships and significant others reduced PA promotion opportunities. Child PA was further negated through intrapersonal factors, including lack of PE-specific teacher training and varying teacher interest in PA and sport. To increase primary school children's school-based PA, barriers and facilitators at the organisational, interpersonal and intrapersonal level must be considered and targeted, and researchers and schools should work in partnership to develop future interventions.

Study two used focus groups to investigate children's perceptions of factors that influence PE enjoyment, and interpreted findings in the context of self-determination theory (SDT) and the promotion of autonomous motivation. Factors reported to influence children's perceived PE enjoyment included 1) individual preferences, 2) peer behaviour, 3) instructor behaviour. PE instructors and peers are important in creating an environment that supports children's psychological needs for autonomy, competence and relatedness, which influence PE enjoyment. To consistently provide children with enjoyable PE lessons, primary schools are advised to support the ongoing development of generalist teachers and facilitate better working relationships between generalist teachers and specialist coaches. SDT can be used by instructors to guide practice that enhances children's enjoyment of PE.

Study three used school educator' experiences and perspectives to refine and justify a proposed multi-component primary school-based PA intervention. Focus group and interview data indicated that for the proposed and other health-based interventions, acceptance into schools and consideration of how to increase educator buy-in is essential. Further, for

educators to feel confident, comfortable and motivated to deliver the proposed intervention, it appears important to support school educators' understanding of the proposed intervention and its impact on pupil outcomes, reduce possible training fears, enhance delivery competence and confidence, and provide easy to implement resources and support frameworks that encourage sustainable delivery.

Study four assessed the acceptability and feasibility of a classroom-based SDT intervention to increase teacher's motivation orientation to facilitate PA throughout the school day. Findings indicated the four-week intervention was acceptable and feasible to deliver in the school environment. Teacher response and recruitment rates were high (100%) possibly to due to head teacher commitment to the intervention. For children however, recruit rates were low and attrition from participants was relatively high. Qualitative findings suggested that for children of all ages to engage in the resources, it is desirable for resources to be developed to support children's psychological needs (i.e. provide optimal challenge). Furthermore, there was evidence that the training increased teacher's intrinsic motivation to implement and deliver the resource. Larger trials are needed to evaluate the impact of classroom PA lessons on teacher and student outcomes.

The thesis highlights the importance of stakeholder buy-in from headteachers, teachers and pupils if school-based PA programs are to be successful. The results highlight the importance of targeting barriers to PA implementation at all levels of the socio-ecological model. Schools provide an important target setting to increase children's PA and staff, when appropriately trained, are able to facilitate the delivery of school-based PA. Training teachers in a need-supportive way and providing them with interpersonal strategies to increase children's PA motivation appears to be an important avenue for further investigation. The findings support evidence for developing interventions as guided by the MRC framework. This is important as this process not only calls for important formative work to take place before intervention implementation, but for researchers to work alongside school educators and pupils to ensure what is being designed is appropriate and fits within the needs of the schools.

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Finally, I dedicate this thesis to my darling sister Jenny. I hope I have made you proud!

Declaration

I declare the work contained in this thesis is entirely my own

Publications directly based on the work described in this thesis

Domville, Matthew S, Paula M Watson, Dave J Richardson, and Lee E F Graves. 2018. "Educator Perspectives on Factors Influencing Children's School-Based Physical Activity."*Health Promotion International*, 1–10. doi:10.1093/heapro/day041.

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Oral communications

Domville, Matthew S, Paula M Watson, Dave J Richardson, and Lee E F Graves. 'It's not what you teach it's the way that you teach it': A SDT approach of school PA and PE practices through the eyes of its students and reflections as a practitioner, Liverpool John Moores Faculty of Science Postgraduate Research Day, UK, 2016.

Domville, Matthew S, Paula M Watson, Dave J Richardson, and Lee E F Graves. Theory into practice: Using self-determination theory to enhance teacher motivation to increase children's in-class PA levels. Physical Activity Exchange Series, Liverpool, UK, 2017

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List of Abbreviations

Comprehensive School-Based Physical Activity Program (CSPAP)

Consolidated Criteria for Reporting Qualitative Research (COREQ)

Continued Professional Development (CPD)

Counts Per Minute (CPM)

Hours a Day ($h \cdot d^{-1}$)

Light Physical Activity (LPA)

Medical Research Council (MRC)

Minutes a Day ($Min \cdot d^{-1}$)

Moderate Physical Activity (MPA)

Moderate to Vigorous Physical Activity (MVPA)

Physical Activity (PA)

Sedentary Behaviour (SB)

Self-Determination Theory (SDT)

Socio-Ecological Model (SEM)

Template for Intervention Description and Replication (TiDieR)

Vigorous Physical Activity (VPA)

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1. Introduction

1.1 The Research Problem

Physical activity (PA) is defined as "any bodily movement produced by skeletal muscle that results in energy expenditure" (Caspersen et al. 1985, p126). PA promotion is vital, as physical inactivity is a leading cause of non-communicable diseases including cardiovascular diseases (e.g. heart attack and stroke), certain cancers and diabetes (World Health Organisation, (WHO) 2010; Strong et al. 2005). Higher levels of PA in children and adults are associated with fewer risk factors for disease (Andersen et al., 2006) and PA has been shown to track from childhood into adolescence and adulthood (Cleland et al., 2012). Childhood therefore appears a crucial time for the promotion of children's PA levels (United Kingdom (UK) Active 2015).

Current UK guidelines recommend children and young people aged 5-18 years engage in moderate-to-vigorous intensity PA (MVPA) for a minimum of 60 $min \cdot d^{-1}$ daily (Department of Health, (DH) 2011)**.** For children, MVPA corresponds to an energy expenditure between 4 and 7 times greater than the energy used at rest, referred to as 4-7 metabolic equivalents of task (METs; Janssen & LeBlanc 2010). Self-report and objective evidence suggest less than 22% of children across England and Europe achieve this MVPA guideline and accrue the associated health benefits (Health Survey England 2016). Many factors are believed to contribute to the low levels of habitual PA and energy expenditure in youth, including parental socio-economic status (Drenowatz et al., 2010), children's PA self-efficacy (Rhodes et al., 2017), parental safety concerns (Eyre et al., 2014; Trigwell et al., 2015) and advances in technology, which is also believed to promote sedentary screen-based activities (i.e. television (TV) viewing, video gaming) (LeBlanc et al., 2015).

In the UK, children and young people are recommended to minimise the amount of time spent sedentary (sitting) for extended periods (Department of Health, 2011). Canadian 24-hour guidelines suggest that children and youth should reduce overall sedentary time and limit screen time to $\leq 2h \cdot d^{-1}$ (Tremblay et al., 2016, 2017). Sedentary behaviour (SB) has been defined as "any waking behaviour characterised by an energy expenditure ≤1.5 METs while in a sitting reclining or lying posture" (Tremblay et al., 2017). Increasing evidence suggests that irrespective of PA levels, increased SB in childhood is associated with the development of risk factors for cardiometabolic diseases, and, depression, anxiety and low self-esteem

(Katzmarzyk et al., 2009; Owen et al., 2009; Tremblay et al., 2011b). Accordingly, approaches to increase PA and reduce SB in children appear vital to improve current and future health.

1.2 The Target Setting

Over the past two decades there has been an increased interest in, and application of ecological models of health behaviour to understand factors influencing PA and SB (Sallis et al., 2006). At their core, ecological models provide a framework for understanding factors that influence behaviour (Sallis et al., 2008) and posit that multiple and interacting factors at multiple levels, influence PA and SB (Bauman et al., 2012) (Figure 1-1). Individual or intrapersonal factors are internal to the self and include psychological (beliefs, motivations) and biological (age, gender) influencers. Interpersonal or social factors include social support, cultural norms and practices, while environmental factors are related to the built, natural and social environment. Policy factors are related to the governing and influence of policy on behaviour at a local and nationwide level. Ecological models assume that all levels can inform the development of settings-based multi-component interventions, offering the best chance of behaviour change success (Sallis et al., 2008). As such, it is important to understand how the combination and interaction of factors may influence PA and SB.

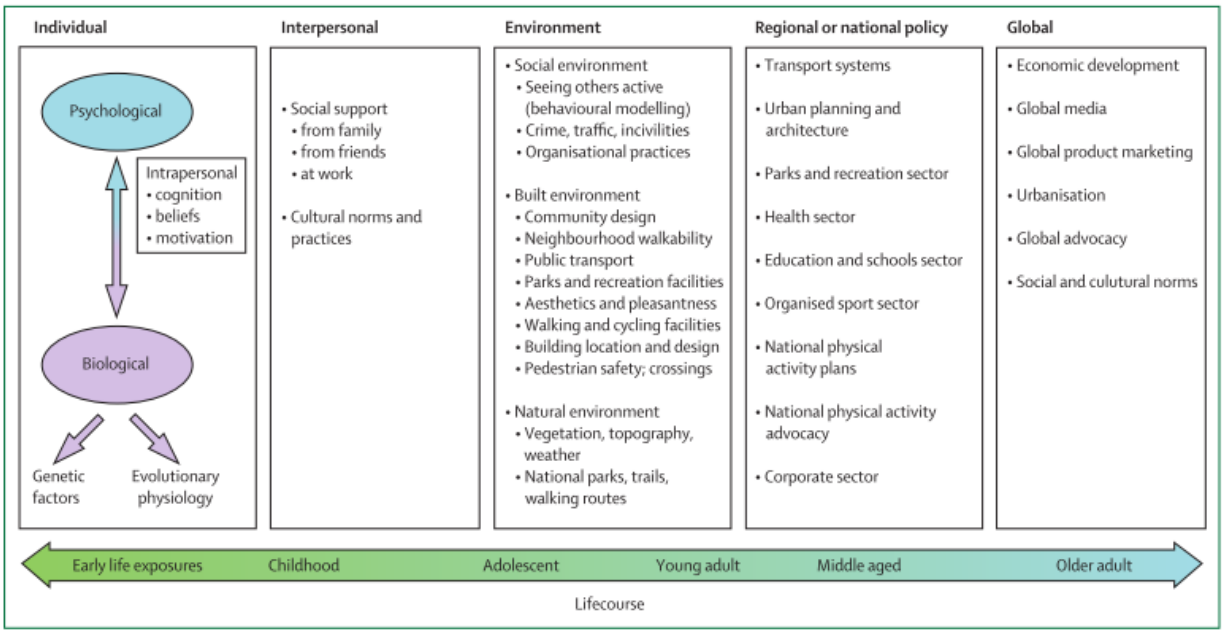

Figure 1-1: Ecological model of factors affecting PA (taken from Bauman et al. 2012, p.259).

Primary schools are believed to be a key setting to promote PA in children (Bush et al., 2011; Kriemler et al., 2011) as all levels of the ecological model can be influenced from within schools. This is supported by qualitative inquiry from school stakeholders who recognise schools as a key influencer for improving heath behaviours (Christian et al., 2015; Todd et al., 2015). Moreover, the application of ecological models to school environments is particularly well suited, considering PA is often undertaken in specific places (e.g. the playground, classroom) and therefore understanding how these environments and the people within them (i.e. teachers, peers) influence PA and SB is a research priority (Sallis et al., 2006).

Factors thought to influence children's school-based PA and SB include children's enjoyment and motivation for PA (Sebire et al. 2013; Eather et al. 2013), social support from peers and teachers (Cox et al., 2009; Eather et al., 2013b), school policy and rules (Langille and Rodgers, 2010) and teachers' confidence and competence to implement and deliver PA practices during the school day (Morgan and Bourke, 2005; Webster, 2011; Goh et al., 2017). Interventions designed and implemented within the school-based setting that have only targeted a single level of the socio-ecological model (SEM) have had mixed success (Metcalf et al. 2012). A major limitation thought to negate the success of school-based interventions is the limited formative research carried out prior to intervention development and implementation (Mackintosh et al., 2011). Furthermore, school educators and pupils are rarely involved in the development phase of interventions, thus jeopardizing perceived intervention ownership, and actual intervention implementation, sustainability and effectiveness (Cole and Horacek, 2009; Christian et al., 2015; Naylor et al., 2015). Accordingly, stakeholder engagement in future research appears critical to identify and understand the current multi-level factors influencing children's school-based PA and SB, and, to subsequently co-develop, implement and evaluate school-based PA and SB interventions.

1.3 Thesis Aims and Objectives

The focus of this PhD was to develop, implement and evaluate a school-based intervention to increase children's PA and reduce their SB. The PhD was completed in collaboration with a private company called SOKKA Circus Ltd (match funder), with the PhD candidate employed as a researcher-practitioner. From a research perspective, this PhD broadly aimed to generate new knowledge for policy makers and researchers to enhance the development and effectiveness of children's school-based PA and SB interventions. From a practitioner perspective, this thesis broadly aimed to inform and develop SOKKA's school-based PA solutions into a viable and sustainable commercial offer. The specific aims and objectives of the four empirical studies in this thesis are described below.

Study one:

Aim: To explore educator perspectives of factors that influence children's school-based PA in primary schools in highly deprived areas in the North West of England.

Objective: Engage headteachers, PE-coordinators and a deputy headteacher in interviews to identify influential factors on children's school-based PA.

Study two:

Aim: To investigate children's perceptions of factors that influence PE enjoyment, and interpret findings in the context of SDT and the promotion of autonomous motivation.

Objectives:

a) Explore through focus groups factors that influence children's enjoyment of PE.
b) Explore the extent to which children's own perceptions aligned with current SDT literature and to gather insights from children themselves to inform future delivery of intervention components.

Study three:

Aim: To use school educator' experiences and perspectives to refine and justify a multi-component SDT-based PA intervention for primary schools, prior to pilot testing.

Objectives:

a) Gather headteacher, deputy headteacher, PE-coordinator and generalist teacher's experiences and perspectives through focus groups.
b) Use identified weaknesses in, and refinements for the proposed intervention to refine and justify the intervention.

Study four:

Aim 1: Assess the acceptability and feasibility of novel school-based PA pilot project to increase teacher's motivation-orientation to support the delivery of PA throughout the school day.

Objectives:

a) Assess response, recruitment and attrition rates, completion rates for all outcome measures.
b) Assess the acceptability of the intervention from teacher and pupil perspectives, including any adverse effects such as injuries and disruption to school practices.

Aim 2: Derive preliminary estimates of the effects of the intervention on teacher and pupil outcomes.

Objective: a) Collect pre-post data on teacher and pupil outcomes and compare intervention effects between an intervention and control group.

1.4 Organisation of the Thesis

In accordance with the aims and objectives of the thesis, **Chapter 2** provides personal reflections to "set the scene" as a researcher-practitioner, and, describes SOKKA and the school-based PA offer they provided at the start of the project (September 2014). Reflections are provided from formative work completed before the primary research studies. **Chapter 3** is a literature review that focuses on the importance of PA and SB for child health, the role of schools in promoting children's PA and reducing their SB, the multi-level factors influencing children's school-based PA and SB, and the effectiveness and sustainability of school-based PA and SB interventions. SDT is introduced as the behaviour change theory underpinning the thesis, with focus on SDT-based interventions and influences on PA motivations. The review concludes with a discussion of the Medical Research Council (MRC) framework and how it supports the development of the thesis and methodological approach used. **Chapter 4, 5, 6** and **7** report the primary research studies conducted. **Chapter 8** synthesises the study findings and key thesis themes and provides recommendations and implications for researchers and practitioners regarding the design, delivery and implementation of future school-based PA and SB interventions.

2. Personal reflections

2.1 My role as a research practitioner

2.1.1 The Purpose

The purpose of this part of the thesis is to inform the reader about my experiences working for SOKKA (www.sokka.co.uk), helping to inform the early development of a school-based PA intervention. In my reflections I will specifically talk about my time delivering the SOKKA schools programme as well as some of the challenges and barriers myself, as well as the company faced when delivering in a school-based setting. My aim in writing this reflective piece is to help the reader develop a clearer understanding of SOKKA, as well as the importance of developing an intervention that is built on the needs of the school and informed by formative research.

2.1.2 The Beginning

From September 2014 to September 2017, I was employed by LJMU and SOKKA on a joint funded scholarship to design a novel school-based PA intervention targeting the primary school population. To gain a greater understanding of the psycho-social and cultural nature of school PA policies and practices I entered schools as an employee of SOKKA. SOKKA was a novel PA experience whereby children could practice their football specific skills in a timely manner (45 seconds (s) of game play). The SOKKA intervention included the delivery of 6 games to 180 children during a typical school day, providing each child with 6 x 45s of activity (4minutes, 30 seconds) per session. Due to the number of children in the class, class sizes consisting of approximately 30 children and lasted an hour. The SOKKA-schools programme also included and 12-week educational package designed and developed by myself. The aim of the package was to educate children and teachers on the importance of PA and nutrition for health and provide a platform for children to enter their SOKKA scores from the games. Aptly named SOKKA-net (nutrition and exercise training), the package was designed to be completed between the time SOKKA first entered the school and when they returned, approximately three months later. Below are my personal reflections of my experiences delivering the SOKKA-schools programme. The reflections were principally used to guide my personal development, and the development of the SOKKA-school intervention. I used the reflection time to ask questions of myself, questions of the product and programme we were offering, as well as

questions related to the school's culture and its educators' perceptions of PA to try to understand how as a company we could increase the provision/support of school-based PA. After reviewing my reflections, I ordered them into reoccurring themes. One quote is presented for each theme which best reflected my feelings throughout this formative process. Themes included a) teacher behaviours, b) intervention worries and c) PA barriers

2.1.3 Personal reflections

Teacher involvement

"I'm feeling disheartened with what I've seen so far [in schools], not with the children, but the teachers. I observe the children and they seem to have more fun when the teachers get involved with the games. Yet for most of the sessions, teachers are uninterested…teacher interest and enjoyment in PA seems to have a giant effect on the PA behaviours of the children. Children whose teachers showed little interest were completely the opposite; irritable, uninterested and badly behaved. There seems to be a correlation occurring between the kids who participate and the children who struggle to. Is the correlation the teacher's attitudes towards PA?" - Reflection date 10/2/15 (One month into PhD)

Competence worries

"I Just got back from my school meeting with the PE-coordinator to talk about when SOKKA can come to the school to deliver the schools intervention. It's a daunting place going back to primary school. Anna is very inquisitive and like most teachers wants to know how the SOKKA is going to impact school physical activity levels…I sometimes feel like a fraud when I can't answer all the questions people have, I sometimes feel a distance between what I know and what I should know. I feel that we've just jumped straight in the deep end. I know that this phase of the project is to find out more, but I don't even know. The whole process is really unsettling for me…even I don't know what the intervention is…is it even an intervention? My job for now is to help SOKKA as much as I can, to develop an intervention that is valid, reliable and measurable" - Reflection date 16/1/16 (Four months into PhD)

PA Barriers

"The lack of time in primary schools have to incorporate the SOKKA-net really seems to be a problem. Of the teachers who have tried it, they say it's too time consuming. This obviously leaves me with questions; is this the lack of time on the teachers' part, or the fact they are teaching a new programme of work (lifestyle and nutrition) that they know nothing about? Is teacher training the way forward?!...The question is, will a teacher training programme actually help develop a teacher's ability to engage better with their children?" - Reflection date 28/2/16 (Three months into PhD)

From my experiences working in the primary school environment, it was evident that barriers related to time were a constant negating factor toward the delivery of school-based PA. Many teachers were uninterested and uninvolved with the programme. I felt isolated. I was looking for answers constantly, answers that I would soon realise do not arise overnight. I was constantly fraught with feelings that the intervention was not what the teachers wanted or expected and this left me feeling unsure about what my role was within the company, within the university and within myself. The nature of my PhD expected that I split my time between SOKKA and my research. My final reflection speaks again of my insecurities about the intervention as well as insecurities about my role and position in the company and how long they could wait as a commercial business until I finally have some answers for them.

"At SOKKA we are still trying to discover what our outcomes of the intervention are. In other words, what does SOKKA actually do; does it increase the children's physical activity levels? Does it increase the children's efficacy to exercise? Does it increase the children's knowledge of health behaviours? I only hope this will become clearer as my research progresses and my knowledge grows, not only for my sake, but for the sake of the company" - Reflection date 18/4/16 (Seven months into PhD)

3. Literature review

3.1 - PA, SB and Health

3.1.1 - Adults

In adults, a dose-response relationship exists between PA and the risk of all-cause mortality (Hupin et al. 2015; Warburton et al. 2010; Löllgen et al. 2009). Further, PA in adulthood has been shown to favourably reduce anxiety and depression, improve cognition and well-being (Mang 'eni Ojiambo, 2013; McKercher et al., 2014; Rebar et al., 2015) and lower the risk of health outcomes including cardiovascular disease, metabolic syndrome, type 2 diabetes and some cancers (Wen et al. 2011; Arem et al. 2015; Lee et al. 2014; Warburton et al. 2010). Seminal and recent evidence also suggests that even relatively small changes in PA levels, from inactive to low-to-moderately active, elicits the greatest reduction in health risks (Paffenbarger et al. 1986; Kesaniemi et al. 2010; Hupin et al. 2015; Warburton et al. 2010). Time spent sedentary is also believed to be detrimental to health (Owen et al., 2009) independent of MVPA (Healy et al., 2011). For example, higher levels of TV-viewing is associated with less favourable cardiometabolic health markers including obesity (Dunstan et al., 2005, 2007) and total sedentary time is detrimentally associated with waist circumference, triglycerides, 2h plasma glucose (Healy et al., 2007, 2008, 2011) and insulin levels (Ekelund et al. 2007; Balkau et al. 2008; Healy et al. 2011). Considering disease risk factors develop in youth (McGill et al., 2000) strategies are needed to promote PA, SB, health and well-being from a young age.

3.1.2 – Children and Adolescents (Physical Health)

For children and youth (age 5-17 years), strong reliable evidence supports negative relationships between total PA and several cardiometabolic biomarkers including body fat percentage, cholesterol, blood pressure, triglycerides, insulin resistance and fasting insulin, fasting glucose and cardiometabolic risk scores (Väistö et al., 2014; Poitras et al., 2016; Saunders et al., 2016). Further, evidence suggests higher PA levels at any intensity i.e. light physical activity (LPA), Moderate physical activity (MPA) vigorous physical activity (VPA) is associated with more favourable health outcomes, with larger benefits seen for higher intensities that are linked to reduced clustered cardiovascular disease risk scores (Poitras et al., 2016). Considering that cardiorespiratory fitness and adiposity are significantly associated with individual and clustered cardiometabolic risk, with adiposity meditating the relationship between cardiorespiratory fitness and risk (Bailey, Savory, Denton, & Kerr, 2015; Ekelund et

al., 2007; Jago et al., 2013) researchers propose a shift in movement behaviours from inactive (i.e. SB) to MVPA.

Objectively measured time spent sedentary has been associated with individual and clustered metabolic risk in children (Ekelund et al., 2007a; Väistö et al., 2014). Further, higher durations of TV viewing (>2h·d), a proxy measure of SB, are significantly associated with higher clustered cardiometabolic risk scores, body composition and reduced fitness irrespective of study design in children and youth aged 5-17 years (Carson, Hunter, Kuzik, Gray, et al. 2016). Evidence suggests favourable changes to children's cardiometabolic risk profile could be achieved when sedentary time is replaced by LPA (Kotz and Levine, 2005; Poitras et al., 2016). Accordingly, given the health benefits of LPA are often overlooked compared to MVPA (Katzmarzyk, 2010; Collings et al., 2017), current evidence suggests supporting children and young people to participate in PA of all intensities, as well as reducing SB, is important for slowing the development of non-communicable diseases that typically manifest in later life.

3.1.3 - Children and Adolescents (Mental and Social Health)

Higher levels of total PA are associated with reduced symptoms of depression in school-aged children and youth (age 5-17 years) irrespective of gender (Poitras et al., 2016). Furthermore, in youth aged 10-16 years, higher levels of school-based and leisure time PA and lower levels of screen-time are associated with lower depressive symptoms and levels of anxiety (Kremer et al., 2014; McMahon et al., 2017). The negative impact of screen time is also associated with a reverse causality hypothesis, whereby those with poorer mental health choose to be more sedentary and may therefore have a lower quality of life (Biddle and Asare, 2011; Tremblay et al., 2011b). This is supported by Carson et al. (2016) and Tremblay et al. (2011) who found higher durations of TV viewing/screen time to be negatively associated with emotional and social health indicators including self-esteem, behavioural conduct and pro-social behaviour in children and adolescents.

In a sample of 10-11 years old's, PA was a positively associated with social acceptance, while peer problems in boys were negatively associated with accelerometer-derived measures of

total PA and MVPA, but not among girls (Sebire et al., 2011). Similar negative relationships between peer problems and objectively measured PA have been reported previously with girls (Brodersen et al., 2005). Studies that have investigated the impact of PA on self-esteem suggest that total PA increases self-esteem in children and adolescents (Biddle & Asare 2011; Liu et al. 2015; Lubans et al. 2016; Ahn & Fedewa 2011). While there is limited evidence for a PA intensity effect on self-esteem (Poitras et al., 2016), higher durations of screen time and computer use are significantly associated with lower self-esteem in children and youth aged 5-17 years. These collective findings support the promotion of PA and reduction of sedentary time in school-aged children and youth for improving mental and social health (Tremblay et al., 2011b; Carson et al., 2016).

3.1.4 – Children and Adolescents (Academic Outcomes)

The most consistent notion when assessing the effects of PA on academic performance is that PA does not negatively affect children's academic development (Resaland et al., 2016). Review articles that have assessed the effects of total PA and PA by intensity on children and youths academic performance and cognition generally support favourable relations for total PA, however effects by intensity were limited (Poitras et al., 2016). While cardiorespiratory fitness alone is believed to have positive effects on academic performance (Srikanth et al., 2015), clustered physical fitness scores (i.e. cardiorespiratory fitness, flexibility and muscular strength) are related to longer term academic performance and cognitive function (Donnelly et al., 2016; Santana et al., 2017) suggesting improved physical fitness leads to increased academic performance over time.

Increased sedentary time and especially screen time has been negatively associated with academic performance and cognitive functions (Syväoja et al., 2014). Longitudinal and cross-sectional studies suggest that higher volumes of TV viewing (>2h·d) are significantly associated with lower academic performance (Tremblay et al. 2011; Carson, Hunter, Kuzik, Gray, Poitras, et al. 2016), and while there are inconsistencies related to video game and computer use for academic attainment (Carson, Hunter, Kuzik, Casey, Gray, Poitras, et al. 2016), a dose-response relationship suggests computer and video game time >3h·d^{-1} was associated with poorer school performance and lower intelligence quotient scores (Tremblay et al., 2011b). Sedentary

time used for completing homework and/or reading is however positively associated with academic performance (Carson, Hunter, Kuzik, Gray, et al. 2016), therefore the type of SB appears important in the relationship with academic performance and mental health outcomes.

3.2 – PA and SB Guidelines for Children

UK children and youth aged 5 to 18 years are recommended to engage in at least 60 min·d^{-1} of MVPA daily, VPA and activities that strengthen muscle and bone on at least 3 days a week, and, minimise time spent sedentary (sitting) for extended periods (Department of Health, 2011). These recommendations are similar to those for Canadian (5-17 years) (Tremblay et al. 2016) and Australian (ages 5-18 years) youth (Okely et al., 2012), however Canadian and Australian guidelines place more emphasis on SB reduction, with children and youth recommended to limit the use of electric media (TV, video gaming and computers) to no more than 2h·d^{-1} of recreational screen time. Previous recommendations for Canadians also suggested limiting motorised transport and time spent indoors (Tremblay et al., 2011a). The Canadian guidelines recently shifted to a "whole day matters" approach and consequently introduced a 24-hour guideline (Tremblay et al., 2016). Added to the recommendations in the UK and Australian guidelines, Canadian 24-hour movement guidelines suggest that children between the ages of 5-13 years achieve 9-11 hours of uninterrupted sleep per night, while adolescents aged 14-17 years have uninterrupted 8-10 hours sleep per night with consistent bed and wake up times (Tremblay et al., 2016). Finally, Canadian guidelines also suggest children and youth engage in several hours of structured and unstructured LPA daily, which reiterates the importance of LPA for improvements in children's health.

3.3 - PA and SB Patterns and Prevalence

Early work conducted into the habitual nature of children's PA found that children's movement is largely intermittent, with sporadic and spontaneous changes between SB, LPA and MVPA (Bailey et al., 1995; Berman et al., 1998; Baquet et al., 2007). Evidence also suggests that up to 96% of children's activity bouts occur at high intensity for short durations, lasting approximately 10s or less, with the majority of bouts lasting between 3s and 22s (Berman et al., 1998; Baquet et al., 2007). As children tend to accumulate PA in short bursts throughout

the day (Welk et al., 2000), when measuring children's habitual PA, high (5 to 10s) rather than low frequency (60s) accelerometery monitoring is recommended to reduce the variability reported in MVPA (Rowlands and Eston, 2007).

Regarding children's and adolescents' PA and MVPA, levels appear higher on weekdays than at weekends (Riddoch et al., 2007; Nader et al., 2008; Brooke et al., 2014; Fairclough et al., 2015; Bürgi and de Bruin, 2016). Differences in weekday and weekend bouts have largely been attributed to increased intensity and frequency of bouts on weekdays (Rowlands et al., 2008; Fairclough et al., 2015). For example, Fairclough et al. (2015) found significant variations in children's weekday and weekend MVPA and SB, showing that all children (apart from the most active children) were more active and less sedentary on weekdays than at weekends. During weekdays, boys MVPA varied between 53.4 $min \cdot d^{-1}$ (least active) to 85.2$min \cdot d^{-1}$ (most active) while girls MVPA was lower between 41.1$min \cdot d^{-1}$ (least active) to 65.8$min \cdot d^{-1}$ (most active). During weekends however, boys MVPA was between 31.4$min \cdot d^{-1}$ (least active) to 55.6$min \cdot d^{-1}$ (most active) with girls MVPA still lower between 26.7$min \cdot d^{-1}$ (least active) to 49.6$min \cdot d^{-1}$ (most active). In agreement with this study, Beck et al. (2016) reported that children of both low and high socio-economic schools participated in significantly less SB during school hours compared to outside of school and on weekdays compared to weekends, with girls being significantly more sedentary than boys during weekdays. These results align with previous research demonstrating that children (age 9-10 years) are more active and less sedentary on weekdays, irrespective of age or gender (Steele et al., 2010).

While these results appear to suggest the weekend as an important time to target children's SB and PA levels, evidence still suggests that high proportions of children fail to meet government recommendations of accruing 30 $min \cdot d^{-1}$ MVPA during school time (Steele et al., 2010; Hubbard et al., 2016). For example, in a sample of 453 children, while only 15% met current MVPA guidelines, only 8% achieved 30 $min \cdot d^{-1}$ MVPA during school time. The greatest disparity was between boys and girls, with girls being far less likely than boys to meet both guidelines, evidencing only 8% and 2% meeting total daily and school time recommendations respectively (Hubbard et al., 2016). Furthermore, self-report and accelerometery-based research indicates that while sedentary time is greater in adolescence than in childhood

(Ekelund et al., 2007; Van Sluijs et al., 2008; Mitchell et al., 2013; Harding et al., 2015) sedentary time begins to increase for both boys and girls from mid-childhood (age 7+ years) (Basterfield et al., 2011) with greater increases in sedentary time for girls across all age groups (Cooper et al., 2015). This evidences the importance of early intervention, targeting children from a young age to reduce their SB and increase PA behaviours that are known to track into adolescence and adulthood (Telama, 2009; Cleland et al., 2012),

During school days, PE is the only curriculum subject to provide MVPA to all children (Fairclough & Stratton, 2005) and has been shown to significantly improve student's school day MVPA when compared to non-PE days (Yli-Piipari et al., 2016). In line with this, Bassett et al (2013) showed that daily mandatory PE contributed to 29 $min \cdot d^{-1}$ of daily MVPA, whereas classroom activity breaks contributed 19 $min \cdot d^{-1}$ and modified recess 5 $min \cdot d^{-1}$ MVPA. In the UK curriculum PE is only mandatory for 2 hours a week, therefore a combination of PE and other school day physical activities appear necessary to promote child MVPA and ensure children receive the recommended health enhancing levels (Yli-Piipari et al., 2016). Therefore, promotion of PA and MVPA during school time, as well as in leisure, appears important for promoting children's current and future health.

UK self-report data has shown only 23% of boys and 20% of girls in England aged 5-15 years meet the government recommended MVPA guideline of 60 minutes daily (Health Survey for England, 2016). Objective measurement of PA however suggest that the percentage of children meeting these PA guidelines are much lower (Riddoch et al., 2007). Biased reporting is particularly likely from children and their parents participating in behaviour change interventions, where they may favourably report on their child's lifestyle (Caballero et al., 2003). Therefore, while objective monitoring can prevent bias-reporting, accelerometers and the cut points used by researchers have had a tendency to over report or under report children's PA levels (Cooper et al., 2015), due to variation in criteria used to assess MVPA.
Researchers have developed numerous cut-points to define MVPA and SB thresholds which differ between 1000 and 3200 counts per minute (CPM) (Puyau et al., 2002; Trost et al., 2002), and 100 to 800 CPM respectively (Puyau et al., 2002; Treuth et al., 2004). This range of thresholds has led to discrepancies in the number of children and adolescents classified as

sufficiently active or the time spent in SB. For example, in a review of European studies where ActiGraph accelerometers were used, Guinhouya et al. (2013) reported 3-5% of children met PA guidelines using thresholds of >3000CPM, and up 87% met guidelines when >2000CPM were used. Accordingly, there is a distinct need for accurate measurement methods (or an agreed set of cut points among researchers) which may reduce variability when converting ActiGraph accelerometer counts into PA outcomes (e.g. time spent in MVPA) (Crouter et al., 2015).

3.4 – Influences on Children's PA and SB

3.4.1 Socio-Ecological Models

A socio-ecological approach suggests that no single factor can explain individual behaviour, but various factors interlink and influence each other at different levels (Sallis et al., 2008). Research proposes that human behaviour is not only driven by intrapersonal biological (i.e. genetics) and psychological factors (i.e. knowledge, attitudes and beliefs), but by external stimuli at the social/interpersonal (i.e. social support and social norms), physical (i.e. structures and facilities) and organisational level (i.e. within school rules and policies) (Morton et al., 2016). Accordingly, environments can impede behaviours by endorsing or demanding certain actions or by discouraging or prohibiting others.

3.4.2 - Correlates and Determinants of Children's Habitual PA and SB

Socio-demographics factors including socio-economic levels, ethnicity, gender and age are strongly related to SB (LeBlanc et al., 2015) and PA in children and youth (Bloemen et al., 2015). The impact of low SES, gender and ethnicity on PA and SB levels is believed to be largely established by the age of 11-12 years signifying that early intervention and introduction to the importance of PA is critical for these populations (Brodersen et al., 2007). Consistent with previous research (Temmel and Rhodes, 2013) boys are shown to engage in more screen time and are less likely to meet screen time guidelines than girls, while girls accumulate more SB than boys (LeBlanc et al., 2015). Negative associations with TV viewing are also related to ethnicity, SES, parental education and depression among children and youth (ages 4-12 years) (Van Der Horst 2007). Furthermore, low PA levels and increased screen time in children and

youth from low SES areas may possibly relate to restricted opportunities for PA due to factors related to parental income and cost of PA (O'Donoghue et al., 2018).

Concerning psychological, cognitive and emotional factors, for children, enjoyment, self-efficacy and motivation remain consistent positive correlates of PA (Sallis et al., 2000; Bauman et al., 2012; Rhodes et al., 2017). Furthermore, enjoyment is believed to influence children's self-reported ability to engage in regular habitual PA through higher self-efficacy ratings (Lewis et al., 2016). From longitudinal studies, evidence suggests that 10-13 year old's with greater self-efficacy for PA show smaller declines in activity across adolescence, while greater-self efficacy, support for PA and behavioural control are important for 14-18 year old's continuation in PA pursuits (Craggs et al., 2011). Childhood therefore appears to be a crucial time for promoting positive attitudes and beliefs towards, and levels of, PA (UK Active, 2015).

Social support is also important for children's PA motivation and enjoyment. For example, at an intrapersonal level, parental and teacher support and modelling of PA behaviours are highly correlated to children's PA levels through the development of social norms within the family (Gustafson & Rhodes 2006; Yao & Rhodes 2015) and at school (Cox and Williams, 2008). Conversely, parents can also significantly increase children's SB through family TV viewing habits (Van der Horst 2007). Parental support for PA is believed to be greater among children of higher SES parents (Stenhammar et al., 2007; Beets et al., 2010), possibly due to fewer financial constraints (Rees et al., 2006) and greater understanding of the importance of PA for health (Xu et al., 2015). Parents can however be a barrier to children's PA due to job commitments, limited time and energy for activity, cost of PA and preference for transport that reduces active communing (Hesketh et al., 2017). Thus, while positive modelling behaviours can create opportunities for children to be involved in health-enhancing PA, focus should be directed to those children from low SES areas who may not have the same opportunities to engage in PA as their peers from more affluent areas. Schools are a useful setting for achieving this as children of all SES can be reached.

As children mature into adolescents, PA and SB behaviours are influenced more by peers than parents, evidencing the import role peers have on influencing children's habitual PA levels (Yao

and Rhodes, 2015), as well as the negative role peers can have on SB such as TV viewing (Edwards et al., 2015). The amount of TV children watch and therefore SB they engage in can also increase due to environmental factors inside the home including TV's in bedrooms, number of electronic devices in the home and/or limited space to be physically active at home (Temmel and Rhodes, 2013; Lou, 2014). External environmental factors outside the home including walkability, traffic volume and speed, residential density and limited access to recreational facilities (Ding et al., 2011) can also affect children's engagement in PA. Children who actively transport to school evidence increased habitual PA than those who do not (Pereira et al., 2017), however barriers including parental safety concerns and weather can limit participation in this (Van Der Horst et al., 2007; Hesketh et al., 2017). Various factors negate and facilitate children's SB and PA participation and therefore understanding the target setting where interventions are to be implemented and the factors that facilitate or negate delivery of PA is crucial.

3.4.3 - The School as a Key Target Setting

Schools are a key target setting for promoting PA and reducing SB in children (Huberty et al., 2012). With the exception of their homes, children and youth spend more time at school than any other setting (Pate et al. 2006). Schools can reach a large number of children from diverse socio-economic backgrounds (Fox et al., 2004; Langford et al., 2015) and therefore provide an important setting to increase the quality and quantity of health and well-being messages delivered to children and their families (Naylor and McKay, 2008; Department of Health, 2011). Furthermore, when appropriately trained, teachers can deliver health-behaviour interventions, enforce healthy lifestyle policies, and serve as influential role models to pupils (Wechsler et al., 2000).

Previous qualitative research with school stakeholders has identified the school setting as an ideal environment to increase health-related outcomes (Christian et al., 2015; Todd et al., 2015). The identification of schools as a health promotion setting has resultantly seen an increase in targeted interventions at increasing PA and reducing SB (Kriemler et al., 2011; Lonsdale et al., 2013; Russ et al., 2015; Mears and Jago, 2016). A general criticism directed toward many school-based interventions however is the lack of consideration given to the

wider school environment during the initial design and development of school-based behaviour change interventions (Doak et al., 2006). Taking an ecological perspective however directs attention to the wider political and environmental factors in schools that influence intrapersonal and interpersonal characteristics (Sallis et al., 2006; Langille and Rodgers, 2010). Accordingly, it appears essential that schools support, provide and promote PA and reduce SB across the school day to improve child health.

3.4.4 – Barriers and Facilitators to School-Based PA and SB

Barriers to PA delivery in schools often include factors related to policy as well as organisational, interpersonal and intrapersonal factors. Public policy can simultaneously and independently impact the amount of PA opportunities children receive (Langille and Rodgers, 2010; Lounsbery et al., 2013). While policy at any level (i.e. government policies; school policies) may impact children's SB and PA levels, this does not necessarily mean that the policy will be correctly implemented (Lounsbery et al., 2013). Headteachers are believed to play a key facilitative role in supporting the implementation of polices and interventions (Gorely et al., 2009; Langille and Rodgers, 2010; Holt et al., 2013; Christian et al., 2015; Hatfield and Chomitz, 2015). Conversely, headteachers also report difficulty implementing PA interventions and polices for pupils (Brown and Elliott 2015; Stone et al. 2012) due to factors relating to accountability for pupils academic attainment which creates tensions around policy decisions and resource allocations (Langille and Rodgers, 2010). Organisational buy in to interventions is therefore thought to differ depending on headteacher and teacher attitudes and beliefs, as well as the perceived needs of the individuals (i.e. pupils) and schools (Stolp et al., 2014; Christian et al., 2015).

Qualitative and quantitative investigations suggest organisational barriers include time constraints (Naylor et al., 2006, 2015; Brown and Elliott, 2015; Goh et al., 2017) insufficient space (Bauer et al., 2006; Eather et al., 2013a; Lounsbery et al., 2013; McMullen et al., 2014; Naylor et al., 2015) and a lack of PA promoting resources (Hyndman, Telford, Finch, et al. 2012; Robbins et al. 2010). While time constraints are frequently reported as the biggest organisational barrier to PA implementation in schools (Naylor et al., 2015), time constraints are often inextricably linked to academic pressures, and several studies have reported

academic pressures and competing curriculum demands to be the principle barrier to school PA delivery (including PE) (Huberty et al., 2012; Morgan & Hansen, 2008; Patti-Jean Naylor et al., 2015). Thus, organisational priorities must be taken into consideration when designing school-based interventions.

