FUNDAMENTAL MOVEMENT SKILLS, PHYSICAL ACTIVITY AND OBESITY FROM EARLY TO LATE CHILDHOOD

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Abstract

Fundamental movement skills (FMS) are a vital part of a child's development, which allow them to advance on to more complex movements, resulting in them functioning successfully in their daily lives and when participating in sports and physical activity. Despite the importance of FMS, previous studies have routinely found children to have low competency levels. Further research on competency levels in this area is required, specifically among UK children, as data on FMS proficiency and FMS interventions is dominated by research from Australia and North America. As such, the aims of this thesis were to a) document the level of FMS competency of preschool children from a highly deprived area of Northwest England, b) determine the effectiveness of a six-week Active Play intervention on FMS competency among preschool children from a highly deprived area of Northwest England, c) examine the relationship between FMS competency, physical activity and weight status over a five-year period between preschool and late primary among children from a highly deprived area of Northwest England and finally, d) gain the thoughts and opinions of experts and practitioners in order to help inform the development of an appropriate intervention to increase the physical literacy of preschool children.

Study One

A cross-sectional study examining FMS among deprived preschool children in Northwest England and exploring sex differences. A total of 168 preschool children (Mean age 4.65 ± 0.58; 54.1% boys) were included in the study. Twelve skills were assessed using the Children's Activity and Movement in Preschool Motor Skills Protocol (Williams et al., 2009) and video analysis. Sex differences were explored using independent t-tests, Mann-Whitney U-test and Chi Square analysis at the subtest, skill and component levels, respectively. Overall competence was found to be low amongst both sexes, although it was higher for locomotor skills than for object-control skills. Similar patterns were observed at the component level. Boys had significantly (p<.05) better object-control skills than girls, with greater competence observed for the kick and overarm throw, whilst girls were more competent at the run, hop and gallop. The findings of low competency suggest that developmentally-appropriate

interventions should be implemented in preschool settings to promote movement skills, with targeted activities for boys and girls.

Study Two

This study examined the effectiveness of an active play intervention on FMS competency amongst 3-5 year-old children from deprived communities. In a cluster randomized controlled trial design, six preschools received a resource pack and a six-week local authority designed program with accompanying practitioner training to implement 60 minute weekly sessions and included post-program support. Six comparison preschools received a resource pack only. Twelve skills were assessed at baseline, post-intervention and at a six-month follow-up using the Children's Activity and Movement in Preschool Study Motor Skills Protocol. One hundred and sixty two children (Mean age = 4.64 ± 0.58yrs; 53.1% boys) were included in the final analyses. There were no significant differences (p>.05) between-groups for total FMS, object-control or locomotor skill scores, indicating a need for program modification in relation to dosage and duration in order to facilitate greater skill improvements.

Study Three

This longitudinal study examines the associations between FMS competency, physical activity and weight status among deprived preschool children from early to late childhood. Twelve FMS were assessed using the Children's Activity and Movement in Preschool Motor Skills Protocol and video analysis. Physical activity was measured via hip-mounted accelerometry. Data was collected over a five year period, baseline October 2009 and March 2010 and follow up assessments June and July 2015. There was an overall pattern of increase for total, object-control and locomotor scores between baseline and follow up. Conversely, there was an overall pattern of decline for MVPA among participants. There was a significant (p<.05) association between total and locomotor scores and MVPA at baseline. However, these associations weakened over time and no significant associations were found at follow up. Baseline competency failed to predict follow up MVPA or weight status. Likewise, baseline MVPA was not found to be a predictor of follow up FMS competency. Further

longitudinal research is required to explore these associations among children from highly deprived areas. Future interventions may require a more holistic approach to improving FMS competency and increasing PA in order to account for the number of variables that can effect these outcomes.

Study Four

A two phase qualitative study seeking to gain the insight of academics/practitioners and children's centre staff in order to design a prospective physical literacy (PL) intervention for preschool children. Phase one included nine semi-structured Skype interviews with academics/practitioners working within the field of young children's physical activity and health and/or physical literacy. The aim of the interviews was to explore experts' opinions on the concept of PL and their perspectives on the design and development of future interventions targeted at improving preschool children's PL. Phase two of the study consisted of four focus groups carried out among educators/practitioners working within children's centres in Liverpool. The purpose of these focus groups was to explore the perspectives of preschool staff on the feasibility and acceptability of future proposed physical literacy interventions aimed at preschool children. Findings from this study indicate that the initial goal of a physical literacy intervention should be to educate children's centre staff about the concept of physical literacy. The design of an intervention should be collaborative and be flexible enough to allow for variation between centres, with children's centres provided with physical resources to develop activities. Finally, any proposed intervention should be flexibly designed to accommodate centres current curriculum, ensuring its long-term feasibility.