The level of support children receive from school educators (i.e. teachers and headteachers) can facilitate and/or negate children's motivation for PA and PE (Cox and Williams, 2008; Huberty et al., 2012) and consequently impact PA levels. Motivation is a key tenant in the development of physical literacy which is associated with with a wide array of behavioural, psychological, social and physical variables (Edwards, Bryant, Keegan, Morgan, & Jones, 2017). Physical literacy includes four elements; 1) confidence, physical competence, motivation and knowledge and understanding (Whitehead, 2010). Most of the research that has been conducted in the area of physical literacy has involved children aged 12 and under as they are readily accessible in the school environment (Edwards et al., 2018) Despite this however, in a recent systematic review conducted by Edwards (2018), the authors stated that the measurement of physical literacy and its related constructs is difficult to quantify given the various and complex integrated phenomena. Accordingly, while a mixed-methods approach, using both qualitative and quantitative methods to assess physical literacy was suggested, fundamentally, the authors stated that practitioners should first concentrate on using high quality pedagogies which reflect the definition, before assessing the outcomes. Expanding on this applying high quality pedagogy to foster physical literacy has suggested that practitioners (i.e., teachers) should consider the creation of a caring climate (Fry and Gano-Overway, 2010) an empowering climate (Milton et al., 2018) and a motivational atmosphere (Keegan et al., 2010).

Cross-sectional, longitudinal and qualitative studies suggest that teacher and peer interactions in PE (Cox et al., 2009; Lewis, 2014; Koekoek and Knoppers, 2015a) as well as perceived competence, especially in girls (Cairney et al., 2012; Lewis, 2014) are important predictors or influencers of perceived PE enjoyment. Accordingly, from a physical literacy perspective, the role of the teacher should be one of support, where children can develop the fundamental skills and competencies to interact with their environment in a positive and enjoyable way,

promoting sustained engagement and PA throughout the life-course (Edwards et al., 2017). Higher PE enjoyment is associated with greater intrinsic motivation, desire to continue PE participation, and enjoyment of PA out of school and into adolescence (Coulter and Woods, 2011; Cairney et al., 2012; Leptokaridou et al., 2015). Few studies however have addressed children's perceptions and views of teacher behaviours as influencers to PE enjoyment. This however is very important as teachers are central to the facilitation of PA practices in schools (Russ et al., 2015) and can serve as important role models for children and youth (Langille and Rodgers, 2010). Previous research has found that engagement of school staff in PA can positively impact pupils PA levels (Dinkel et al., 2014) and enjoyment of PA, which as perceived by children, is a key facilitator of their engagement in school-based PA (Hyndman, Telford, Finch, et al. 2012).

Arguably the most important factor that determines a teacher's motivation to deliver school PA practices, including PE, is the training they receive during their pre-service education (Xiang, Lowy and McBride, 2002; Webster, 2011). Teachers report receiving only partial training before entering the profession (Harris, Cale, & Musson, 2012) and limited continual professional development (CPD) on the job (Armour et al., 2015). Consequently, there is a clear need for more CPD training that not only helps teachers increase their competence and confidence to deliver school PA practices, but helps reduce the barriers to PA delivery, in order to support an increase in children's enjoyment, self-efficacy and motivation for PA in and out of school. An understanding of factors that influence the delivery of school-based PA opportunities are needed to better understand how school-based PA interventions can be effective and sustainable in the long term (Webster, 2011).

3.5 School-Based PA and SB Interventions

3.5.1 Recess

In a systematic review of recess interventions (*n*=13) conducted by Ickes et al. (2013), 95% of studies demonstrated positive outcomes for MVPA and total PA. While a variety of strategies were used to promote recess PA, the most effective strategies included added equipment/materials in the form of playground markings, playground zones, teacher training and involvement, and planned activity cards. Of the thirteen studies, seven that incorporated

additional equipment or materials significantly increased children's PA both in the short (1-2 weeks) and longer term (7 months) compared to control conditions. More recently, Van Kann et al. (2017) reported that when changes to a school physical environment (e.g. playground markings) are supported by changes to the social environment through teacher support, significant increases in LPA of 15.4 $min \cdot d^{-1}$ were observed after a 12 month follow up, compared to the control condition in children aged 8-11 years. While there was no significant change in MVPA or SB this research aligns with previous evidence that transitioning children from SB to more LPA is potentially a more achievable target than trying to increase MVPA (Matthews et al., 2008; Mitchell et al., 2013).

A systemic review by Parrish et al. (2013) identified nine studies that implemented primary school recess interventions, however the level of evidence was not adequate to establish conclusive intervention effects on children's recess PA, possibly due to limited number of studies. Nevertheless, several studies in the review reported significant intervention effects, highlighting promising strategies to increase children's recess PA. For example, interventions that used environmental changes in combination or separately, including playground markings, court rotation (rotating the use of the playground) and non-fixed equipment, significantly increased recess PA levels. Of the single component strategies used, recess equipment (Verstraete et al., 2006) and playground markings (Stratton, 2002; Stratton and Mullan, 2005) significantly increased PA levels while active video games had negative outcomes on children's lunchtime PA levels (Duncan and Staples, 2010). Another single component strategy carried out by Kobel et al. (2015) found that in 294 children (48% boys, mean age 7.1 years), those given two recess breaks (intervention group) compared to one (control group) accumulated significantly more MVPA irrespective of playground size. Altogether, results appear to support the implementation of multi-component approaches especially those that include a social support factor to facilitate behaviour change.

3.5.2 Physical Education (PE)

A recent systematic review and meta-analysis was conducted by Russ et al. (2015). In this review, the authors noted that counter to expectations, interventions with PE components evidenced a smaller effect size than ones without PE. In the review of studies, PE was delivered

by a variety of people including project staff, classroom teachers and PE specialists. Further analysis revealed inconsistencies, specifically in the staff-training component, noting that training often appeared to be a one-off event rather than a continual supportive process. The difference in outcomes between the studies and reviews may relate to the engagement and motivation of the pupils during the lessons, and resultantly the type of motivation strategies used by the instructors. Accordingly, instead of a focus on dose and reach of interventions, some researchers suggest greater focus should be directed to the motivational teaching styles teachers implement during lessons to increase children's PA levels (Quested et al., 2017).

Lonsdale et al. (2013) conducted a systematic review and meta-analysis of PE interventions on children's MVPA levels. The review indicated that PE interventions were successful in increasing the amount of time spent in MVPA from normal practice (10%) to 24% on average. Aligned with previous work (McKenzie et al. 2004) effective strategies identified by Lonsdale et al. (2013) to increase children's MVPA included a focus on class management, organisation and instruction, and supplementing usual PE lessons with more high intensity activities (i.e. fitness infusion). Even though Lonsdale et al. (2013) warranted caution regarding the strength of the available evidence due to high risk of bias and the heterogeneity of results, interventions that included a teacher training element were the most effective. Notably, only half the studies included in the review cited a theoretical framework to support behaviour change and many lacked a focus on teacher training.

Another approach that has been taken, not aligned with that of teacher training are extended/modified PE sessions to increase MVPA in PE. For example, in the KISS intervention conducted by Kriemler et al. (2010), children (*n*=502) were split by intervention (*n*=297) and received a multi-component PA programme that included adding two additional 45 minute PE lessons per week 'taught by expert PE teachers' compared to control who were taught by 'usual classroom teachers'. The intervention group also received daily activity breaks (5mins) and PA homework (10mins) to the existing PE curriculum. Follow up (9 months later) data evidenced significant changes in BMI and aerobic fitness over the control condition. Following this, a 3 year follow up of this study by Meyer et al. (2014) concluded that aerobic fitness remained significantly higher in the intervention compared to the controls, while other

primary outcomes were not sustained. Linked to the conclusions of the previous two reviews, altogether these findings highlight that while PE is an important curriculum subject to increase children's school-day PA, generalist teacher training is critical if children are to consistently have access to quality health enhancing PA.

3.5.3 Classroom-Based PA Interventions

Movement integration or classroom PA breaks have been highlighted as a progressive strategy to increase PA during the school day (Watson et al., 2017). The systematic review and meta-analysis of Watson et al. (2017) identified that irrespective of type of classroom break used (i.e. physically active lessons including new content, curriculum focused active breaks reviewing old content, or PA breaks with no academic content), classroom-based PA improved pupil's on task, and reduced pupil's off-task, classroom behaviour. There was however, no effect on cognitive function or PA despite a 2% to 16% increase in MVPA during intervention lessons and a 2% to 12% increase in school day MVPA. As described by Watson et al. (2017), the no effect found for cognitive function which may relate to the level of cognitive engagement (e.g. the amount of PA combined with cognitive demands) within each classroom-based PA intervention, however further research is warranted. A conclusion of the review stated that classroom-based PA is unique from other forms of school-based PA as it does not compete with instruction time and requires only minimal time commitment. Despite this, various other classroom-based PA interventions have still reported time as consistent barrier to teacher delivery motivations (Goh et al., 2013; Webster et al., 2015). This may stem from the fact that very few classroom-based PA interventions are underpinned by behaviour change theories, a critique which Webster (2015) has previously alluded to.

One study within the systematic review was the Brain BITES (Better Ideas Through Exercise) intervention (Howie et al., 2014). The authors focused on aerobic exercises, delivered by research staff with third and fourth grade pupils (equivalent year 4 and 5 UK; aged 9-12 years) for a 4-week duration. Using a within-subjects design, the authors assigned each of the participants (n=96) to four treatment conditions including 10 $min \cdot d^{-1}$ of seated classroom activity, and 5, 10 and 20 $min \cdot d^{-1}$ of classroom exercise breaks. The order of the conditions was randomised, and participants took part in one of each treatment condition a week. Results

indicated a significant improvement in observed on task behaviour after 10 min·d^{-1} PA and trends toward increased on-task behaviour after 20 min·d^{-1} of PA compared to the sedentary treatment. The real-world efficacy of this study is however unclear as teachers in other studies have reported hesitancy to implement breaks over 5 min·d^{-1}, consistent with previous evidence that competing priorities and barriers in school's limit PA engagement (Howie et al., 2014; Goh et al., 2017). Accordingly, training to increase teacher's motivation, confidence and competence to implement classroom-PA interventions may be a critical component if teachers are to consistently implement PA into the curriculum time.

Interventions that have included training programs to increase classroom PA include the instant recess program conducted by Whitt-Glover et al. (2011) and the ABC (Activity Bursts in the Classroom) for Fitness Program conducted by Katz et al. (2010). Details on training received by teachers were limited in both studies, and therefore comparisons cannot be made. Using direct observation as a measurement for PA, Whitt-Glover et al. (2011) integrated 10 min·d^{-1} PA breaks with third and fourth grade classrooms (9-12 years). The trial evidenced significant increases in children's LPA (51%), MPA (16%) and on-task behaviour (11%) from baseline to follow-up (6-months) in the intervention group compared to controls. The authors concluded that additional research was needed to better understand how to create policies to more readily support PA breaks in sustainable ways. The ABC (Activity Bursts in the Classroom) for Fitness Program was designed to use structured activity bursts in replacement of time teachers use to settle pupils down (Katz et al., 2010). The randomised control trial lasted a school year involving pupils (*n*=1,214) from across five schools (two control schools, three intervention). Results indicated that pupils from the intervention schools significantly increased physical fitness measures of upper body strength, abdominal, and trunk extensor improvements relative to the control group. Furthermore, it was reported that use of medication for asthma, attention-deficit hyperactivity disorder and collective use of medication significantly decreased. The authors concluded that PA breaks can be implemented successfully without any basic curriculum change (i.e. no interruptions to the normal prescribed curriculum). While both studies evidenced positive outcomes related to children's PA levels and physical fitness, caution must be taken as objective measurements were not used to assess children's PA levels.

The success of classroom movement integration as concluded by Erwin et al. (2011) is reliant on teachers' motivation and willingness to implement classroom interventions as intended. For example, teachers that were willing to integrate 1 activity break per day during the intervention period provided 5.75 activity breaks a week, increasing children's PA levels (as assessed by step counts) by 33% compared to controls. Erwin et al. (2011) proposed that to increase intervention fidelity, it was important to train teachers on the importance of PA for academic benefits to prevent teachers viewing PA as time away from learning. Considering that teacher motivation is a central factor for increasing children's exposure of classroom-based PA interventions, it is surprising that very few interventions are underpinned by theories of motivation (Webster et al., 2015). Further, few studies have reported on children's perceptions of classroom-based PA interventions, with little exploration of factors that influence their perceived enjoyment of the interventions (Howie et al. 2014). Accordingly, greater understanding of children's perceptions are warranted to provide a more informative multi-perspective evaluation of classroom-based PA interventions.

3.6 Fostering PA Motivation at School

3.6.1 Self-Determination Theory Overview

SDT provides a framework to understand the dynamics of human motivation (Deci and Ryan, 1985). SDT posits that by nature, individuals are active, self-motivated, inquisitive and eager to succeed because success is psychologically nourishing and rewarding (Deci and Ryan, 2008a). Yet, under the wrong conditions, individuals can become alienated, passive and disaffected. Three types of motivation have been identified in SDT including intrinsic motivation, extrinsic motivation and amotivation (Deci and Ryan, 1985; Ryan and Deci, 2000). SDT helps to explain how these different types of motivation regulate an individual's behaviour in relation to the social environments in which they interact (Ryan & Deci, 2000). SDT is commonly applied as a working theory in interventions to facilitate health-related behaviour change (Ryan et al., 2008) and supports psychological functioning through perceived need support, leading to need satisfaction and the internalisation of motivation regulations (Fortier et al., 2012).

Figure 3-1 taken from Fortier et al. (2012) is the SDT process model and depicts the underlying

mechanisms that must proceed one another, starting with the health intervention, if lasting health behaviour change is to occur and benefit ones psychological well-being. Specifically, SDT posits that intrinsic motivation, four types of extrinsic motivation (namely external regulation, introjected regulation, identified regulation and integrated regulation) and amotivation exist on a continuum of self-determination (Ryan and Deci, 2000).

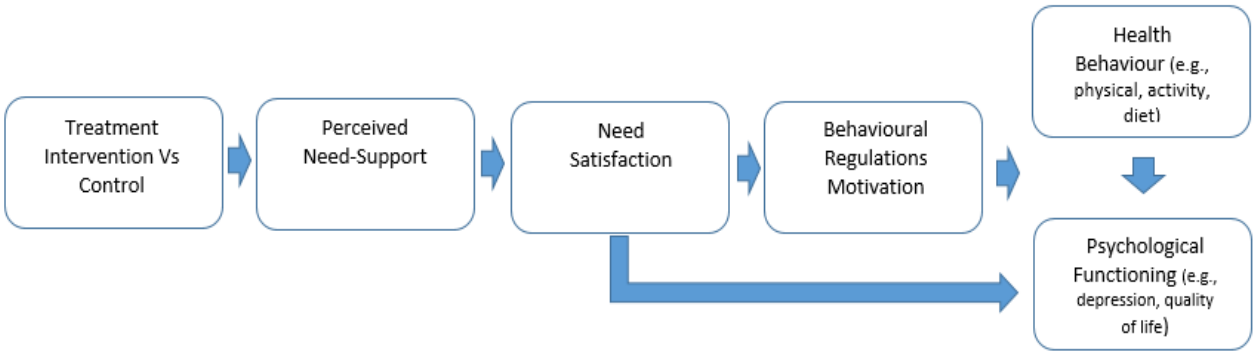

Figure 3-1 The SDT process model for health behaviour change in intervention research (taken from Fortier et al. (2012)

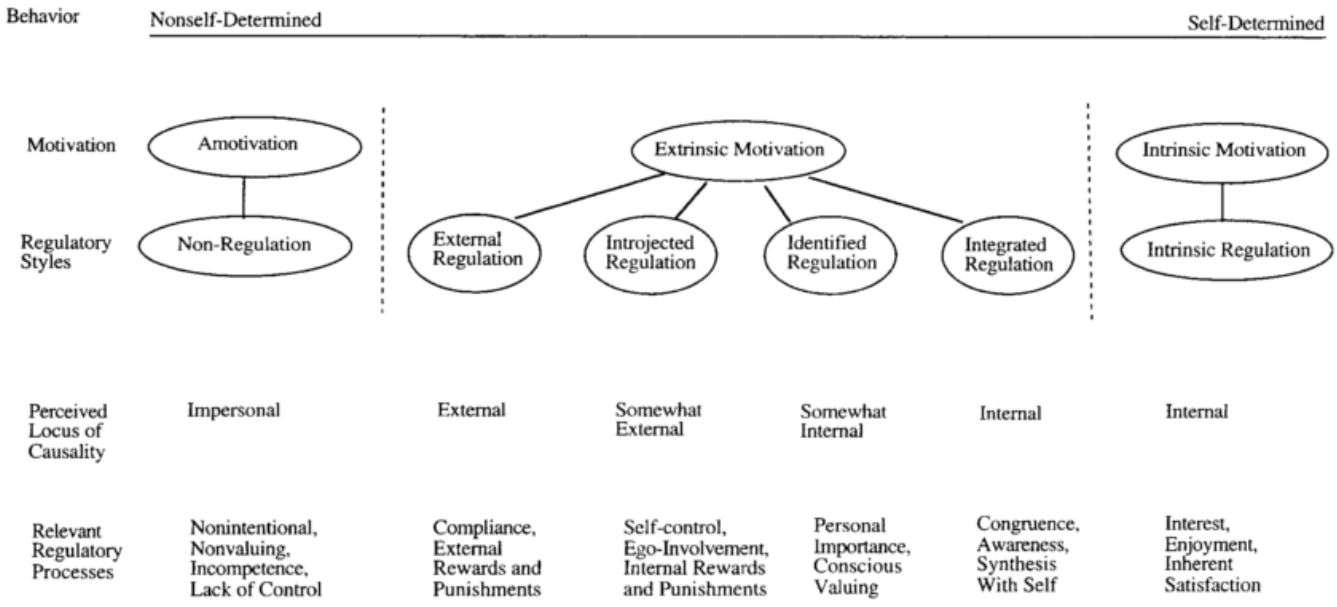

Figure 3-2 The self-determination continium showing types of motivation with their regulatory styles, loci of causality and corresponding processes (taken from Ryan & Deci 2000, p.72).

Amotivation (Figure 2-2) represents instances where there is no intention to undertake a specific behaviour. Amotivation stems from a lack of competence, whereby individuals perceive the activity or task to be personally unimportant through limited contingencies between one's behaviour and the desired outcome (Ryan & Deci, 2000; Vallerand, Guay, & Fortier, 1997). For example, in a PA setting a child may refuse to participate, irrespective of the external motivations placed upon them.

Extrinsic motivation is different from intrinsic motivation in that motives for engaging in PA are related to outcomes separate from the self (e.g. threat, reward, coershion). Extrinsic motivations are manifested by the degree of autonomy underpinning them. Accordingly, extrinsic motivations include intergrated regulation (degree of self regulation = very high), identified regulation (degree of self regulation = moderately high), introjected regulation (degree of self regulation = moderately low) and external regulation (degree of self regulation = very low) (Standage et al., 2005). **External regulation** is the least self-determined form of extrinsic motivation where actions are controlled through external contingencies separate to the self often through promises of rewards or to avoid punishments (Deci and Ryan, 1985). A child who is externally motivated therefore, will participate in PA either to receive praise (i.e. reward) or avoid confrontation from a teacher, parent or coach (i.e. to appease the situation).

Introjected regulation represents another form of extrinsic motivation, characterised by individuals internalising external regulation. The incentive for action here however is controlled by sanctions that are self-imposed, often through shame or guilt (Deci & Ryan, 2002). The measurement of introjected behaviour in children is believed to be difficult, requiring participants to recognise and understand feelings congruent to shame and guilt as a motivational input (Sebire et al., 2013), as opposed to external constraints that underlie external regulation. An example of an introjected regulation would be a child who participates in school PA, not because they want to but because they feel they should do, as participating in PA is what 'good pupils do'. Controlled motivations (i.e. external and introjected regulations) and amotivation are often associated with student unhappiness and boredom in PE (Mouratidis et al. 2008; Standage et al. 2005), need frustration in PE (Haerens et al. 2013) and limited intentions to be physically active during leisure time (Standage et al. 2003).

Identified regulation refers to an autonomous regulatory style where individuals participate because they accept some relevance, usefulness or significance of the behaviour, as activities are often aligned to personal goals, expressing a degree of meaningful choice in participation (Edward, Deci & Ryan, 1985). For example, a child who recognises PA as an important activity for facilitating health gains and participates accordingly due to those reasons (i.e. I participate in PA to stay healthy) would be displaying identified regulation. **Integrated regulation** therefore is the most autonomous from of external regulation where behaviours or actions become fully assimilated with their true self through a coming together of needs and values (Ryan & Deci, 2000). While Integrated and intrinsic regulations share similar qualities, they are carried out to attain separable outcomes and therefore are internalised differently within the self. Considering this, as people internalise motivations and assimilate them to themselves, they experience greater autonomy in action and enhanced maintenance and transference of behaviour change (Ryan & Deci, 2000). It should be noted that young children may not be able to recognise integrated regulations as they may be too young to experience or have not yet achieved a sense of integration with the self (Vallerand et al., 1997; Ryan and Deci, 2000).

Intrinsic motivation found on the far right of the continuum (Figure 3-2) is the most self-determined type of motivation. When intrinsically motivated, individuals engage in activities for their own sake mainly to derive feelings of pleasure. Individuals are thought to become intrinsically motivated when activities performed have been fully internalised and are done to achieve inherent satisfaction/enjoyment of a task, irrespective of external contingencies/rewards (Ryan & Deci, 2000). For example, a child who is intrinsically motivated would engage in PA because of the feelings of satisfaction they derive from their involvement in the activity alone. High levels of intrinsic motivation for PE for example, are desirable in children as it is assumed that participation is not solely limited to the influence of the setting, meaning children are more likely to be physically active during their leisure time (Lim & Wang 2009).

Most research within the PE setting has shown that autonomous motivations (including intrinsic and identified regulations) are consistently associated with positive child outcomes

including increased interest (Goudas & Biddle 1994), self-esteem (Standage & Gillison 2007), positive effect (Standage et al. 2005), concentration (Ntoumanis 2005), effort (Ntoumanis 2001), enjoyment (Koka & Hein 2003), and, increased PA levels inside and outside PE (Lonsdale et al. 2009; Ullrich-French & Cox 2009). Interestingly however, Sebire et al. (2013) found that intrinsic motivation was the only type of motivation associated with children's PA. This finding is different to adolescent investigations whereby identified regulation has always been positively associated with PA (Verloigne et al. 2011; Teixeira et al. 2012) and suggests that extrinsic forms of motivation for PA (e.g. improvements in health and well-being) are more central to adolescents than for children (Sebire et al. 2013).

3.6.2 Basic Psychological Needs Theory

SDT proposes that human beings choose behaviours in an attempt to satisfy their basic psychological needs to increase well-being and behavioural engagement (Ryan & Deci, 2000). These universal needs include autonomy, competence and relatedness, and are central to the initiation, internalisation and maintenance of behaviours. Autonomy refers to the feeling of being the initiator of one's own actions, thereby experiencing psychological freedom when engaging in an activity (Ryan and Deci, 2000; Assor et al., 2002). Competence refers to individuals experiencing a sense of effectance in one's ability to achieve the desired outcome (Sierens et al., 2009). Relatedness refers to the growth of strong, positive relationships developed through reciprocal feelings of closeness and trust (Ryan & Deci, 2000). These psychological needs have also been combined into a composite variable named psychological need satisfaction (Ryan & Deci, 2000).

According to SDT, satisfaction or fulfilment of these needs (i.e. need-satisfaction) is the mechanism whereby individuals move toward self-determined motivation (Deci and Ryan 2000). Therefore, while psychological need-satisfaction leads to psychological, behavioural and social wellness, psychological need frustration (i.e. lack of need support) results in psychological, behavioural and social ill-being (Ryan and Deci, 2017). As such, basic psychological needs theory suggests that social-environmental factors (i.e. behaviours of teachers and/or peers) play an important role in shaping and promoting self-determination (Standage et al., 2005) by the varied degree of autonomy, competence and relatedness

support they provide. Social-environmental variables that support the three basic psychological needs and promote individual enjoyment and engagement for activities will lead to satisfaction of cognitive, emotional and behavioural experiences that are mobilised by the three needs (Vansteenkiste and Ryan, 2013). Teachers can increase the need-satisfaction and internalisation of behaviours by supporting student psychological needs through various teaching strategies, specifically named autonomy-support, competence-support and relatedness-support. Accordingly, gains in need-satisfaction produce a wide range of positive outcomes for both pupils and teachers (Ryan & Deci, 2017).

3.6.3 Spectrum of Teaching styles

According to Mosston & Ashworth, (2008), the spectrum of teaching styles' is a continuum of teaching styles categorised according to decisions made by the teacher and learner. Specifically, these decisions occur in the planning (pre-impact), teaching (impact) and evaluation (post-impact) stages of the lesson. At one end of the continuum, known as the extreme teacher-centred end is the command style, whereby all decisions are made by the teacher across all three stages of the lesson. Oppositely, at the other end, is the self-teaching style, known as the pupil-centred approach, where learners take full responsibility for their own development in the learning process. Between these two opposing styles is the Mosston & Ashworth, (2008) have identified and described a string of other styles, each with their own decision-making structure (Table 3-1).

The spectrum of styles can then be further broken down into clusters of teachers namely called reproduction and production. In the reproduction cluster learning involves the learning and recall of motor skills and known information whereas the production cluster is centred more on pupil discovery of new information creating new and unique solutions to problems by investing, comparing, contrasting and synthesising information (Mosston and Ashworth, 2008). Despite the increasing awareness of the spectrum of teaching styles, evidence appears to suggest that teaching styles used in the UK are still relatively teacher centred (Morgan, Kingston, & Sproule, 2005) which may limit pupil self-determined motivation for PE. According to Jaakkola & Watt, (2011) teacher age and perceived ability to use the teaching styles appear

influence the implementation of the teaching styles as well as education level (undergraduate-graduate) (Zeng, 2016), teacher beliefs about the styles (Cothran et al., 2005) and motivation to implement them (Hein et al., 2012).

In a recent systematic review carried out by Chatoupis, (2018) on the use of Mosston & Ashworth's, (2008) spectrum of teaching styles internationally, evidence suggested that with the exception of self-check, the reproduction styles are used more than the production styles. Furthermore, the teaching style used most by PE teachers was the practice style, followed by the command style and the inclusion style. The least used style, (which provides the most-self determined behaviour on the part of the student) were the self-teaching style. In their implications for teacher education programs, Chatoupis, (2018) noted that the PE teacher training programs should inspire, encourage and challenge undergraduate students and in-service teachers to explore and use a broad range of teaching styles.

Table 3-1 Teaching styles and strategies grid taken from Mosston & Ashworth, (2008).

Mosston & Ashworth 'Teaching Style'	Interaction	Role of practitioner	Role of participant	Clusters
Command (A)	Practitioner makes decisions Participant copies and complies with decisions and instructions	Instructing	Copying	Reproduction
Practice (B)	Practitioner sets up opportunities giving feedback to participant who is working at own pace on tasks set	Establishing	Repeating and improving	
Reciprocal (C)	Participants work together, receiving feedback from each other Practitioner provides reference points for feedback	Supporting	Performing and peer assessing	
Self-check (D)	Practitioner sets criteria for success Participants check own performance against these	Directing	Self-assessing	
Inclusion (E)	Practitioner sets out a variety of tasks/opportunities Participants select which task is most appropriate for their abilities and/or motivations	Facilitating	Selecting	
Guided discovery (F)	Practitioner uses questions and tasks to gradually direct participants towards a pre-determined learning target	Questioning	Uncovering	Production
Convergent discovery (G)	Practitioner sets or frames problems Participant attempts to find most appropriate solutions	Guiding	Finding out	
Divergent discovery (H)	Practitioner sets or frames problems Participant attempts to create possible solutions	Prompting	Creating	
Learner designed (I)	Practitioner decides on area of focus Participants develop within this area, drawing on practitioners' expertise	Advising	Initiating	
Learner initiated (J)	Participant decides on how and what they are aiming for Practitioner drawn on for support as needed	Mentoring	Deciding	
Self-teach (K)	Participant engages in development on their own	N/A	Self-determined	

3.6.4 SDT and learning in PE (Domains of learning)

PE compared to other curriculum subjects is a unique subject concerned with the development of the psychomotor, cognitive and affective learning domains (Rink, 2003). SDT-based literature in PE has evidenced that perceived autonomy support is indictive of positive learning outcomes related to the psychomotor, cognitive and affective learning (Ntoumanis and Standage, 2009; Sun et al., 2017), especially in the affective learning domain. Collectively results suggest that, self-determined motivation is positively related to greater performance measures in PE including, motor skill knowledge (Boiché et al., 2008), intention to be physically active in the future (Ntoumanis, 2001; Standage, Duda, & Ntoumanis, 2003), concentration, enjoyment, preference for more challenging tasks (Standage et al., 2005), persistence and performance (Vansteenkiste et al., 2004). In contrast, students who are less self-determined in PE report greater amounts of boredom during lesson and feelings of unhappiness (Ntoumanis, 2001; Standage et al., 2005).

The psychomotor domain is related to the development of key sport related skills as well as the development of fundamental movement skills which are crucial for promoting PA participation (Kalaja et al., 2009). The affective learning domain is more centred on students' social behaviours, emotions, values, attitudes and related personality traits (Lacy and Williams, 2018). Finally, the cognitive domain is related to knowledge learning in PE, however research in PE has rarely included knowledge as a learning outcome measure (Sun et al., 2017). In the following section, we will provide a discussion of how SDT, and in particular, tenants of psychological needs theory (autonomy, competence and relatedness) may help support the development of children in each of these three learning domains.

3.6.5 Autonomy-Support

Autonomy support is a fundamental tenant for the development of autonomous motivation (Ryan & Deci 2000). Environments are autonomy supportive when teachers offer meaningful student choice, nurture individual self-interest and minimise controlling language (Reeve and Jang, 2006). This is developed through a combination of engaging, challenging and relevant activities, whereby teachers create opportunities for initiative taking in order to attract student

interest and curiosity (Vansteenkiste et al., 2004; Reeve and Jang, 2006).

Cross-sectional, experimental and longitudinal educational research indicates that autonomy-supportive teaching facilitates positive educational and developmental outcomes in pupils as indexed by deep-level learning (Vansteenkiste et al. 2004), engagement, (Reeve et al. 2004), academic achievement (Vansteenkiste et al. 2005) and persistence (Vallerand et al. 1997; Vansteenkiste et al. 2004). In PE, considerable research has been conducted from an SDT perspective to support autonomy-supportive teaching styles, with evidence suggesting a direct correlation between student-perceived autonomy and self-determined forms of motivation for PE and PA outside of school (e.g. Hagger et al. 2005; Hagger et al. 2003). The effect of self-determined motivation on effort and engagement in PE, related to the affective learning domain points to the important role of teacher autonomy support in fostering student motivation and feelings of effort and engagement (Sun et al., 2017).

Perceived choice is particularly important to increase autonomous intentions for PA (Hagger et al. 2002), as evidence suggests choice, and in particular meaningful choice (i.e. choice of activity; task difficulty), reduces the sense of a controlled environment (Tessier et al. 2010). In practice however, while free choice can promote PA engagement in children, it is unlikely that student learning objectives related to motor skill development and cognitive knowledge of the task will be achieved (Sun et al., 2017). Accordingly, if the aim is to promote experiences in PE that are positive and rich in knowledge acquisition and skill learning, lessons should be structured and interesting, and contain opportunities for free choice (Lonsdale et al., 2009). The acquisition of knowledge in PE related to the cognitive domain has provided very few studies to suggest a positive relationship between self-determined motivation and cognitive knowledge growth (Sun et al., 2017). Of those that have evidenced a favourable relationship, results suggest that tangible cognitive outcomes are more difficult to achieve when students did not value the learning or lacked motivation (Sun and Chen, 2010). These results provide support for the importance of well-established lesson goals, and the important role of the teacher to acknowledge student feelings, in that some students may not want to do what they are being asked to do. Accordingly, it is critical that lessons are structured in such a way to increase student motivation for learning, even if tasks are not necessarily intrinsically

motivating.

Accordingly, other strategies teachers may employ to support the development of student autonomy, especially when choice is limited, is the provision of a meaningful rationale, empathising with the leaner's perspective, and limiting controlling language (Sierens et al. 2009). In support for a meaningful rationale, Assor et al. (2002) tested this strategy in a classroom environment with children. The authors concluded that this particular strategy (offering meaningful rationale) not only promoted positive student feelings and engagement, but also provided a link between student's personal goals and their schoolwork. It should be stated however that providing a rationale for an activity does not necessary mean that the person carrying out the activity will become intrinsically motivated. Thus, to help facilitate internalisation it is important that teachers acknowledge student feelings and take their perspective, conveying respect to the individual's inclinations and right to choose (Deci et al. 1994). This can help alleviate some tensions that co-exist, allowing the individual to recognise that the requested behaviour can harmoniously coexist with his or her inclinations.

It should be recognised that the development of a need-supportive environment (i.e. a combination of autonomy, competence and relatedness support) is also related to the social and contextual conditions of the environment. For example, in both laboratory and field experiments, evidence suggests that pressure on teachers to feel responsible for student performance led to maladaptive (controlling) strategies, compared to teachers who were not pressured (Flink et al. 1990; Deci et al. 1982). Similar results have been shown in PE studies, for example, Taylor et al. (2008) examined contextual and personal antecedents of three motivational strategies used by PE teachers including providing a meaningful rationale, offering instrumental help and support, and gaining an understanding of the students. Results indicated that teacher perceptions of job pressure, autonomous orientation and perceptions of student self-determined motivation all impacted the psychological need-satisfaction of the teacher. Thus, it appears that while it is important for teachers to support a child's psychological need for autonomy to increase motivation for engagement in PE and PA, school authorities may need to reduce pressures on teachers to ensure their psychological needs are not undermined.

3.6.6 Competence-Support

For children to develop competence for an activity or task, it is important that teachers structure the environment correctly through the provision of optimally challenging tasks, adequate help, positive feedback and clear communication of guidelines and expectations (Sierens et al. 2009). Research indicated that structuring elements involving clear rules, contingency and positive feedback are positivity associated with a perception of control (Skinner et al. 1990), optimal motivation (Mouratidis et al. 2008) and engagement (Tucker et al. 2002). In contrast, unorganised classrooms without meaningful objectives, help or feedback have been described as chaotic (Reeve 2009).

Perceived competence in one's ability to perform a task is essential towards the development of autonomous motivation (Ryan & Deci 2000), and students who perceive themselves as more competent are more likely to attempt more challenging motor skills (Kalaja et al., 2009), thereby facilitating greater psychomotor learning and development of specific sport related skills. Moreover, perceptions of competence and perceived success have been evidenced to predict PA enjoyment in children while reducing undesirable perceptions such as boredom (Williams & Gill 1995; Baron et al. 2007). Therefore, the extent to which environments support or thwart the development of a child's perceived competence may play a key role in the affective learning domain as enjoyment and boredom are among the most influential affective reactions students experience in PE class (Karagiannidis et al., 2015). In relation to this, students who perceive learning environments to emphasize effort, personal development and trying (i.e. a task orientation approach) are likely to experience greater enjoyment (Jaakkola et al., 2017) vs a teaching approach which is ego-orientated. In a longitudinal study spanning 2 years, Cairney et al. (2012) tested the associations between gender, perceived athletic competence and enjoyment of PE in a cohort of 2262 children aged 9 to 10 years. Using mixed effects modelling to examine change over time, the authors concluded that low perceived athletic competence is associated with low enjoyment of PE. Low perceived competence of children in PE is also believed to impact the amount of PA undertaken outside of school, with more competent children engaging in additional PA and at higher intensities (Carroll & Loumidis 2001). These findings are particularly important as they may explain why some

children meet PA guidelines and others do not.

One critical way teachers can support perceived competence is through the provision of optimal challenge, related to a child's physical capabilities and aptitudes. Repeated lessons and a lack of challenge in PE has been reported to decrease student enjoyment and interest in adolescents (Carlson 1995; Subramaniam & Silverman 2007) while optimal challenge posed the opposite effect. To understand the importance of optimal challenge toward increasing student motivation for PE, Mandigo & Holt (2006) interviewed 27 children (aged 7-9 years) during which children were shown video recordings of their PE class and invited to describe experiences of optimally challenging activities. From the interviews, findings highlighted that optimally challenging experiences were associated with feelings of positive effect (i.e. fun, enjoyment and motivation to continue engagement). It was noted that possessing the required skill or ability level (e.g. competence), as well as the opportunity to modify challenge levels during the activity, facilitated the feelings of positive effect.

Positive effect for pupils in PE has also been related to the type of feedback pupils receive, with failure feedback likely to produce feelings of incompetence, thereby negating one's intrinsic motivation for an activity (Koka & Hein 2003). Studies investigating adolescent competence in PE have suggested that positive perceptions of teacher feedback regarding knowledge of performance (i.e. informational feedback) is a strong predictor of perceived competence and intrinsic motivation (Ferrer-Caja & Weiss 2000; Koka & Hein 2003; Amorose & Horn 2000). Furthermore, positive general feedback from teachers (e.g. praise and encouragement) has been shown to increase perceived competence (Koka, Hein, and Anonymous 2005). Accordingly, the provision of positive feedback enhances one's intrinsic motivation through the satisfaction of one's basic need for competence (Vallerand & Reid 1984). Therefore, the development of perceived competence through a combination of well-structured and enjoyable learning environments promoting psychomotor skill development through affective learning appears to be critical in the development towards intentions to be physically active.

3.6.7 Relatedness-Support

Relatedness support is developed when teachers spend a considerable amount of time, energy and resources on pupils (Haerens et al., 2013) through interactions that are warm, friendly and affectionate (Soenens et al., 2007; Cox and Williams, 2008). In academic settings, relatedness support has been positively associated to classroom engagement, motivation and effort of pupils (Ryan et al. 1986; Wentzel 1997; Ryan & Patrick 2001; Skinner & Belmont 1993). The development of close relationships with teachers is believed to help individuals internalise communicated values and behaviours, thereby becoming more autonomous in their motivation (Ryan & Powelson 1991).

Social factors related to student perceptions of relatedness support have largely been associated with perceptions of teacher behaviours. Perceived relatedness from pupils and teachers plays an important mediating role on autonomous motivation and perceived enjoyment (Cox et al. 2009), which has been supported qualitatively (Lewis 2014). Positive student perceptions of teacher relatedness in PE has also been associated with perceptions of teacher co-operation (Ntoumanis 2001), teacher autonomy support (Standage et al. 2003) and opportunities for building social connections in class (Standage et al. 2005). Furthermore, there is evidence that perceived teacher relatedness support is a stronger predictor than autonomous motivation in PE over that of perceived competence and autonomy (Cox & Williams 2008; Standage et al. 2003).

Peer acceptance in PE (e.g. peer-peer support) has also been shown to be an important factor toward increasing autonomous motivation (Cox et al. 2009; Lewis 2014). Consistent with other peer-relationship literature in youth PA settings, greater feelings of peer acceptance are associated with increased perceived competence and enjoyment as well as lower feelings of stress (Ullrich-French & Smith 2006). Importantly however, while peer-peer relatedness may increase perceived belonging in PA domains, studies from both the academic and PE settings agree that teacher-peer relatedness is more beneficial for engagement, positive effect and autonomous motivation (Klassen et al. 2012; Cox et al. 2009).

Teachers can increase student autonomous motivation using the variety of strategies aforementioned. The creation of a need-supportive environment and one that supports children's psychological needs for autonomy, competence and relatedness can have positive effects on student's motivation to engage in class. While there has been an abundance on the benefits of need-support for students, studies indicate that this style of teaching is rarely used in PE (Haerens et al., 2013).

3.6.8 SDT-Based Interventions (Need-Supportive Training)

School-based interventions aiming to increase children's autonomous motivation for PA have mainly targeted secondary school teacher's motivational strategies in PE, with a particular focus on training teachers to adopt an interpersonal need-supportive teaching approach. Need-supportive teaching practices entails teaching that is open to the satisfaction of a child's basic psychological needs (Cincinnato et al., 2016), yet to date, only a few PE interventions have been implemented (Chatzisarantis and Hagger, 2009; Tessier et al., 2010; Cheon and Reeve, 2013; Aelterman et al., 2014; Cheon et al., 2018).

In genral, intervention researchers that have trained teachers to adopt need-supportive interperosnal teaching styles within the PE setting have had positive results. Training of teachers has been shown to increase student self-reported autonomous motivation for PE, when compared to control conditions, through increases in percieved need-support from teachers (Cheon and Reeve, 2013). Furthermore, pupils taught by teachers trained in autonomy-supportive interpersonal styles report stronger intentions to exercise during leisure time and report greater participation in leisure activites over controls (Chatzisarantis and Hagger, 2009). The positve outcomes percieved by students are belived to be perpetuated by gains in teacher efficacy, well-being and motivation to deliver need-supportive stratagies (Cheon et al., 2014). For example, in the autonomy-supportive intervention programe conducted by Cheon et al., (2012) the authors reported that need-satisfaction from training fully mediated and expliained the positive effect that teacher training had on student educational outcomes. Thus, a recriprocal relationship between students and teachers classroom functioning and outcomes has been suggested (Reeve, 2013).

One reason why teachers may become more autonomy-supporive post-training is due to change in beliefs that instructional behaviour (i.e. take the students perspectives) are effective and easy to do (Reeve and Cheon, 2016). In a recent study conduced by Aelterman et al. (2014), authors recruited 39 teachers (31 men), aged 23 to 58 years, and 669 pupils (424 boys) aged 11 to 20 years to test whether professional development training grounded in SDT led to changes in (a) teachers beliefs about the effectiveness and feasibility of autonomy-supportive and structuring strategies, and (b) teachers' in-class reliance on such strategies, as rated by external observers, teachers and students. Teacher training lasted 1 day and was designed to support PE teacher's psychological needs for autonomy, competence and relatedness whilst similarly increasing teacher's knowledge and competence to implement motivational strategies in PE. Like previous investigations (i.e. Cheon and Reeve, 2013), examples of autonomy support included offering meaningful rationale, providing choice and adopting an empathetic attitude, while examples of structure support (closely related to competence support) included communicating clear guidelines and expectations, providing informational feedback and offering help. Results from the three-month intervention revealed positive changes in teacher beliefs regarding the ease of autonomy support and structure and observed improvements (as assessed by pupils and independent observers) in teacher lesson structure and autonomy-support. While these results are optimistic, it is difficult to confer whether changes in student perceived autonomy-support led to increase in PA outcomes in PE or leisure time as no objective measures were taken (i.e. accelerometery). Furthermore, all aforementioned studies were conducted with secondary school teachers who by enlarge are trained to teach PE, unlike generalist primary school teachers who have no specific qualification or training to deliver PE. Therefore, whether these findings generalise to primary school settings is relativity unknown.

More recently, Escriva-Boulley et al. (2017) conducted an intervention involving 13 state elementary (primary) schools. Similar to past teacher training programmes (e.g. Morris et al. 2013), control and intervention teachers were provided with learning and teaching resources (i.e. notebooks presenting a variety of learning tasks), however, intervention teachers were also provided with 12 hours teacher training split over 4 separate occasions (end of each school term). It was hypothesised that control teachers may support student need for competence,

but not autonomy or relatedness. Each training session was split into three parts including, 1) introduction to theory of need-support (or a refresh), 2) consideration of how these needs (i.e. autonomy, competence and relatedness) apply to the PE environment, and 3) practice implementing need-support strategies through role-play, similar to strategies of employed by Aelterman et al. (2014). Results suggested teachers in the treatment condition who received 4x12 hours of training increased support of their student's psychological needs as assessed by independent observers, for the majority of the school year. Furthermore, through the use of objective measurement, the authors were able to confirm that pupils in the treatment condition increased time spent in MVPA, independent of the sport taught, while the in the control condition, MVPA decreased. While a limitation of the Escriva-Boulley et al. (2017) study is the lack of student self-reported questionnaires to measure change in perceived need-support, taken together, the aforementioned interventions highlight the importance of teacher training that is underpinned and supported by appropriate pedagogies (i.e. need-support) in order to satisfy both student and teacher psychological needs.

These findings are important, as research indicates that autonomy supportive styles are rarely observed in current PE teaching, with room for improved structuring (Haerens et al., 2013). Further, these results support findings that teachers can learn to become more autonomy-supportive (Cheon and Reeve, 2013; Reeve and Cheon, 2014) and need-supportive (Tessier et al., 2010; Aelterman et al., 2014), highlighting the importance of changing teacher beliefs, as teacher beliefs strongly predict motivation styles (Reeve, Vansteenkiste Assor, 2014). In particular, psychological need-satisfaction experienced during training (i.e. the internalisation of beliefs) is related to change in effectiveness and feasibility beliefs regarding psychological need support strategies and intentions to apply the proposed strategies (Aelterman et al., 2016).

The importance of changing beliefs was recently noted in an intervention conducted by (Powell et al., 2016). The intervention was underpinned by SDT, and used need-support strategies to target specific levels of the SEM. For example, teacher autonomy-support was integrated into the intervention through teacher choice of lesson content. Competence-support was integrated via increased knowledge of specific intervention delivery principles and

relatedness-support was provided via increased social support from other teachers and headteachers (i.e. organisational and interpersonal support; planning lessons together). The intervention revealed significant improvements in children's mean %MVPA level in lesson time compared to the control school, exceeding current MVPA guidelines by 27 $min \cdot d^{-1}$. Most importantly however, there were significant increases teacher's attitudes toward teaching PE from baseline to post-test relative to the control, supporting evidence for the importance of interventions to be underpinned by appropriate behaviour change theories if interventions are to positively change teacher delivery attitudes and motivations.

Of the PE studies that report a teacher training component lasting ≥1 day, 90% report positive intervention effects (Lander et al. 2017), suggesting comprehensive training is needed to increase teachers competence, confidence and motivation to deliver PE. Evidence from systematic reviews and intervention studies also suggests that teacher training underpinned by behaviour change models (e.g. SDT), targeting the necessary mediators of change (e.g. autonomy support) are more successful at changing behaviour than atheoretical studies (Lubans et al., 2008; Lander et al., 2017). Yet despite the positive results seen in PE settings, there has been limited transfer of this knowledge to other important areas of the CSPAP model to help support and increase children's PA promotion throughout the school day. As expressed by Carson et al. (2014), PE is just one component of a larger model and therefore research to increase our understanding of other components, such as classroom-PA promotion, and how they can support increases in children's school-based PA is critical. Worryingly however, a large proportion of interventions are still targeting children's PA levels without any prior consideration for the wider psycho-social, cultural and environmental factors that influence children's PA. Added to this, many school-based PA interventions are developed without prior formative research, opinions of end-users, or understanding of the factors that limit intervention effectiveness. Work conducted in the PE setting has provided a strong platform from where other researchers can now extend this knowledge into other areas of the comprehensive school-based PA program (CSPAP) model. To further help the development of interventions focused on elements of the CSPAP model other than PE, frameworks for complex intervention development can be used to help increase the likelihood of intervention implementation and sustainability.

3.7 – Medical Research Council Framework

Figure 3-3, taken from MRC framework, (2008) describes the four-stage process of developing complex interventions including development, feasibility/piloting, evaluation and implementation (Craig et al., 2008). Aligned with other existing frameworks and guidance for intervention development (i.e., the PRECEDE-PROCEED model), the MRC framework is oriented towards social-psychological, individual behaviour change (Wight et al., 2015). Drawing on the strengths and weaknesses of the MRC framework, Wight et al., (2015) stated that strengths of the MRC framework were the identification of three broad stages of intervention development. These stages include developing theory, modelling processes and outcomes and assessing feasibility. One possible limitation of this framework, as stated by Wight et al., (2015) was the limited breakdown of the stages into further parts and the high focus devoted to evaluation. Despite this critique of the framework, many interventions are still developed without an underlying framework (Lander et al., 2017), which has a greater danger of enhancing the probability that the intervention will fail due to limited process development. Nevertheless, as suggested by Craig et al., (2008), use of other formal frameworks can supplement and/or provide a good source of ideas on the development of behaviour change interventions.

The first stage of the MRC framework is the development stage. This stage encompasses the identification the evidence base via previous investigations and formative research, identifying and/or developing an appropriate theory to understand the likely process of change, and, modelling processes and outcomes to identify weakness and inform future refinements. Researchers advocate that well-designed and well-implemented school-based interventions can influence the PA and health of children (Naylor et al., 2006; Reed et al., 2008; Kriemler et al., 2011; Jago et al., 2015a). Importantly however, few school-based PA interventions have been effective (Metcalf et al., 2012; Russ et al., 2015; Atkin et al., 2016). In general, researchers have reported various reasons for intervention inconsistencies including varying levels of intervention adherence, limited intervention exposure and implementation, as well as the quality and quantity of intervention components (van Sluijs et al., 2008; Metcalf et al., 2012; Dobbins et al., 2013; Naylor et al., 2015; Van Kann et al., 2016). One possible explanation

however is that school educators and pupils are rarely involved in the development of school-based interventions, jeopardizing perceived intervention ownership, actual intervention implementation, sustainability and effectiveness (Cole and Horacek, 2009; Christian et al., 2015; Naylor et al., 2015).

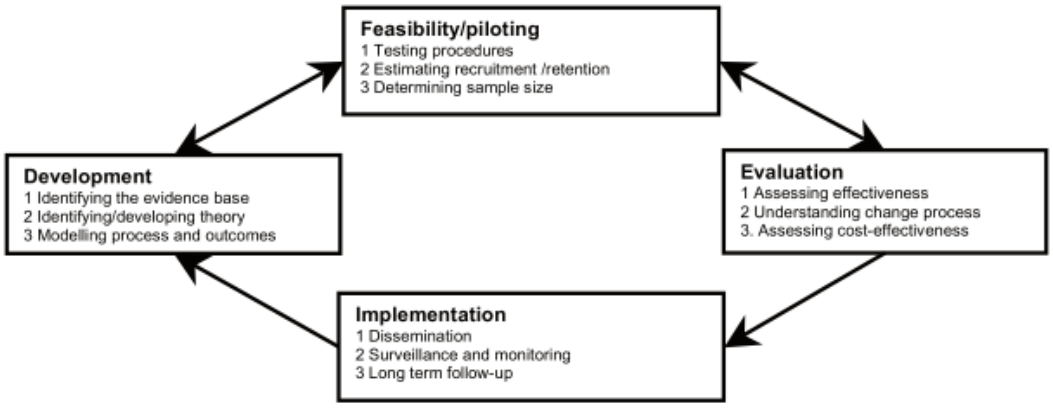

Figure 3-3: Key elements of the Medical Research Council development and evaluation process (taken from Craig et al., 2008, p.8)

Within health-care settings, there has been a growing focus on co-production literature which advocated the co-production of interventions (Clarke, Jones, Harris, & Robert, 2017). While traditional co-production has been applied in community settings, there is now a recognition for the growing value of a joint approach from those who are both delivering interventions and receiving them, thus meeting the psychosocial needs of end-users (Boyle et al., 2006). Aligned with recent recommendations from the healthcare sector (Clarke et al., 2017; Palumbo & Manna, 2017), school-based researchers have also suggested similar co-production approaches in PE interventions. In particular Aelterman et al. (2013) highlights the importance of teacher involvement in the early design of SDT interventions to encourage greater teacher buy-in and successful implementation. The shift in focus from researcher developed interventions to a co-developed approach is relativity new for PA intervention developers. As a result, it is suggested that many school-based interventions have been unsuccessful because

they have failed to take into account the wider social, cultural and environmental factors influencing behaviour (Morton et al., 2016), factors end-users know all too well (Hesketh et al., 2017).

Interventions that have paid particular attention to these factors, and been multi-component, are believed to be more successful than single-component interventions (van Sluijs et al., 2008; Guerra et al., 2013), particularly on outcomes including PA, fitness and adiposity (Gorely et al., 2009; Kriemler et al., 2011; Langford et al., 2014). Multi-component interventions tend to be supported by ecological models and accordingly target various factors (i.e. intrapersonal, interpersonal and environmental) at different levels of the SEM. Interestingly however, inconclusive evidence has also been reported for the effectiveness of multi-component interventions for increasing children's MVPA and reducing SB (van Sluijs et al., 2008; Russ et al., 2015; Van Kann et al., 2016).

3.8 - Summary

Primary schools are a key target setting for increasing PA and reducing SB in children (Kriemler et al., 2011), despite this many interventions implemented into this setting fail to effectively increase children's PA levels or reduce SB. Accordingly research is warranted to understand why interventions are failing and how researchers can better design interventions to meet the needs of schools. This is of upmost importance since early positive PA experiences in children are believed to influence the adoption of PA in adulthood (Department of Health, 2011). Furthermore, considering that PA levels track from childhood into adolescence and adulthood, targeting children's PA behaviours at a young age is a promising strategy to increase the health of the population (Cleland et al., 2012). Added to this, the school environment is a particularly important setting to target as many children from low SES areas, who may not receive the same opportunities to be physically active as more affluent peers, can be targeted here. Considering the positive independent effects of increasing PA and reducing SB can have for health of children (Poitras et al. 2016; Carson, Hunter, Kuzik,Gray, et al. 2016) as well as school-related outcomes (Donnelly et al., 2016), effective school-based interventions are needed.

4. Educator perspectives on factors influencing children's school-based physical activity

4.1 Introduction

UK guidelines recommend children and young people aged 5-18 years should engage in MVPA for at least 60 minutes daily (Department of Health, 2011). Children achieving this guideline have improved aerobic fitness (Janssen and LeBlanc, 2010; Füssenich et al., 2015), academic outcome (Rasberry et al., 2011; Singh et al., 2012) self-esteem, brain function and cognition (Ortega et al., 2008; Biddle and Asare, 2011; Khan and Hillman, 2014) compared to physically inactive peers. Additionally, there is strong evidence to suggest higher levels of total daily PA can improve children's adiposity, cardiometabolic biomarkers, physical fitness and bone health (Poitras *et al.* 2016). Considering that PA has been shown to track from childhood into adolescence and adulthood (Cleland et al., 2012), the importance of early PA promotion in children is warranted. Worryingly however, only 23% of boys and 20% of girls in England aged 5-15 years meet this MVPA guideline (Health Survey for England, 2016), making child PA promotion a major public health priority.

Primary schools are a key setting for child PA promotion (Kriemler et al., 2011). Children spend on average 180 days/year in school (Bush et al., 2011) accruing PA through opportunities including travel to and from school, recess, PE lessons, in-class PA breaks, and after school activities and sports teams (Slater et al., 2012). To further promote child PA many UK primary schools appoint one teacher as a PE-coordinator, supporting the headteacher to organise, implement and promote school-based PA opportunities, despite limited formal training (Webster, 2011; Harris et al., 2012). Yet, even with the provision of PA opportunities and the supporting role of PE co-ordinators, few school-based UK PA interventions have been effective (van Sluijs et al., 2008; Metcalf et al., 2012; Russ et al., 2015) or translated from research into practice to positively impact population levels of child PA (Arnold et al., 2016). One possible explanation is that school educators and pupils are rarely involved in the development of school-based interventions, jeopardizing perceived intervention ownership, actual intervention implementation, sustainability and effectiveness (Cole and Horacek, 2009; Christian et al., 2015; Naylor et al., 2015).

Engaging school stakeholders in the development phase of an intervention aligns to the MRC guidance (Craig et al., 2008) and can identify factors that influence children's school-based PA

to be targeted in subsequent interventions. In accordance with the SEM of health behaviour (Sallis, Owen and Fisher, 2008), various factors across multiple levels of influence can promote or impede children's school-based PA, including the development of effective intervention components that sufficiently target the school-based barriers to increase PA (Russ et al., 2015). Factors associated with school-based PA promotion include school PA policies (Langille & Rodgers, 2010) headteacher values towards health interventions (Christian et al., 2015; Persson and Haraldsson, 2017) pre-existing teacher attitudes and beliefs regarding PA promotion (Webster, Monsma, & Erwin, 2010; Webster, 2011) as well as time, skills and competence to deliver PA (Clarke et al., 2015). Factors influencing PE delivery include the availability of facilities and resources (Decorby et al., 2005; Kirk, 2005), organisational priorities (Hastie et al., 2012), relationships between teachers and children (Cox & Williams, 2008), and pupil motivation for PE (Berghe, Vansteenkiste, Cardon, & Kirk, 2014). Despite this body of literature, only one known study (Mackintosh et al., 2011) used school educators in formative investigate work to assist in the design of a new PA intervention program. Unlike previous formative research, our investigation specifically targets headteacher and PE-coordinator perspectives on factors influencing school-based PA in children from areas of high socio-economic deprivation.

The North West of England includes three of the five most highly deprived local authority districts in England (Department for Communities and Local Government, 2015). Targeting schools and children in deprived areas is vital as these children have higher reported body mass index, are less active and more sedentary than peers in affluent areas (Drenowatz et al., 2010). This is supported by findings that children from areas of higher deprivation are twice as likely to be obese than children in lesser deprived areas, with obesity levels rising year on year (Health and Social Care Information Centre, 2016). Accordingly, collaborating with school educators to develop interventions promoting child PA in deprived schools is more likely to lead to long-term, sustained improvements in PA and health (Sallis et al., 2008). The aim of this study was to explore educator perspectives of factors that influence children's school-based PA in primary schools in highly deprived areas in the North West of England.

4.2 Methods

4.2.1 Study design

Semi-structured interviews were conducted with school educators to obtain a deeper understanding of the factors that influence children's school-based PA. The study adhered to the consolidated criteria for reporting qualitative research (COREQ) checklist (Tong et al., 2007) ensuring transparent reporting of key study components. Informed written consent was obtained from all participants and ethical approval granted from the institutional research ethics committee.

4.2.2 Participants and settings

Participants were recruited from a cluster of four primary schools within a socio-economically deprived area of a large city in the North-West of England, after an initial interest in taking part in a new school-based PA intervention. Two schools held multi-academy trust status (i.e. self-governed), one school was local authority run, and one was a faith school. School characteristics are shown in Table 4-1. Interviews were conducted with the headteachers (2 male, 2 female) and PE-coordinators of each school (4 female) plus 1 deputy headteacher (male) who was available during the time of the interviews. The four schools in the present study had a staff structure that included a headteacher, PE-coordinator and generalist teachers, typical of most UK primary schools in low socio-economic areas. Headteachers main responsibility regarding PE and PA was to ensure the implementation of school PA opportunities and school PE, while PE-coordinators led on the delivery, promotion and organisation of such opportunities, as described by respondents. All participants held a standard primary teacher training degree. The PE-coordinators included 1 PE-specialist with a higher education degree for teaching PE at primary and secondary institutions, and 3 non-specialist PE-coordinators with no such PE specific qualification.

Table 4-1 School characteristics

School	School 1	School 2	School 3	School 4
Participants **Male (M)** **Female (F)**	Headteacher (F) Deputy-head (M) PE-coordinator (F)	Headteacher (M) PE-coordinator (F)	Headteacher (F) PE-coordinator (F)	Headteacher (M) PE-coordinator (F)
School size	1-form entry	2-form entry	1-form entry	3-form entry
School Type	Faith school	MAT	Local authority	MAT
Is PA a school priority?	As part of the healthy schools	No	As part of the healthy schools	Yes
Do you have a PE-coordinator?	Yes	Yes	Yes	Yes
Do generalist teachers teach PE?	Yes 50% of the time	No	Yes	Yes
Are external specialist coaches employed?	Yes 50% of the time	Yes	Yes	Yes
Can pupils access a playing field for PA?	Yes	Yes	Yes	Yes
Is the PE/sports hall different from the dinner hall?	Yes	Yes	No (shared hall for PE and lunch)	Yes
What PA opportunities are available to pupils?	Breakfast clubs Break and lunch recess After school club and Sports teams	Break and lunch recess After school clubs Sports teams	Breakfast clubs Break and lunch recess After school clubs Sports teams	Break and lunch recess After school clubs Sports teams

PA: physical activity
PE: physical education
MAT: Multi-Academy Trust
School size: number of classes (forms) per school year group
PA as a school priority: indicates whether PA was written into the school's development plan for academic year 2016-17

4.2.3 Interviews

A semi-structured interview guide was developed using open-ended questions to facilitate the exploration of participant views. Open ended questions allow participants to fully express their viewpoints and experiences while offering the researcher the opportunity to ask probing questions as a means of follow-up (Turner, 2010). Interview sections included 1) current school PA practices, 2) roles and responsibilities of staff toward PA promotion, 3) and challenges and needs of school PA promotion. Once developed, the interview schedules were piloted with the second and last authors. Piloting helps researchers determine flaws, limitations and weaknesses prior to data collection (Kvale, 2008), allowing questions to be re-assembled reducing participant misunderstanding and developing effective follow-up prompts to further understanding (Creswell, 2007). Moreover, the principle researcher followed an eight stage interview preparation phase suggested by McNamara (2009) which included (1) choosing a setting to minimise distraction; (2) explaining the interview purpose; (3) addressing terms of confidentiality; (4) explaining the interview format; (5) stating the interview duration; (6) providing researcher contact information; (7) asking if participants have questions before starting; and (8) asking permission to record the interview (see preparation for interview section). Interviews were conducted by the first author between February-April 2015 and lasted 30-60 minutes, with conversations being audiotaped via the use of an Olympus digital voice recorder.

Table 4-2 Headteacher and Teacher interview schedule

Main question	Additional questions/probes	Theoretical underpinning of questions
1. What does your school currently do to promote physical activity for children? (***Organisational level***)	a. PA opportunities during school time (e.g., break, PE, after school etc.) b. PA opportunities outside of school time (e.g., charity events	The socio-ecological model was used as an underpinning theory during the design and development of study 1 interview questions. **Current practice** questions were designed to understand factors that influence PA at the organisational, intrapersonal and interpersonal levels. Current practice questions were designed to understand what the current culture of PA in the school. **Roles and responsibility** questions are related to the organisational, intrapersonal and interpersonal levels and were designed to understand both the perceived role of the school as well as the individual teacher for PA promotion. **Challenges and needs** questions were targeted at all three levels of the socio-ecological model in a hope to understand the varying challenges that occur for the provision of PA at each level.
2. What role do you personally play in terms of promoting physical activity? (***Intrapersonal and Interpersonal level***)	a. Do other teachers have specific roles b. What are your views toward PA engagement c. How do you view school PA	
1. What should the roles and responsibilities of school (including staff) be with regard to promoting children's school-based PA?	School role (***Organisational level***) a. Should schools have clearly defined roles and responsibilities for PA promotion? b. How would a clear definition of roles and responsibilities better help practice Teachers (***Intrapersonal and Interpersonal level***) a. Within school, who's role and responsibility is it to care for a child's P.A levels? b. How could these roles and responsibilities be better integrated across the school and teachers?	
1. Do you as teachers face any challenges when trying to promote PA? (***Intrapersonal, Interpersonal and Organisational level***)	a. What is the biggest challenge you personally face and why? b. What is the cause of these challenges?	
2. How can these challenges be overcome? (***Intrapersonal, Interpersonal and Organisational level***)	a. What do teachers need to overcome these challenges? b. What do you personally need to increase child PA levels c. How can external organisations help to overcome these challenges?	

4.2.4 Addressing trustworthiness

Several approaches were used to enhance trustworthiness (Sparkes, 1998; Sparkes and Smith, 2009). For example, the interviews conducted were steered by the first author and active listening and paraphrasing were also used to help participants feel relaxed and at ease, whilst providing opportunity to check understanding of participant meanings (Shenton, 2004). Added to this, transcribed transcripts were handed back to participants who were given the opportunity to re-read the transcript allowing for appropriate member checks, ensuring the data collected was accurate to the participants meanings. Once transcripts had been checked a process of triangulation occurred for each interview increasing the credibility and validity of results. Triangulation as defined by Cohen, Manion, & Morrison, (2000) attempts to map or explain, in a more contextualized manner the richness and complexity of human behavior by studying it from more than one standpoint. Accordingly, each transcript was read and re-read by two or more independent persons, who was able to challenge the first author on the creation of themes. From this process thematic categories, themes and sub-themes could be subjectively and objectively reviewed ensuring that the data was representative of the participants meaning. According to Braun & Clarke, (2006) there is no clear agreement on what thematic analysis is, or how one should go about it. What is important however, when analyzing data, is that the process is consistent and decisions made are recognized as decisions, to best interpret meaning from the data.

4.2.5 Data analysis and representation

Interview data was transcribed verbatim and each transcript read several times by the first author to help them become immersed in the data (Silverman, 2005). Transcripts were read, re-read, imported into NVivo10 qualitative analysis software and analysed thematically (Braun and Clarke, 2006). Analysis first began with an inductive approach by initially segmenting the data and coding it to allow specific codes and categories to emerge. The assigning of specific quotes, conversations and paragraphs were then further analysed allowing broader themes to emerge from the data to best encapsulate participants' meanings. This process, known as open coding is considered a desirable way of enhancing credibility when using semi-structured interviews (Morse, 2015). The SEM was then used to organise themes into broader categories

representing intrapersonal, interpersonal and organisational level influences on children's school-based PA. Consequently a combination of deductive and inductive techniques were used to generate codes (Trigwell et al., 2015). This allowed the researcher to better represent the multiple levels of influence and how the different levels can impact children's school-based PA. Frequent de-briefing sessions between all authors facilitated the discussion, debate and re-definition of themes.

4.3 Results

This study aimed to explore the factors that influence children's school-based PA, from perspectives of school educators in primary schools from deprived areas in the North West of England. Results are presented using main themes corresponding to levels of influence in the SEM of health-related behaviour, namely, organisational (headteacher belief and value system; child PA needs; low priority for school PA and PE), interpersonal (teacher-coach relationships; significant others), and intrapersonal level factors (teacher PA involvement; lack of confidence, competence and training). Data from headteacher, deputy headteacher and PE-coordinator interviews are combined throughout the results section to promote a deeper understanding and holistic representation of the factors discussed. All participants have been anonymized and pseudonyms used in the following presentation of the data.

4.3.1 Organisational factors

Headteacher belief and value system. Each school offered various PA opportunities for their children throughout the school day, including breakfast clubs, online activities (e.g. wake up, shake up), recess free play, lunchtime multi-skill activities and after school extra-curricular activities. Schools also provided 2 hours of curriculum PE per week with delivery often shared between classroom teachers and external coaches employed by the schools. All headteachers held positive beliefs toward primary school PA and believed schools were important for establishing a good base for continued PA and healthy lifestyles throughout the life-course.

> *"I think it's (PA) extremely important in a primary school, you're hoping you're going to set the children up with the skills, life skills not just, they will be fit and active here, that you know, hopefully you will instil in them the need for a healthy lifestyle that will continue throughout secondary school and into their adulthood" (Janet, Headteacher, School 3)*

Moreover, headteachers believed they played a defining role in the availability of school-based PA opportunities, stating a personal interest and involvement in sport as a key factor toward school PA provisions.

"I think that my own interest in sport has helped immensely develop the sports round the school. I personally feel that it's very, very important that children have the opportunity to develop not only healthy lifestyles, but have the opportunity to access /clubs and centres outside of the school" (Jenny, Headteacher, School 1)

"Well, I am very keen on PE and sport myself, so what I try to do is ensure that...My philosophy really about sport in school is that children get a broad range of opportunities to play a range of different sports, and take part in physical activity as part of developing healthy lifestyles" (Ryan, Headteacher, School 2)

Such personally held beliefs and active support from headteachers for the promotion of school-based PA encouraged the development of PA opportunities across the school day.

Child developmental needs. The importance and value placed on school-based PA and PE by headteachers was mirrored by the PE-coordinators toward the positive effects that PE and PA have on children's physical and psycho-social development.

"I think it's [PE] *really important, and it helps them not only outside of the classroom but inside the classroom too. I've got quite a challenging boy-heavy class this* [year]*, and if we don't get our PE in, you know, they really need it… even if it is something at lunch or the lunchtime football club…they come in with a much better attitude to learning… And it's really important as well for their social skills and development, I think, as well as their physical and fitness." (Claire, PE-coordinator, School 2).*

School PE and PA opportunities were also described as an important factor for improving academic outcomes and behaviour as well as encouraging participation in PA outside of school.

"Now because I'm a former PE teacher, I think it's beneficial that we do PE. I only have to look down in the nursery and reception to see the improvement on academic outcomes...The number of children who are starting to become more engaged with

sporting activities, not only in school, but outside of school, has been enhanced. And there's hardly any punch-ups in the yard at lunchtime" (Tommy, Headteacher, School 4)

Recognition by school educators that school-based PA opportunities engendered the development of the children, both academically and holistically, appeared to be key facilitators toward the positive beliefs staff held about PA.

Low priority for school PA and PE. Despite the positive views staff held toward school-based PA, organisational barriers, including lack of time and particularly in the smaller schools, a lack of space, often negated the promotion of PA and in some cases the delivery of PE.

"There's so little time to do all the stuff we have to do, and because of the way schools are managed and the results, sport and everything does slip off…and it's a shame that it does, but I can't go, "Ooh, it's outrageous", because I just know what it's like… the facilities are feeble, so the hall isn't treated as the gym hall, and it's not a gym hall, I get that. But [P.E] *it's never priority" (Natalie, PE-coordinator, School 3)*

Lack of time was further associated with the high priorities placed on the academic attainment of the children compared to their PA levels at school. This was described in relation to school standards inspections.

"Currently OFSTED inspection, whilst they will look at health and wellbeing, there isn't the same priority given to physical activity as there is to the academic attainment of pupils." (Ryan – Head teacher, school 2).

4.3.2 Interpersonal factors

Teacher-coach relationship. External coaches were perceived by educators to be an important facilitator for increasing children's school-based PA. Schools employed coaches for various reasons, including the delivery of PE, lunchtime activities and after school clubs. Yet, participants believed that to encourage more teachers to engage in the delivery of school PA opportunities, a more collaborative delivery style with coaches was needed.

"I know its brilliant having coaches down, working on site with [the children]*, but what often happens is, they're* [coaches] *left to it, and you observe, which is great, and you do absorb a lot of the information, but I think there needs to be more of a partnership, and actually more to be able to take over that role as it were" (Lauren, PE-coordinator, School 1)*

Another teacher however stated that while coaches are important, there should be greater focus on upskilling teacher's knowledge and understanding of how to appropriately deliver PE and increase children's school-based PA.

"I think what needs to happen is that teachers themselves need to be up-skilled because it's the teachers who are in the schools, and know the children, and they're already here…A gymnastics coach coming in doesn't necessarily know the children, it can be hit or miss depending on who you're getting in as well, and they might be off one day, and then you're stuck. It creates a lot of problems. My own view is up-skilling the teachers that are on site." (Grace, Specialist PE-coordinator, School 4)

Significant others. While there were perceived advantages and disadvantages of using coaches in schools to promote child PA, all teachers agreed that to increase the probability of children engaging in school-based PA, schools needed a collaboration of all significant others in the child's life.

"Schools don't work properly… unless all parties are involved. So, if you can get the parents involved, the children, the specialists, and the teachers, it's [the relationship] going to be fruitful, I would imagine." (Claire, PE-coordinator, School 2)

It was however the parents and the child's home environment that teachers believed had the biggest impact on the child's engagement in PA.

"…it could be something to do with home, because their parents aren't very active, if they're not given the opportunities obviously some children are given [opportunities]*, they go off to extra-curricular sports clubs during the week. Lots of mine go to extra*

clubs and things, and then others don't go to any, so already they're slightly behind. So I think it's a lot to do with home life." (Lauren, PE-coordinator, School 1)

Yet one PE-co-ordinator believed that teachers could positively influence children's PA through role modelling healthy behaviours.

"But what we can do as staff as well is be role models for [the children]*, do you know? And I know it's a massive effort for me to be cycling into work, but I purposefully do that a lot of the time, so that the children when they're walking to school…some of them say, "Oh, Miss, I saw you", and I was like, "Oh yes, just trying to keep fit" (Grace, Specialist PE-coordinator, School 4)*

Most PE-coordinators, while understanding and appreciating that they have a responsibility to promote their pupils' PA levels, were uncertain about what their individual responsibility was.

*"I just feel there's a responsibility as a teacher for your children to hopefully gain a bit of exercise in school, but the reality is, I can't say a child in Year Four who I hardly know, and I don't come across, that I am responsible, because I think you've got to at least have the exposure [*at home*]. A lot of it's educating the parents, though, isn't it?" (Natalie, PE-coordinator, School 3)*

4.3.3 Intrapersonal factors

Teacher PA involvement (interests, values and individual commitments). While many teachers across the schools were reported to support and facilitate the development of school PA opportunities, individual teachers (excluding PE-coordinators) were only expected to ensure children received the pre-requisite of 2 hours PE set by the school policy makers. Anything above the 2 hours of PE appeared to be at the discretion of individual teachers.

"The role and responsibility of a teacher is to make sure that those children have access to their requirement in terms of PE curriculum. That's pretty much it I would expect from a teacher's point of view." (Ryan, Headteacher, School 2)

The involvement of individual teachers in PA delivery in school but outside of the curriculum was primarily dependent upon their personal interests, values and individual commitments, such as family priorities.

> *"It's just hit and miss as to what staff that you've got in place, what their interest is and what their commitments are…Stereotypically* [a] *primary school teacher of say older generation,* [it] *could be that they are not so keen themselves on physical activity, that's because* [in] *primary school(s) they have different interests. So the percentage chance of getting a primary school teacher who has got an interest…there's a very low percentage, and for me coming to any school, that's always a battle." (Grace, Specialist PE-coordinator, School 4)*

Added to this, one PE-coordinator described how a culmination of other factors may affect a teacher's ability to promote PA opportunities at school.

> *"Some people outside of school don't do sport. I think some of the older members of staff, and I include myself in this, have little injuries…people are conscious of their weight, so then they're conscious of what they wear, and I think to do sport you have to have the right gear, and people don't particularly want to pay, and they won't own trainers, so I think it's a bit of a culmination of things really." (Natalie, PE-coordinator, School 3)*

Consequently, while headteachers are an important stakeholder in ensuring the implementation of school PA opportunities and school PE, if staff are uncommitted to deliver school-based PA opportunities, increases in pupil's PA may be restricted.

Lack of teacher confidence, competence and training. A factor thought to limit teacher's ability to deliver quality PE and promote PA was a deficiency in PE training during their initial teacher training program.

> *"I'm finding in my experience, we have a very, very mixed skills set of our teaching staff, partly due to the fact that primary teacher training…doesn't focus as heavily as I would*

hope on training teachers to deliver physical education sessions. So a lot of the skill set stems from their own personal awareness or personal interest in sport." (Jenny, Headteacher, School 1)

To improve the delivery of PE, headteachers offered teachers various CPD opportunities including on-site training delivered by existing staff, and off-site training on specific sports. Despite these training opportunities, PE-coordinators believed many generalist teachers still felt scared, worried and fearful about delivering PE, which may have influenced the teacher's wider promotion and delivery of school-based PA.

"*I think people are quite fearful of* [PE] *at the moment. I think because there is quite a lot involved in it, and I think if teachers don't feel very confident with it, they're reluctant to want to teach it." (Lauren, PE-coordinator, School 1)*

Headteachers and PE-coordinators believed the only way to combat this negative perception of PE delivery was to offer the correct training to build confidence and competence in the area.

"I think that we need more CPD opportunities…I think we need to have more training right from the word go…I would say the main thing is the teachers need to be equipped with the right skills…remove this negative sort of perception of [PE]*, and to build confidence in the teachers really, instil life skills, offer them correct training, have more observations…so* [teachers] *know how they can move on and improve." (Lauren, PE-coordinator, School 1)*

4.4 Discussion

This study sought to explore the perspectives of school educators on factors that influence children's school-based PA in a highly deprived area in the North West of England. Using the SEM as a framework, the present study suggests that children's school-based PA is influenced by various organisational, interpersonal and intrapersonal factors.

The current study supports previous investigations that positive headteacher PA beliefs can facilitate the adoption, implementation and continued support of school PA opportunities in schools (Stolp et al., 2014). Personal positive values of key stakeholders, regarding health and wellness of children has previously been regarded as a key factor in the availability of PA opportunities along with maintenance of healthy school initiatives (Langille and Rodgers, 2010; Christian et al., 2015; Persson and Haraldsson, 2017). Fundamentally however, while these positive beliefs may provide more opportunities for children to engage in PA during the school day, teachers are ultimately responsible for implementing PA initiatives and interventions (Russ et al., 2015). Accordingly, while headteachers can facilitate the uptake of PA opportunities through the monitoring of teacher adherence to school-level PA polices (Langille and Rodgers, 2010) intrapersonal factors at the level of the individual teachers (i.e. motivations and beliefs about the importance of PA) are clearly as influential.

Congruent with previous research (Langille and Rodgers, 2010; Clarke et al., 2015), school educators, and in particular the PE specialist, believed school staff can positively influence children's PA, including health and wellness through role modelling. Yet variations in teacher's personal interest, values and individual commitments largely determined how involved staff were regarding their school PA participation. While established curriculum guidelines specified 2 hours PE a week, anything over and above this was at the discretion of individual teachers. Consequently, a dilemma exists in schools between the promotion of PA by headteachers and the varied delivery of PA opportunities by teachers. Evidence from the pre-service teacher literature suggests that numerous factors, including pre-university experiences in PE, perceived competence in PA, and perceived competence in PA promotion, impact a teachers attitudes towards school-based PA promotion (Webster et al., 2010). Therefore, it is imperative to change teacher's attitudes towards the promotion of school-based PA, especially if children are to receive and benefit from more PA opportunities. While Webster (2011) suggests that the pre-service education years are a critical time to improve teachers' perceptions of PE and school-based PA promotion, it also appears vital to change the attitudes of current teachers in-service.

In the present investigation teachers reported little opportunities for CPD in PE or PA. Previous studies that have looked at the various intrapersonal, interpersonal and organisational factors that may influence the successful implementation of PA practices in schools suggest that teacher training is a key factor (Lander et al., 2017). For example, in a movement integration study conducted by (Goh et al., 2013), the authors discovered that while organisational factors (i.e. limited time, curriculum pressures) were perceived as barriers to classroom-based movement integration, intrapersonal and interpersonal factors were not. This finding, as noted by the authors could relate to a series of training events that teachers undertook to increase their knowledge, skills and competence to deliver classroom-based PA practices. Accordingly, as reported in the present study, training appears to be of critical importance if intrapersonal and interpersonal barriers related to PA implementation are to be reduced. In addition to a reported need to increase teacher competence and confidence to teach PE, CPD opportunities that support teachers to promote PA across the school day, in ways that may not necessarily require teachers to teach sport-specific concepts/skills, may further benefit children's PA and health (Webster, 2011).

Unsurprisingly, while school educators in the present study perceived school-based PA opportunities to engender the development of children, both academically and holistically, factors at the organisational level were perceived to limit PA the most. For example, lack of time, poor facilities and academic pressures were reported to negate the delivery of school-based PA, despite these perceived benefits. Evidence supports the positive relationship PA can have on children's academic attainment (Singh et al., 2012) and at the very least, incorporation of PA into the school day has no negative effect on academic attainment (Rasberry et al., 2011). Nevertheless, the low priority placed on PA by OFSTED (Office for Standards in Education, Children's Services and Skills) meant that school PA provision and opportunities were not recognised through inspection, and therefore, was lower on the priority list for these schools than academic achievement.

If time, space and academic pressures are limiting factors for the delivery of PA in schools, then the integration of PA into the classroom may be an avenue for schools to consider, as some evidence supports the use of classroom PA for improving child PA levels (e.g. Hill, Williams,

Aucott, Milne, & Thomson, 2010). Webster (2011) suggests that generalist teachers can be supported to promote children's PA in academic lessons by implementing movement breaks, and, at recess and in before and after school settings. Considering previous research has highlighted teacher failings in regard to the infrequent delivery of PE (Morgan & Hansen, 2008) promoting PA across the school day appears necessary. What's more, given the evidence that academic pressures from time devoted to subjects such as English, Science and Maths, inhibit the development of children in curriculum subjects such as PE (Powell, 2015), the promotion of PA during the school day is even more warranted.

Limited communication between teachers and specialist coaches and thus, limited knowledge transfer, may have reduced teachers' motivation and desire to deliver PE when the coaches' contract with the school ended. This is supported by previous research that suggests the presence of coaches can reduce teacher involvement and attendance in PE (Powell, 2015). This is worrisome as specialist coaches are reported to have limited knowledge of the learners, learning environment, curriculum and pedagogy (Petrie et al., 2014). In the present study and similar to previous research (Sloan, 2010), teachers suggested that coaches should be more supportive in helping generalist teachers to develop competence and confidence to deliver PE. Therefore if existing practices including observations are ineffective for teachers learning, the provision of alternative CPD opportunities for teachers appears vital (Kirk, 2012). Accordingly, while schools appear to value specialist coaches, better working relationships between coaches and teachers appear vital to support teacher development and the sustained delivery of high-quality PE and PA.

The involvement of significant others in a child's life, including parents, teachers and coaches, were viewed by teachers to play a role in promoting children's PA. Yet, while most staff believed that teachers had some responsibility to promote children's school-based PA, what that responsibly was, was poorly established. Todd et al., (2015) reported that teachers experienced moral dilemmas, especially in deprived areas, as to whether it was their responsibility to address the social aspects of children's health. This dilemma was similarly found in the present study; however, teachers believed the school and parents should both be responsible for addressing the children's health issues. This is especially important considering

that positive early PA experiences, including both parental and teacher support for PA can positively influence the engagement of children in PA in later life (Thompson et al., 2003). Considering this, during the design of PA interventions, efforts could be made to target improvements not only in the school environment, but also within a family's psycho-social environment as parents are a key cornerstone in the reinforcement of positive healthy behaviours at home (Brown et al., 2016; Christian et al., 2015). Accordingly, it is advised that for intervention success a strong focus should be on improving PA opportunities of the whole family with a particular focus on the child as the agent of change to positivity influence family behaviour.

4.4.1 Strengths and Limitations

This is the first study to formatively explore the multiple levels of influence on primary school children's school-based PA from the perspective of headteachers and PE-coordinators. Furthermore, this is the first study to explore these factors in a highly deprived area of England, which is vital given the negative impact low socio-economic status has on children's current and future PA and health. These findings are valuable for school educators and coaches, as well as academics designing and developing school-based PA interventions. Nonetheless and despite these strengths, caution should be undertaken when generalising the findings to populations outside of deprived regions in the North West of England. Finally, it is acknowledged that the headteachers from the four primary schools held generally positive attitudes towards PA and hence may not be representative of the voice of headteachers generally.

4.4.2 Conclusion

School educators perceived various organisational, interpersonal and intrapersonal level factors to influence children's school-based PA. At the organisational level, headteacher's beliefs and values towards PA and sport influenced their support and promotion of school-based PA opportunities and associated teacher CPD opportunities. Time constraints, academic pressures, and, limited resources and facilities were found to impede children's school-based PA however. In addition, perceived factors inhibiting the delivery of PE and PA opportunities by teachers included low teacher competence, confidence and skill level, plus teacher's

motivation for delivery, which appeared to be influenced by their personal interests, commitments and values related to PA. Lastly, teachers called for better working relationships between teachers, parents and coaches, to ensure children had the best opportunity and support to become more active.

To help children accrue health-enhancing MVPA on school days, barriers to the provision and delivery of quality PA and PE opportunities must be targeted in future interventions. Considering a lack of training is a key barrier to children's school-based PA it is suggested that existing teachers are educated on the importance of PA for children's health, and how teacher attitudes and behaviours can inhibit or facilitate a child's participation in school-based PA opportunities. Furthermore, promoting headteachers and PE-coordinators recognition that PA can enhance academic achievement and out of school development may motivate teachers to support and promote children's school-based PA. There is a need for suitable CPD opportunities that build teacher's confidence in, and perceived importance of, promoting and delivering PA across the school day. This may help to reduce the impact of the organisational barriers of a lack of time and space to deliver PE and PA opportunities, enabling teachers to hit targets set for academic attainment whilst supporting children to be physically active. Yet, for school staff to fully internalise ownership and support the implementation and delivery of school-based PA interventions, their input during the development phase of interventions is crucial. Consequently, understanding and keeping the needs of headteachers, teachers and pupils in mind should not only help to cultivate school buy-in, but support researchers and schools to work together to develop, implement and evaluate school-based PA interventions that are sustainable and effective at promoting child PA in the long-term.