Publications and Conference Outputs from the PhD

Scientific Publications

Foulkes J. D., Knowles Z., Fairclough S. J., Stratton G, O'Dwyer M., Ridgers N. D. & Foweather L. (2016). Effect of a six week active play intervention on fundamental movement skill competence of preschool children: a cluster randomised controlled trial. *Perceptual & Motor Skills*, 124(2):393-412. doi: 10.1177/0031512516685200

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Conference Presentations

Foulkes J. D., Knowles Z., Fairclough S. J., Stratton G, O'Dwyer M., Ridgers N. D. & Foweather L. (2015). Effect of a six week active play intervention on fundamental movement skill competence of preschool children: a cluster randomised controlled trial. European College of Sports Science Annual Congress, Vienna, July 2016

Foulkes J. D., Knowles Z., Fairclough S. J., Stratton G, O'Dwyer M., Ridgers N. D. & Foweather L. Fundamental Movement Skills of Preschool Children in Northwest England. European College of Sports Science Annual Congress, Amsterdam, June 2014

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Finally, I would like to dedicate this thesis to the following:

John & Margaret Foulkes

Arthur Potter

And

John & Maureen Mulhaney

It gives me great comfort knowing how proud you would be.

Night, God Bless.

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Glossary of Terms

Fundamental Movement Skills	An organised series of basic movements requiring the combination of movement patterns of two or more body segments (Gallahue & Donnelly, 2003).
Preschool Children	Children aged between 3 and 5 years of age
Primary Children	Children aged between 5 and 11 years of age
Physical Activity	Defined as *"any bodily movement produced by skeletal muscles resulting in energy expenditure"* (Casperson et al. 1985, p. 126)
Sedentary Behaviour	There is no agreed upon definition for sedentary behaviour. It has been described as the absence physical activity and involves the intentional engagement in mostly seated activities that require minimal and low energy expenditure (Biddle, 2010; Reilly & McDowell, 2003)
Physical Literacy	Defined as *"the motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for engagement in physical activities for life."* (Whitehead, 2016)

Chapter One

Introduction

Introduction

1.1 Obesity and Physical Activity

The most recent figures for the United Kingdom (UK) show that almost a third of children aged 2-15 yr. are classed as being either overweight or obese, with similar proportions reported for both boys and girls (Health and Social Care Information Centre, 2015). Furthermore, longitudinal data from the United Kingdom birth cohort studies states that younger generations are becoming obese at earlier ages and remaining obese for longer (Johnson, Li, Kuh, & Hardy, 2015). Similar to obesity among adults, childhood obesity has been associated with an increased risk of developing cardiovascular disease, metabolic syndrome and type II diabetes in later life (Daniels, 2009; Pulgarón, 2013; Reilly et al., 2003).

Higher levels of habitual physical activity (PA) (defined as "any bodily movement produced by skeletal muscles that results in energy expenditure" (Caspersen, Powell, & Christenson, 1985, p. 126) during early childhood have been found to be protective against obesity (Jiménez-Pavón, Kelly, & Reilly, 2010; Moore et al., 2003), whilst sustained PA throughout childhood and adolescence also assists with weight management (Kwon, Janz, Letuchy, Burns, & Levy, 2015). Further benefits of participation in PA during early and middle childhood include prevention of cardiovascular disease (Burgi et al., 2011; Ekelund, Luan, Sherar, & et al., 2012; Sääkslahti et al., 2004), improved bone health (Baptista et al., 2012; Janz et al., 2010; McKay et al., 2005; Tobias, Steer, Mattocks, Riddoch, & Ness, 2007), motor development (Burgi et al., 2011; Hardy, King, Kelly, Farrell, & Howlett, 2010; Laukkanen, Pesola, Havu, Sääkslahti, & Finni, 2014) and cognitive functioning (Hillman, Kamijo, & Scudder, 2011; Syväoja, Tammelin, Ahonen, Kankaanpää, & Kantomaa, 2014).

To achieve such health benefits, the most recent PA guidelines from the UK recommend that preschool children should engage in at least three hours of PA, of any intensity, spread over the course of a day (Department of Health, 2011). The UK PA guidelines also offer specific guidelines for children and young people (5-18 yr.), whereby this age group should be engaging in moderate-to-vigorous physical activity (MVPA) for a minimum of one hour and up to several hours each day.

These guidelines encompass recommendations that vigorous intensity activities, including those that help to strengthen muscle and bone, should be incorporated at least three days a week (Department of Health, 2011).

In August 2016 the UK Government published their plan for action on childhood obesity (Her Majesty's Government, 2016), setting out a number of strategies to tackle the rise in childhood obesity. One such strategy included helping children to enjoy an hour of PA every day by improving the co-ordination of quality sport and physical activity programmes for schools, and supporting early years settings (Her Majesty's Government, 2016). Such actions will be important as figures from the Health Survey for England (2012) (Health and Social Care Information Centre, 2013) show that among English preschool aged children (2-4 yr.) only nine percent of boys and ten percent of girls meet the recommended national PA guidelines. With evidence showing tracking of both PA and sedentary behaviour from early childhood (0-5.9 yr.) to middle childhood (6-12 yr.) (Jones, Hinkley, Okely, & Salmon, 2013), it is not surprising that the proportion of primary aged (8-10 yr.) boys (24%) and girls (16%) meeting the UK PA guidelines for children and young people is also low. With further research showing that PA levels track further still from early childhood into adolescence and adulthood (Telama et al., 2014), this suggests that the early years are a significant time period for developing positive PA behaviours across the life course.