4.4.3 Summary for business and practitioners

This study provides clear evidence that many school-based barriers exist at all levels of the socio-ecological model. Accordingly, if children are to increase the proportion of time engaged in MVPA throughout the school day, well-defined procedures need to be established, helping reduce barriers to school-based PA. From a business and practitioner perspective, companies may need to engage more with schools and school stakeholders to design PA programs that

meet the needs of staff and pupils, ensuring that programs are co-developed and thus provide teachers with ownership of delivery. At present, very few school-based interventions are designed alongside appropriate staff members, even though school staff members are often the main intervention delivery agents. This speaks not only for the necessity of well-designed training programmes to upskill and motivate staff to deliver PE and PA, but also for the inclusion of staff in intervention design, ensuring that the real-world challenges negating PA promotion and implementation in schools are well thought out and appropriately supported. Accordingly, to ensure interventions are well designed and support behaviour change, it is critical that researchers, understand the behaviour change process and appropriate models that help facilitate these outcomes (i.e., increased MVPA). Aligned with the MRC framework (Craig et al., 2019), the next part of the thesis was conducted to further guide the development of a multi-component intervention, with a specific focus on identifying a relevant theory to support behaviour change. This time however the target end users were children, where insights were gathered to inform the future design and delivery of intervention components.

5. Children's perceptions of factors that influence PE enjoyment: A qualitative investigation

5.1 Introduction

To increase children's school-based PA levels, the UK government recently introduced premium funding to improve the provision of PE and sport (Department of Education 2015). This is supported by evidence that generalist primary school teachers lack competence and subject knowledge to deliver PE (Sloan, 2010; Domville et al., 2018). The increased funding has led to an upsurge in privatised specialist coaching companies delivering or co-delivering primary school PE with existing generalist teachers (Jones & Green, 2015), however, the impact of this delivery approach on children's PE experiences are unknown. Coaches, while having

coaching qualifications, are not trained educators and therefore may lack basic pedagogical skills needed to motivate and encourage student learning and engagement in lessons (Griggs 2010). Thus, it is important to understand how current delivery approaches in UK primary schools influence pupil enjoyment for PE.

One theoretical approach that has increased in popularity in primary school PE literature is SDT (Ryan and Deci 2000). SDT proposes a continuum through which motivation varies in quality from 'controlled' to 'autonomous' forms (Deci & Ryan, 2008b). Controlled motivation is characterised by either an external pressure (e.g. punishment, reward) or an internal pressure (e.g. guilt, pride) to engage in an activity (Deci and Ryan, 2008b). Within a PE setting, controlled motivation can lead to negative feelings such as boredom and lack of effort (Taylor et al., 2010; Karagiannidis et al., 2015). Autonomous motivation however is characterised by volitional engagement and a feeling that participation in PE is of the student's own choice and willing. Autonomous motivation is associated with improved psychological well-being, interest, persistence and long-term behavioural engagement (Ryan and Deci 2000) and has been associated with increased enjoyment of PE and increased PA outside of school (Karagiannidis et al., 2015; Jaakkola et al., 2017).

The most internalised form of autonomous motivation is intrinsic motivation, characterised by engagement in an activity for its inherent satisfactions (Ryan and Deci 2000). Enjoyment is a central component of intrinsic motivation and relates to feelings of fun, liking and pleasure (Scanlan and Simons 1992). While more value-based forms of autonomous motivation are specified within SDT (e.g. identified regulation which focusses on achievement of a personally valued outcome), intrinsic motivation may hold the most relevance for children (Sebire et al., 2013), whose motivation between the ages of 7 and 11 years tends to focus on fun and enjoyment (Kirk, 2005). Higher levels of PE enjoyment are associated with long lasting PE participation and increased habitual PA outside of school, whereas limited enjoyment in PE is associated with low effort, boredom and lack of perceived competence, especially in girls (Cairney et al., 2012; Leptokaridou et al., 2015; Jaakkola et al., 2017). Early positive PE experiences therefore appear vital if children are to benefit from a physically active lifestyle.

Applying SDT to investigate the development of children's PE motivation is valuable, as the psychological conditions underpinning motivation are specified (Sebire et al., 2013). SDT suggests three basic psychological needs are important for the development/maintenance of intrinsic motivation, namely *competence* (perceived ability to carry out a task effectively), *autonomy* (perception that behaviour is self-determined) and *relatedness* (perceived social connections with peers and teacher) (Cox, Duncheon, and McDavid 2009; Ryan and Deci 2000). These psychological conditions are influenced by an individual's social environment, including a child's teacher and peers, with student-teacher interactions shown to support and undermine student motivation (Cox et al., 2009). Several teaching strategies are available to support autonomy (e.g. offering meaningful choice, nurturing self-interest and exploration, minimising controlling language [Reeve 2009]) competence (e.g. offering structure, tailored support and feedback, communicating clear guidelines and expectations [Sierens et al. 2009]) and relatedness (e.g. energetic and eager delivery, listening to children, coming from the child's perspective [Haerens et al. 2013]). Teaching styles reminiscent of a disengaged, controlling and chaotic environment however are believed to typically thwart a student's basic needs, which can lead to an undermining of motivation and learning (Ryan and Deci 2000). Accordingly, linked Mosston & Ashworth, (2008) spectrum of teaching styles, teachers should try to encourage self-determined student learning in PE through the provision of appropriately planned lessons, which meet the individual needs of students and foster a culture of autonomous learning.

To assist in the proper learning and development of the child in PE researchers note the importance of learning across three domains which include the psychomotor, affective and cognitive domain (Rink, 1996). SDT-based literature in PE has evidenced that perceived autonomy support is indictive of positive learning outcomes related to the psychomotor, cognitive and affective learning (Ntoumanis and Standage, 2009; Sun et al., 2017), especially in the affective learning domain. Collectively results suggest that, self-determined motivation is positively related to greater performance measures in PE including, motor skill knowledge (Boiché et al., 2008), intention to be physically active in the future (Ntoumanis, 2001; Standage, Duda, & Ntoumanis, 2003), concentration, enjoyment, preference for more challenging tasks (Standage et al., 2005), persistence and performance (Vansteenkiste et al., 2004). In contrast,

students who are less self-determined in PE report greater amounts of boredom during lesson and feelings of unhappiness (Ntoumanis, 2001; Standage et al., 2005).

A growing body of quantitative research shows PE climates that are supportive of student's basic psychological needs are associated with greater enjoyment and more autonomously regulated behaviour (Hastie et al., 2012; Haerens et al., 2015; Karagiannidis et al., 2015; Sun et al., 2017). Studies that have used elementary populations are however less numerous. Furthermore, even less is known about the factors children perceive to be important in promoting enjoyment, and how the current PE delivery framework in UK primary schools (combining specialist external coaches and generalist teachers) impacts on children's motivational experiences. Such open questions are not easily addressed through quantitative methodologies, and require qualitative approaches that allow for rich and context-specific investigation of the phenomenon of interest (Krueger and Casey, 2009). For the first time, this study employed a qualitative approach to investigate how children themselves perceive their PE environment and factors that influence their enjoyment within the current PE delivery framework in UK primary schools. This aim of this study was to inform the development of a Pa intervention underpinned by SDT. Accordingly, it was the aim of the current study to address children's perceptions of school PE, and to gather insights from children to inform the future delivery of intervention components.

5.2 Methods

5.2.1 Study design

Semi-structured interviews were conducted with school children to understand factors that influenced children's perceived enjoyment of the PE setting. The study adhered to the COREQ checklist (Tong et al., 2007) ensuring transparent reporting of key study components. Informed written consent was obtained from all participants and ethical approval granted from the institutional research ethics committee.

5.2.2 Participants and setting

Participants were recruited from a cluster of four primary schools within a socio-economically deprived area of a large city in the North-West of England. School characteristics are shown in Table 5-1. Participants were recruited for the study due to each school's interest in taking part in a new school-based PA intervention. Two schools held multi-academy trust status (i.e. self-governed schools; schools 2 and 4), and two schools were local authority run (school 1 and 3). After obtaining written informed gatekeeper consent, all children from years 3-6 (aged 7-11 years) were invited to participate in the study via a verbal presentation at the school by the first author. Sixty children returned written informed child assent and parent/guardian consent forms. We planned to conduct eight focus groups (one with year 3-4 pupils (age 7-9 years) and one with year 5-6 pupils (age 9-11 years) in each school), each with a maximum of 6 children, as per recommendations of Morgan et al. (2002). Therefore, a random sampling method (stratified by school years) was used to select 48 children from the interested 60. Resultantly, eight mixed-gender focus groups were conducted with 47 children (23 boys) aged 7-11 years (one child was not present on the day of the focus group). The study adhered to the COREQ checklist (Tong et al., 2007) ensuring transparent reporting of key study components. Ethical approval was obtained from the institutional research ethics committee.

Table 5-1 School characteristics

School	School 1	School 2	School 3	School 4
Participants **Male (M)** **Female (F)**	Year 3 and 4 4M and 2F	Year 3 and 4 3M and 3F	Year 3 and 4 2M and 4F	Year 3 and 4 3M and 3F
	Year 5 and 6 3M and 3F	Year 5 and 6 2M and 4F	Year 5 and 6 3M and 3F	Year 5 and 6 3 and 2F
School size	1-form entry	2-form entry	1-form entry	3-form entry
School Type	Local authority	MAT	Local authority	MAT
Is PA a school priority?	As part of the healthy schools	No	As part of the healthy schools	Yes
Do you have a PE-coordinator?	Yes	Yes	Yes	Yes
Do generalist teachers teach PE?	Yes 50% of the time	No	Yes	Yes
Are external specialist coaches employed?	Yes 50% of the time	Yes	Yes	Yes
Can pupils access a playing field for PA?	Yes	Yes	Yes	Yes
Is the PE/sports hall different from the dinner hall?	Yes	Yes	No (shared hall for PE and lunch)	Yes
What PA opportunities are available to pupils?	Breakfast clubs Break and lunch recess After school club and Sports teams	Break and lunch recess After school clubs Sports teams	Breakfast clubs Break and lunch recess After school clubs Sports teams	Break and lunch recess After school clubs Sports teams

PA: physical activity
PE: physical education
MAT: Multi-Academy Trust
School size: number of classes (forms) per school year group
PA as a school priority: indicates whether PA was written into the school's development plan for academic year 2016-17

5.2.3 Focus groups

Focus groups lasted between 30 and 45 minutes, ensuring children remained engaged with the discussion topics (Gibson, 2007). Focus groups were conducted in a quiet room with only the first author (male moderator, trained in qualitative methods) and children present. School premises were chosen for convenience and to provide a familiar location to reduce child anxieties (Kennedy et al., 2001). At the start of the focus group, the moderator introduced himself and provided name badges for the children. Throughout, the moderator tried to display important characteristics such as patience, warmth, respect and active listening. Autonomous engagement was encouraged by offering children choices (e.g. choosing to sit on chairs or the floor) and providing a supportive relationship and opportunities where children could voice their needs and opinions (Shier 2001). Children were positioned around the moderator in a circular position to project a non-authoritarian climate (Gibson, 2007). Once the children were seated, the moderator read aloud ground rules to set boundaries and establish expectations. This information covered the moderator's role, the study aim, confidentiality, safeguarding, and how the group would operate (Morgan et al. 2002; Gibson 2007). The moderator then facilitated an ice-breaker activity, with each child saying their name, age and favourite sport/PA into the Dictaphone, before listening to their answers. Throughout the focus groups, the moderator made efforts to involve quieter group members and ensure all participants were encouraged to express their opinions, even if these differed from peers (Morgan et al. 2002).

Focus groups were semi-structured and focussed on children's PE experiences and perceptions of factors that influence PE enjoyment. Focus group schedules were pilot tested with LG and PW before the final agreement on questions were reached. The focus group schedule (fable 5-2) included questions of 'What do you like and what do you dislike about PE?', 'What would make school PE more fun?', 'What are your thoughts of your school PE teachers/specialist coaches?', and, 'How do your PE teachers/specialist coaches make you feel during PE?'

5.2.4 Addressing trustworthiness

As with study 1 several approaches were used to enhance trustworthiness. In the case of the present study however, the child population and nature of the focus groups required different techniques to be used to ensure trustworthiness of child meanings. For example, an independent moderator (the first author) carried out the child focus groups. Furthermore, in an attempt to reduce the power imbalance that can arise when an adult facilitates a children's focus group, it was made clear the moderator was not a teacher, there were no right, or wrong answers and the children were free to express their own opinions (Morgan et al. 2002). To help children describe their feelings and emotions, they could select from a range of paper-based emoticons (pictorial representations of facial expressions; e.g. bored, happy). Subsequent probing questions asked why they felt that way. Emoticons helped children's experiences remain the centre of the research process (Hyvönen et al., 2014), promoted enjoyment, and gave each child the opportunity to express their opinions (Hill, Layboum, and Borland 1996). As it was not possible for children to member check the transcribed focus groups, at the end of each section the first author summarised the main points of the focus groups, ensuring what the children said was appropriately interpreted by the first author. Accordingly, active listening and paraphrasing were also used to help participants feel relaxed and at ease, whilst providing opportunity to check understanding of participant meanings (Shenton, 2004). Once transcripts had been checked, the process of triangulation occurred (please refer to study 1 for process undertaken).

Table 5-2 Children's focus group schedule

Main questions	Additional questions/probes	Theoretical underpinning
Is physical activity good for you? (PA knowledge)	Why?	These questions were designed to be used as ice-breakers while simultaneously gaining a better understanding of children's thoughts, feelings and knowledge of PA
What do you think about physical activity?	What's good and what's bad about PA?	
	How does PA make you feel?	
What kind of PA do you do?	Why do you do it?	
	Do you enjoy it?	
	How much P.A do you think children should do?	
PE class in schools		
What do you think about school P.E **(Like/Dislike)**	Why do you feel this way?	PE class in school questions were designed to better understand how the social environment (i.e. peers and teachers) impacted children's enjoyment of PE. Feelings of fun, liking and pleasure were used to signify enjoyment, which according to SDT is a key tenant for the development of intrinsic motivation. By gaining an understanding of how the social environment facilitated and/or negated children's enjoyment of PE and the specific behaviors that lead to such feelings (i.e. limited choice from teacher), basic psychological needs theory (a sub-theory of SDT) was used to better understand how the social environment could better support children's well-being and motivation in PE.
	What would make school P.E it more fun?	
	What do you think of your P.E teachers?	
	How do your P.E teachers make you feel?	
Do you take part in extra-curricular physical activities?	What are they?	
	Why do you take part?	

5.2.5 Data analysis and representation

Focus group data was transcribed verbatim and each transcript read several times by the first author. Staying close to the data was an important way of ensuring that data interpretation, where possible, was undertaken through the eyes of the child, rather than researcher (Janesick, 1994). Transcripts were imported into NVivo10 qualitative analysis software and analysed by the first author using the principles of thematic analysis (Braun and Clarke, 2006). Thematic analysis was chosen as the preferred analytical technique as the analysis process allows the researcher to identify, analyse and report patterns (themes) within a particular data set (Braun and Clarke 2006). Whilst we were interested in exploring the extent to which children's perceptions mapped onto SDT constructs, the primary objective was to extract the factors that children themselves perceived to be important in influencing enjoyment. As such, an inductive approach to analysis was taken to ensure perceptions of factors that influence PE enjoyment, that did not readily fit the SDT framework were not missed. This began by segmenting the data and coding it to allow specific codes and categories to emerge. The assigning of specific quotes, conversations and paragraphs were then further analysed to allow broader themes to emerge from the data to best encapsulate participants' meanings. This process, known as open coding, is considered to enhance credibility when analysing semi-structured data collection techniques (Morse, 2015). Regular meetings between all authors took place to discuss emerging codes and refine codes as appropriate until consensus was reached. The emergent themes were then reviewed for their relevance to SDT and interpreted in relation to existing academic literature.

5.3 Results

Three themes emerged as influential on children's enjoyment of PE: 1) individual preferences, 2) peer behaviour and, 3) instructor behaviour. The themes include factors that facilitate and negate children's PE enjoyment. Each theme will be discussed in turn, with illustrative quotes to support the narrative. For quotes that do not compare generalist teachers and specialist coaches, the term 'instructors' is used. Participants were anonymized and pseudonyms are given throughout.

5.3.1 Individual preferences. While most children were positive about participating in PE, some expressed a desire to do PE more regularly *('I think we should do it more often'* – Sarah, School 1, Year5/6) and for longer *('They don't let us go out for long enough'* – Edward, School 4, Year3/4). Children believed PE would be more enjoyable if it was tailored to their individual preferences. The majority of children were interested in a variety of sports/activities, but perceived PE to provide few of these. Consequently, children wanted more choice in PE activities, and to do more of the PE activities they enjoyed.

> *"The children should get a bit more choice of what they're doing, and like we shouldn't just have to do like the same things every week".* (Ethan, School 3, Year 5/6)
>
> *"Because we do one half term of one sport, and then another half term of a different sport, and to be honest, I only like a couple of sports, and we don't really get to do them very much".* (John, School 1, Year 3/4)

Preferences for sports were particularly important for the children, as many children expressed feelings of boredom when they took part in activities that they personally did not enjoy.

> *"It depends what the sport is, say if it's like football or rounders, or like netball or basketball, its things I enjoy. But if it's like tennis or things I don't like, so it's boring".* (Anna, School 4, Year 5/6)

Accordingly, some children wanted to vote on what sports/activities they did in PE.

Charlotte *'I reckon we could get to vote for which sport we do, and the* [instructors] *still get to choose every sport, and then we vote, and which one has the most votes we get to do.'*

Tommy *'Yes, and you don't get to choose what you're doing.'*

Danny *'Like Charlotte said, we would vote on what sport we should do, because I think it's like everyone's opinion counts, saying what they want to do, not just the* [instructors']*.'* (School 4, Year 5/6)

Through a voting system, children believed sports/activities that held inherent interest should be provided more regularly to increase enjoyment and engagement. A link between choice and enjoyment was further evidenced within a pupil's suggestion of a 'freestyle week'.

> *"We could go on the field and do whatever we want, and get skipping ropes on it, and have hula hoops, and bats and balls, and all them. That would just be really, really fun if we could have a freestyle week".* (Sarah, School 2, Year 3/4)

5.3.2 Peer behaviour. Arguments between peers, perceived unfair teams and pupil disengagement often reduced children's PE enjoyment through perceptions of an undesirable learning environment. This was especially prevalent when instructors had to stop lessons to re-explain rules or re-engage pupils.

> *"I feel bored because most of the time we have to stop doing the lesson because either the two boys in my class who are dead naughty and always arguing…and then we have to stop the games while the* [instructor] *goes to sort them out…* [and] *we have to wait there for five minutes sometimes, and it's our PE time".* (Fred, School 4, Year 5/6)

> *"Sometimes people are listening, and then you get other people that just think about themselves and they don't think about the team, and they never listen, so then like say someone who's like talking to someone,* [the instructor] *would go, "Oh, everyone, I'll tell you again, and I'll tell you again", and it just gets really boring, because we've listened, but they haven't".* (Maisy, School 2, Year 5/6)

Peer-to-peer interactions also influenced PE enjoyment, with one child highlighting how the presence and absence of peer support can affect their feelings and PE motivation.

> "*People always shout at you, like not for doing it right, and then people on my team,* [they say] *"Oh, come on. Why are you out?" and things like that…it's like they always hit it* [the ball]*, and you never do, so like you feel a bit, you feel as if you've let your team down… But like when you've got a positive team, and like they're really nice, they'll keep cheering you on, and you'll keep making you do more, like to believe in yourself".* (Gina, School 2, Year 5/6)

As well as affecting children's feelings during PE, negative peer comments were thought to deter some children from future PE participation.

> *"I think some people don't want to do PE because some people* [other children] *might have said something to them about they're not very good at it, and so it might put them down a bit, so that's why they don't want to do it".* (Julie, School 4, Year 5/6)

5.3.3 Instructor behaviour

Teacher presence. Children noted they liked it when their teachers were involved in PE, since it gave the impression they cared.

Billy *'Because everyone then learns things, and like everyone can show people how to do things, and like if you get stuck, the teachers can help you, and like pair up with you and do something.'*

Researcher *'Yes, that's a great point.'*

Gem *'It shows us that they actually care about our PE.'*

Researcher *'Your learning and your PE. Great.'*

Ethan *'And it also shows that they do want us to stay healthy and fit.'* (School 3, Year 5/6)

Despite the perceived benefits of teachers being involved in PE, children described how this was rarely the case and when teachers were involved, they showed little interest.

Fin *'Like our teacher doesn't play, and he has a whistle and stands to the side.'*

Lucy *'And they just go off. The teachers just go off, and they won't watch you.'*

Billy *'Sometimes teachers just like stay at the side, tell you what to do.'* (School 3, Year 5/6)

Tailoring to children's abilities. Children highlighted the role of the instructor in encouraging children to persist with activities, try new skills and build confidence.

> *"Well, it makes you feel comfortable because you know that if you get something wrong, they're* [instructor] *just going to help you and try again, and they'll tell you to try again, and then eventually when you get it, they'll say that we've made progress and still help us build up the confidence".* (Sarah, School 1, Year 5/6)

Children however perceived a difference in the ability of the teachers and the specialist coaches to progress skills to a level that challenged their abilities. This was particularly the case in areas such as gymnastics and dance, where teachers were perceived to repeat what the specialist coaches had already taught.

> *"Like when you do gymnastics…when like the* [specialist] *coach, she sees what you can do she makes it that bit harder. Cos like I go to this dance school, and like the teacher* [school teacher] *doesn't make it that hard".* (Elizabeth, School 3, Year 3/4)
>
> *"Specialist coaches, they're teaching us things that we don't know, but then they teach us to show us. But then after the* [specialist] *coaches have gone…the teachers are teaching us the things that the specialist coaches have already taught us".* (Tom, School 4, Year 3/4)

On the flip side, some children described instances in which teachers asked children to do activities that were too difficult, leading to limited enjoyment and lack of engagement.

> *"Sometimes she* [teacher] *makes us do more like a bit harder physical stuff, and sometimes not everyone likes to do it, so a lot of people get grumpy and things. And*

they start like not wanting to join in, and they start saying like they feel ill, just so they can get out of it". (Gina, School 2, Year 5/6)

As a result, children spoke about their preference to be taught by specialist coaches who were perceived better equipped to teach PE.

"They're better, the specialist coaches, they're better than the teachers, the class teachers. The class teachers are supposed to teach you literacy, while the specialist coaches, they're supposed to teach sports". (Edward, School 4, Year 3/4)

Relationships with specialist coaches. Whilst children felt some interpersonal relationships with specialist coaches were good, others were poorly developed (e.g. not knowing names, or being unsupportive), which appeared to influence enjoyment.

"I think some of the [specialist coaches] *are good because they encouraged us, but then we've had other* [specialist coaches]*, and they sometimes put us down a bit, saying, "You can do better", but they said it in a mean way. They didn't say it in a supportive way".* (Sandra, School 4, Year 5/6)

"Because they [specialist coaches] just go like, "You", or "You in the red bib" or like, "Number Seven". Like learn my name. I don't like getting called number seven or you in the red bib". (Amy, School 1, Year 5/6)

Children did however speak of positive interactions with specialist coaches, and perceived PE to be more enjoyable when coaches were understanding, showed children respect, and were able to display positive personality traits (e.g. the ability to have a laugh and a joke).

"If you accidentally did something, they wouldn't sit you out. They'd just start laughing and saying, "It's all right. Just remember to do that". (Jack, School 1, Year 5/6)

"I think our lacrosse teacher was really fun and funny, and because he was from America, most of the girls started saying, "Please say hamburger", and things like that, so he used to say it, and we always used to laugh at him saying it". (Emma, School 3, Year 3/4)

5.4 Discussion

To the best of our knowledge this is the first study to qualitatively investigate children's perceptions of factors that influence PE enjoyment, interpreted from a SDT perspective to inform psychological need support recommendations. Children's perceived enjoyment of PE appeared to be influenced by individual preferences, peer behaviour, and instructor behaviour. The factors reported as influential on children's enjoyment complement existing SDT research in PE (Cox et al., 2009; Xiang et al., 2011; Haerens et al., 2013) and provide insight in to the ways in which the psychological needs may play a role in PE environments. The following section discusses the study findings in relation to SDT and the ways in which psychological needs for autonomy, competence and relatedness may increase students' PE enjoyment.

The children in this study expressed a desire for a greater choice of activities within PE, as not all children enjoy the same things. It has been shown elsewhere that meaningful choice is an important tenant in the development of pupils' autonomous motivation for PE (Xiang, Gao, and Mcbride 2011; Ntoumanis and Standage 2009) and plays a key role in learning process as choice depicts a teaching style that is more pupil centred (Mosston and Ashworth, 2008). Our qualitative data provides an insight into the mechanisms through which this increase in autonomous motivation may occur. For choice to be meaningful, choices should align with and reflect pupils goals, interests and values (Assor et al., 2002). While there are different ways instructors can offer meaningful choice (Xiang et al., 2011), children in our study suggested procedural choice (e.g. asking pupils which activities they would like to engage in) was important for increasing PE enjoyment, an important outcome within the affective learning domain (Sun et al., 2017). Such procedural choice was linked to an increased sense of autonomy, through giving children a feeling that "everyone's opinion counts" and that they were being listened to. There were also examples however where lack of choice (i.e. being "made" to do activities that were too difficult) diminished children's sense of competence, which in turn reduced their enjoyment and engagement with PE. Perceived competence is thought to be closely related to the enjoyment element of intrinsic motivation (Reeve, 1989) and our data supports this notion. Children noted that teachers in particular (compared with specialist coaches) struggled to tailor activities appropriately to children's ability, which led to

boredom (if too easy) or disengagement (if too difficult). The ability to get to know children's abilities, listen to their needs, and tailor activities accordingly is also important in enhancing children's sense of relatedness (Reeve and Halusic, 2009) and thus an inability to align sessions with children's needs may have a poor effect on their relatedness. Whilst choice is often associated with the basic psychological need of autonomy (Ryan and Deci 2000) our qualitative data suggests choice may also be important for improving children's sense of competence and relatedness in PE. While we cannot deduce the type of teaching style used by the teacher from the children's quotes, we may infer that the approach taken was reproduction based, where the focus is primarily teacher led and more controlling than autonomous.

Within the UK, elementary school teachers are required to achieve standardised learning objectives as part of the national PE curriculum. It is important to note that giving children choice in the activities they do need not compromise these learning objectives. Indeed, children in our study appeared cognisant of the requirements on teachers to deliver certain activities, in suggesting a process of "guided choice", such that teachers allow children to "vote" for options from a pre-defined programme, thus voicing opinions and providing input into PE lessons, key components of autonomy support (Assor et al., 2002) and more pupil centred teaching styles (Mosston and Ashworth, 2008). Children seemed however to lack confidence in their teachers' competence to effectively deliver PE, which in turn impacted negatively on the children's sense of competence and enjoyment (through lack of tailored progression and feedback, thus children did not feel optimally challenged). Given that competence is related to the development of good psychomotor skills and enjoyment related to affective learning, children's autonomous motivation to engage in PE may have been negated due to the actions of the teacher. It is possible also that children sensed the teachers' own lack of perceived competence and knowledge (Sloan, 2010; Domville et al., 2018) which in turn led them to de-value the teachers' attempts to deliver a structured learning environment. A well structured environment is believed to be fundamental in the development of children's perceived competence (Ryan and Deci 2000), and involves clearly framing learning activities, integrating activates that are of optimal challenge and providing clear guidance and feedback (Skinner, Kindermann, and Furrer 2009; Skinner and Belmont 1993), again reminiscent of pupil-centred teaching styles that promote autonomous learning

and lesson engagement (Mosston and Ashworth, 2008). There was little evidence in our findings to suggest generalist teachers were achieving this aim, which ultimately impacted (negatively) on children's enjoyment of PE. Such findings are worrying given many generalist teachers are responsible for delivering PE-specific skills in primary schools and developing child competencies that prepare children for, and promote, life-long engagement in health-enhancing PA (Ntoumanis and Standage, 2009). Accordingly, improving teacher competence and motivation for PE delivery could not only support children's short-term learning but could improve children's perceived competence and autonomous motivation for PA in the longer term.

Similar to previous investigations (Cox, Duncheon, and McDavid 2009), children in this study suggested instructor behaviour can impact children's feelings of relatedness, and consequently their PE enjoyment. Children described use of controlling language from specialist coaches (e.g. saying things "in a mean way" or shouting, "you in the red bib!"), denoting a poor sense of relatedness and as teaching style reminiscent of a command style (Mosston and Ashworth, 2008) which may have negatively impacted on their PE enjoyment. Conversely, children spoke of teachers showing they "care" through taking an active role in sessions, and suggested specialist coaches who were "fun" and showed "a sense of humour" created a more enjoyable PE environment relating to the provision of autonomy support as gaining an interest in children is also a component of autonomy support. While relatedness is thought to have a more distal role in the development of autonomous motivation than autonomy and competence (Ryan and Deci 2000), individuals are more likely to internalise values and skills in a well-supported relatedness context (Ryan et al. 2009) and positive pupil-instructor connections are deemed essential for child enjoyment and engagement in PE (Haerens et al. 2013). Use of controlling language by social agents (i.e. parents, teachers and coaches) has been shown to undermine motivation and is associated with need frustration, leading to negative cognitive, affective and behavioural outcomes (Ntoumanis et al., 2017). Researchers have suggested training teachers and/or coaches to communicate with students in more need-supportive style and found some positive results related to greater student satisfaction and enjoyment of lessons, as well as increased teacher motivation for PE delivery (Cheon et al., 2012; Reeve and Cheon, 2014). While various communication techniques have been suggested to help increase need

supportive communication, a relatively simple communication technique such as using children's first names (which was highlighted as important by the children in our study) has been shown to increase autonomous motivation and children's perceived connection with instructors (Vidourek et al., 2011). Evidence from this study highlights how students notice the use of controlling language and respond negatively toward it, thereby supporting suggestions that controlling language should be minimised in the PE setting to increase lesson enjoyment.

Koekoek and Knoppers (2015) suggest the PE environment is unique, with students consistently negotiating their abilities and preferences to work alongside peers and friends through challenges inside and outside their comfort zone. Children in our study perceived the PE environment (created by the instructor) to allow negative peer behaviour to impact (negatively) on their PE enjoyment. For example, children expressed frustrations related to the way teams were picked (frustrating the needs for relatedness and competence if criticised by other team members), or the way the class was disciplined (frustrating the need for autonomy, in having to "pay the price" for others' misbehaviour; and frustrating the need for competence, in wasting PE time that could be spent on skill development). Instructors are in a position of power to prevent and manage poor behaviour, plan opportunities for children to build social connectedness with peers, and, use knowledge of peer relationships to guide decisions important for children, such as team allocation (Standage et al., 2005). Accordingly, instructors must recognise their role in creating a positive PE environment that supports children's psychological needs for autonomy, competence and relatedness and fosters PE enjoyment.

In the present study, various situations were described whereby teachers had limited involvement in the lessons, or watched from the side, telling pupils "what to do", which is reminiscent of controlling techniques and a command style which and thwart a child's need for autonomy, competence and relatedness. It appears vital therefore for generalist primary teachers to receive more appropriate and sufficient training for PE delivery before working in schools. One approach teachers may benefit from learning is Mosston & Ashworth, (2008) spectrum of teaching styles which may allow teachers to better support the individual needs of their pupils and structure lessons to support the three domains of learning. More

specifically, it would benefit children and teachers learning if more robust working relationships were developed, whereby two-way knowledge transfer supports teachers and specialist coaches to develop their competence and confidence to deliver PE. This may promote greater interaction between teachers and coaches in PE lessons and co-delivery of PE, which may reduce child frustrations associated with uninvolved instructors and facilitate their enjoyment and learning in PE.

5.4.1 Strengths and Limitations

To our knowledge, this is the first qualitative study to explore children's perceptions of factors influencing their PE enjoyment, with a unique insight into perceptions of PE delivery by generalist teachers and specialist coaches. Further, this is the first study to interpret these influences from a SDT perspective. The application of focus groups across different age groups and schools allowed for a rich understanding of how instructors and peers impact children's perceived PE enjoyment, and how their behaviours can be interpreted in the context of psychological needs support. The findings do not however allow conclusions to be drawn on the mechanisms through which the identified factors influenced perceived enjoyment, as questions did not specifically address psychological needs satisfaction or motivational orientations of the children. Further research is needed to elucidate the impact of PE experiences on children's satisfaction of autonomy, competence and relatedness and the quality of motivation that results. While the authors felt data saturation was reached, caution is warranted before generalising the study findings to schools outside of low-socioeconomic areas in the North-West of England.

5.4.2 Conclusion

Taking a SDT perspective, this study investigated children's perceptions of factors influencing their PE enjoyment. Findings suggest both instructor and peer behaviours influence children's perceived PE enjoyment. In the context of SDT, children's views indicate the importance of psychological need support to enhance their effort, persistence, enjoyment and autonomous motivation to engage in PE, indicative of affective domains of learning. In particular, our data evidenced the importance of offering meaningful choice to increase children's lesson enjoyment. While meaningful choice is often associated with autonomy support, limited

choice also appeared to impact children's perceived competence (i.e. when activities provided where to hard or to easy) and thus reduce perceived relatedness (i.e. when instructors did not take not listen to children/tailor activities accordingly to meet their needs). Furthermore, the limited perceived competence of instructors appeared to impact children's perceived enjoyment of lessons, often when instructors were not able to appropriately support children's skill progression or structure the environment in motivationally adaptive ways. Accordingly, given the current climate of PE in the UK, where a dual-delivery responsibility is shared between coaches and teachers, instructors should try to ensure that working relationships are robust to promote child competence for engagement and teacher competence for delivery. As a final note, the use of controlling language by instructors was noticed by children and was largely perceived to negate their PE enjoyment, as was the perceived lack of interest of some instructors toward getting to know the children (i.e. their names). Fundamentally, the present investigation provides a unique insight from the perspectives of children, highlighting the importance of instructors to be aware of the environment they create and the impact this has on peer-to-peer interactions & relatedness, competence, autonomy. Collectively awareness of these actions may help enhance children's perceived enjoyment and engagement with PE and support the development of children's autonomous motivation for PA in the longer-term.

5.4.3 Summary for business and practitioners

According to the present investigation, PE instructors can help support a child's enjoyment and engagement in PE by providing a positive learning environment, guided by an appropriate pedagogical approach. One such approach is provided through a need-supportive social context, as specified in SDT. While this study has specific implications for teaching PE, it also provides several wider implications. For example, judging from the responses of children, enjoyment can be enhanced by the creation of an environment that supports one's psychological needs for autonomy, competence and relatedness. Accordingly, to increase the sustainability of interventions, specific components of such interventions, irrespective of level targeted, may benefit from a design that takes into account the psychological needs of end-users thus fostering increased motivation and well-being from taking part. This corresponds with teachers being appropriately trained to deliver PA interventions in a need supportive way.

Taking these results into account, the next stage of intervention development was the design of a blueprint intervention. In keeping with a central theme of intervention design, it was critical that school stakeholders be involved in the development phase of the intervention, ensuring barriers were reduced during the implementation and sustainability phase. Accordingly, after drawing up a blue print intervention Table 6-3, study three of the thesis was concerned with gathering educator experiences and perspectives, to refine and justify the proposed intervention. These processes highlight for businesses and practitioners the necessity of rigorous design, accompanied by end-user feedback with the intention of increasing ownership and sustainable implementation.

6. Development of a novel self-determination theory-based physical activity intervention for primary schools: drawing on perspectives of educators

6.1 Introduction

Regular PA has physical, mental and social health benefits for children (Janssen and LeBlanc, 2010; Poitras et al., 2016). Primary schools are a key target setting for children's PA promotion, though systematic reviews demonstrate mixed evidence for efficacy of school-based PA interventions (Metcalf 2012; Dobbins 2013; Lai 2014; Russ 2015). Efficacy appears to improve if interventions are multi-component (Kriemler et al., 2011; Dobbins et al., 2013b; Russ et al., 2015), over 1 year, underpinned by a theoretical model or framework (Lai et al., 2014) and implemented as planned, which is influenced by the availability of quality resources, time and a supportive school climate (Metcalf, Henley, and Wilkin 2012; Russ et al. 2015; Naylor et al. 2015). To develop a supportive school climate for PA and PE interventions, achieving headteacher and teacher buy-in appears critical (Brown and Elliott, 2015; Todd et al., 2015; Domville et al., 2018). Specifically, at the teacher level, buy-in and implementation of PE and PA opportunities appear influenced by teacher motivation, pre-existing attitudes and beliefs, and, confidence, competence and experience in delivering PE and PA (Brown & Elliott, 2015; Domville et al., 2018; Webster, 2011). Accordingly, in addition to utilising effective trial design features, involving headteachers, teachers and pupils in the development of school-based interventions appears important for improving efficacy, and supports intervention development guidance (Craig et al., 2008).

Previous research and formative studies with headteachers, teachers and pupils and pupils (Domville et al., 2018; Domville et al., under review a) led the present authors to develop a novel multi-component school-based PA intervention, underpinned by SDT. The intervention aims to improve generalist teacher's motivation orientation towards need-supportive, and consequently increase their pupil's school-based PA levels. A need-supportive motivating style is one whereby teachers cultivate and nurture a pupil's psychological needs for autonomy, competence and relatedness (Reeve et al., 2004; Reeve, 2009). Autonomy is the need of students to experience freedom of choice and be the initiators of their own actions during an activity, competence is the need to effectively carry out tasks set by a teacher, and relatedness is the need to develop meaningful social connections with teachers and peers (Cox, Duncheon, and McDavid 2009; Ryan and Deci 2000). Interventions training teachers to increase their need-supportive motivating style have observed positive changes in pupil's engagement

(Cheon et al., 2012, 2016) and MVPA levels (Escriva-Boulley, Tessier, Ntoumanis, & Sarrazin, 2017) in PE, and pupil's intention to exercise in leisure (Chatzisarantis and Hagger, 2009; Cheon et al., 2012). Further, need-support from teachers in PE is positively associated with pupil's positive effect (Standage et al., 2005), concentration (Ntoumanis, 2005; Standage et al., 2005), enjoyment (Cox, Smith, and Williams 2008; Cox and Williams 2008), general self-esteem (Standage and Gillison, 2007), and, teacher and pupil-rated persistence and effort (Standage et al., 2006; Zhang et al., 2011). These findings therefore support interventions seeking to increase generalist primary teachers' need-supportive motivating styles. Before piloting the planned intervention, the authors wanted to engage educators in further formative work to identify weaknesses in, and refinements for, the intervention. The aim of the present study therefore was to use school educator' experiences and perspectives to refine and justify a SDT-based PA intervention for primary schools, prior to future pilot testing.

6.2 Method

6.2.1 Study design

Semi-structured interviews were conducted with school teachers to gather educator opinions and perceptions of the of the blue-print intervention. The study adhered to the COREQ checklist (Tong et al., 2007) ensuring transparent reporting of key study components. Informed written consent was obtained from all participants and ethical approval granted from the institutional research ethics committee.

6.2.2 Participants and setting

Thirty schools in socio-economically deprived areas of North West England received an email invitation to participate from the research team. Five local authority run schools (16%) who expressed interest were contacted by phone by the research team to discuss the study. After obtaining written informed gatekeeper consent, all teachers were invited to participate via information sheets distributed in person. Written informed consent was obtained from 4 headteachers, 4 deputy headteachers, 4 PE coordinators (who oversee school PE development) and 6 generalist teachers across the five schools (Table 6-1).

Participants had a standard primary teacher training degree but received no specialised PE training in their pre-service education. Each school had a staff structure of a headteacher, PE-coordinator and generalist teachers. PA was not a priority in any schools' strategic development plans for improvement, but PA was promoted in three schools in accordance with UK Government initiatives (school 3, Every Child Matters, Department of Education, 2003; school 1 and 2, Healthy Schools, 2005). Generalist teachers and external coaches employed by the school shared PE teaching in schools 1, 2, 3 and 5, and only external coaches taught PE in school 4. The study adhered to the COREQ checklist (Tong et al., 2007) ensuring transparent reporting of study components. Ethical approval was obtained from the institutional research ethics committee.

6.2.3 Enhancing trustworthiness

Several approaches were used to enhance trustworthiness (Sparkes, 1998; Sparkes and Smith, 2009). For example, the focus groups were steered by the first author and trustworthiness was enhanced by encouraging participants to speak openly and honestly even if participants disagreed with the opinions of others (Shenton, 2004). In addition to this, transcribed transcripts were handed back to participants who were given the opportunity to re-read the transcript allowing for appropriate member checks, ensuring the data collected was accurate to the participants meanings. Active listening and paraphrasing were also used to help participants feel relaxed and at ease, whilst providing opportunity to check understanding of participant meanings (Shenton, 2004). The same triangulation process was carried out as stated in study 1.

Table 6-1 School characteristic information

School	School 1	School 2	School 3	School 4	School 5
Participant (male (M), female (F))	Headteacher (F) Deputy-head (M) PE-coordinator (F)	Headteacher (M) Deputy-head (F) PE-coordinator (M) Teacher 1 (F) Teacher 2 (F)	Headteacher (F) Deputy-head (M) PE-coordinator (F) Teacher 1 (M) Teacher 2 (F)	Deputy-head (F) PE-coordinator (F) Teacher 1 (M) Teacher 2 (M)	Headteacher (F)
School size	1-form entry	2-form entry	1-form entry	2-form entry	2-form entry
School Type	Faith school	Local authority	Local authority	Local authority	Local authority
Is PA a school priority?	As part of the healthy schools	As part of the healthy schools	As part of every child matters improvement points	No	No
Do you have a PE-coordinator?	Yes	Yes	Yes	P.E manager	Yes
Do generalist teachers teach PE?	Yes 50% of the time	Yes	Yes	No	Some do
Are external specialist coaches employed?	Yes 50% of the time	No (2 specialist PE teachers from local schools)	Sometimes after school	Yes	Yes
Can pupils access a playing field for PA?	Yes	Yes (poor drainage)	Yes	Astroturf	Yes
Is the PE/sports hall different from the dinner hall?	Yes	Yes	No (shared hall for PE and lunch)	No (shared hall for PE and lunch)	Yes
What PA opportunities are available to pupils?	Breakfast clubs Break and lunch recess After school club and Sports teams	Break and lunch recess After school clubs	Break and lunch recess After school clubs Sports teams	Break and lunch recess After school clubs Sports teams	Break and lunch recess After school clubs Sports teams

PA: physical activity
PE: physical education
School size: number of classes (forms) per school year group
PA as a school priority: indicates whether PA was written into the school's development plan for academic year 2016-17

6.2.4 Proposed Intervention

The primary aim of the proposed intervention was to evaluate whether a 3-month multi-component school-based PA intervention improves generalist teacher's motivation orientation towards need-supportive. Secondary aims were to evaluate the intervention effect on, teacher's motivation and self-efficacy toward school PA delivery, and pupils' PA levels, and perceived autonomy support, motivation and self-efficacy for PA. Following the present study, the authors planned to evaluate these aims in a two-arm (treatment vs control) clustered randomised controlled pilot study. The research team would provide generalist teachers training and resources to implement the intervention to pupils. The intervention was informed by previous research including the qualitative exploration of headteacher, PE-coordinator and generalist teacher perspectives on factors perceived to influence children's school-based PA (Domville et al., 2018) and pupil perspectives on factors perceived to influence their enjoyment of PE (Domville, under review a). These studies supported the use of SDT as a theoretical basis for the intervention, and in accordance with relevant items of the template for intervention description and replication (TIDieR) checklist (Hoffmann et al., 2014), Table 6-2 describes each intervention component and how they are underpinned by SDT.

Table 6-2 Proposed intervention components.

Organisational component: Leadership commitment session
After a school is randomised to the treatment arm, a researcher will meet the headteacher and PE-coordinator at their school for 1 hour to further promote organisational buy-in and intervention support. A PowerPoint presentation will facilitate discussion of the study background, rationale and aim, including the relationship between PA and health, attainment, behaviour and concentration in pupils and how schools can influence these relationships. Actions required of the school will be discussed, including the headteacher sending biweekly support emails to school educators, and, appointing a study coordinator (suggested to be the PE-coordinator) to encourage intervention implementation and facilitate communication between the school and researchers.
Individual component: Teacher training session
A researcher will deliver one 2-hour training session to teachers at their school to promote their competence and confidence to deliver the intervention. A PowerPoint presentation will facilitate the session. To support teacher's autonomy, competence and relatedness, the researcher will deliver the three-part session in a need-supportive way and create an open and friendly environment with time for questions and reflection.

Part 1 (~30 minutes) will discuss the study background, rationale and aim, the relationship between PA and health, attainment, behaviour and concentration in pupils and how schools can influence these relationships, and, barriers to school PA and how barriers can reduce teacher's motivation to deliver PA opportunities. Teachers will be invited to share their experiences of school PA and PE delivery, how the school environment influences this, and how pupil PA could be promoted. Part 1 seeks to support the fulfilment of teachers need for autonomy.

Part 2 (~30 minutes) will educate on the theory of need-supportive teaching and strategies to increase pupil's intrinsic motivation. Video examples will facilitate discussion of strategies for increasing autonomy (e.g. offering meaningful choice, nurturing self-interest and exploration, minimising controlling language), competence (e.g. offering structure, tailored support and feedback, communicating clear guidelines and expectations) and relatedness support (e.g. energetic and eager delivery, listening to pupils, coming from the pupils' perspective). The researcher will describe how teachers who internalise these strategies and use them correctly feel more competent and confident to deliver PA and show more enjoyment and motivation for teaching. Part 2 seeks to support the fulfilment of teacher autonomy and competence.

Part 3 (~1 hour) will educate on how to access and use an online PA resource centre. Practical's will provide experience of the PA videos and need-supportive teaching strategies to be implemented, including the researcher (playing the teacher) delivering videos to the teachers (playing the pupils) in a classroom. To promote and incentivise video use, teachers will be encouraged to set progressive weekly goals (e.g. engage your class in one video in week 1, two videos in week 2 etc.) with an associated reward system. The teacher's class will earn 100 points for the first 10 videos played per week and 10 points for each subsequent video. Points will be recorded via a sticker chart provided by the research team. Part 3 seeks to support the fulfilment of relatedness, helping teachers feel a sense of ownership and connectedness to the training and trainer.

Individual component: Online PA resource centre

After the teacher training session, teachers will have access to an online PA resource centre across the intervention. The centre includes 10 videos per 7 movement categories (balance, stretching, yoga, energizers, wind-down, breathing, co-ordination), designed to promote pupil's school-based PA, especially in classrooms, and pupil's PA confidence, competence, motivation, knowledge and understanding. The centre is designed to support a pupil's need for autonomy, competence and relatedness as follows.

Autonomy support: Each video is led by an onscreen coach who invites pupils to participate. Pupils determine their involvement level, with teachers trained to encourage participation when the pupil wishes, to allow self-interest to arise. Each video enables self-exploration (e.g. time to practice, explore movements). No controlling language is used by the online coach, or should be used by the teacher, with language encouraging participation and learning.

Competence support: Each category has videos of increasing difficulty to support progression and development. The onscreen coach provides guidelines and expectations

throughout, including the movement purpose (e.g. to increase one-leg balance) and how the movement relates to health, fitness and/or wellbeing (e.g. increased leg balance can increase knee strength and keep the knee injury free for sport and PE). Teachers will be trained to support and encourage the pupils by offering feedback and praise. The onscreen coach provides praise after each movement (e.g. "well done kids, you managed to balance for 30s on one leg, great effort"). *Relatedness support*: Teachers will be encouraged to participate with their pupils, listen to their concerns, and take their perspective if issues or concerns arise. Upbeat and energetic delivery by the onscreen coach seeks to create an active and engaging environment that emphasises fun and enjoyment.
Individual component: On-going teacher support
The headteacher will email teachers every 2 weeks across the intervention. The emails encourage teachers to implement the intervention and highlight existing and new videos in the resource centre. The emails will be created by the research team and forwarded to the headteacher and study coordinator. The study coordinator is to encourage the headteacher to forward the emails. A researcher will make onsite visits in intervention weeks 2, 4 6 8 and 11. Two days before each visit, the study coordinator will send teachers an email, on behalf of the research team, with time and venue information for these optional drop-in sessions. The sessions provide an opportunity to discuss the intervention and address any perceived implementation barriers. This ongoing support seeks to support the teacher's needs for autonomy, competence and relatedness.

6.2.5 Focus groups and interview

Educators from school 1, 2, 3 and 4 participated in focus groups lasting 47-65 minutes, with one headteacher interviewed (school 5, 51 minutes) (Table6-3). Focus groups and the interview were audiotaped (Olympus digital recorder) and scheduled to last no longer than 70 minutes to maintain staff engagement (Krueger and Casey, 2009). Apart from different timings and participants involved, the focus groups and interview used identical questions and semi-structured topic guides to allow free responses whilst ensuring topics were addressed in detail, permitting comparison across transcripts (Flick, 2009). To facilitate a relaxed and comfortable environment, data were collected at respective schools, in a quiet room (Doody et al., 2013) and moderated by the first author (male) trained in qualitative methods. Participants and the moderator sat in a circle to promote interaction and discussion. The moderator introduced himself and sought to reduce any participant tension by highlighting the notion of confidentiality between the participants and moderator (Krueger and Casey, 2009). Before formal questions, the moderator explained in detail the study rationale and proposed intervention components, with participants encouraged to ask questions if clarification was needed (Table 6-2). Once the participants understood each intervention component, each component was discussed separately and began with the question "*What do you think about this part of the intervention?*" Probing and discussion questions facilitated dialogue and encouraged participant interaction. Trustworthiness was enhanced by encouraging participants to speak openly and honestly even if they disagreed. Active listening and paraphrasing were used to help participants feel relaxed and at ease, whilst providing opportunity to check understanding of participant meanings (Shenton, 2004).

Table 6-3 Headteacher and Teacher Focus groups and interview schedule.

Organisational component - Leadership commitment session We propose that headteachers are trained on the importance of PA to create buy-in to PA culture which will consist of a 1hour induction session that will include; A PowerPoint presentation will facilitate discussion of the study background, rationale and aim, including the relationship between PA and health, attainment, behaviour and concentration in pupils and how schools can influence these relationships. Discuss actions required of the school including the headteacher support (i.e. sending biweekly support emails to school educators, and, appointing a study coordinator) to encourage intervention implementation and facilitate communication between the school and researchers.		
Main Question	**Discussion development/probes**	**Theoretical underpinning**
What do you think of the Intervention proposal?	Is this the most feasible approach to take? What do you as a headteachers and teachers think about the headteacher "buy-in session"? What is the best way to educate headteachers on the importance of PA for child's health, development and attainment? Will providing an "headteacher buy-in session make a difference to weather headteachers adopt an active school culture? If not, why not? What other options do you suggest to create buy-in from the Headteachers? What barriers do you foresee preventing headteachers from engaging in this session?	Headteachers are an important stakeholder in the design, development and successful implementation of school-based PA interventions. Accordingly, from a socio-ecological perspective it was important to unearth the factors that encourage headteachers to more sustainably support the implementation of school-based interventions. Furthermore, by encouraging headteachers to help in the design of the intervention, thus giving ownership and autonomy (a psychological need), their motivation to implement the intervention could be increased.

Individual component - Teacher training session (Part 1)

We propose that teachers take part in a CPD session to improve their confidence and competence to deliver PA during the school day. The session will be approximately 2 hours in length and will be split into 3 parts.

Firstly, teachers will be asked to share their experiences about school PA and PE delivery, how their specific environment negates or engenders the delivery of PA and suggest ways that PA could be increased in their school. Secondly, the presenter will present a few slides about the barriers to school PA (e.g., time, facilities etc.) and how these can reduce a teachers motivation to deliver school PA practices (Contextual info that relates to the real world of teaching -empathetic understanding of situation). Researcher will then explain importance of PA for children's health (tracking data), with a specific emphasis on the attainment, behaviour and concentration of children.

Main Question	Discussion development/probes	Theoretical underpinning
What do you think about this part of the CPD session?	What other ways do you suggest to start a CPD session? Do PE CPD session talk about these topics, if not, what do they normally address? What do you think about the structure and timing of part 1 this CPD session? What part of the session so far would teachers be *most* interested in learning about? Is there anything else you would include in this part to inspire teachers' interest/buy-in? Do you think this is a beneficial part of the CPD session – what else do you suggest?	Similar to the headteacher questions, the teacher's questions were developed again to encourage ownership and autonomy. Factors related to the organisational, interpersonal and intrapersonal levels of the socio-ecological model were discussed, as well as ways to increase teacher competence (i.e. one of the psychological needs) through the education of teachers on the importance of PA for child health, well-being and school related outcomes.

Individual component - Teacher training session (Part 2)

During this section of the CPD session we will address using PowerPoint how teachers can support or thwart a child's need for autonomy, competence and relatedness. We will address some research within the area specific to PE & give concrete examples of what need-supportive teaching is and how to use these teaching techniques to increase a child's motivation for PA and PE. We will also address how teachers who internalise these techniques and use them correctly feel more competent, confident to deliver PA and show more enjoyment and motivation for teaching PE and PA in schools

Main Question	Discussion development/probes	Theoretical underpinning
What do you think about this part of the CPD session?	How important is it to address previous CPD experiences of teachers? What is the best amount of time for the theory component of a CPD session? Would a mix of different media i.e., PowerPoint, video clips etc. be useful and if so, what do other CPD sessions do? Is it important to mention how this training will effect wider school application? Will all teachers attend the CDP sessions or is it only for those who choose?	Specifically relating to the discussion of underpinning pedagogy to support intervention outcomes, need-support was highlighted by the researchers as an important pedagogy to increase both teachers' motivation (to deliver PA) and children's motivation (to engage in PA). Again, by encouraging teacher involvement in the development of the intervention, it was hoped that this would encourage ownership during the implementation stage.

Individual component - Teacher training session: Putting theory into practice (Part 3)

During this part of the CPD session teachers will get to put the teaching techniques they have learnt into practice. There will be four blocks within this hour practice period consisting on of: Block 1: Integrating autonomy support – Using other teachers as a platform for learning, each teacher will be given a situation and with that situation have to choose the best form of autonomy support. The same ideas will be used here for competence (block 2) and relatedness (block 3). Block 4: Block 4 – Self-reflection of teaching practices task, time for questions, setting any queries etc.

Main Question	Discussion development/probes	Theoretical underpinning
What do you think about the practical part of the CPD session?	How does this structure, content and layout compare to other practical CPD sessions you have attended? Would it be better if the researcher took a typical lesson and tried to involve the need-supportive aspects as part of the lesson? How would you like to be taught in this practical session?	Similar to the importance of ownership discussed above, teachers were again provided with an opportunity to discuss the practical training of the intervention, and how best this may work in the school-environment, considering all levels of the socio-ecological model. The importance of psychological need support for enhancing teacher engagement in the session was also intended to improve teacher motivation to deliver the sessions.

Individual component: Online PA resource centre

The final part of the CPD session will involve an introduction to the classroom PA resources. By this, we will introduce the teachers to the resource centre whereby they can access exercise sessions to help increase classroom PA levels. **Show teachers examples of classroom PA resources.** Explain that the resources have been designed to support children's psychological needs for autonomy, relatedness and competence using a model on screen to "model the PA movements"

Main Question	Discussion development/probes	Theoretical underpinning
What are your initial thoughts on the resources?	What would you/would you not change/why?	This part of the session was underpinned by SDT, and in particular, the development of the resources that were designed to support children's psychological needs. For example, to increase competence there was a model available on screen for the children to copy.

Individual component: On-going teacher support

After the CPD session researchers would like to continue to support teachers to deliver school PA practices. There are many ways to continue to support teachers. One way for example is to send daily emails with new material. We could come to the school in person, or simply deliver more CPD sessions to ensure teachers are feeling confident and competent to deliver PA.

Main Question	Discussion development/probes	Theoretical underpinning
What do you believe is the best way to support the teachers and foster a continued and sustained PA culture?		Supporting teachers throughout the intervention and after the training, all levels of the socio-ecological model were discussed for targeting. For example, organisational support could be delivered through weekly headteacher emails sent from the researchers to encourage teacher buy-in.

6.2.6 Data analysis and representation

Focus group and interview data was transcribed verbatim and each transcript read several times to immerse the first author in the data (Silverman, 2005). Transcripts were imported into NVivo10 qualitative analysis software. The first author used thematic analysis to identify, analyse and report patterns (themes) within the data (Braun and Clarke 2006). Deductive and inductive coding was used to extract factors that educators perceived important for the successful implementation and maintenance of the proposed intervention. Pre-determined broad themes (based on the intervention components) helped structure the emerging themes using a deductive approach. Once themes were established, inductive coding facilitated the emergence of specific codes and categories, and specific quotes, conversations and paragraphs, allowing broader themes to emerge from the data to best encapsulate participants' meanings (Braun and Clarke, 2006). This process, known as open coding, is believed to enhance credibility when analysing semi-structured data collection techniques (Morse, 2015). Frequent meetings between all authors enabled the discussion, debate and re-definition of themes until consensus was reached.

6.3 Results

Three themes emerged with regard to the refinement and justification of the proposed SDT-based PA intervention for primary schools: 1) pre-implementation considerations, 2) intervention training and delivery, and 3) post-intervention support (Table 6-4). Each theme is presented in turn, with supportive illustrative quotes attributed by school number (1-5) and participant job role (e.g. headteacher) in accordance with Table 6-1.

Table 6-4 Themes, subthemes and illustrative quotes related to the proposed intervention.

Theme	Sub-theme	School	Illustrative quotes
Pre-implementation considerations	Tailoring to school preferences	1, 2, 3, 4, 5	*"I suppose if you're planning the delivery, you're talking to the head beforehand. There's a needs analysis before you actually deliver the training, and tailor-making it [intervention] for each school." (PE-coordinator, school 2)*
	Providing an evidence-based rationale	1, 2, 3, 4	*"I think a lot of school educators, especially if you've got data, and you say, "This is what happens, the average child gets this much exercise a week, and if they did an extra ten minutes a day, it improves this, it reduces...So giving teachers the actual knowledge of why it's benefit." (PE-coordinator, school 4)* *"I think also, highlighting the worth. I think school teachers'd be more willing to engage and be more pro-active and implementing it, if they can see the purpose and the worth of it…like what children gain from doing regular exercise. So if it's considered as a valuable activity, we're more likely then to ensure that it happens" (Head-teacher, school 2)*
	Offering demonstration lessons	1, 4, 5	*"I mean personally, I feel that the best way of accessing, all access in schools is through demonstration lessons." (Headteacher, school 1)*
Intervention training and delivery	Reducing teacher's anxieties	1, 2, 3, 4, 5	*"Have something practical, a bit of fun. I just think it comes in that little wow factor, like you would do with the children. You'd want to create a buzz with them first, otherwise it's*

			going to be something that they won't be engaging with." (Deputy head, school 1)
	Enhancing teacher's confidence and competence	1, 2, 3, 4, 5	*"If they're [resources] simple and they're easy to use, and you can fit them into the timetable because they're nice and short…If you could show the teachers they can do it there and then in their classroom, and they don't have to get changed, they don't have to walk down the corridor to somewhere else, I think that might help enormously." (PE-coordinator, school 3)*
	Gaining practical experience	2, 3, 4, 5	*"So if we are doing what they [kids] would do, then you experience sort of how it could be done, and how we would feel as we were experiencing it, if you will…'What you've just experienced in the last five minutes is this, this, this'…and that's what we're trying to do", making the link between the knowledge and doing the stuff." (Deputy head, school 3).*
Intervention support and maintenance		1, 2, 3, 4, 5	*"Keep them [school educators] updated, like you said, with the new things they've added. 'You might want to see this', and then kind of firing [emailing] things out to them would be good. But like I said, teachers like to see things in action and stuff like that, so those touch days that you come back in are good." (Deputy head, school 1)* *"It [the intervention delivery] has to be part of the school's ongoing development, so they'd have to kind of commit to it, and say, "Right, ok, every third staff meeting is going to review how everyone's going…but you have to make sure that the schools that are bringing it in, they're committing to it as whole school."(Headteacher, school 3)*

6.3.1 Pre-implementation considerations

Three subthemes emerged as important factors to consider before implementing the proposed intervention (Table 6-2): a) tailoring to school preferences, b) providing an evidenced-based rationale, c) offering demonstration lessons.

Tailoring to school preferences. Headteachers and teachers believed that before implementing the proposed or any other school-based PA intervention, researchers should consider the current needs, beliefs and priorities of schools and their staff, and align the intervention to these, where appropriate. In relation, while teachers supported the proposed leadership commitment session, they suggested the length, content and delivery method should be adaptable to individual schools. While three teachers supported the 1-hour duration, one headteacher (school 2) suggested offering alternative delivery methods (e.g. printed information) to the use of PowerPoint to discuss the study background, rationale and aim, as time with teachers is often limited. Further, all teachers stated they understood the importance of PA for child health and therefore the educational component of the session may be better suited to teachers lacking this knowledge.

Providing an evidenced-based rationale. Educators indicated that providing an evidenced-based rationale for an intervention would promote school and teacher buy-in, and the likelihood of the intervention being implemented, with one supportive quote stating, "*Fundamentally I think we should understand why we're doing stuff. So if we're using it as an intervention, and we're trying to increase stuff, we have to understand why"* (Teacher 2, school 3).

Offering demonstration lessons. When subsequently asked about other ways to increase school and teacher intervention buy-in, all participants identified demonstration lessons as a means to see the intervention in action and assess its fit with school needs and priorities. Teachers also perceived demonstration lessons as an opportunity for researchers to establish relationships with schools, generate interest in the intervention, and, analyse the current needs, beliefs and priorities of a school to help inform intervention content and delivery.

6.3.2 Intervention training and delivery

Three subthemes emerged as important factors to consider when training teachers to deliver the intervention (Table 6-3): a) reducing teacher's anxieties, b) enhancing teacher's competence and confidence, c) gaining practical experience.

Reducing teacher's anxieties. Teachers indicated PA and PE-related training often causes anxiety or fear in generalist school educators, leading to low engagement in training. Consequently, educators stated the importance of reducing such anxiety or fear from the start of the proposed teacher training session. To do this, teachers suggested introducing the training as a partnership for personal development, and, being clear that school educators' level of practical involvement was not a judgement of their delivery skills. Educators stated that providing 'a hook' at the start of the training was essential to increase engagement and show teachers the training was nothing to fear. Suggestions for 'the hook' included a short practical related to the intervention or the use of media such as videos. All believed 'the hook' should be "outside the box", "easy to engage in" and have a "wow factor" related to the intervention. One teacher further suggested notifying the teachers before the training of what to expect, and making participation in practical elements optional, with these suggestions supported by other participants. Regarding other content in the training session, some educators agreed with including discussion of barriers and challenges to delivering PA and PE in schools, while others perceived it unnecessary, as they believed they already knew them.

Enhancing teacher confidence and competence. Teachers believed the online PA resource centre and videos were a good way to implement PA across the school day, avoiding barriers to PA and PE outside the classroom, such as changing location and into kit. To promote use of the resource centre and videos, educators stated they had to be easy to use, quickly accessible and require little planning, with ease of use especially important for increasing teacher's confidence and competence to implement the videos. Teachers noted the training should enable teachers to deliver the videos the next day, with one stating, "*I always like coming away from any form of training, knowing that I've got something to use straight away…it's going to benefit the children, because that's why I'm here at training"* (Teacher 1, school 2). Educators believed that school educators' level of engagement in the training will vary depending on their

confidence and competence to engage in PA. Accordingly, educators highlighted the importance of being aware of and flexible to individual preferences and needs. To this end, educators believed that to encourage teacher participation, training should be delivered in short blocks, be non-threatening and non-competitive.

Gaining practical experience. Educators agreed with the proposal for teachers to experience the theory in action during the training session, especially from a pupil's perspective. Contrary to the proposition to provide practical experience of the theory after the theory section, educators suggested integrating the theory into the practical. Educators believed a training delivery style that helps teachers physically see and understand how the intervention is to be delivered will improve school educators' understanding of the theory and facilitate discussions of the theory in the training. Lastly, educators believed the proposed time for reflection and questions in the session would help teachers begin to understand how they could apply the resources and teaching strategies in their practice and develop perceived ownership of the intervention.

6.3.3 Intervention support and maintenance. Educators stated that the proposed on-going support and study coordinator appointment were critical to keep teachers motivated to deliver the intervention, as "*one off training events do not work*" (Teacher 1, school 2). Educators perceived the proposed bi-weekly emails as a simple and quick way to keep school educators' action-focused and suggested they could provide additional training material and ideas to support video use. Educators believed the proposed researcher school visits were a good way to assess the interventions impact and offer support and feedback. In addition, educators suggested that continuous discussion and monitoring of the intervention were important to encourage short and longer-term implementation. One teacher (Teacher 2, school 4) suggested a forum would enable teachers to support each other and share knowledge and experiences of the intervention, and others identified school staff meetings as an opportunity to regularly discuss the intervention and promote buy-in from teachers less inclined to attend or engage in the proposed researcher school visits. Regarding monitoring, educators supported the proposed weekly goal setting and saw it as important to help promote individual commitment and implementation. By having these individual commitments or goals,

educators considered it easier for teachers and researchers to track teacher progress and support on-going delivery.

6.4 Discussion

The present study used school educator experiences and perspectives to refine and justify a novel, SDT-based PA intervention for primary schools. Teachers offered invaluable opinions and suggestions on how to improve the intervention components and promote the likelihood of the intervention being implemented by generalist teachers over a sustained period. These findings support previous investigations and intervention development guidance that advocate co-developing interventions with end users (Craig et al., 2019). The following discusses the findings in relation to previous research, and justification and refinement of the proposed intervention. The new blueprint intervention is provided at the end of the discussion in Table 6-5

Before implementing the proposed intervention, educators believed it was necessary to consider the varying needs, beliefs and priorities of schools and its staff to promote intervention buy-in. Specifically, researchers should consider how interventions can support schools at an organisational (i.e. school priorities), interpersonal (i.e. teacher needs) and intrapersonal level (i.e. teacher beliefs), in order to enhance successful and sustained implementation. Similar formative work, assessing teacher beliefs and opinions support the necessity of staff buy-in and training to encourage program maintenance (Jago et al., 2015). Despite this however, organisational pressures including limited time and curriculum pressures still reduce successful PA implementation, even when training programmes have been implemented to increase teacher delivery confidence and competence (Goh et al., 2013; Langille & Rodgers, 2010).

From an organisational perspective, educators noted the importance of intervention flexibility. Flexibility has previously been noted as a key factor to facilitate intervention implementation (Naylor et al., 2006; Christian et al., 2015) possibly due to competing demands (i.e. demands on time) that exist throughout schools. Flexibility in intervention design, timing and personal (Jain and Langwith, 2013) have all been highlighted as key factors that influence the successful

implementation of PA interventions, further supporting a multi-component approach to intervention design. Accordingly, as described in the present investigation, and supported by previous work, a needs analysis that takes into account the organisational, interpersonal and intrapersonal factors that may limit successful PA implementation is key (Langille and Rodgers, 2010). This supports notions that the school environment is constantly shifting, which as described by Jones et al. (2014), requires "responsiveness to changing school circumstances" if interventions are to be successfully implemented. The constantly shifting nature of the school environment of course demands that researchers stay up to date with changing school polices and priorities by developing interventions informed in partnership with end users (Cole and Horacek, 2009; Christian et al., 2015; Naylor et al., 2015).

Stakeholder buy-in has been previously evidenced as a critical factor to support the implementation of interventions in schools (Brown & Elliott, 2015; Russell Jago et al., 2015; Stolp et al., 2014). Our findings support this notion and extend reasoning that buy-in exists at all levels of the school, from the head teacher to the pupils. For example, teachers stated that a critical component of buy-in during training was the provision of an evidenced-based rationale (i.e. why is this intervention important and how will it affect pupil outcomes). Evidence-based rationales have been previously reported by teachers as import during training (Aelterman et al., 2014), and also play a key role in the development of an autonomy-supportive environment (Ryan & Deci, 2000) helping to increase teacher PA delivery motivations. This highlights the significance of providing education and rationale on the importance of PA for child health and how PA can positivity impact school-related outcomes (Donnelly et al., 2016). Considering that headteachers are given "a degree of autonomy" about the health programs they choose to implement, based on their perception of school needs (Todd et al., 2015), rationales that align with school needs (i.e. to increase academic performance), may help facilitate intervention adoption, implementation and maintenance.

Offering a meaningful rationale (which includes a theoretical underpinning), providing engaging content (to promote teacher interest) and offering choice of involvement during training (to reduce training fears) are all school educator provided examples of autonomy-support described in the present investigation and relate somewhat to the affective and

cognitive learning domains which can increase engagement motivations (Sun et al., 2017). While most of the learning domain research related to SDT has been carried out in PE with child and adolescent participants, evidence also suggests that need-support during training is a fundamental component in the development of autonomous teacher motivation (Aelterman et al., 2014). This is extraordinary, considering the same motivational techniques not only appear to impact child motivation for PE, but also teacher motivation to deliver it. Accordingly, providing training in such a way that it satisfies teachers psychological needs for autonomy, competence and relatedness (i.e. need-fulfilment) is related to changes in teacher's effectiveness and feasibility beliefs to implement new teaching strategies, which support intervention implementation (Aelterman et al., 2016). The opinions expressed by teachers to facilitate buy-in are closely aligned with interpersonal strategies to increase teacher motivation. It is therefore recommended that interventions are underpinned by appropriate motivational theories and aim to provide learning experiences on all domains, supported by motivational techniques that help support behaviour change (Lai et al. 2014)

Investigations that have assessed classroom-based PA resources also suggest resource availability, flexibility and preparation time all effect school educators' implementation and delivery motivation (Naylor et al., 2006). The motivation to deliver PA during the school day is also largely affected by intrapersonal factors including school educator confidence and competence, as well interests, values and individual commitments (Domville et al 2018). Teachers in the present study liked the provision of an online PA resource centre to promote PA across the school day and especially in classrooms. Teachers stated that for the PA resources to be continually implemented, resources had to be easy to use, require little planning and be quickly accessible, as reported in previous studies (Goh et al., 2017; Patti-Jean Naylor et al., 2006) . Resources described in the current investigation were perceived beneficial as they overcame barriers to PA outside the classroom, including limited space and time, and logistical issues such as relocating the children and getting them changed into kit. While these findings are supported by previous work (Metcalf et al., 2012; Naylor et al., 2015; Russ et al., 2015), it must be noted that teachers opinions were based on perceptions of how the resources may reduce barriers to PA. Educators in the present investigation believed that training was important to help teachers overcome intrapersonal and interpersonal barriers to

PA delivery including reducing training fears and increasing intervention engagement. While training has been shown to help teachers overcome interpersonal and intrapersonal barriers, often organisational ones still exist (Goh et al., 2013). Accordingly, while the researcher should be aware of individual educator needs and preferences, targeting organisational barriers appear most integral.

While some teachers liked the idea of an in-depth theory section in the proposed training session, others preferred the theory to be integrated into the proposed practical section, or even presented after the practical. The reason for integration into the proposed practical was to provide teachers with a greater understanding of how they can assimilate the theory into classroom practices, whilst staving time in the process, a finding that has been previously reported as important to teachers (Naylor et al., 2015). Experiential learning opportunities such as these are believed to be critical when developing professional learning programs, allowing the development of an authentic work situation that aligns closely to the classroom environment (O'Sullivan and Deglau, 2006). When discussing how teachers can gain practical experience of implementing the intervention, teachers recognised the value of activities that enabled them to step in the children's shoes and experience how children might "feel" during activities. This is a unique finding of the present investigation and supports findings that for interventions to be successful, teachers need to first recognise how the intervention will affect their children and how they may respond to it (Naylor 2006). By delivering the intervention to teachers in such a way (i.e. role play), the environment provides an opportunity to support teacher needs for relatedness (i.e. creation of a warm, friendly environment), whilst simultaneously showing teachers how the intervention is to be delivered (Aelterman et al., 2013) and thus providing opportunities to increase competence and relatedness.

Teachers also agreed that time during the proposed practical section was needed for reflection, to take ownership of the techniques and consider delivery approaches that suited their teaching style and the needs of their pupils. This is supported by Armour and Yelling (2004) who state a significant feature of effective teacher training is the opportunity to reflect. Reflection not only helps in the acceptance of a new teaching style (Reason & Bradbury, 2008) but may fulfil a teachers need for autonomy and competence through the exchanging of

opinions and ideas (Aelterman et al., 2013). Similar to Mosston & Ashworth, (2008) spectrum of teaching styles, the aim of the practical and reflection session is to encourage teacher ownership, where a dual-learning approach can be taken, helping to guide the teachers toward a more self-determined learning approach, rather than a command-style approach which may reduce teacher autonomy.

Educators perceived emails and on-site visits by the research team as a good approach for assessing intervention effectiveness and offering on-going support and feedback. According to Lai et al. (2014), many PA interventions fail to appropriately support school educators, which negatively impacts maintenance. Yet, follow-up support, training and consultation, such as face-to-face meetings, are critical to ensure interventions are achieving the proposed outcomes (Lander et al., 2017). Accordingly, most staff noted that to promote intervention implementation and maintenance, it was important to regularly review the intervention as part of the schools on-going development, thus increasing organisational buy-in. Staff meetings were viewed as an ideal platform for this as they provide a regular structured opportunity for all staff to share experiences, discuss challenges and promote good practice. This is a unique finding and supports the importance of interventions to align to school development plans or be prioritised within schools and not viewed as an "add-on". To further support staff, teachers suggested setting individual goals and commitments to promote sustained intervention delivery, provide ownership and allow progress to be tracked. Aligned with the suggestion of Jago et al. (2015), one participant also noted having a study coordinator to support teachers when researchers are not present, possibly increasing relatedness and autonomous motivation for intervention implementation and maintenance.

Table 6-5 The intervention design evaluated in study 3, and the refined intervention design evaluated in study 4

Organisational component - Leadership commitment session changes	
Pre-intervention design (study 3)	***Post-intervention design (study 3)***
No offering of demonstration lessons to increase school buy-in	Offering of demonstration lessons to increase school buy-in and foster intervention support from school stakeholders including head teachers, staff and pupils.
Structured 1-hour PowerPoint session delivering the aims stated. Discuss; a) PA resources to be implemented; b) importance of PA for children's health, attainment, behaviour and concentration; c) establishing of a study co-ordinator, who is present during the school recruitment and d) establishing of commitments to forward researcher emails to appropriate members of staff.	Changes made to the organisational component of the intervention, as suggested by school stakeholders included the offering of various media to upskill headteachers on the importance of PA for child health, well-being and school related outcomes. Accordingly, instead of just a PowerPoint option, headteachers wanted a menu of options including PowerPoint (computer based), booklet (to read) or an informal chat option. Variations in opinions were suggested to be related to time constraints, as well as current knowledge and understanding of PA for health and school related outcomes.
Individual component - Teacher training session changes	
Intervention design (study 3)	***Post-intervention design (study 3)***
Delivery of a 2-hour training session The 2-hour training session included; A) a background and rationale on the importance of PA for children's health and school related outcomes. B) Education on the theory of need-supportive behaviour and education on how to access C) Explanation on the use of the online PA resource centre D) Practical experience delivering PA resources.	Delivery of a 1-hour training session due to perceived barriers related to time. The 1-hour training to also focus on; A) Reduce teacher training fears and providing "a hook" to increase early teacher buy-in to the training. B) Delivering the education and pedagogy with a clear focus on why teachers were delivering intervention in such a way. C) This included delivering training as a partnership, and using role play to increase delivery experience

Individual component – Description of resources and training manual (see links to YouTube resources in appendix page 206)	
Intervention design (study 3)	***Post-intervention design (study 3)***
After the teacher training session, teachers will have access to an online PA resource centre across the intervention. The centre includes 10 videos per 7 movement categories (balance, stretching, yoga, energizers, wind-down, breathing, co-ordination), designed to promote pupil's school-based PA, especially in classrooms, and pupil's PA confidence, competence, motivation, knowledge and understanding. The centre is designed to support a pupil's need for autonomy, competence and relatedness as follows. *Autonomy support*: Each video is led by an onscreen coach who invites pupils to participate. Pupils determine their involvement level, with teachers trained to encourage participation when the pupil wishes, to allow self-interest to arise. Each video enables self-exploration (e.g. time to practice, explore movements). No controlling language is used by the online coach, or should be used by the teacher, with language encouraging participation and learning. *Competence support*: Each category has videos of increasing difficulty to support progression and development. The onscreen coach provides guidelines and expectations throughout, including the movement purpose (e.g. to increase one-leg balance) and how the movement relates to health, fitness and/or wellbeing (e.g. increased leg balance can increase knee strength and keep the knee injury free for sport and PE). Teachers will be trained to support and encourage the pupils by offering feedback and praise. The onscreen coach	No specific changes were made post study 3 to the online PA resources A user-manual was created however which included pictorial images of the movements to do with the children if videos were inaccessible online. The user-manual also introduced; a) each of the coaches to the teachers via a picture and an informational paragraph; b) provided a step by step procedure for accessing the videos; c) provided various ways teachers could increase the need-support of children during the PA lessons and d) provided a description of each of the video's and perceived effects on children's health and school related outcomes (see appendix). Before starting the videos, teachers were asked to play the 'coach introduction video', a video presented by the PA coach (i.e. principle researcher) which explained specifically to the children what they would achieve from the PA videos.

provides praise after each movement (e.g. “well done kids, you managed to balance for 30s on one leg, great effort”). *Relatedness support*: Teachers will be encouraged to participate with their pupils, listen to their concerns, and take their perspective if issues or concerns arise. Upbeat and energetic delivery by the onscreen coach seeks to create an active and engaging environment that emphasises fun and enjoyment.	
Individual component - On-going teacher support	
Intervention design (study 3)	***Post-intervention design (study 3)***
The headteacher will email teachers every 2 weeks across the intervention period. The emails encourage teachers to implement the intervention and highlight existing and new videos in the resource centre. The emails will be created by the research team and forwarded to the headteacher and study coordinator. The study coordinator is to encourage the headteacher to forward the emails. A researcher will make onsite visits in intervention weeks 2, 4, 6, 8 and 11. Two days before each visit, the study coordinator will send teachers an email, on behalf of the research team, with time and venue information for these optional drop-in sessions. The sessions provide an opportunity to discuss the intervention and address any perceived implementation barriers. This ongoing support seeks to support the teacher’s needs for autonomy, competence and relatedness.	Emails to include additional training materials. Teachers received an email from the study co-ordinator at the start of weeks 2 and 4 of the intervention (9am). Drop in sessions occurred at the end of week 1 and the start of week 3. Two days before each visit, the study co-ordinator sent teachers an email, on behalf of the research team, reminding them of the time and venue of these optional drop-in sessions. Drop in session usually typically involved meetings with the study co-ordinator as other teachers were unable to attend. The sessions provide an opportunity to understand how the intervention is proceeding and discuss and address any perceived implementation barriers. This ongoing support seeks to support the teacher’s needs for autonomy, competence and relatedness.

6.4.1 Strengths, Limitations and future directions

In accordance with the MRC framework for developing complex interventions (Craig et al., 2008) the present study supports the importance of co-developing primary school-based PA interventions with school educators. The experiences and perceptions gathered from school educators, teachers and PE-coordinators will inform the development of the proposed school-based PA intervention, increasing its likely implementation and maintenance, and thus likely effectiveness at improving generalist primary school teacher's motivation orientation for PA delivery, and ultimately children's school-based PA and health. The findings are also valuable for practitioners and teachers involved in developing and implementing school-based PA interventions. While the application of focus groups and one interview provided a rich understanding of how the intervention could be refined and developed, caution is warranted when generalising the findings beyond the proposed intervention. Due to the convenience sampling based on level of interest and the small sample size which may not be representative of the population. Furthermore, as teachers provided perceptions of a proposed intervention rather than perceptions after participating in the actual intervention, similar evaluation post-intervention participation is encouraged. A challenge for future researchers, practitioners and teachers is to engage in similar development work to understand the factors that may influence the implementation and maintenance of school-based PA interventions, to build on the present study and improve our understanding of how more effective school-based PA interventions can be developed.

6.4.2 Conclusion

The present study explored the perspectives of teachers on a novel, SDT-based PA intervention for primary schools. The findings suggest that the proposed, and other primary school PA interventions, can be designed and developed in a flexible manner to meet the needs of a school, its staff and its pupils. Providing a clear, evidence-based rationale for the intervention, and demonstration sessions of the intervention, appear critical for gaining headteacher and school buy-in. Educators believed it was important to ensure teachers felt comfortable during training sessions, and this could be achieved by reducing training fears, offering choice of involvement, and, delivering the training in short, manageable chunks with time for reflection, practice and feedback. Furthermore, educators believed the training would be more effective

and time efficient if the theory underpinning the training was incorporated into the practical parts of the training session, as this would allow teachers to understand how and why the intervention was to be delivered as intended. Critical to the training was increasing the educator's confidence and competence to deliver the online PA resources and to that end, ensuring that the resources were quick to use, easily accessible and required little planning. Finally, to promote intervention implementation and maintenance, monitoring of the intervention via staff meetings and continued support for teachers via emails and drops-ins were perceived critical. Ultimately however, if generalist teachers are to be autonomously motivated to deliver the proposed or other school-based PA interventions, interventions must be given high status by teachers to ensure staff are consistently encouraged, supported and monitored to deliver the intervention as intended.

6.4.3 Summary for business and practitioners

The present investigation plays a critical role in highlighting the necessity of end-user feedback with respect to a proposed intervention, prior to the implementation stage. In accordance with the MRC framework (Craig et al., 2008), as well as the opinions of other authors (Doak et al., 2006), one of the fundamental problems with school-based interventions is a lack of consideration given to the wider school environment during the initial design and development of school-based behaviour change interventions. Accordingly, by designing interventions alongside end-users, interventions stand a greater chance of being successful and effective once implemented into a real-world setting. Given the data collected in study 3, the refinement and application of the proposed intervention could now be implemented and evaluated for acceptability and feasibility in school-based environments. While the process of formative research and co-production of the intervention was a long process spanning 3 separate studies, it allowed the first author to develop an intervention which was underpinned by appropriate behaviour change theory, and was aligned to the needs of school, teachers and its pupils. Furthermore, the multi-component nature of the intervention was perceived to further enhance implementation success and sustainability over single component counterparts. Taking this perspective, it is of absolute importance that practitioners and businesses alike to understand what schools want from an intervention and accordingly have flexibility in their approach to meet the specific needs of schools. The constantly changing

landscape of the educational system requires intervention developers to adopt this flexible approach and co-produce interventions with end users to ensure what is developed is fit for purpose.

7. Acceptability and feasibility of a novel self-determination theory-based physical activity intervention for primary schools

7.1 Introduction

Children spend a large proportion of a school day in the classroom, providing a unique opportunity to promote PA (Kohl et al., 2001), yet only 5% of daily PA occurs in the classroom (Brusseau et al., 2011). Barriers to PA in the classroom include limited time, space and insufficient teacher training to implement and deliver PA opportunities (Goh et al., 2013, 2017; Webster et al., 2015). Despite these barriers, evidence suggests that classroom-based PA interventions can improve pupil's academic achievement (Uhrich and Swalm, 2007; Adams-Blair and Oliver, 2011; Donnelly and Lambourne, 2011), on-task and off-task behaviour (Mahar et al., 2006; Mahar, 2011; Ma et al., 2014), perceived competence and classroom effort (Vazou et al., 2012), enjoyment and positive effect (Donnelly et al., 2009; Howie et al., 2014; Vazou and Smiley-Oyen, 2014), school-based PA levels (Webster et al., 2015) and PA outside of school (Sirota et al., 2014). Systematic reviews further suggest classroom-PA promotion is an important component of CSPAP (Erwin et al., 2012; Webster et al., 2015; Watson et al., 2017). While the aforementioned interventions observed positive effects, none were underpinned by behaviour change theory and none provided on-going teacher support. This may have reduced their effectiveness, as interventions underpinned by behaviour change theory, and providing teachers with adequate training (≥1 day) and on-going support, appear more effective (Lai et al., 2014; Lander et al., 2017). A further critique of classroom-based interventions is their failure to consider the wider socio-cultural factors that may influence implementation and delivery (Webster et al., 2015) even though such barriers have been previously reported (Erwin et al., 2011; Goh et al., 2013, 2017).

Based on the results of formative research by the present authors (thesis studies 1, 2 and 3) and other investigations (Langille and Rodgers, 2010; Webster, 2011; Huberty et al., 2012; Christian et al., 2015; Clarke et al., 2015) a multi-component, online classroom-based PA intervention for primary schools was developed to increase teachers motivation-orientation to support the delivery of PA throughout the school day. Before solely evaluating the intervention for effectiveness however, the authors sought to assess the acceptability and feasibility of the intervention. This is important for identifying potential problems with the acceptability, compliance and delivery of the intervention, plus recruitment and retention rates (Craig et al., 2008; Feeley et al., 2009). Feasibility testing is often overlooked in the design

of complex interventions (Eldridge et al., 2004) and can lead to poor implementation, sustainability and impact during the evaluation stage (Craig et al., 2008). Therefore, the first aim of the present study was to evaluate the acceptability and feasibility of the intervention. Specific objectives were to assess response, recruitment and attrition rates, completion rates for all outcome measures, and the acceptability of the intervention from teacher and pupil perspectives, including any adverse effects such as injuries and disruption to school practices. A secondary aim was to derive preliminary estimates of the effects of the intervention on teacher and pupil outcomes. Specific objectives were to collect pre-post data on teacher and pupil outcomes and compare intervention effects between an intervention and control group.

7.2 Method

7.2.1 Study Design

A two-arm (control and intervention) non-randomised pilot study was conducted between September 2016 and July 2017. Two, one-form entry schools (school 1 and 2) were allocated to the intervention condition to provide similar participant numbers to the one school (school 3; two-form entry) in the control group. See table 7-1 for details of school characteristics. The intervention was carried out in accordance with relevant items of the TIDieR checklist (Hoffmann et al., 2014). Ethical approval was obtained from the institutional research ethics committee.

7.2.2 Participants and Settings

Organisational Level

Open information retrieved from the websites of Government-funded primary schools across Liverpool and Manchester enabled the principle researcher to assess schools for study eligibility based on the following criteria: student enrolment >180 (4-11 years old)), availability of smart-board delivery technologies in classrooms (assessed via call to school reception), school index of multiple deprivation (IMD: as an indicator of socio-economic status) below 40 (indicates low, i.e. in a high deprivation area; McWhannell et al., 2018) defined by school postcode. Of 21 eligible schools contacted via email which (included an introduction to the study and study information sheets) by the principle researcher between September 2016 and December 2016, 5 expressed an interest via return of email. After further explanation of the

study via phone conversation with the headteachers, 3 consented to their involvement. Upon meeting the head teachers at their respective schools, written-informed signed consent was given from the head teachers to have access to school grounds and to recruit teachers and pupils for the study. During this time, head teachers also took part in the leadership commitment session (Table 7-1).

Individual Level – Generalist Teachers

The principle researcher conducted an information session at each of the three schools with the respective generalist teachers (*n*=16 across school years 3-6). The information session comprised of an explanation of the study and its aims, the role of the teacher in the study and a live demonstration (taster session) of the online PA resource centre and videos. Teachers who expressed verbal interest were provided with a pack which included a study information sheet and consent form. Teachers were given 7 days to return the forms. The inclusion criteria was that teachers taught key stage 2 children, were full time members of staff, had access to email, and had no planned absence from work for >2weeks or a planned relocation to another school/job during the 4-week intervention.

Individual Level - Children

The principle researcher conducted an information session at each of the three schools. For ease of recruitment all children (years 3-6) were shown to the hall where the principle researcher explained the study and its aims, the roles of the children in the study and a live demonstration (taster session) of the online PA resource centre and videos. Children received a pack which included an information sheet, an assent form (to be signed by the child) and a consent form (to be signed by the parent/guardian). Both forms were asked to be returned within a week if children wished to be included in the study. The inclusion criteria was that students were in key stage 2 (7-11 years old) and available for the duration of the intervention period (four weeks).

Table 7-1 School characteristics

School	School 1 Intervention school	School 2 Intervention school	School 3 Control school
School size	1-form entry	1-form entry	2-form entry
School Type	Local authority	Local authority	Local authority
Is PA a school priority?	As part of the healthy schools	As part of the healthy schools	No
Do you have a PE-coordinator?	Yes	Yes	Yes
Do generalist teachers teach PE?	Yes 50% of the time	Yes	Some do, but prefer to use specialist employed by the school
Are external specialist coaches employed?	Yes 50% of the time	No	Yes
Can pupils access a playing field for PA?	Yes	Yes	Yes
Is the PE/sports hall different from the dinner hall?	Yes	No	Yes
What PA opportunities are available to pupils?	Breakfast clubs Break and lunch recess After school club and Sports teams	Break and lunch recess After school clubs	Break and lunch recess After school clubs Sports teams

PA: physical activity
PE: physical education
School size: number of classes (forms) per school year group
PA as a school priority: indicates whether PA was written into the school's development plan for academic year 2016-17

7.2.3 Intervention

The primary aim of the proposed school-based PA intervention was to improve generalist teacher's motivation orientation towards need-supportive. Secondary aims were to promote teacher's motivation and self-efficacy toward school PA delivery, and pupils' PA levels, and perceived autonomy support, motivation and self-efficacy for PA. The planned intervention duration was 3-months, however due to logistical issues with development of the intervention resources and limited time due to the schools' academic calendars, the duration reduced to 1-month. At no cost to the school, the intervention was designed to be delivered by generalist teachers and was informed by previous formative work conducted with headteachers, teachers and pupils (study 1, 2, and 3). The intervention was underpinned by SDT and SEM (see schematic map below, Figure 7-1) and consisted of four intervention components: 1) a leadership commitment session, 2) a teacher training session, 3) a resource centre for teachers, and, 4) on-going support for teachers. Table 7-2 describes each component in accordance with relevant items of the TIDier checklist (Hoffmann et al., 2014), how formative investigations informed the intervention and how SDT constructs (e.g. autonomy, relatedness and competence) informed/supported the development of each intervention components.

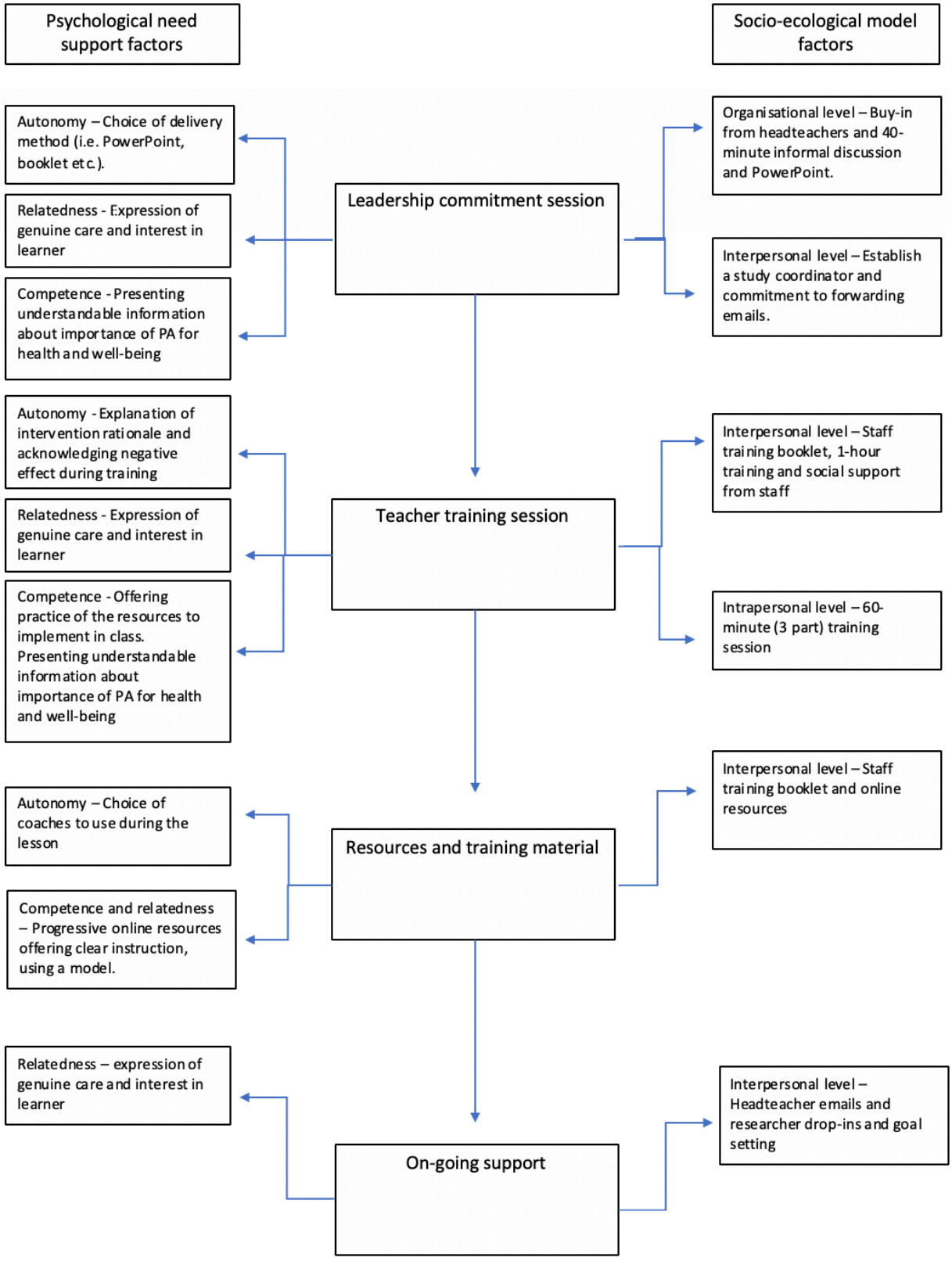

Figure 7-1 Schematic map of intervention mapped to SDT and SEM

Table 7-2 Intervention components delivered as part of the classroom-based intervention.

Organisational component - Leadership commitment session
Due to limited time headteachers were not available for the leadership commitment session. Most of the aims of this session were however met during the school's recruitment process which included a 40-minute informal discussion reviewing; a) PA resources to be implemented; b) importance of PA for children's health, attainment, behaviour and concentration; c) establishing of a study co-ordinator, who is present during the school recruitment and d) establishing of commitments to forward researcher emails to appropriate members of staff.
Individual component - Teacher training session
1-hour training session consisted of three parts, taught in a need-supportive way to support teacher's autonomy, competence and relatedness. Part 1 (~20 minutes) started with a 5-minute video to introduce the teachers to a PA resource of their choosing. The study background was recapped, as was the rationale and aim, including a description of the relationship between PA and health, attainment, behaviour and concentration in children, and how schools can influence these relationships. Teachers were invited to share their experiences of school PA and PE delivery. Discussion and reflection of the PA resources and anxieties related to school-based PA delivery also took place. Part 1 aimed to support the fulfilment of teachers need for autonomy Part 2 (~20 minutes) educate teachers on the theory of need-supportive teaching and teaching strategies to increase children's intrinsic motivation. Strategies for increasing autonomy (e.g. offering meaningful choice, nurturing self-interest and exploration, minimising controlling language), competence (e.g. offering structure, tailored support and feedback, communicating clear guidelines and expectations) and relatedness support (e.g. energetic and eager delivery, listening to children, coming from the child's perspective) were discussed, supported by video examples in a PowerPoint presentation and from the booklet (see appendix). The researcher described how teachers who internalise these strategies and use them correctly feel more competent and confident to deliver PA and show more enjoyment and motivation for teaching. Part 2 aimed to support the fulfilment of teacher's autonomy and competence. Discussions included specific need-support strategies that teachers believed could be easily implemented using the teacher training manual to guide their delivery. Part 2 aimed to support the fulfilment of teacher autonomy and competence. Part 3 (~20 minutes) train teachers how to access and use the online resources centre (see appendix). Practical's provided teachers with experience of the videos in the resource centre and need-supportive teaching strategies they are to implement. This includes the researcher (playing the role of the teacher) engaging the teachers (playing the role of the pupils) in several videos in a classroom. To promote and incentivise use of the videos, teachers were asked to set weekly goals. Progressive goals were encouraged (e.g. engage your class in one video in week 1, two videos in week 2, and three videos in week 3 etc.). The teachers' class accumulated points which were recorded via a sticker chart each time a video was used. 100 points were earned for the first 10 videos played per week, with 10 points for each subsequent video. Finally, time as be provided to reflect and discuss feelings related to

implementation anxieties, offering a final opportunity to practice PA resource implementation

The researcher created an open and friendly environment in which teachers had time to ask questions and reflect on the training. Part 3 aimed to support the fulfilment of relatedness, helping teachers feel a sense of ownership and connectedness to the training and trainer.

Individual component – Description of resources and training manual (see links to YouTube resources in appendix page 206)

Approximately 80 videos were provided to the teachers including 7 coach introduction videos and a further 70 videos (ten per each PA coach) for each classroom to complete. Coach Sessions included; a yoga coach, a balance coach, a co-ordination coach, a stretching coach, an energiser coach (to increase MVPA), a mindfulness and a breathing coach. Videos were between 5-10 minutes in length and provided a model to show the children how to perform the exercises as well as verbal explanations of the movements and benefits of the exercises. The resource is designed to support a child's need for autonomy, competence and relatedness in the following ways.

Autonomy support: Each video is led by an onscreen coach. Children are "invited" to take part by the coach and can determine their involvement level. Teachers will be trained to encourage children to join in whenever, allowing self-interest to arise. Each video enables self-exploration (e.g. time to practice and explore movements). No controlling language is used by the online coach, or should be used by the teacher, with language encouraging participation and learning.

Competence support: Each category has videos of increasing difficulty to support children's progression and development. The onscreen coach provides clear guidelines and expectations to the children at the start and throughout each video. This includes why they are doing the movements (e.g. to increase one-leg balance) and how the movement can improve health, fitness and/or well-being (e.g. increased leg balance can increase knee strength and keep the knee injury free for sport and PE). Teachers will be trained to support and encourage the children (e.g. offering feedback and praise). The onscreen coach praises the children after each movement (e.g. "well done kids, you managed to balance for 30s on one leg, great effort").

Relatedness support: Teachers were encouraged to participate in the activities with children, listen to the children's concerns, and take the children's perspective if any issues or concerns arise. The upbeat and energetic delivery of the onscreen coach seeks to create an active and engaging environment with an emphasis on fun and enjoyment.

Teachers were also provided with a user-manual for the intervention which included pictorial images of the movements to do with the children if videos were inaccessible online. The user-manual also introduced; a) each of the coaches to the teachers via a picture and an informational paragraph; b) provided a step by step procedure for accessing the videos; c) provided various ways teachers could increase the need-support of children during the PA lessons and d) provided a description of each of the video's and perceived effects on children's health and school related outcomes (see appendix). Before starting the videos,

teachers were asked to play the 'coach introduction video', a video presented by the PA coach (i.e. principle researcher) which explained specifically to the children what they would achieve from the PA videos.
Individual component - On-going teacher support
Teachers received an email from the study co-ordinator at the start of weeks 2 and 4 of the intervention (9am). Drop in sessions occurred at the end of week 1 and the start of week 3. Two days before each visit, the study co-ordinator sent teachers an email, on behalf of the research team, reminding them of the time and venue of these optional drop-in sessions. Drop in session usually typically involved meetings with the study co-ordinator as other teachers were unable to attend. The sessions provide an opportunity to understand how the intervention is proceeding and discuss and address any perceived implementation barriers. This ongoing support seeks to support the teacher's needs for autonomy, competence and relatedness.

7.3 Procedures and Measures

Issues related to the adoption and sustainability of school-based PA interventions are complex. Utilizing the combined strengths of both qualitative and quantitative approaches offers researchers the best possible methods to shape a complete picture of factors related to successful intervention implementation. Through a quantitative approach we can assess children's objective PA behaviours, and teachers and children's changes in attitudes, beliefs, behaviours and experiences related to intervention outcomes, while qualitative techniques can provide enquiry into the why and how these changes occurred (Burke and Onwuegbuzie, 2004). Furthermore, mixed methods design can not only naturalise bias and weakness, but can strengthen evidence through approval and validation of findings (Creswell, 2009). The use of questionnaire data from both teachers and pupils was to derive preliminary estimates of the effects of the intervention on teacher and pupil outcomes stated above. Collection of these outcomes allowed objective comparisons to be made between the intervention and control conditions in relation to change pre to post intervention. Added to this, the collection of quantitative data allowed response, recruitment and attrition rates to be collected, as well as completion rates for all outcome measures.

Baseline (week 0) and post-test (week 4) data collection occurred between February-July 2017 at participant's respective schools for convenience (Figure 7-3). Children (anthropometrics,

questionnaires, 7-day accelerometery) and teachers (questionnaires) completed the same measures at baseline and post-test, and intervention children (sub-sample) and teachers took part in a focus group at post-test (week 5). For ease, data collection in children occurred in groups of 10-15 during school time. Teacher questionnaires were completed after school on the same day as the child assessments. Before completing questionnaires, the principle researcher explained their purpose and gave guidance on completion and was available throughout completion. Once questionnaires were completed, the questionnaires were checked for completion by the researcher.

7.3.1 Qualitative Measures

7.3.1.1 Focus Groups

Focus groups were conducted to ascertain teacher and pupil perspectives regarding the acceptability and feasibility of the intervention in schools as well as any adverse effects such as injuries and disruptions to school practice. All intervention group teachers (Table 7-3) were available for the focus groups. Focus groups lasted between 45-60 minutes in each school to help maintain staff engagement with the discussion topics (Krueger and Casey, 2009) and For the intervention group children, 4 focus groups were planned (two with year 3-4 pupils (age 7-9 years); two with year 5-6 pupils (age 9-11 years) per school), each with a maximum of 6 children, as per recommendations of Morgan et al. (2002). A random sampling method (stratified by school years) was used to select 48 children from the 63. Resultantly, 4 mixed-gender focus groups were conducted with 48 children (21 boys) aged 7-11 years. The child focus groups lasted between 30-35 minutes to help children remain engaged with the discussion topics (Gibson, 2007). Focus groups were conducted in a quiet room, with only the participants and an external moderator present (male, trained in qualitative methods). To help avoid social desirability bias, teachers and children had not previously met the moderator and the moderator was not involved in the design, development or training of teachers. School premises were chosen for convenience for the teachers and to help reduce child anxieties (Kennedy et al., 2001). A relaxed and comfortable environment was facilitated by the moderator, choosing in a quiet room on the schools site away from excess noise to collect the data (Doody et al., 2013). To promote interaction and discussion participants were seated

around the moderator. Focus group schedules were piloted with co-authors (LG, PW) and the external moderator before final agreement on questions were reached.

Table 7-3. Focus group participants (intervention teachers).

School	**1 (*n*=4)**	**2 (*n*=4)**
Participant (male (M) female (F), School year (3, 4, 5, 6)	Teacher 1 (F, 5) Teacher 2 (F, 6) Study co-ordinator (F, 4) Teacher 4 (F, 3)	Study co-ordinator (F, 5) Teacher 6 (F. 4) Teacher 7 (M, 3) Teacher 8 (F, 6)

7.3.1.2 Teacher Focus Groups

At the start of the teacher focus groups the moderator introduced himself and his role to the participants. A relaxed and comfortable environment was facilitated by the moderator, choosing in a quiet room on the schools site away from excess noise to collect the data (Doody et al., 2013). To promote interaction and discussion participants were seated around the moderator. Once seated the moderator formally introduced himself, the purpose of the focus group as well as the notion of confidentiality, helping to reduce participant tensions (Krueger and Casey, 2009). Semi-structured topic guides (Table 7-4) were used during the focus groups allowing all teachers the freedom to respond in detail whilst permitting comparison across transcripts (Flick, 2009). Teacher schedules focused on the intervention (i.e. the training received, the resources used and the on-going support). Example questions used in the schedule included “tell me about your experience of the intervention” and “can you tell me about the 1-hour long training your received”. Verbal prompts (i.e. could you tell me more about that) were used to extract greater detail from the participants. Trustworthiness was enhanced throughout by encouraging participants to speak openly and honestly even if they disagreed with one another. The moderator used active listening and paraphrasing techniques to help participants feel relaxed and at ease, whilst providing opportunity to check understanding of participant meanings (Shenton, 2004).

Table 7-4 Teacher's focus group schedule

Teachers' Interview Schedule		
Main questions	**Prompts**	**Theoretical underpinning**
Tell me about your experience of the SOKKA intervention.	- Go where they want with it "Interesting points you've made about different aspects of the intervention. I'd like to go through a few of those in more detail. How about we start at the beginning…"	The idea behind these questions was to establish a greater understanding about what teachers thought about the training. Were they motivated post training (due to the delivery in a need-supportive way?) did they understand why they were doing the training (Autonomy), did they feel competent to deliver the training within the 1-hoiur training session provided (competence). Again, this also provided an opportunity to understand barriers and facilitators related to teacher behaviours from an ecological perspective.
Can you tell me about the hour-long training you received from Matt? Imagine you did not have the training… (some of them may not), how do you think you would have felt about doing the SOKKA intervention?	- content of the session - what did they learn - Confidence? How did they feel after the training was over? - Understand the purpose of the intervention? - What was the motivation for doing the intervention? - Was the training necessary	
How do you feel about the instructional booklet you were provided with?	- Frequency of use - Language and content - Example of when they used the booklet	
How would you describe your experience of using the videos and challenges? (Use the picture cards on the board to aid assistance on recall) - Why they used the ones they did? - Why they didn't use the one's they did?	- Characters/topics/videos that worked well - Characters/topics/videos that didn't work well - Duration of the videos (5-9) - Typical example - Time of day that was good or bad - Like the booklet, how did they feel about the language and content.	These questions were highly related to understanding end-user feedback (i.e. did the intervention do what it said it was going to do). What were the teacher's thoughts, opinions beliefs (intrapersonal), did the coaches sufficiently support and motivate the children to engage (interpersonal), were there any barriers (environmental/organisational)

	- WHAT DID THE STUDENTS THINK?	
I'd like to talk about the online resource. What do you think of the online teaching resource?	- Accessibility- did the booklet explain how to access. - How do you feel about the concept of the resource being accessible online (as opposed to manual)	This question was related to the ease and accessibility of use and therefore, what environmental factors facilitated or negated motivation of use.
Having finished the intervention, what effect if any at all, do feel the intervention has had on the children?	- Use the picture cards again - Behaviour - Attitude - Physical exercise - A-attainment, B-behaviour, C-concentration	Underpinning of this question was related to school-based outcomes
Finally, I'd like some your advice. Potentially, this intervention could be applied to many more schools. What advice would you give to prospective teachers implementing this intervention?	- How can we make/ensure these activities are sustained - If you still had access to the videos, do you think you would still use them?	

7.3.1.3 Child Focus Groups

At the start of the focus group, the moderator introduced himself and provided name badges for the children. Autonomous engagement was encouraged by offering children choices (e.g. choosing to sit on chairs or the floor) (Shier 2001). Once children were seated around the moderator in a circular position to project a non-authoritarian climate (Gibson, 2007) the moderator read aloud ground rules to set boundaries and establish expectations. This information covered the moderator's role, the study aim, confidentiality, safeguarding, and how the group would operate (Morgan et al. 2002; Gibson 2007). The moderator facilitated an ice-breaker activity (Table 7-5), with each child saying their name or a pseudonym name of their own choosing (e.g. Cool Chris), their age and favourite sport/PA into the Dictaphone, before listening back to their answers. Attempts were made to reduce the power balance of the focus groups by explaining to the children that there were no right or wrong answers and that the children were free to express their own opinions (Morgan et al. 2002). To encourage involvement of quieter group members the moderator made efforts to ensure all participants were encouraged to express their opinions, even if these differed from peers (Morgan et al. 2002). Child focus groups were semi-structured and developed around the children's perceptions of the resources and what impact they may have had on the children. Example questions included "which activity coaches were your favourite" and "how did they make you feel". To facilitate children's descriptions of their feelings and emotions, children could select from a range of paper-based emoticons (pictorial representations of facial expressions; e.g. bored, happy). Emoticons helped children's experiences remain the centre of the research process (Hyvönen et al., 2014), promoted enjoyment, and gave each child the opportunity to express their opinions (Hill, Layboum, and Borland 1996). Subsequent probing questions asked why they felt that way. A4 pictures of the 7 coaches were provided to prompt the children's memory so they could describe in more detail the likes and dislikes of each.

7.3.1.4 Enhancing trustworthiness.

Several approaches were used to enhance trustworthiness (Sparkes, 1998; Sparkes and Smith, 2009). Unlike the previous studies however (i.e. study 1,2,and 3) an independent moderator carried out the focus groups to reduce social desirability regarding participant perceived intervention effects. Furthermore, trustworthiness was enhanced by encouraging participants

to speak openly and honestly even if participants disagreed with the opinions of others (Shenton, 2004). In addition to this, transcribed transcripts were handed back to adult participants who were given the opportunity to re-read the transcript allowing for appropriate member checks, ensuring the data collected was accurate to the participants meanings. As this was not possible with the children's transcripts, at the end of each section of the focus groups, the first author summarised the main points of the focus groups, ensuring what the children said was appropriately interpreted by the first author. Accordingly, active listening and paraphrasing were also used to help participants feel relaxed and at ease, whilst providing opportunity to check understanding of participant meanings (Shenton, 2004). Once transcripts had been checked a process of triangulation occurred for each focus group increasing the credibility and validity of results (see study 1 for the process of triangulation undertaken).

Table 7-5 Children's focus group schedule

Student's Interview Schedule		
Main Questions	**Prompts**	**Theoretical underpinning**
1. What did you think of the SOKKA activities you've been doing? 2. Looking at the cards, I want you to pick 1 or 2 cards to describe what you thought of the SOKKA activities you've been doing? 3. How have they made you feel?	Purpose of the activities What was it about it that made you feel (emotion)	It was important to get an understanding of how the resources the children took part in made them feel. Enjoyable resources are linked to the development of intrinsic motivation and therefore, those that are not enjoyable may need re-developing. Secondly, aligned with the MRC framework, evaluation of the resources could take place from an end-user perspective.
(Introduce the characters and activities display for prompts) 4. Which characters were your favourite? How did they make you feel?	Which one's were used, not used Likes and dislikes (characters, videos, exercises) Location within school (Have you tried these exercises at home? Have you shown them to anyone outside of school?) Feeling before/during/after the challenges	
5. Can you describe a typical lesson when you used the activities?	Source of motivation Who chose the videos? Why did they not do some videos?	This question was asked, from a socio-ecological perspective to understand the behaviours of the teachers and peers in the classroom and how these behaviours may have helped or hindered the children's motivation to engage.
6. Has doing the activities helped you with anything?	Task-Show picture cards to aid assistance	This question was asked to gage whether children had noticed differences in mental, physical, social and/or school-related outcomes and how these changes had impacted their behaviours
7. Imagine you could make your own character, with your own choice of physical activity. What character would you make, and what activity would you do?		

7.3.2 Quantitative Measures (Teacher Questionnaires)

7.3.2.1 Teachers' Sense of Efficacy Scale (TSES)

Teachers completed an adapted, 12-item, short version (Breslin et al., 2012) of the validated Teachers Sense of Self Efficacy Scale (TSES: Tschannen-Moran and Hoy, 2001). The adapted version was validated in a sample of 22 primary school teachers, with reliable internal consistencies shown across subscales (Cronbach alpha = 0.96 to 0.99; (Breslin et al., 2012)). Items were adapted to reflect confidence towards teaching PE rather confidence towards teaching in general. The TSES assessed 3 factors (4 items per factor) of efficacy in classroom management (how much can the teacher do to control disruptive behaviour during PE), efficacy in student engagement (how much can the teacher do to motivate students who show low interest in PE) and efficacy in instructional strategies (how much can a teacher use a variety of strategies during PE). Like the original questionnaire, participants responded on a Likert scale (1= Nothing, 9= A great deal) and individual item scores were averaged to make an overall composite score for the 3 factors.

7.3.2.2 Multi-dimensional Work Motivation Scale (MWMS)

Teacher motivation to deliver PA was measured using an adapted version of the validated MWMS, with the original scale reported to have good stability and internal consistencies across subscales (Cronbach alpha = 0.70 to 0.82; Gagné et al. 2015). The questionnaire comprised of 16 questions, representing 5 factors (3 items per scale): intrinsic, identified, interojected (4 items), extrinsic (social) and amotivation. One factor, extrinsic (material) was removed as it related to monetary gain. The questionnaire was adapted to fit the context of classroom PA by including a stem (i.e. Why do you, or why would you put efforts into promoting PA within your classroom?). Further, references to work motivation were replaced with motivations related to delivering classroom-based PA. For example, the item "Because putting effort into my job aligns with my personal values" was changed to "Because putting effort into delivering classroom-based PA aligns with my personal values". Teachers filled in the questionnaire using a 7-point Likert scale (1 = Not at all, 7 = Exactly) similar to the original scale (Gagné et al., 2015). Individual item scores were averaged to make an overall composite score for the 5 factors.

7.3.2.3 The Problems in School Questionnaire (PIS).

Teaching styles were assessed using the PIS questionnaire (Deci et al., 1981). Consisting of eight vignettes, the questionnaire depicts problems that might arise at schools to assess how the teachers would handle each problem. For each vignette, teachers were asked to rate the appropriateness of four possible strategies (highly autonomous, moderately autonomous, highly controlling, moderately controlling) using a Likert scale (1 = Not appropriate, 7 = Very appropriate). Each factor score was computed by averaging its eight responses to create an overall composite for the 4 factors. Negative scores reflected a relatively controlling motivation style and positive scores a relatively autonomy supportive style. The scale was developed and validated with teachers and reliabilities using Cronbach's alpha are reported to range from α=0.73 to α=0.80 for the subscales (Deci et al., 1981).

7.3.3 Quantitative methods (Child Questionnaires)

7.3.3.1 Perceived Locus of Causality-Children (PLOC-C)

Child motivational regulations for PE was assessed using an adapted version of the perceived locus of causality scale for children (PLOC-C: Goudas et al., 1994). The PLOC-C was developed to measure PE motivations in 9-12 year olds with evidence for good validity and reliability across subscales in children (Cronbach alpha = 0.71 to 0.72; Pannekoek et al., 2014). Children completed a 15-item questionnaire and responded to the questions using a 4-point Likert scale (1=strongly disagree to 4=strongly agree). Each question began with the stem "I take part in PE because..." and example items for each regulation included "because I enjoy doing it" (intrinsic motivation), "because I want to learn how to do new things" (identified motivation), "because I want others to think I'm good at it" (introjected motivation) and "because I will get into trouble if I don't" (external motivation). Amotivation questions began with the stem "I take part in PE but…" with an example including, "I don't know the reason why I take part in PE". Individual item scores were averaged to make an overall composite score for the 4 factors.

7.3.3.2 Teacher as a Social Context Questionnaire (TASCQ)

Child perceived need-support was assessed using an adapted yet validated version (Haerens et al., 2013) of the short form Teacher as Social Context Questionnaire (TASCQ; Belmont et al., 1988). This version of the questionnaire was adapted to fit the context of PE by including a

stem “During your PE lessons…” and replaced references to academic subjects with PE. Six items were removed from the original scale as Haerens et al., (2013) stated by removing these six items, a more internally consistent scale was developed, as determined by Cronbach’s alpha for “perceived autonomy support” (e.g. “My teacher explains how I can use the things we learn in PE, α = 0.78), “perceived relatedness support” (e.g. “My teacher really cares about me,” α = 0.78) and “perceived competence support” (e.g. “The teacher explains his/hers expectations to me”; α = 0.76). Accordingly, the scale consisted of 18 items (6 items per scale). Individual item scores were averaged to make an overall composite score for the 3 factors.

7.3.3.3 Self-Perceptions of Adequacy in and Predilection for Physical Activity (CSAPPA)

Children completed the CSAPPA to assess generalised self-efficacy towards PA (Hay, 1992). The CSAPPA has been shown to be significant predictor of children’s participation in structured and free play activities (Hay, 1992), has high test-retest reliability (r = 0.84-0.90) and strong predictive and construct validity (Cronbach alpha = 0.83 to 0.86; Cairney et al., 2007; Hay, 1992). The 19-item scale included three factors, predilection (8 items) adequacy (8 items) and enjoyment (3 items). Each question consisted of two statements and used a structured alternative format. Each child read the two statements for each item and decided which child was most like them, marking an (X) if it was ‘really true’ or ‘sort of true’ for them. Younger children (7-8 years) had the questions slowly read to them by the principle researcher to avoid confusion. Questions were scored one to four, 1 indicating low self-efficacy, 4 indicating high self-efficacy. Individual item scores were averaged to make an overall composite score for the 3 factors

7.3.4 Anthropometry

With children in light clothes and without shoes, and using standard techniques (Lohman et al., 1991) stature and sitting stature was measured twice to the nearest 0.1cm using a Leicester stadiometer (Seca Ltd, Birmingham, UK), and body mass to the nearest 0.1kg using a mechanical flat scale (Seca Ltd, Birmingham, UK). The average of the two measures was used to calculate BMI (BMI; kg/m^2). Stature, sitting stature and age were entered into a customised Excel macro to calculate sex-specific maturity offset (predicting years from peak height

velocity; PHV), which is a somatic indicator of physical maturity (Fairclough and Stratton, 2006).

7.4. Habitual PA Assessment and Data Analysis

The ActiGraph GT9X (ActiGraph, FL, USA) wrist-worn accelerometer assessed habitual PA for 7 consecutive days (5 weekdays, 2 weekend days). ActiGraph is valid and reliable for use in children (Robusto and Trost, 2012; Hänggi et al., 2013). Wrist-worn devices were preferred to hip-worn due to evidence of improved device wear in children (Fairclough et al., 2016). Children were provided the same device at each time point where possible, but due to high requirements of accelerometers within the research department, this was not always achievable. An instruction sheet was provided to teachers and parents to promote them to encourage proper wearing of the device by children, and verbal and written instructions (sheet) were provided to the children. The child instruction sheet included a wear time diary with children asked to log when they wore and removed the monitor. Children were familiarised with the device and asked to wear it on their non-dominant wrist during all waking hours except when swimming and bathing. Two-days prior to the collection of accelerometers, teachers were sent an email by the principle researcher asking them to remind the children to bring the accelerometer into school.

As to capture the intermittent, short burst high intensity nature of children's (Baquet et al., 2007) accelerometers were set at 30 Hz and step count feedback was disabled from the watch face to reduce reactivity, leaving only the time visible. Once collected, data from the accelerometers was downloaded using ActiLife software (version v.6.11.4, ActiGraph, FL, USA) and PA graphs automatically produced by ActiLife were visually checked for compliance. Children who clearly had not worn the device for approximately 10 hours on at least 3 days were fitted with the accelerometer the following day and asked to wear it for another 7 consecutive days. Downloaded data was saved as GT3X files and converted to CSV format to facilitate data processing.

Sustained bouts of 60 minutes of 0 counts indicated monitor removal (i.e. non-wear) (Troiano et al., 2007) and missing counts were removed from the calculation of daily wear. To minimise

the impact of monitor wear during sleep, a time filter was set to only include data between 06:00 and 23:59 for the whole day analyses. A time filter was set on week days between 08:30 (school start time) and 15:45 (school stop time) to enable analyses of school time data. A sensitivity analysis (analysis of covariance (ANCOVA); data not shown) was used to evaluate differences in sample sizes by treatment arm based on various wear time inclusion criteria across both time points, considering different combinations of the number of valid days (any 1, 2 and 3 days, 2-week day + 1 weekend day) and valid minutes (whole day analyses ≥9 and ≥10 hours; school day analyses ≥240 and ≥324 minutes). To be retained in the whole day analyses, participants had to provide ≥10 hours (≥599 minutes) of wear time on ≥2-week days at baseline and post-test. To be retained in the school day analyses, participants had to provide ≥324 minutes of wear time on ≥2-week days at baseline and post-test. Similar time filters and inclusion criteria have been used, and shown to be acceptable and reliable in similar aged children for school day (Martin and Murtagh, 2015) and whole day analysis (McWhannell et al., 2018).

To analyse the data the cut points of Crouter et al., (2015) were used. These cut points, as counts per 5s, are ≤100 (SB), 101-609 (LPA), 610-1809 (MPA) and ≥ 1809 (VPA). When using these cut points however, original analysis classified an implausibly large number of epochs as VPA, relative to SB, LPA or MPA. Accordingly, the original cut points were multiplied by 12 and applied to reintegrated 60 second epoch data, with the cut points used being 0-1200 CPM (SB), 1201-7308 CPM (LPA) 7309-21708 CPM (MPA) and ≥21709 CPM (VPA). After re-running the analysis, time spent in SB, LPA and MPA was higher than VPA, which is suggestive of a more typical and expected activity profile as seen in previous research (Riddoch et al., 2007). Steps taken and CPM were also calculated. PA data was adjusted for wear time (volume/mean wear time of valid days) to account for significant differences (derived from analysis of variance (ANOVA); data not shown) in each PA component at baseline between participants providing ≥ 13hr·d^{-1}, and 11.0-11.9 hr·d^{-1} and 12.0-12.9 hr·d^{-1} (whole day data), and, ≥ 7hr·d^{-1}, and 6-6.9hr·d^{-1} (school day data) of valid mean wear time. Accordingly, data is presented as minutes/hour (min·h^{-1}: SB, LPA, MPA, VPA) and steps/hour (steps·h^{-1}: steps). CPM data remained unchanged.

7.5 Qualitative Analysis

7.5.1 Data Analysis and Representation

Focus group data was transcribed verbatim and each transcript read several times by the first author to help immerse themselves in the data (Silverman, 2005). Transcripts were imported into NVivo10 qualitative analysis software and analysed by the first author using the principles of thematic analysis (Braun and Clarke, 2006). Thematic analysis was chosen as the preferred analytical technique as the analysis process allows the researcher to identify, analyse and report patterns (themes) within a particular data set (Braun and Clarke 2006). Analysis first began with a combination of deductive and inductive coding. The primary objective for both the teacher and child focus groups was to extract factors related to the acceptability and feasibility of the intervention in primary school settings. For teachers this included the 1-hour training component, the resource centre and on-going support. For children, the specific focus was on the perceptions of the videos (i.e. what did you think of the PA resources you have been using?) and the environment created (what was your teacher doing during the videos). Pre-determined broad themes (based on the intervention components) were initially used to help structure the emerging themes using a deductive approach. Once these themes were established an inductive approach was used to further identify factors that facilitated or negated the successful implementation and delivery of the PA resources across the school day. Inductive coding facilitated the emergence of specific codes and categories, and, specific quotes, conversations and paragraphs, which were then further analysed allowing the researcher to better represent participant opinions and perspectives of the intervention components and subcomponents. This process, known as open coding, is considered to enhance credibility when analysing semi-structured data collection techniques (Morse, 2015). Frequent meetings between all authors, LG, PW and DR enabled themes to be discussed, debated and re-defined.

7.6 Statistical Analysis

All analysis was completed with SPSS statistics for Windows version 24 (IBM, New York USA). Accelerometery and questionnaire data was initially analysed to test for normal distribution of residuals using the Shapiro-Wilks test for normality. Results suggested the residual data from

the questionnaires were normally distributed ($P > 0.05$), but PA components and CPM were not ($P < 0.05$). Accordingly, LOG10 was applied to the whole day and school day accelerometery data and the tests re-ran producing normally distributed residuals ($P > 0.05$) for each PA component and CPM. Baseline differences for all outcomes were tested using independent t-test. ANCOVA compared the intervention effect at 4 weeks from baseline on the dependant variables. The intervention group was the independent variable and the variable change score (post-baseline) the dependant variable. A covariate in all analysis was the baseline value for the dependant variable to help control for any imbalances at baseline (Vickers and Altman, 2001). The inclusion of other potential covariates was investigated for accelerometer and questionnaire data. Potential covariates considered in the analyses, for which data was available, were age, gender, maturity offset and school year for children, and age, gender, school year and marital status for teachers. When tested however, the potential covariates did not significantly ($p > 0.05$) contribute to the models when included in the ANCOVA analysis, and thus only respective baseline values were included as covariates.

7.7 Results

7.7.1 Response, Recruitment, Attrition and Completion Rates

Twenty-one schools (Figure 7-2) were contacted to take part. Five schools expressed interest (23%) however 3 only schools (14%) agreed to take part following further descriptions of study procedures with head teachers. Of the sixteen teachers approached all expressed interest in the study, and all were eligible and recruited (100%). All sixteen teachers provided questionnaire data at baseline and post-test (100%). 456 children were approached (94%) as assessed by study information packs given to children after the video showcasing. Response rates of the children were 27% (*n*=124). After assessment for the inclusion criteria, child eligibility was 100% (*n*=124; intervention *n*=63; control *n*=61). At baseline testing, the sample size reduced to 26% (*n*=118; control *n*=59; intervention *n*=59) after six students were unavailable on the day of baseline collection. Accordingly, 118 students provided questionnaire data and accelerometer data at baseline. From baseline to post-test the sample size reduced to 106 children who completed all measures at each time point. Accordingly, 12 participants (10%) were lost to attrition including 8 children in the intervention group and 4 children in the control group. When assessing accelerometer wear time in the control group, 78% of children (n=43) met the school day inclusion criteria and 78% (n=43) the whole day criteria. In the intervention group, 80% of children (n=41) met the school day inclusion criteria and 76% (n=39) the whole day criteria.

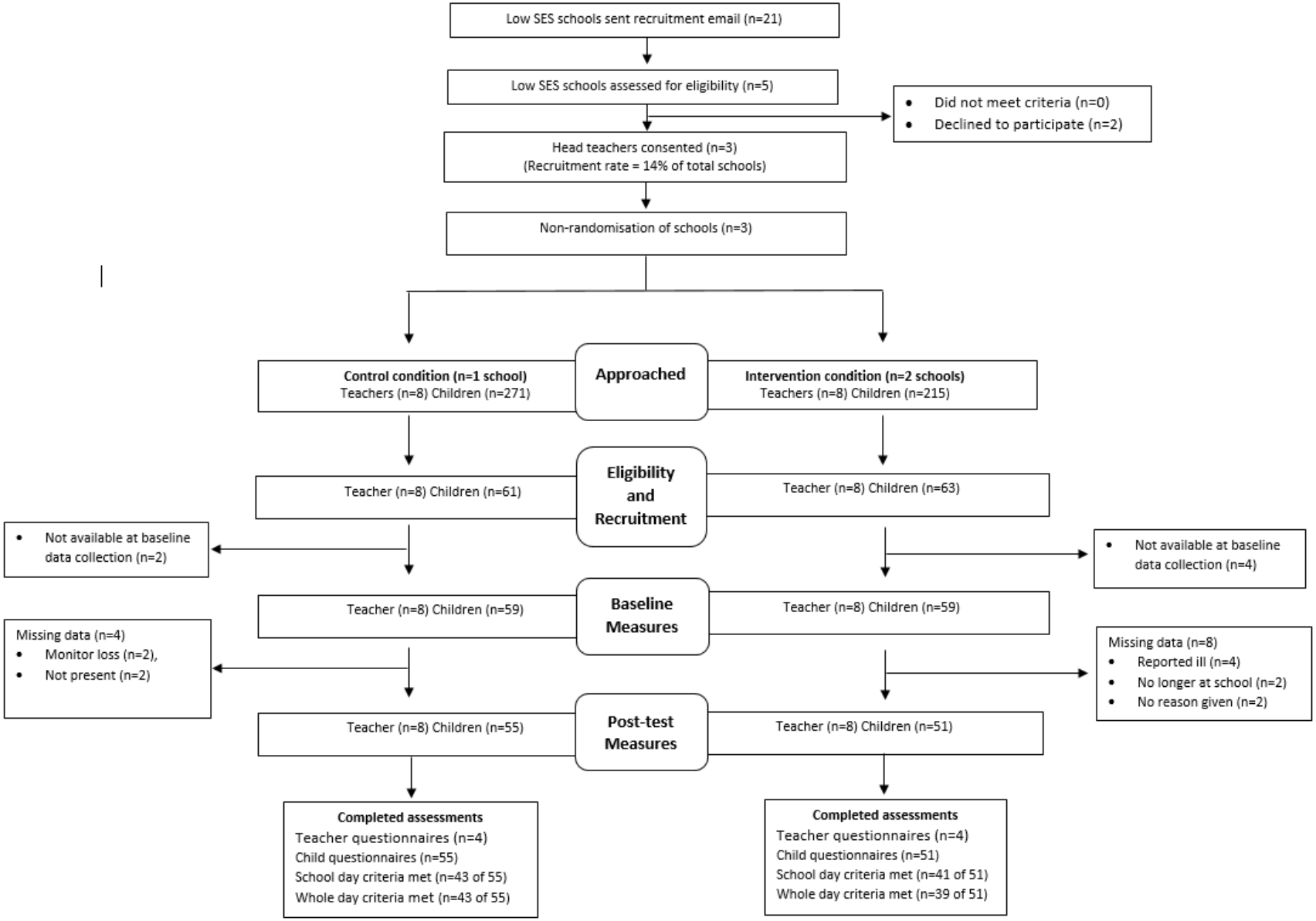

Figure 7-2. Consort flow diagram of recruitment, allocation, follow up and analysis.

7.7.2 Baseline Characteristics

Participant baseline characteristics are described in Table 7-6. All between-group baseline characteristics for teachers and children were comparable ($p > 0.05$) as examined by independent t-tests. The majority of the teachers sample were female, White British, educated to tertiary level, either married or in a civil partnership and employed on a fulltime basis. The children's sample was equally split (52% female). The ethnic composition of the sample was 70% Caucasian/White; 19% Black/Other black background; 6% Asian; 5% Other. On average children's BMI was classified as healthy weight (Chinn and Rona, 2002).

Table 7-6. Baseline characteristics by treatment arm, presented as mean (SD) or % (n) of group.

Teachers	Control (n=8)	Intervention (n=8)	All (n=16)
Age (years)	32.5 (7.8)	29.4 (3.8)	30.9 ± 6.1
Female	63 (5)	88 (7)	75 (12)
White British	100 (8)	88 (7)	94 (15)
Married	63 (5)	37.5 (3)	50 (8)
Tertiary Education	100 (8)	100 (8)	100 (16)
Job category			
Generalist teacher	75 (6)	75 (6)	75 (12)
Study co-ordinator	25 (2)	25 (2)	25 (4)

Children	Control (n=51)	Intervention (n=55)	All (n=106)
Age (years)	8.9 (1.2)	9.1 (1.1)	9.0 ± 1.2
Female	28% (30)	24% (26)	52% (56)
White British	38% (40)	34% (36)	72% (76)
School year			
Year 3	14% (15)	10% (11)	24% (26)
Year 4	13% (14)	9% (9)	22% (23)
Year 5	12% (13)	18% (19)	30% (32)
Year 6	12% (13)	11% (12)	24% (25)
Body mass (kg)	34.9 (7.1)	34.1 (6.9)	34.0 (7.0)
Stature (cm)	137.2 (14.2)	136.7 (7.1)	137.7 (11.4)
Sitting stature (cm)	72.9 (4.3)	72.1 (3.3)	72.5 (3.9)
Maturity offset (Years)	-2.1 (1.0)	-2.2 (0.8)	-2.2 (0.9)
Body Mass Index (BMI)	18.1 (3.1)	19.2 (7.5)	18.6 (5.7)

7.8 Intervention Acceptability and Feasibility

From the focus group data, four main themes (Table 7-7) emerged regarding the acceptability and feasibility of the intervention: 1) training perceptions, 2) intervention acceptability and barriers, 3) intervention delivery preferences and 4) perceived intervention effects. Teacher and child perceptions are combined throughout the results to promote a deeper understanding and holistic representation of the themes. All participants have been anonymized in the presentation of the data where each theme is presented in turn with supportive illustrative quotes attributed to the teacher job role, their gender and their school year taught (Table 7-3). Child quotes will be supported by a pseudonym and school year (i.e. Year 3 and 4, Year 5 and 6).

Table 7-7 Themes, Subthemes and illustrative quotes related to the proposed intervention

Theme	Sub-theme	Illustrative quotes
Training perceptions	1-hour training	*Researcher: "How were you with things…the training".* *Teacher 4, (F, 3): "I enjoyed it, yes. I thought it was really good, really beneficial".* *Researcher: "So how did you feel after you'd done it? Did you feel less confident or more confident?"* *Teacher 4, (F, 3): "More confident, definitely. Because it's always just nice to have somebody to explain something to you, isn't it, rather than just diving in, because I think you miss things, don't you? And because he explained sort of the benefits of it, it's definitely beneficial" (School 1)* *Teacher 7 (M, 3): "I felt I could just go, with then yeah a bit of a look at the handbook I felt I could then go and get started really because I knew".* *Teacher 8 (F, 6): "I agree, I felt I could go away and deliver it and understand why I was delivering it"* *PE-coordinator 5 (F, 5): "And letting us take part in the video"* *Teacher 6 (F, 4): "Or making us…"* *PE-coordinator 5 (F, 5): "No, he didn't he said if you wanted to…and that helped put it in context from the child's point of view as well" (School 2)*

Intervention acceptability and barriers	Time, Time of year, technology and school priorities	*"As with most things, it's just finding the time to really commit to it has been quite a challenge, because there's just so much else with leavers assemblies, productions" (Teacher 8, school 1, (F,6))* *"So the process [implementing the videos and booklet] is very long, and my inference is that we want it to be quick and snappy… it's an extra, it's an add on to P.E and it's something extra for them. We don't want it to turn into a massive long intervention" (PE-coordinator, School 2, (F, 5))* *"We had like computer problems and things in the classroom, in which it stops me from being able to do it or hindered the amount of times that we could and with the time of year" (Teacher 7, school 2, (F,6))*
	Length of the videos	*"I feel some of the videos could be made a little shorter, to be like five minutes, then it would fit really well…but there's some bits of that there's talking and there's not much more and they're standing around" (Teacher 6, school 2, (F,4))* *"I think it's quite a nice length of time really…sometimes it's too much talking, I think, between him and the coach, and it'd be nice for him just to be talking to the kids" (PE-coordinator, school 1, (F,4))* *Researcher: "Okay, how about you Daisy which one-bored you? How come you picked bored"?* *Daisy: "Because like the videos like three moves and it's just like the same for like ten minutes".* *Hannah: 'Yeah"* *Researcher: "So you feel like if maybe if there was more moves"?* *Sean: "I just like feel like there a bit like they need to be shorter"* *Grace: "There needs to be more exercise in them…a variety"* *Hannah: "Yeah if it was a variety"* *Researcher: "Variety'.* *Amy: "So tell Matt to get more active" (Year 5 and 6, School 2)*
	Video design (acceptability)	*They take the mick out of it [videos] almost [the older children], as if like, "Oh, she's making us do this", kind of thing. Do you know what I mean? It almost becomes a bit of a…but you wouldn't find that with the younger children necessarily (Teacher 1, school 1, (F,5))* *A few of them, coz' I have more of an SEN behavioural class, a few of them when they're silly, it's when they think the coach is a bit more silly…the stranger the accent, or the dress up. Then*

		the children take that as an opportunity to be silly (PE-coordinator, school 2, (F,5)) *I think what I've noticed about the videos is that some of the language used in the videos is a bit over their heads (Teacher 7, school 2, (M,3))* *Anna: "I think it was alright because, because at least people were getting like"* *Daisy: "The little ones were into it"* *Anna: "Yeah and we were just like" (imitates)-* *Researcher: "You felt maybe that"* *Hannah: "It was for a smaller audience"* *Anna: "We felt embarrassed coz' we had to go we had to go" (imitates)* *Daisy: "Year fours downwards"* *Sean: "Like the younger ones" (School 2)* *Teacher 2, (F, 6): "If he was a PE coach. Like if he was dressed as like a City footballer or something".* *Teacher 1, (F, 5): "Yes. You know, if he was dressed as something that they related to. Rather than, because it just makes it a bit silly" (School 1)* *Teacher 8, (F, 6): "It'd be good to have a time-a timer on there. Timing down. So that they know how long they need to hold that pose for coz' they don't have a real concept of time".* *Teacher 6, (F, 4): "Change the background based on, because they're all like oh it's the same guy because it's in the same place".* *PE-coordinator 5, (F, 5): "Oh I see what you mean, because there's effort-coz' there's different characters have a background to match that character' (School 2)*
	Easy of accessibility	*"I think if you analyse it, had I not have had the videos I probably would have just sort of not done it. I'll be honest. Because I wouldn't have felt confident enough, so the videos are the key for it being successful I think" (Teacher 7, School 2, M, 3)).* *I like the fact as well that I don't have to do anything. I can just click on, and it's done, and they're already engaged, and it's quite visually nice as well, and they're being instructed all the way through it, so it just saves my voice, so it's quite nice, really, you know. It's a good little break for me" (PE-coordinator 3, School 1, (F, 4)).*
	On-going support	*Teacher 2 (F,6) I think what's been good as well is that you've [study co-ordinator] been dead helpful to us, haven't you? Like*

		sending them links [from the researcher], and keeping us updated as well, which has been good" *Teacher 4 (F,3) "Teacher And reminding us to do it".* *Teacher 1 (F,5) "And reminding us, and knocking on the window".* *"And I think that because we've all done it and we've started at the same time, that's helped the children realise yano this is what we're gonna' do. It's [intervention] not a flash in the pan" (PE-coordinator 5, School 2, F, 5)).*
Intervention delivery preferences	Delivery approaches (dependant on student needs)	*"So it's sort of knowing the children and knowing what your children are like and picking what's best for them…like we've done here, pick the parts [videos] that are applicable to our class at the moment. It's not a rigid program, it's very much flexible to how you need it and the needs of the children" (PE-coordinator, school 2, (F,5))* *"I think if you're a fully trained teacher, you know your kids and you know what video they need…I didn't do the challenge One, and I just, bobbed in and out. I just selected ones that I felt were relevant at the time" (Teacher 4, school 1, (F,3))* *"Whilst in assembly they can see everybody's doing it so they're quite eager to join in. Plus, it's a lot of people getting the same intervention in one go which is obviously quite successful, rather than having a five minute everywhere…cos time piles up doesn't it" (PE-coordinator, school 2, (F,5))*
	Teacher support (Child perceptions)	*Researcher: "So did the teacher always show you what to do"?* *Tommy: "No, she did it with us".* *Jen: "She did it with us, and then at the end if we did anything like wrong, then she'll show us"* *Jen: "some of us couldn't like go like that and stretch out properly, so she showed us how to do it at the end, and then we had a little go doing it" (School 1, Year 5 and 6)* *Researcher: "What are the teachers doing while you're doing it" (playing the PA video)* *Arabella: "Nothing. Just sat there like this" (gestures cross armed).* *David: "Sat there telling us to get up".* *(Discussion)* *Arabella: "No the teachers are just sitting there like this and then they're like shouting at us you better do it stand up after them*

		kids, and we're just like how about you do it" (School 2, Year 5 and 6)
	Points system	*"I assigned a child to go and do it for me, and it meant that I didn't forget then, because he was checking the clock every day, and he said, "It's twelve o'clock", and he went and did it, so that suits me, because I'll forget otherwise. So to have someone in charge of it" (PE-coordinator, School 1, (F,4))* *"On a Wednesday we share how many points they've got during the week and then how many altogether and they want to get more and more points so they're always excited. But I think they'd want to do it without the points anyway, they do really enjoy it. So they've reacted well to it yeah, positively" (PE-coordinator, School 2, (F,5))* *Sally: "We do do it but she just doesn't put the points on".* *Researcher: "Oh so would you would you like to see the points"?* *ALL: "Yes".* *Researcher: "Is that important"?* *All: "Yes".* *Sally: "Like when you go on [the videos] while our teachers putting it on, like you can see what points you've got on the board" (School 2, 3 and 4)*
Perceived intervention effects	Classroom management	*"So for example, you can see that they're not particularly focused in a maths lesson or something, just put that on [video], do yoga with Yuko and then come back to the Maths. It's had impact in that sense" (Teacher 7, School 2, (M,3))"For me personally, because it's done in the classroom, I think it has helped their concentration, to have that time out from the desk, and then to go back to the desk a bit more fresh, having a bit of zone out time, I'd definitely agree, with concentration and focus" (Teacher 1, School 1 (F, 5))* *"If I'm standing there and saying "come on guys we need to calm down, the noise level is too noisy", then that doesn't work as well as maybe the video does. So I've used it as little bit of a behaviour management strategy as well" (Teacher 8, School 2, (F,6))* *"Honestly it has helped me at times yeah definitely. Because I just, sometimes I just want to take that breathe or use that strategy myself. And I don't get the space to do that unless I'm modelling it to the children" (PE-coordinator, School 2, (F,5))*
	Skill development	*"It's another thing that can help with resilience…some of them that may not be that confident with what they're able to do*

	and holistic outcomes	*within exercise or certain movements, but when they've done say three videos of Balance with Bobby they think "well actually I can do this" (PE-coordinator, School 2, (F,5))* *I think because there's quite a few children who aren't very fit, and it highlights to me actually that some of the children in my class can balance on one leg…so that was like a motivation for me doing it (PE-coordinator, School 1, (F,4))* *I think it's helped improve attitudes…most of my more able sport ones couldn't hold it [balance] whereas my much more reserved one could, so it helped initially to raise their profile (Teacher 6, School 2, (F,1))*
	Children's video perceptions (positive and negative effects)	*Liam: "It makes me feel relaxed and yoga's a really calm activity to use when you're feeling stressed out or annoyed and I like the fact of yoga because it makes me feel calm" (School 2, Year 3 and 4)* *Jack: "I liked Breathe with Steve because it's relaxing, and I've got asthma, so it helps me like calm down a bit as well" (School 1, Year 5 and 6)* *Sonney: "Because like on a day like a Monday every time we done it, it made me feel like energetic and like ready for like the afternoon" (School 2, Year 5 and 6)* *Amy: "I've got something to say. Some of them some of them were like some of them were funny but some of them like Daisy said were trying to be funny but they weren't, but they were just cringey" (School 2, Year 5 and 6)* *Sally: "I didn't like energise with Eddy because erm…coz' when you were doing it wasn't actually that fun it was just like it was just like teaching you more about your heart…everyone was like so hyper active and stuff. They were like bouncing off the walls …and you got out of breath a lot because you're like running on the spot for like one minute" (School 1, year 3 and 4).*

7.8.1 Training Perceptions

1-Hour Training. Teachers perceived that the 1-hour teacher training session (delivered after-school in school 2 and during lunch-time in school 1) was sufficient to increase their confidence, competence and motivation to facilitate the intervention delivery as planned the

following day. By as planned, teachers were referring to accessing the resources and using the booklet to guide their intervention delivery in the classroom. Teachers from both schools stated that once they understood why they were delivering the intervention and how they could fit the intervention into their own class schedule, the next challenge was related to how the children would respond to the resources.

7.8.2 Intervention Acceptability and Barriers

Five subthemes emerged as important factors post intervention training (Table 7-4) including: a) Time, Time of year, technology and school priorities, b) Length of the videos, c) Video design (acceptability), d) Ease of accessibility and e) On-going support and maintenance.

Time, Time of year, Technology and School Priorities. Implementation of the intervention at the end of the school year was perceived as a barrier to successful implementation of the PA resources. Lack of time, and school priorities such as leaver's assemblies, were noted as the main factors for this. In both school's views, the intervention was not a priority, but an "add-on", reducing perceived commitment and therefore reducing intervention fidelity. This was particularly evident regarding the combined delivery of the booklet and video which teachers noted did not fit within the allotted time available to them. Accordingly, the booklet was rarely used throughout the intervention period. Interestingly, one teacher stated that had the resources only been in booklet form and videos not been provided, it is unlikely that the intervention would have been implemented due to feelings of lack of confidence to deliver it. Teachers from both schools also mentioned technology issues as a barrier to the video implementation. Specifically, teachers from school 2 noted that due to problems with the smart board in their classrooms, delivery of the intervention was not as regular as they would have liked.

Length of the Videos. While some teachers viewed the videos were a "nice length of time" (Teacher 3, school 1), other teachers felt some videos could have been reduced in length to 5 minutes maximum. By reducing the video length teachers believed they would fit better within the curriculum time available to them and thus be more inclined to implement them daily. Teachers of both schools noted the videos contained too much talking, with children stood around for a large proportion of the time. Similar perceptions were mirrored by the children

when videos were perceived too long and exercises were repeated leading the children to describe feelings of boredom, especially among the elder years. Accordingly, children stated more variety in exercises were needed to reduce boredom and increase engagement.

Video Design (acceptability). Teachers from both schools liked the educational underpinning of the videos but believed some content was too advanced for younger children. Furthermore, teachers descried children to be too focused on what the coach was doing during the exercises (i.e. copying the exercises) to be aware of what he was saying (i.e. importance of PA for health). The content and age appropriateness of the videos was further expanded upon by a year 6 teacher in school 1 who noted that in her classroom, the older children found the videos more difficult to engage with. Interestingly, this was also mirrored by of the older children (School 2, Year 5 and 6) who described some of the videos as "cringy", "trying too hard" (to be funny) and "embarrassing", believing that they were better suited for "a younger audience". Teachers perceived the actions of the coaches, in particular the dress-up and voices (i.e. different accents) encouraged children to be silly. Staff and older children recommend that to increase engagement, specifically from the boys, coaches should be dressed in more relatable clothing (i.e. sports kit) and offer more variation of exercises. Furthermore, teachers noted that background changes to the videos, through use of green screen may engage children more. The addition of a countdown timer was also suggested to increasing video structure and provide children with a chance to adjust their effort level accordingly (i.e. to decide how much they were to challenge themselves). Furthermore, teachers also stated to be wary of spelling and punctuation mistakes and reduce the videos to 5 minutes max (school 2).

Ease of Accessibility. All teachers from both schools believed that the online resources were easy to access. Teachers liked that the videos were pre-developed and there was a model (coach) on screen for the children to follow who was competent and able to deliver the activities.

On-going Support and Maintenance. Teachers stated that the on-going support provided by the researcher by way of email and drop-in support was positive. The on-going support as well as researcher "keenness" to assess how the intervention was going helped the teachers stay

motivated to deliver the intervention. Staff perceived support from PA-ambassadors to be key in their motivation to deliver the intervention, providing a link between the researcher and teachers. Staff perceived that buy-in from the whole school was critical in getting the children on board too.

7.8.3 Intervention Delivery Preferences

Three subthemes emerged as important factors post intervention training (Table 7-4), including: a) Delivery approaches (dependant on student needs), b) Teacher support (child perceptions) and c) Points system.

Delivery Approaches (Dependant on Student Needs). Teachers from both schools all spoke of different ways in which they implemented the intervention and described using the videos at various times of the day. Some teachers chose a specific time (e.g. 12pm) to develop a consistent routine and to break up lesson time sitting. Other teachers implemented the videos in relation to children's classroom specific needs. The teachers believed that the flexibility of the program, i.e. autonomy to implement videos based on the needs of the children, was particularly important. For example, while one teacher from school 1 used energizer videos to release energy of the children, teachers from school 2 noted that a similar strategy would not work with their children and were accordingly only used as a PE warmup. Afternoons were believed to be the best time to implement the videos to relax and re-focus the children. Added to this, school 2 also chose to implement the videos in the hall to increase the reach of the intervention across the whole school.

Teacher Support (Child Perceptions). A variety of motivations emerged when children were asked why they took part in the videos. Most centred on fun and enjoyment of the videos as well as teacher support and involvement in the delivery of the intervention. On the other hand, when teacher involvement was limited or perceived as negative through controlling behaviours (i.e. pressuring children to participate), children were less motivated to take part in the sessions.

Points System. Children and staff stated that the points system was a good motivator, allowing children to track progress of the exercises they had completed. Schools again however showed variation in how they implemented the points system. For example, while most teachers added points themselves, the study co-ordinator (F, 4) ensured she would not forget to add points by assigning a child to be *point's keeper*. The other school (school 2) increased motivation for the intervention by reading out weekly points in assembly. Teachers stated however that the points system was not necessary as they felt children would have still engaged with the content irrespective of a points system. The points system appeared to be more of a motivator for younger children.

7.8.4 Perceived Intervention Effects

Three subthemes emerged as important factors post intervention training (Table 7-4), including: a) Classroom support and behaviour management (positive effects), b) Skill development and holistic outcomes and c) Children's video perceptions (positive and negative)

Classroom Support and Behaviour Management (Positive Effects). Teachers liked that videos were implementable within the classroom and perceived child responses to videos as positive. Teachers perceived benefits to include increased pupil concentration and focus (i.e. on-task behaviour) with one teacher describing the videos as a behaviour management strategy (Teacher 8, School 2, (F, 6)). Teachers stated that the best videos for behaviour management included those videos that incorporated slow and controlled movements (e.g. yoga; balance and mindfulness), helping increase calm in the children, 'turning high energy into something that's going to be productive energy' (Teacher 8, school 2 (F, 6)). Interestingly, teachers from both schools described using the videos as a strategy to take a break from lesson instruction and induce calm in themselves (PA-ambassador 1, School 1 (F, 4); Teacher 8, School 2 (F, 6)).

Skill Development and Holistic Outcomes. Teachers perceived the intervention to increase the development of children's physical skills, especially in relation to balancing. Teacher also described seeing improvements in children as a motivation for them to want to keep implementing the videos. Furthermore, teachers perceived that the resilience to complete the videos and confidence gained from successfully doing so could transfer into other areas of the

curriculum. Furthermore, teachers who taught special educational needs pupils noted that children had begun to recognise how the videos can help them in other areas of their life.

> *"I have a child in my class that has strategy cards and he flips between strategies that he uses to calm himself down or create a different energy. And one of them is breathing. And it says take some deep breaths which we've already talked about, what is a deep breath? And he's come back and said, "Breathe with Steve has helped me to understand that concept" …So he's made a massive link there" (Teacher 6, School 2)*

Children's Video Perceptions (Positive and Negative). A large proportion of the children across years 3-6 appeared to enjoy the videos, describing them as entertaining and fun to do. There was considerable variation however between what videos children had experienced. Interestingly, most of children irrespective of year group enjoyed the LPA based videos (e.g. balance, mindfulness and yoga) reporting feelings of calm and relaxation after engagement in them. This was especially poignant for the Wind down with Wendy videos, noting the quietness of the classroom as enjoyable, as children were invited to read off the screen and follow the slow structured movements to calming music. Viewpoints of the children regarding the high intensity videos (e.g. energizer videos) were however varied, with some of the younger children expressing difficulty in completing all the movements due to the challenging nature of the exercises.

7.9 Quantitative results (Teacher questionnaires)

7.9.1 Teachers' Sense of Efficacy scale (TSES)

ANCOVA indicated no significant difference ($p > 0.05$) between the control and intervention group for change in instructional strategies ($p = .472$), classroom management ($p = .469$), or student engagement ($p = .885$) (Table 7-8).

7.9.2 Multi-dimensional Work Motivation Scale (MWMS)

ANCOVA indicated a significant difference ($p < 0.05$) between the control and intervention group for change in intrinsic motivation ($F, 1, 13 = 14.767$, $P < 0.05$) and introjected motivation ($F,1, 13 = 14.246$, $P < 0.05$). Post hoc comparison was performed with a Bonferroni adjustment. Post-intervention intrinsic motivation (mean difference of 3.42 (95% CI, 1.52 to 5.45)) and introjected motivation (mean difference of -0.87 (95% CI, -1.37 to 0.37)) were significantly greater in the intervention group compared to the control group. For identified motivation ($P = .305$), external motivation ($P = .416$) and amotivation ($P = .199$), ANCOVA revealed no significant change between the control and intervention groups (Table 7-8).

7.9.3 Problems in School Questionnaire (PIS)

ANCOVA indicated no significant difference ($p > 0.05$) between the control and intervention group for change in highly autonomous teaching styles ($p = .197$), moderately autonomous teaching styles ($p = .203$), highly controlling teaching styles ($p = .073$) and moderately controlling teaching styles ($p = .283$) (Table 7-8).

Table 7-8. Questionnaire values for the TSSE, MWMS and PIS for the intervention and control groups.[a]

	Baseline (0 weeks)		**Post-test (4 weeks)**		**Adjusted change 0-4 (95% CI)[b]**
TSSE	**Control**	**Intervention**	**Control**	**Intervention**	
Instructional strategies	7.37 (0.91)	6.25 (1.51)	6.75 (0.46)	6.50 (1.10)	0.02 (-0.54 to 0.57)
Classroom management	7.62 (0.74)	7.00 (0.75)	7.12 (0.83)	7.25 (0.70)	0.03 (-0.58 to 0.64)
Student engagement	5.75 (1.03)	6.13 (0.83)	6.25 (0.88)	6.37 (0.91)	0.34 (-0.27 to 0.96)
MDWMS					
Intrinsic motivation	8.0 (3.91)	7.9 (2.26)	7.5 (3.91)	10.9 (2.64)	3.49 (1.52 to 5.44)*
Identified motivation	4.5 (1.53)	4.9 (1.56)	4.4 (1.73)	5.1 (1.33)	0.32 (-0.32 to 0.97)
Introjected motivation	-2.9 (0.94)	-2.4 (0.58)	-2.8 (0.59)	-3.5 (0.55)	-0.87 (-1.37 to -3.37)*
External motivation	-2.9 (1.02)	-3.1 (1.10)	-2.6 (0.61)	-3.0 (0.79)	-0.31 (-1.11 to 0.48)
Amotivation	2.2 (1.20)	2.6 (1.20)	2.2 (1.14)	2.2 (1.51)	-0.36 (-0.95 to 0.22)
PIS					
Highly Autonomous	5.40 (0.93)	5.65 (0.69)	5.18 (1.01)	5.09 (1.1)	-0.57 (-0.99 to -0.15)
Moderately Autonomous	4.64 (0.62)	4.71 (0.99)	4.68 (0.31)	4.32 (1.04)	-0.41 (-1.08 to 0.24)
Highly Controlling	4.06 (0.35)	3.89 (1.13)	4.21 (0.31)	3.87 (0.35)	-0.34 (-0.72 to 0.37)
Moderately Controlling	4.56 (0.79)	4.54 (0.79)	4.65 (0.75)	4.32 (0.71)	-0.31 (-0.93 to 0.29)

[a]Baseline and post-test intervention values are unadjusted mean (SD).
[b]Change scores and 95% confidence intervals (CIs are the differences between the groups (relative to the control) after adjustment by ANCOVA.
*Significant (p <0.05).

7.10 Children's Questionnaires

7.10.1 Perceived Locus of Causality Questionnaire (PLOC)

ANCOVA indicated no significant difference ($p > 0.05$) between the control and intervention group for the change in Amotivation (p = .184), External (p = .587), introjected (p = .704), integrated (p = .939), or intrinsic motivation (p = .485) (Table 7-9).

7.10.2 Teacher as Social Context Questionnaire (TASCQ)

ANCOVA indicated no significant difference ($p > 0.05$) between the control and intervention group for change in involvement (p = .392), autonomy (p =.799) or structure (p =.405) (Table 7-9).

7.10.3 Children's Self-Perceptions of Adequacy in and Predilection for PA (CSAPPA)

ANCOVA indicated no significant difference ($p > 0.05$) between the control and intervention group for change in adequacy (p = .374), predilection (p = .829) or enjoyment (p = .237) (Table 7-9).

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Table 7-9 Questionnaire values for the PLOC, TASCQ and CSAPPA for the intervention and control groups.[a]

	Baseline (0 weeks)		**Post-test (4 weeks)**		**Adjusted change 0-4 (95% CI)[b]**
PLOC	Control	Intervention	Control	Intervention	
Amotivation	1.71 (0.67)	1.43 (0.43)	1.54 (0.61)	1.39 (0.42)	-0.64 (-0.14 to 0.70)
External	2.75 (0.70)	2.85 (0.68)	2.73 (0.70)	2.77 (0.53)	-0.66 (-0.15 to 0.27
Introjected	2.92 (0.60)	2.99 (0.59)	2.94 (0.61)	3.02 (0.51)	-0.03 (-0.48 to 0.12
Integrated	3.65 (0.47)	3.79 (0.25)	3.74 (0.43)	3.85 (0.24)	-0.80 (0.27 to 0.13)
Intrinsic	3.58 (0.70)	3.83 (0.30)	3.67 (0.49)	3.86 (0.23)	0.78 (0.31 to 0.12)
TASCQ					
Involvement	4.36 (1.24)	4.61 (1.15)	4.42 (1.24)	4.66 (1.13)	0.15 (-0.15 to 0.47)
Autonomy	4.67 (0.79)	4.83 (0.60)	4.71 (0.68)	4.82 (0.66)	0.03 (-0.13 to 0.18)
Structure	4.62 (0.73)	4.81 (0.96)	4.75 (0.77)	4.96 (0.88)	0.20 (-0.03 to 0.41)
CSAPPA					
Adequacy	4..26 (0.71)	3.92 (0.62)	3.95 (0.75)	3.68 (0.59)	-0.33 (-0.51 to -0.16)
Predilection	3.88 (0.76)	4.04 (0.63)	3.71 (0.63)	3.78 (0.55)	-0.23 (-0.35 to -0.10)
Enjoyment	2.37 (1.14)	2.82 (1.26)	2.43 (1.11)	2.38 (1.05)	-0.30 (-0.59 to -0.02)

[a]Baseline and post-test intervention values are unadjusted mean (SD)

[b]Change scores and 95% confidence intervals (CIs are the differences between the groups (relative to the control) after adjustment by ANCOVA

*Significant (p <0.05)

7.11 Quantitative results

7.11.1. Habitual PA and SB (whole day and school day)

Results from the ANCOVA suggested that for both the school day and whole day analyses, there were no significant differences ($p > 0.05$) for any SB or PA outcome between the control and intervention groups after adjustment for baseline PA levels (Table 7-10).

Table 7-10. Children's school day and whole day accelerometery data with adjusted group differences.[a]

	Baseline (0 weeks)		Post-test (4 weeks)		
School day (min·h^{-1})	**Control**	**Intervention**	**Control**	**Intervention**	**Adjusted change 0-4 (95% CI)[b]**
Sedentary	20.8 (4.1)	22.1 (5.1)	19.1 (3.9)	19.9 (4.6)	-1.9 (-2.9 to -1.1)
LPA	25.2 (2.1)	25.2 (2.7)	26.0 (2.1)	26.6 (2.4)	1.4 (0.8 to 1.9)
MPA	12.3 (2.4)	11.5 (3.0)	13.2 (2.7)	12.3 (2.8)	0.8 (0.2 to 1.3)
VPA	1.64 (0.9)	1.23 (0.7)	1.62 (0.8)	1.13 (0.6)	-0.1 (-0.3 to –0.1)
Steps (steps·h^{-1})	1316.2 (193.3)	1206.4 (211.2)	1339.8 (156.9)	1253.6 (195.7)	23.4 (-18.1 to 65.0)
CPM	4643.1 (900.7)	4227.1 (918.9)	4834.3 (780.1)	4401.1 (790.3)	80 (-107.1 to 267.3)
Whole day (min·h^{-1})	**Control**	**Intervention**	**Control**	**Intervention**	**Adjusted change 0-4 (95% CI)[b]**
Sedentary	23.4 (3.8)	26.3 (5.2)	22.8 (4.1)	25.0 (4.5)	-0.8 (-1.8 to 0.2)
LPA	22.8 (2.2)	21.6 (2.8)	23.0 (2.0)	22.3 (2.3)	0.5 (-0.1 to 1.03)
MPA	12.3 (2.3)	10.9 (2.5)	12.6 (2.5)	11.5 (2.3)	0.4 (-0.9 to 0.9)
VPA	1.8 (0.7)	1.1 (0.6)	1.5 (0.6)	1.1 (0.6)	-0.7 (-0.2 to 0.7)
Steps (steps·h^{-1})	1235.3 (157.6)	1079.6 (187.4)	1233.1 (162.9)	1120.3 (171.8)	10.3 (-32.6 to 53.3)
CPM	4422.9 (683.3)	3856.5 (821.1)	4500.4 (749.9)	39971.1 (766.9)	56.3 (-121.6 to 234.3)

[a]Baseline and post-test intervention values are unadjusted mean (SD).
[b]Change scores and 95% confidence intervals (CIs are the differences between the groups (relative to the control) after adjustment by ANCOVA.
LPA, light physical activity; MPA, moderate physical activity; VPA, vigorous physical activity; CPM, counts per minute.

7.12 Discussion

This non-randomised pilot study evaluated the acceptability and feasibility of a novel SDT school-based PA intervention for primary school settings, deriving preliminary estimates of the effects of the intervention on teacher and pupil outcomes between an intervention and control group. Perceptions and opinions provided by teachers and children adds valuable insight into the importance of developing interventions alongside end-users (Cole and Horacek, 2009; Christian et al., 2015; Naylor et al., 2015) and supports the MRC framework's development and piloting phase for developing effective complex interventions (Craig et al., 2008). The results will be discussed in accordance with these aims and related objectives, with quantitative findings used to support qualitative findings as appropriate.

Out of a total of 21 schools contacted, the response rate was 5 and the recruitment rate was 3 indicating that it was difficult to engage schools in the current study. It is possible that response rates were low due to the time of year that the intervention was to be implemented as well as the already limited time schools have. Schools are however, notoriously difficult to recruit, especially in areas of high deprivation (Barnett and Stevenson, 2016). Furthermore, as leadership turnover is so high in these schools, this creates inconstant programme implementation (Haberman, 1996). In an attempt to increase recruitment rates the principle author offered the delivery of a taster session as recommended by previous investigations (Jago et al. 2015; Domville et al. 2018). Teacher response rates were positive with 16 teachers (100%) showing an initial interest in the study. After assessing for eligibility, participant numbers remained and were retained throughout the intervention period. There is no evidence to suggest why teacher numbers were sustained, however it is quite possible that this is due to the short intervention period (4-weeks).

Of the 486 children approached, 456 (94%) expressed an interest. This may reflect the taster session provided to the students. All students who expressed interest were eligible, but recruitment rates were low, with 124 children (27%) (Control *n*=61; Intervention *n*=63) returning the necessary documentation. Teacher believed a potential reason for low recruitment rates were related to parental unawareness of the intervention. Previous interventions have noted low parental engagement to hinder the response stage of health

interventions (Christian et al., 2015). Furthermore, it has also been reported that health-interventions/research projects can create anxiety in parents (Christian et al., 2015) which again may reduce response rates of their children. Further attrition before baseline collection (*n*=6) reduced the child recruitment rate to 26%, however this was above the 25% threshold which has been previously reported as an important criterion for cRCT (Tibbitts et al., 2017).

From baseline to post-test, of the 118 children, 12 participants were lost to attrition (10%) reducing the sample to 106 children. Reasons for this included illness (*n*=4), lost accelerometers (*n*=2), moved school (*n*=2), not present on data collection day (*n*=2), and not specified (*n*=2). Furthermore, for the school day and whole day analysis 21% and 24% of children respectively (n=22) and (n=24) did not meet the accelerometery criteria. Previous interventions that have assessed sample sizes have allowed for 15%-20% loss of participants from baseline to follow-up (Magnusson et al., 2011; Lawlor et al., 2013; Kipping et al., 2014). Our data is under the 15%-20% attrition rate used in previous studies, however these studies had much greater intervention periods (i.e. 7 months to 2 years). Accordingly, finding creative ways to engage schools and educate school leadership and parents before intervention recruitment stages may increase child response rates and reduce child attrition rates during future interventions.

Intervention training perceptions described by teachers were positive noting increased confidence and competence to implement the intervention during the school day. This was further supported by quantitative analysis indicating a significant increase in teacher's intrinsic motivation to support the delivery of classroom-based PA resources. An unexpected finding with regard to PA resource delivery, was a negative increase in teacher's introjected motivation. Introjected motivation relates to actions controlled by sanctions that are self-imposed (i.e. feelings of shame or guilt) (Deci & Ryan, 2002). Introjected motivations may have possibly increased the delivery of the resources due to feelings of external pressure and/or guilt to deliver the intervention from staff, the researcher or children. Nevertheless, while controlled forms of extrinsic motivation can influence behaviour regulations (or motivations) in the short term they do not sustain maintenance over time (Deci & Ryan, 1985).

While increases in intrinsic motivation could be a case of the training, it is also possible that recognition of the perceived positive effects related to student outcomes may have further facilitated the process. Similar findings have been evidenced in previous investigations and support suggestions that once teachers see the positive impact of classroom PA interventions on children's school related outcomes, they are more likely to implement them (Tsai et al., 2009). Conversely, other teachers, may have internalised controlled behaviours from staff member (i.e. staff, "knocking on the window, as a reminder to do the resources") which took the form of introjected motivation, not integration. Accordingly, if teachers did use the resources from an introjected perspective, they would have done so in spite of not feeling free, not enjoying it and not believing it was personally important. This begs the question as to why some teachers felt this way, compared to others who may have done it out of their own volition.

Interestingly, when analysing the accelerometer data between the control and intervention conditions, there was some interesting results. Evidence suggested insignificant, but favourable changes to children's school day PA behaviours. In particular, SB was reduced by 14 min·day^{-1}, LPA increased by 10 min·day^{-1} and MVPA increased by 5 min·day^{-1}. Considering the greatest health benefits occur when moving individuals form SB to LPA (Department of Health, 2011; Poitras et al., 2016), classroom interventions may hold a positive health related impacts on children's overall health profile. This is especially important for children from areas of low deprivation as these children have higher reported body mass index, are less active and more sedentary than peers in affluent areas (Drenowatz et al., 2010). This is supported by findings that children from areas of higher deprivation are twice as likely to be obese than children in lesser deprived areas, with obesity levels rising year on year (Health and Social Care Information Centre, 2016). Added to this, the increase in daily MVPA, while not a large amount, still adds to the government recommended 30 minutes MVPA during school time and suggests that the implementation of daily PA videos around 5 minutes in length are manageable to implement in a real-world setting (Howie et al., 2014; Goh et al., 2017).

According to teachers, the acceptability and feasibility of the videos in classroom-settings were related to ease of video implementation and were described by teachers as a critical

component of the intervention. Interestingly, most of the perceived effects were believed to be related to children's on-task behaviour, specifically children's focus and concentration post video delivery, which support previous studies (Mahar et al., 2006; Carlson et al., 2015), however improvements in children's movement skills were also perceived by teachers (i.e. balance). Improvements in movement skills may be related to the progressive nature of the videos, allowing children to learn skills and increase motivation and competence within the psychosocial learning domain (Sun et al., 2017). Recent evidence suggests that for the enhancement of locomotor skills, student satisfaction for their need for competence appears to play a critical role (Kalaja et al., 2009). Accordingly, the classroom environment may play a key role in the development of children's physical literacy, especially when environments emphasize student effort, progress and learning. It was further noted that through practicing these skills, it offered a chance for students to increase their resilience, self-efficacy and confidence which teachers believed could transfer into other subjects. While, objective measurements of children's PA self-efficacy revealed no significant change pre-post intervention, it could be that the questionnaire was not sensitive enough to detect changes in children's PA-self efficacy, or that longer trials are needed for children to recognise changes.

A unique finding of this investigation was the self-prescribed use of the videos by teachers to induce calm in themselves. Primarily through the implementation of breathing videos, teachers perceived the strategies as a useful alternative to help deal with the stress and pressures of the classroom. Recent investigations have looked at the use of yogic breathing for reducing teacher's stress and found that participants recommended future application of strategies in school-based programs for staff and students (Hepburn and McMahon, 2017). Offering programs and resources that target both student outcomes and staff well-being may be an important avenue for future PA interventions to explore and could increase school acceptability of interventions through staff well-being components. Furthermore, it would be of interest to see in future investigations how online meditative videos, with an emphasis placed on child movement (i.e. mindful movement) could increase children's physical literacy and therefore motor competence for PA.

As previously noted, the notion that training was sufficient to change teacher's need-supportive behaviour is doubtful and not supported by the qualitative results. Previous systematic reviews that have evaluated PE teacher training components of interventions suggest that it is critical for school-based PE interventions to offer training of ≥ 1day, offer on-going support, use comprehensive pedagogy that translates content into practice and measure teacher satisfaction and fidelity as essential design elements (Lander et al., 2017). Added to this, child reports of negative feelings during intervention implementation related to teacher actions (i.e. feelings of coercion to take part) suggest that some staff behaviours were internalised in a controlling context and brings into questions the limited training time for promoting autonomy-supportive PA climates. Nonetheless results still supports other investigations for the importance of need-supportive teaching styles to increase motivation (Cheon et al., 2012, 2018; Reeve and Cheon, 2014). While the perceived negative actions of teachers were only described in one focus group, our qualitative findings supplement previous studies and support notions that perceptions of a need-supportive environment is built on the development of perceived fun and enjoyment (Donnelly et al., 2009; Howie et al., 2014; Vazou and Smiley-Oyen, 2014) and again points to the importance of the affective learning domain for increasing PA motivation (Sun et al., 2017).

It should be stated that some children described some activities as unenjoyable irrespective of teacher actions. In particular, teachers and Year 5 and 6 pupils perceived that the video content was not age-appropriate and/or relatable, leading some children to describe feelings of embarrassment and boredom when engaging with the video content. Previous investigations have highlighted the importance of age-appropriate content to increase child engagement (Jago et al., 2015a). The findings also support basic psychological needs theory, highlighting the importance of optimal challenge (a factor a competence support) and feelings of relatedness to the instructor to increase motivation and enjoyment (Reeve and Halusic, 2009; Ryan and Deci, 2000; Study 2). Perhaps teachers could have placed more emphasis on acknowledging children's negative effects towards the video's which may have in some way helped to support their need for autonomy (Sierens, 2010). These results support beliefs that for children to positively engage in classroom-based PA, not only does the environment need to support children's psychological needs, but fundamentally intervention content (i.e. the

videos) need to be enjoyable and engaging and designed to be age-appropriate and optimally challenging.

While classroom-based PA interventions have previously shown promise at increasing children's PA levels over control conditions (Webster et al., 2015) it is often difficult to assess why, as compliance rates are rarely or poorly reported (Watson 2017). While active breaks delivered by research staff have shown high fidelity for achieving required PA intensities, this is less evident in teacher delivered sessions. This again points to the various interpersonal, intrapersonal and organisational barriers teachers report and highlights again the importance of intervention flexibility in school-based settings (Naylor et al., 2006; Jain and Langwith, 2013; Quested et al., 2017). Such flexibility as reported as necessary study 3 allowed teachers to cater to the individual needs of the children which support previous investigations for the importance of teachers delivering interventions, as teachers know the pupils and their particular needs (Domville et al., 2018) which may explain why interventions are more successful when delivered by teachers who undergo appropriate training (Lander et al., 2017). Furthermore, additional support or aligning interventions to school priorities may be needed to encourage breaks of 5min·d^{-1} or more, more than once a day. This is especially important considering that teachers perceived the intervention to be an "add-on to PE" or a "non-priority" irrespective of the on-going support provided. Accordingly, best efforts should be made to align interventions to school development plans, thus increasing their priority status and releasing funds to support intervention sustainability.

As a final note, teachers offered recommendations to increase the acceptability of the videos in the classroom. Issues related to time (i.e. making some of the videos shorter; (5mins max)) were noted, as well as changing the backgrounds of the videos to make them more visually stimulating. Adding a timer so children knew how long they will be active for (to assess the challenge of the video) and making the coaches more relatable to the older children (i.e. wearing sports kit instead of fancy dress) were also perceived important. Furthermore, teachers believed that wearing a sports kit would increase the buy-in from boys. As there was only a male instructor leading the sessions, this raises an interesting question of what would increase buy-in from girls and the possibility of a female instructor.

7.12.1 Strengths and limitations

This study can be used to support the further justification and refinement of the present, and other, classroom-based PA interventions for primary schools. Engaging teachers and pupils in the mixed-methods evaluation is a strength, as different perspectives were offered, which supports the importance of engaging multiple stakeholders in the development of interventions. Despite its strengths, caution is warranted when interpreting the results. The small sample of low SES schools limited to one region of the UK reduces the studies generalisability to the population. Further, convenience sampling and the non-randomised design increases the chances of bias affecting the results, with feasibility testing of the intervention via randomised controlled trials in larger more diverse samples warranted. There is also some uncertainty about the validity of the questionnaires, especially the adapted teacher questionnaire (MWMS), as it has not been validated to assess teacher's motivation to deliver classroom-based PA resources. The intervention would have also benefited from data collected on compliance of teachers implementing PA breaks or the number of breaks conducted per day/week. Finally, the intervention duration was short, and the influence of a longer intervention period on response, recruitment, attrition and completion rates as well as the acceptability, feasibility and effectiveness of the intervention is unknown, with further research warranted to investigate this.

7.12.2 Conclusion

The present study explored the feasibility and acceptability of a classroom-based PA intervention underpinned by SDT. The findings suggest that the proposed intervention is acceptable and feasible to implement into primary school settings subject to specific changes. As attested to in previous studies, time is an essential commodity in school and therefore effective interventions should aim to reduce factors related to intervention implementation and resource delivery time. Pre-developed resources and those that are easily accessible are recommended to help do this. Furthermore, training and on-going support for generalist teachers to increase implementation and delivery confidence, competence and motivation are essential factors to ensure interventions are delivered as intended. Difficulties may arise however when interventions are viewed or perceived as an add-on or a non-priority, again

limiting school time and resource allocation for appropriate training. Researchers should aim to develop resources in conjunction with end-users, where a specific focus is directed toward aligning interventions to school-specific development plan, as opposed to a sole focus on PA and SB. The relative research of PA supporting the importance of health and school related outcomes provides a platform from where researchers can start to recruit schools and develop initial interest. It must be noted however, that PA interventions need to be designed with flexibility and adaptability to withstand the changing primary school landscape and offer resources that stratify student and teacher needs. Related to this, to increase children's engagement of PA interventions, resources may benefit from age appropriate design by key stage, being optimally challenging, and above all fun and enjoyable. Furthermore, interventions may benefit from a theoretical underpinning (i.e. a behaviour change theory) and appropriate supporting pedagogies (i.e. need-support) if student outcomes are to improve. As a final note, intervention effectives may benefit from implementation closer to the start of the school year, where barriers to implementation may be reduced.

7.12.3 Summary for business and practitioners

There present study would appear to suggest that the classroom-based PA intervention implemented in study 4 was acceptable and feasible to be evaluated as a cRCT in a primary school setting (subject to some modifications, as suggested by end-users). Furthermore, these initial results suggest that by following a rigorous intervention design process, as defined by the MRC framework (Craig et al., 2008), interventions may have greater success and sustainability when evaluated in larger scale studies. Interestingly, while the findings suggest that the training had no effect on increasing teacher's autonomy support, pre-developed, easy to use resources that quickly implementable may have a positive, while not significant effects on children's MVPA levels and SB. This study again supports the need for interventions to be multi-component, underpinned by appropriate behaviour change theory and developed with a socio-ecological approach in mind. Saying this, it should be noted that classroom PA breaks are only one part of the CSPAP and therefore, PA break interventions such as that implemented in study 4 should be used to supplement PA and reduce SB, and not be viewed as the gold standard for increasing school-based PA levels. Nevertheless, these results offer hope that classroom-based PA interventions not only increase PA and reduce SB but may also play an

important role toward increasing children's school-based outcomes. Accordingly, these results as well as the many other classroom PA interventions out there, support a role for commercial businesses to provide a platform whereby teachers can increase the PA levels of their pupils during the school day, from the comfort of their classroom.

8. Synthesis and findings

8.1 Aims and Objectives

This synthesis will discuss results from all four studies and their implications in relation to the central theme within this thesis, of what factors need to be considered when designing primary school-based interventions to promote PA and reduce SB in children at school. The implications of the results for research, school policy and practice, and the private sector will be discussed. To recap, studies in this thesis were guided by the MRC framework, with formative research in schools initially undertaken to better understand factors perceived by educators to influence pupils' school-based PA (study 1) as well as explore children's perceptions of factors influencing their PE enjoyment (study 2). An intervention underpinned by SDT was then developed, and school educator opinions and perspectives were gathered to refine and justify the intervention (study 3) before the intervention was evaluated for acceptability, feasibility and preliminary effectiveness (study 4). The intervention developed and evaluated in study 4 provided generalist teachers with training, on-going support and an online PA resources centre to help reduce sedentary time and increase PA in children at school.

8.2 Major Findings

8.2.1 A Socio-Ecological Approach to School Buy-In

One of the factors to consider when designing school-based interventions is the importance of school stakeholder buy-in to PA interventions (i.e. from headteachers, teacher and pupils). Study 1, 3 and 4 found that for PA practices/interventions to be sustainably implemented in schools, headteacher and staff support is critical. Headteacher support involved an embracing attitude for the positive impact that PA had on the health and school related outcomes of pupils. Despite these perceived benefits psychosocial behavioural benefits, headteachers attested to the difficulties of implementation and sustained delivery (study 1). The headteachers and staff in all 4 studies has generally positive beliefs about the importance of PA for child health and well-being, yet still indicated implementation difficulties. This raises concerns especially related to children from low SES areas who attend schools where stakeholders (headteacher and staff) may overlook the positive health-related impact of PA. This is especially worrisome considering the importance of early positive PA and PE experiences for increasing long-lasting health behaviours (Department of Health, 2011).

Various researcher now suggest that to increase sustainability of school-based PA interventions on-going support and staff buy-in is a critical factor (Jago et al. 2015; Stolp et al. 2014). Ongoing support that offers continued training of teacher's is one reported factor considered to increase delivery confidence and competence of interventions (Study 1 and Study 3) and may increase buy-in. Buy-in however is multi-faceted and exists at various levels of the SEM. Furthermore, teacher buy-in, (which relates to their beliefs, attitudes and opinions) is affected by pressures from above (i.e. pressures to meet children's academic needs; limited time (study 1 and 3 and 4) as well as pressures from below (i.e. children's motivation to engage in lessons (study 4). Pressures from above have been found to elicit use of controlling teaching strategies by teachers which can negate child motivation and enjoyment (Reeve et al., 2014). The development of child motivation, enjoyment and engagement is dependent on environments that support their innate psychological needs (Ryan & Deci 2000; study 2). Similarly, lessons and resources that are not well structured or perceived as unenjoyable can limit engagement leading to feelings of boredom thus negating motivation (Jago et al. 2015; study 2; study 4). Our preliminary findings evidence that for interventions to be effective and sustainable, perceived support is a fundamental factor at all levels of the SEM and is therefore a key focus of this systematic review.

8.2.2 Aligning Interventions to School Development Plans (Organisational and Interpersonal Support)

While the maintenance and/or cultivation of a supportive school climate is believed essential to increase school PA provision (Naylor et al., 2015) organisational barriers related to time, space, availability of resources and academic priorities (Naylor et al. 2015; Clarke et al. 2015; Brown and Elliott 2015), or priorities related to the school development plan (study 3 and 4) can hugely impact the availability of PA resources and the promotion of school-wide PA opportunities. As noted by the Department of Education (2016), the school development plan is a strategic plan for improvement. SDP's bring together school priorities, the measures it will take to raise standards, the resources required to do so and the key outcomes and targets it attends to achieve. The school development plan is often internally and externally assessed which put pressures to staff to ensure targets are reached.

If we consider the eight schools who participated in study 1, 3 and 4, no schools had PA as part of their development plan. Accordingly, the amount of provisions and resources given to the improvement of outcomes related to PA were minimal, if compared to more pressing priorities and outcomes related to the SDP. To put this in perspective, school-based practices to increase the provision of PA were viewed by headteachers and teachers as an "add-on" (Study 3, School 5) where implementation and delivery of PA is at the discretion of individual teachers (Study 1, School 2). These descriptions not only highlight limited organisational support for PA, but infer that PA, left in the hands of teachers, is a choice. Accordingly, the amount of PA children receive during the school day, could significantly vary depending on the beliefs, values and motivations of teachers who teach them. This finding was particularly evident in study 1 and again highlights the variation in buy-in from staff and how that can influence the PA opportunities children receive during the day. Take for example, the perceptions of the PE-coordinator in study 1, who was a specialist PE teacher. She described the implementation of PA practices into school as a "*constant challenge*", noting that the amount of PA children receive during the school day was *"hit and miss".* With this in mind, we call for two new ways of thinking when approaching the design of PA interventions, one that primarily relates to the re-framing of interventions, not as an-add on, but an integral part of the school culture and two, that throughout the development of the intervention, co-development with schools is seen as a priority.

As a researcher (recruiting schools) or as a business (selling a product) we can align our interventions to the needs of schools, through a co-development process, as this will primarily create initial buy-in and early rapport. For example, if behaviour of students is a priority on the school development plan (as expressed by teachers), the focus of the intervention (irrespective of its initial design, i.e. to increase PA and reduce SB) should be targeted towards behaviour, and therefore, designed in a collaborative way. This is advantageous for three reasons, the first as previously mentioned, is likely increase organisational support from the headteacher due to alignment of the intervention with specific school needs related to improved student outcomes. Secondly, teachers who are often the main delivers of interventions (Russ et al. 2015) are less likely to view the intervention as an "add-on" and because it is a "priority" will be much more inclined to implement it. Thirdly, co-development of the intervention with

teachers reduce barriers to implementation and increase intervention flexibility across schools. Furthermore, with amassing evidence that PA interventions, and in particular classroom-based PA can help improve children's school-based outcomes, including improved on-task behaviour and concentration (Mahar et al., 2006; Mahar, 2011; Ma et al., 2014), academic achievement (Uhrich and Swalm, 2007; Adams-Blair and Oliver, 2011; Donnelly and Lambourne, 2011) and classroom effort (Vazou et al., 2012) there is ever more reason to upsell and educate teachers on the school-related benefits of PA rather than the innate health benefits of PA itself. Let's consider also that classroom-based interventions occur within the classroom, a familiar place for teachers and one where they feel comfortable and more "at home". Establishing PA in this setting (under a school development plan pseudo-priority) may again help reduce barriers to PA delivery including those reported by teachers in study 3, i.e. "changing children into PE kit" and may possibly allow teacher to become more comfortable and confident delivering PA.

8.2.3 Implications for Business and Research

Considering that headteachers are usually given autonomy regarding the health interventions they choose to implement (Todd et al., 2015) due to the idea that schools are best placed to identify areas for improvement themselves (Department of Education, 2016), this provides great incentives for business to match their products to the specific needs of schools, again promoting the co-development of interventions. Learning to speak the language of schools in relation to perceived pupil success appears a defining factor when considering the design of PA interventions from both a research and commercial perspective and may again increase buy-in. These proposals align with teacher opinions and perspectives from studies 1, 2, and 3, which have all consistently supported the notion that interventions need to be flexible and adaptable in their design to support the perceived needs of individual schools. Accordingly, PA researchers and companies may benefit from paying particular attention to specific school needs and teacher opinions, designing interventions and their accompanying components (i.e. resources) to facilitate school-based outcomes (i.e. classroom management; behaviour management) over more explicit health-based outcomes (i.e. increases in PA and reductions in SB) that schools and stakeholders may not necessary perceive as essential to children's educational success.

8.2.4 Training Teachers to Increase Motivation, Confidence and Competence (Intrapersonal Support)

Currently in the UK, each primary school is provided with up to £20,000 by government schemes including the school sports premium and sugar tax premium to enhance school PE, sport and PA. As part of these schemes, schools employ external coaches under the premise that teachers are upskilled and provided with appropriate continued professional development opportunities to increase their knowledge, confidence and competence to deliver PE. Studies 1, 2, 3 and 4 all support the beneficial effects of teacher training, especially training underpinned by a motivational approach such as need-support (studies, 2, 3, and 4). Furthermore, all studies provide evidence to suggest that training alone without appropriate resources and on-going support across the different levels of the SEM may not be as effective (Lander et al., 2017).

This issue of outsourcing PE, using coaches as the main delivers of teacher training (even though they may have no formal pedagogical knowledge (Jones and Green 2015) has led teachers (study 1), children (study 2) and researchers to criticise the current delivery model (Powell 2015). The issues related to the current PE environment describe a disconnect between teachers left wanting and not receiving training, and contrary to the Primary Sport Premium implementation policies, teachers using coach delivered PE lesson time for planning preparation and assessment (study 1). While there are obvious positives that can come from the new delivery approach (i.e. children being taught by trained professionals), there are also negatives. For example, when external coaches leave, children's PE is taught by (for the most part) staff who lack the confidence, competence and knowledge to deliver well-structured lessons (study 2). This is worrying for two reasons, the first, poorly structured and delivered lessons can negate children's motivations through the lack of need support. Secondly, enjoyment of PE is correlated to increased PA during children's leisure time (Karagiannidis et al., 2015; Jaakkola et al., 2017).

These results beg the question as to whether this current delivery system to increase school-based PA in the UK is failing both teachers and pupils and concurrently not providing the

sustainable improvements of school-based PE, sport and PA as it was intended to do so. Aligned with the findings of study 2, evidence now suggests that central to the development of children's PA and PE enjoyment is the development of a need-supportive environment that supports student's psychological needs for autonomy, competence and relatedness (Reeve 2009; Reeve et al. 2004). While study 2 was important to identify a behaviour change model to underpin the blue-print intervention, study 3 extended previous evidence (Aelterman et al., 2014) that perceptions of need-support during training are fundamental for increasing delivery motivations and buy-in to PA interventions. Therefore, while studies 1 and 3 provided great depths of insight to support contentions that teacher training is necessary for increases in delivery competence and confidence, study 2 and 3 subtly suggested that it was desirable to underpin training using motivational theories that would facilitate teacher delivery and increase pupil engagement.

To enable this, we propose two options. The first, involves training teachers in a need-supportive way, to deliver PE/PA sessions that are need-supportive to increase confidence, competence and delivery motivation. The second involves the provision of, easy to implement online PA resources, designed alongside end-users, that can be used as a 'classroom management strategy' to increase student's school-related outcomes and support CSPAP. The most critical piece of both recommendations is the provision of training that not only seeks to increase teacher's delivery confidence and competence, but in doing so, satisfies teacher psychological needs in the process. There is new and emerging research to suggest that psychological need satisfaction during training is related to change in effectiveness and efficacy beliefs to implement new psychological need support strategies and intentions to apply the proposed strategies (Aelterman et al., 2016). While most of the research is currently undertaken in PE in secondary schools, where teachers are already trained to deliver PE, Escriva-Boulley et al., (2017) found that similar training can increase primary school teacher motivation, leading to objectively increased student MVPA. Applying these strategies in PE as well as other important CSPAP (i.e. classroom-based PA) should help to further increase student PA levels, while possibly supporting school-related outcomes too.

8.2.5 – A New Policy Approach to School-Based PA Delivery

In order for children to reduce SB and increase school day MVPA levels it is recommended that in-service and pre-service teachers are appropriately trained to deliver CSPAP. As previously discussed, beliefs at the intrapersonal level may be why some teachers are more inclined than others to deliver PA during the school day. Forcing teachers to deliver PA does not align with need support and therefore motivation will not be autonomous. However, targeting in-service teachers who are receptive to training and school-based PA may be a good starting point. Another option, which could be more sustainable is the introduction of policy changes at the university level, whereby all teachers who are progressing through the pre-service education system received ample training, support and follow-up to deliver CSPAP. This would then create a culture of teachers progressing through the education system who are confident and motivated to deliver school-based PA, helping to upskill existing teachers.

Previous research has looked at the effects training pre-service teachers to deliver CSPAP. Evidence suggested that training significantly increased pre to post-test collective efficacy beliefs, willingness to integrate PA into the school day and a decrease in perceived barriers to PA (Webster et al., 2013). Furthermore, evidence suggests that in-service teachers are often less-willing to deliver PA programmes when organisational barriers such as time constrains, tight schedules and pressure from standardised testing was high (Cothran et al., 2010). The collective findings that organisational barriers and intrapersonal beliefs, which may develop from interpersonal norms and practices (i.e. “only external coaches deliver PE/PA at our school”) are consistent themes throughout the thesis and highlights why buy-in, co-development of interventions and acceptance to change is so important if school-based PA interventions are to be effective and feasible.

8.2.6 Implications for Business and Research

It is now evident that for children to engage in PE and PA, their enjoyment of the lesson is fundamental (study 2). Therefore, it only seems natural that for teachers to provide quality PA experiences to children, appropriate training to increase their confidence and competence is preferable. Pre-service teacher training provides an interesting alternative to the current delivery approach and evidence also suggest that through training, pre-service teachers can

develop an awareness of how to develop administrative support (school buy-in) for movement integration (Webster et al., 2013) which as discussed is critical to increase organisational buy-in. Designing and developing training programmes that target pre-service teachers, as well as in-service teachers could provide an avenue for businesses to increase the successful implementation and sustainability of PA interventions in schools with newly employed in-service teachers upskilling existing staff, acting as the agent of change. As we have previously discussed, need-supportive approaches and training designed to increase teachers autonomous delivery motivation is desirable (Aelterman et al., 2014; Russ et al., 2015). Accordingly, during the early design of PA interventions, identifying how researchers can increase need support during training and on-going support post training is warranted.

8.2.7 Designing Resources to Meet Student Psychological Needs and Support Teacher Classroom Needs (Intrapersonal Support)

Preliminary findings from study 4 suggest that teachers are willing to implement new products/resources into schools if ease and accessibility are the priority and teacher training supports ease of implementation. This then provides more supporting evidence that to increase buy-in, it is essential that products/resources are designed in such a way that they align with teacher perceived student needs. The intervention resources that were developed (study 3) and evaluated (study 4) are a prime example of how teachers can easily implement PA throughout the school-day, requiring little planning, whilst using supportive technologies (i.e. Smart Boards) already present within school. While intervention resources were unfortunately not aligned with school development plan needs, they offered teachers an opportunity to try a new mode of delivery to increase children's PA levels and reduce SB. The training provided was brief (1-hour), yet teachers felt confident and competent to deliver the product in schools the next day. Understandably, the training appeared insufficient for fostering changes in teachers' self-efficacy and use of motivational strategies (as reported in both child and teacher questionnaires), yet teachers were receptive to implementing the intervention as it was co-developed and was accordingly based on their needs i.e. "it's just a click away" (study 3).

When considering school stakeholder buy-in, it is children's buy in that is critically overlooked. Studies that have taken their time in development to conduct rigorous formative research and process evaluations have found similar results (Jago 2015). Children hold an important share in the success of PA interventions and can provide key feedback to improve future component development. Take for example study 2 and study 4. In both cases, children offered in-depth understanding that guided resource development. In study four, children gave brutally honest accounts of their feelings toward the resource centre, but without such knowledge, progression cannot occur. What may be important in future intervention design is more rigorous co-development of resources with children. As children are the end-users and their enjoyment level is critical to engagement, views of children will help increase engagement and may foster more interventions support from teachers (study 4).

What is clear of teacher and child resource perceptions from study 4, is that school-based PA interventions should not try to encompass a "one size fits all approach" and again specifies the importance of intervention flexibility even at the intrapersonal level of the children. Intervention content (and especially resource design) will not appeal to the needs of everyone, however intervention content can be better designed and aligned to children's psychological needs, increasing enjoyment, engagement and ultimately buy-in. Study 4 as well as study 2 evidenced that to increase children's engagement in lessons (study 2) and with resources PA (study 4), autonomy (i.e. thorough choice), competence (i.e. through optimally challenging resources) and relatedness (i.e. through coach/teacher support) is key. This again supports the MRC framework (Craig et al., 2008) and the critical importance of robust development of interventions at all levels of the SEM to ensure what is delivered has the best chance of supporting long-term behaviour change. These results not only support the necessity for end-user feedback during the critical development and piloting stages of interventions but provide informative information of ways interventions may need to be changed or altered before larger trials are implemented. Therese findings also highlight the importance of process evaluations to ensure interventions were implemented as intended.

8.2.8 Implications for business and research

Aligned with barriers related to implementation cost, classroom-based interventions have been shown to be the cheapest form of school-based delivery method as shown in a recent economic analysis comparing school based programmes (Babey et al., 2014). This provides further incentives for researchers and businesses to work with schools and design intervention content and training programmes that upskill teachers and provide them with the motivation, competence and confidence to incorporate PA into their classroom on a daily basis. Although the resources were designed and underpinned by need-supportive strategies to increase motivation (i.e. offer choice), feedback from children in study four was mixed. This implies that further research needs to be undertaken with children to better understand how online PA resources can be designed to meet their psychological needs. Online resources designed and underpinned by SDT is, from what we can see, a relatively new idea within classroom-based PA intervention design and therefore it is difficult to compare findings to previous interventions. Despite this, it also offers an opportunity for business and researchers to be creative, original and innovative designing training and interventions in novel and new ways that appeal to both headteachers, teachers and children. For this co-development is key.

8.2.9 Summary and Future Directions.

The primary aim of this thesis was to test the acceptability and feasibility of a new and novel SDT classroom-based PA intervention to be delivered in primary school settings. Classroom-based PA interventions are quickly becoming new hot research area within CSPAP (Webster, 2015). Classroom PA interventions have been shown impact important PA outcomes, as well as school related outcomes too. The success of PA interventions and in particular classroom-based interventions are dependent on stakeholder buy-in and the co-development of the intervention as suggested by the MRC framework (Craig et al., 2008). Buy-in exists across all levels of the SEM and therefore targeting interventions to increase buy-in and reduce barriers to implementation appear key. A fundamental part of this process is development work with end-user. It is staggering how many PA interventions are designed without full appreciation for the complexities of the environment in which they are to be implemented. As with most products that go on sale, product testing is a key and crucial area that businesses do not underestimate. Yet, it appears that very little of this occurs with end users of PA interventions.

If interventions are to be effective at targeting specific mediators of change (i.e. increasing autonomy support) it is essential they components are well developed, evaluated, re-developed and revaluated. This process is one that aligns with the MRC model for developing complex interventions.

Considering future directions, it is interesting to consider the possibility of resource access to parents and the wider community and weather this could increase intervention support and effectives. For example, if PA resources at home for parents and children to engage with together, this could potentially increase the reach of the intervention to the wider community. While there is a possibly of this helping intervention effectiveness, for now, the focus should be on developing intervention components that support all levels of the SEM to reduce delivery barriers and increase teacher confidence and competence to increase delivery motivations.

9. Personal reflections

9.1 The end of the journey

9.1.1 A brief update

When I reflect back now on my researcher-practitioner journey, one part of me feels like a failure, while the other part feels that I was able to create something worthwhile and challenge myself more than ever before. I feel that as a researcher-practitioner I let SOKKA down. I wasn't able to provide the support SOKKA needed, at least from a research perspective. On the other-hand however, I'm extremely feel proud that I was able to overcome some serious challenges during my journey, related to personal isolation (most probably from living in a different city to my university colleagues) lack of direction (related to both myself and the company) and limited belief in myself (likely due to a new area of study I hadn't undertaken before). The quote below sums these feeling up relatively well as my time with SOKKA was coming to a close.

> *"I don't know whether to be happy or be sad, SOKKA don't want to continue pushing the business forward and have decided to mothball. I've got such mixed feelings about the whole thing, I wanted to do to something great, to show my worth…maybe it's just meant to be…what at first seems too good to be true normally is. SOKKA have kindly said they will continue to support me until the end of my contract in 2017. I feel so isolated again…I don't even want to continue this anymore"* – Reflection date 15/09/16 (Two years into PhD)

The struggle was real, and it didn't real get any easier, however I had committed myself to following through with this, and this is what I needed to do. I suppose if I were to talk to any research-practitioner now, and offer them advice on such a role it would be this.

> "Number 1 – Be damn sure you want to do the PhD, and be very aware that this is no normal PhD journey. Number 2 – Let other people help you, don't try and do everything yourself. Number 3 – It's a long journey, etched with some great wins and echoed with times of great sadness, but ultimately it is in these critical moments you will develop your future character. Number 4 – You are not going to change the world, but you may

> change how you view it. And finally, number 5, don't believe for a moment you can't do it…" Reflection date 6/2/19 (End of PhD)

As a closing reflection, I think it's important to take you back into the schools, where the real magic happened. I think this quote really speaks to the value of the research-practitioner role, or for me, the practitioner-research role and the critical importance of Number 4 mentioned above - You are not going to change the world, but you may change how you view it.

> "I've just visited (school name). It feels great to hear a that all my hard work is paying off and the children are enjoying the resources, some teachers even say they notice improvements in the children's concentration post video implementation… As I left the meeting, a few kids saw me and must have recognised me from the videos, they shouted "hey, its Bobby Balance", laughed and ran away. I'm not changing lives here, but if I'm making people happy, well that's good enough for me" – Reflection date 3/7/17 (Two and half years into PhD)

From where I'm sat now, I can appreciate the difficulties that come with increasing children's PA levels and reducing SB. There are so many factors to consider and one approach is not going to fix it all. For me, there is no right or wrong approach, all that matters is that you have the right attitude, the right people around you, and rightly or wrongly, turn up to your job, day in, day out, and give it your all, with your hope hung high you'll change the world for the better – and with that, maybe one day a bright budding research-practitioner will change the world. I wish them all the best!

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10. Appendix

SOKKA P.L.A.N.E.T Intervention

Contents

List of need-supportive-behaviours

Recap of three psychological needs

1. Students experience **AUTONOMY** when they feel supported to explore, take initiative to develop and implement solutions to own problems.

   Autonomy supportive behaviours include;

   - Nurturing interest, enjoyment and sense of challenge
   - Creating opportunities for initiative taking
   - Providing choices to students
   - Providing explanatory rationales
   - Displaying patience and allowing time for self-paced learning
   - Acknowledging and accepting expressions of negative effect
   - Accepting complaints and using non-controlling language (e.g. “you may want” to vs “you have to”)

2. Students experience **COMPETANCE** when challenged and given prompt feedback

   Competence supportive behaviours include;

   - Presenting understandable, clear detailed directions and framing the upcoming lesson well
   - Offering considerable guidance
   - Providing clear action plans and goals
   - Offering constructive and informative feedback to enhance sense of gaining control over desired outcomes. Chaos leads to in-competence

3. Students experience **RELATEDNESS** when they perceive others are listening and responding to them.

   Relatedness supportive behaviours include;

- Expression of genuine and sincere care and interest in the person with whom you are working. Through limited interpersonal involvement students feel uninvolved and perceive the environment as hostile.

Application of need-support to the classroom

"It is not your role as a teacher not to motivate your students – but to create a supporting environment whereby students feel autonomously motivated to act"

Below is a list of the **21 need-supportive techniques** that teachers may use to help support the development of a child's self-determined motivation by helping to foster a need supportive environment.

Important - Teachers do not have to do all the need supportive behaviours, but maybe pick some that they are comfortable doing – know that the more they do, the more need-supportive the teacher will be, leading to greater motivation in the child to engage.

1. Take a genuine interest (Autonomy/Relatedness)

Asks questions about interests, problems, wishes or values. This technique can be used **before**, **during** or **after** the lesson. See example questions you may use below.

Before

1. You could pick a child to choose a time for a SOKKA break
2. Ask "Who is interested in having a SOKKA break"?
3. Ask "What movement activity would you like to do/coach would you like to use"?
   Teacher may (if want to) explain the lesson (using the resource pack) and then ask
4. "Does everyone understand what we're going to do"?
5. "Is everyone happy to continue"?

During

1. "How is everyone doing"?
2. "Is everyone enjoying themselves"?
3. "Is anyone experiencing any problems/issues with the movements"?

After

1. "Which movements did you find had to engage with"? Ask individual children and promote class discussion
2. "What was easy, what was difficult"?
3. "Is that challenge something you would like to practice again"?
4. "What did you learn during the challenge today"?

2. Offer students a voice and a choice (Autonomy)

There are three types of choice teachers can offer and include cognitive choice (e.g. letting students ask questions), organisational choice (e.g. allowing students to choose partners) and procedural choice (e.g. providing students with opportunities to choose movements)

Below are some suggestions for how you may apply choice within the intervention

Coach selection – Allow the children to choose their movement coach from the SOKKA 7 provided
Choice of footwear – Shoes or no shoes? (YOGA, BALANCE, BREATHING) – Without shoes promotes better balance and provides children with a sense of autonomy
Choice of deliverer - maybe the students would like to choose a movement challenge and deliver it themselves using the teacher manual after the challenge video

3. Give children time to experiment (Autonomy)

Offer the opportunity to experience problems, to practice independently, to experiment, to exercise and to solve problems on their own, without interfering

Before – Before a challenge for example, you may let children have a minute of trying to experiment with movements using the teacher manual as a guide
During – During the challenge you may stop the video and/or offer the children extra time to practice independently
After – After a challenge, you may ask them to practice the challenge in playground or at home time themselves.

4. Give meaningful rationale (Competence)

Each of the videos offer the pupils a specific explanation of the tasks or exercises (e.g. this is important because…placing one foot in front of the other will improve your balance skills). Emphasizing the importance of an exercise and therefore the challenge is also part of this practice and can be read from the user manual **(see pp 8)**

5. Give an overview of the content and structure of the lesson (Competence)

This is provided in each of the videos; however, a quick verbal explanation from the teacher can cement the importance, which will then be reinforced during the video. If video is not being used, verbal instruction before the teacher led lesson is important **(see pp 8)**

6. Give clear verbal instructions (Competence/Relatedness)

Instructions are provided throughout the videos but look for children who may not understand (**note: videos are mirrored for the benefit of the children**). Again, if activity is teacher led, clear instruction is a must, which again are provided in the user manual giving pictures, instructions and timings of the activity **(see pp 9).**

7. Monitor pupil's actions (competence)

Do the pupils consequently live up to the (verbal) instructions (e.g. do pupils perform exercises as instructed). Note: Remember, allow some time for experimentation and offer help where necessary.

8. Uses variation between and within exercises (Autonomy)

Videos provide different movement options for children to do to meet their competency levels so varying movement competences are catered for

9. Applies differentiation (Autonomy)

The videos provide continual progression of movements, offering differentiation of skills between challenges and coaches allowing different degrees of difficulty whilst considering the different needs pupils

10. Offer pupils (apart from instruction) new guidelines, tips and advice (Relatedness/competence)

Teachers can take opportunity of this need-supportive behaviour by offering a teacher tip during the video. Teacher tips are provided in the manual and offer either new tips, challenges or advice (e.g. during a YOGA class a teacher tip may be "try to feel as though someone is pulling your arms from both directions). Teacher tips can be used during any point in the class **(see pp 8)**

11. Offer positive feedback (Relatedness/competence)

Positive feedback and reinforcement is key for developing autonomous motivation. While you can offer this to the class as a whole during the challenges, (e.g. “well done”, “you all doing really well”) you can also do this individually, after the class (e.g. “Tommy, your balance and concentration today was great today”). General positive feedback (e.g. praise and encouragement) when supportive of one’s competence can increase motivation.

Key point in **developing relatedness** (“It’s not that I like my teacher, but my teacher likes me”)

12. Encourages pupils to persistence (Relatedness)

You may want to encourage persistence in a task in several ways;

- Through empathetic positive encouragement and feedback (e.g. “come on, you can do it”) showing the students you care about their health and fitness
- Through peer to peer help (e.g. using peers to assist other students)
- Setting movement practice tasks to do at break or at home

13. Uses pupils as positive role models (competence/relatedness)

Children who are good at certain movements, you may want to use them to model movements to the class, or use the pupil to help and encourage others who may not feel as competent.

14. Offer help during exercises (Relatedness)

If you are not involved physically in the class, walk round the class, offering guidance, use the teacher tips, offer **positive feedback** etc. Really try to be present during the challenges.

15. Addresses pupils by their first name (Relatedness)

In any situation, address pupils by their first name when the opportunity occurs.

16. Be physically nearby the pupils (Relatedness)

It’s easy to put a video on and walk away to get on with the other 100 things you must do, but staying in the room, showing your physical presence is important in the development of trust and relatedness.

17. Be enthusiastic and eager (Relatedness)

Enthusiasm is so important for increasing motivation. If a teacher shows enthusiasm, this rubs off on the children and they want to be involved in whatever the challenge may be. Example behaviours you may show are.

Surprising the children – "Okay I'm feeling tired, who wants to get up and active"
Set out a timeframe – "After this class were going to do some SOKKA, I can't wait to see how much you have all improved…"

18. Puts effort and energy into the lesson (Relatedness)

If you are modelling the activity yourself or doing the activity challenge video with the children, personal effort and involvement is critical to child perceived importance and relatedness.

19. Take the perspective of pupils into account, is empathic

(Autonomy/relatedness)

All pupils will vary in their range of skills so it's a teacher's role to simply "be there emotionally" for the pupils and help them to develop confidence in their self and their movement abilities.

20. Pays attention to what the pupils are saying (Autonomy)

How well is the teacher capable of listening to the pupil's needs, wants and desires? Acknowledge and except expressions of negative affect. Acknowledging students' perspective by accepting that students will inevitably encounter rules and requests that are not consistent with their preferences and when they do they will not engage fully.

21. Demonstrates the tasks himself, serves as a "model" for the pupils

(Relatedness/competence)

Weather this is involvement in the challenges, modelling from the teacher resource pack or following along as the children model, teacher involvement is always welcomed and encouraged

SDT classroom applications

1. Nurture a student's inner motivational resources and incorporate student's interests, preferences and values into learning activities and try to avoid external regulators such as rewards, directives, deadlines and compliance requests.

2. Rely on non-controlling language and communicate using informational and flexible messages (i.e. information rich and competence affirming rather than controlling and rigid messages (i.e. coercive and pressuring).
3. Communicate value and provide rationale when tasks do not appear to capture the interest of the students, identify and explain the use and importance of the tasks.
4. Know your students and be involved with them. Interpersonal involvement helps them to become motivated and self-determined.
5. Positive feedback will most likely improve competence and intrinsic motivation.
6. Acknowledge and except expressions of negative affect, acknowledging student's perspective by accepting that students will inevitably encounter rules and requests that are not consistent with their preferences and when they do they will not engage fully. Acknowledging their feelings of not liking the tasks or not liking the request will help them to feel self-determined.

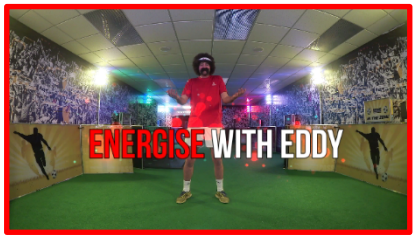
Meet the coaches

Bobby is from the American wild west and will introduce your children to the basics of balance and why good balance is important in all aspects of life.

Bakkis a born and bread South African and will teach the children all about the different muscles in the body, their role in movement and how to keep muscles injury free!

Want to learn the basics of yoga…? Well, **Yuko's** Californian chill is perfect to relax and revive! Children will learn a variety of yoga poses along with the incredible health benefits behind it.

King is from a kingdom far away and prides his pupils on good posture and co-ordination. His fun activities will help the children become masters of movement and control.



Want to get fit, energised and on track...? No fear the French poet is here! In his high paced classes **Eddy** will teach the children about the importance of physical activity and the magnifique healthy heart benefits

Steve is your typical Australian. With his wacky ways your children will go on some extraordinary adventures, learning about the breath and how to self-regulate their emotions using the breath and body

Finally, not forgetting wonderful **Wendy**. Her calming aura will invite the children to relax and regenerate with her meditative manner

Balance with Bobby

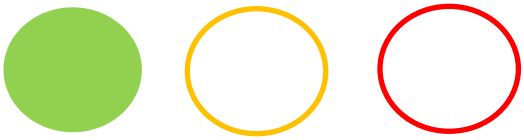
Challenge Intensity	Name	Body effect	Usage
1	Learning to balance	**We believe these sessions will increase children's in-class concentration and attention through focused effort and persistence in balance tasks.**	**As a lesson transition Brain Break (fidgety) Increase energy**
2	One legged balance		
3	Hip aligners		
4	Tip toe stands		
5	Star balancers		
6	Flowing balance		
7	Dynamic balance		
8	The bean stalk*		
9	Stretch & balance*		
10	Kenny core		

*** Depending on the balance abilities of the children some may find these challenges more difficult than others.**

Light intensity

Moderate intensity

High intensity

SOKKA P.L.A.N.E.T 7	**Balance with BOBBY** **CHALLENGE 2 – ONE LEGGED BALANCE**
Time of class – 4m	**Teacher tip (pedagogy)** These movements could be challenging for some children so to improve their **competence,** find another time after the video to get the children up to practice these movements again. They don't take long, and **practice** really does **make perfect**! In fact, you can get the **children to take this class**, that way you can walk round the room and help the children who may be struggling.
What will the children achieve? During the second class with Bobby, Stars continue to work on their static balance but this time focus on movements of the legs and arms, trying to hold a stationary position. Remember kids, static balance isn't easy so **anchor your gaze** on something not moving.	
Intensity level  Light Moderate Vigorous	**Anchor your gaze** Fixing the gaze when balancing provides a visual anchor to help you achieve a state of balance. In yoga we call this drshti (or drishti), which means fixing the gaze on a stable object without straining the body or eyesight. One purpose of drshti is to help you balance in more challenging postures, but it also has another important task of focusing your attention.
Body effect The slow tempo of this class makes it a perfect session to relax the children into a lesson as it requires **increased concentration** to perform the specific balance skills	**Teacher Notes**
When should I use this? • As a lesson transition • Brain break (e.g. when fidgety) • After break or lunch (Relaxation) • Before a lesson (increase concentration)	

BALANCE Movement Models

Follow pics A-H giving **everyone time** to test and **feel** their balance

YouTube links to view resources

Link 1 is the explanation of the SOKKA resources by the SOKKA coach (principle researcher). The aim of this video was to provide the children with an understanding of why they are doing the videos.

1. https://www.youtube.com/watch?v=_AAQuVumB10

Link 2 is one of the 'coach introduction videos' (Bobby Balance).

2. https://www.youtube.com/watch?v=ilL2-Ie411s

Link 3 is Challenge 2 of 10, a balance video the children completed to increase their balance skills

3. https://www.youtube.com/watch?v=VyOSXTeTtVM