1.2 Fundamental Movement Skills

Fundamental movement skills (FMS) are an organised series of basic movements requiring the combination of movement patterns of two or more body segments (Gallahue & Donnelly, 2003) and are often described as being the building blocks for more complex movements (Gallahue, Ozmun, & Goodway, 2011). Developing FMS competency is an important aspect of a child's development and can affect their ability to move throughout their life course (Payne & Isaacs, 2002). As such, FMS are suggested as a potentially important determinant of PA through a bi-directional relationship that strengthens from early childhood to adolescence (Barnett, Morgan, Van Beurden, Ball, & Lubans, 2011; Stodden et al., 2008). Whilst cross-sectional evidence suggests that there is a positive

association between FMS competency and PA among preschool (Burgi et al., 2011; Fisher et al., 2005; Foweather et al., 2014; Iivonen et al., 2013) and primary school-aged children (Barnett, Van Beurden, Morgan, Brooks, & Beard, 2009), there remains only limited evidence from longitudinal (Bryant, James, Birch, & Duncan, 2014; Robinson et al., 2015) or intervention (Lai et al., 2014) studies. Furthermore, little is known about whether early years FMS competency is able to predict later PA and can protect against obesity and sedentary behaviour. This would be useful for researchers as if early years FMS competency was found to be a predictor for PA and weight status in late childhood then early years interventions could be put in place to prioritise children increasing their FMS competency.

Whilst data is available on FMS competency among preschool children from Australia (Hardy, King, Farrell, Macniven, & Howlett, 2010; Okely & Booth, 2004) and America (Goodway, Robinson, & Crowe, 2010; Ulrich, 2000), data on FMS competency levels among UK preschool children is lacking. Such data is important because of the cultural differences that exist between countries, be it through education or sporting pursuits, which may be reflected in children's FMS competency levels (Simons & Van Hombeeck, 2003). Likewise, there is only limited FMS competency data on UK children from areas of high deprivation, yet it has been previously reported that low SES children are significantly less proficient than their high SES peers (Morley, Till, Ogilvie, & Turner, 2015), as well as being at risk for a number of other health inequalities in both their mental and physical health (Elgar et al., 2015; Hargreaves, Marbini, & Viner, 2013; Reiss, 2013). With the UK Government now setting mandatory guidelines for children's physical development (Department for Education, 2014), data on the FMS competency levels of preschool children will be needed in order to help monitor this aspect of children's development. Furthermore, there is only limited evidence on how to improve FMS competence among English children (Foweather et al., 2008), with further information required on initiatives that could be undertaken in schools and early years settings in order to help improve children's FMS competency and make sure that children nationally are meeting the required goals.

FMS competency is an important component of physical competence, which is an aspect of *Physical Literacy* (PL), a concept that is defined as an individual who has the motivation, confidence,

physical competence, knowledge, and understanding to value and take responsibility for engagement in physical activities for life (Whitehead, 2016). The concept of physical literacy has become more popular in recent years and is now being used within policy documents by large scale organisations such as the British Heart Foundation's "*The Best Start in Life: A Manifesto for Physical Activity in the Early Years*" (British Heart Foundation Foundation, 2016) and the Youth Sport Trust's *"Primary School Physical Literacy Framework."* (Youth Sport Trust, 2016). These documents would seem to indicate a shift towards a more widespread approach to children's PL, which preschools will need to be aware of and have effective strategies for that they can implement. At present there is no evidence on what is best practice in regards to PL intervention design, as such, formative research is needed in this area in order to provide preschools and practitioners with a framework for how to increase children's PL.

1.3 The Local Context

The research undertaken within this thesis was conducted in Liverpool, a large urban city in Northwest England. The health of people living in Liverpool is worse than the national average for England, with Liverpool one of the 20% most deprived districts/unitary authorities in England and approximately 32% of children living in low income families (Public Health England, 2016). Promoting PA is especially important in Liverpool, as recent figures have shown that North-West England has the highest levels of physical inactivity among adults, with only 26% of men and 31% of women meeting national PA guidelines (Townsend, Wickramasinghe, Williams, Bhatnagar, & Rayner, 2015).

1.4 The Active Play Project

The studies conducted in this thesis have directly followed on from a wider programme of research, entitled the *Active Play Project* (APP). The APP was a 2010 Local Authority designed and funded intervention in response to surveillance data on local primary school children reporting low levels of

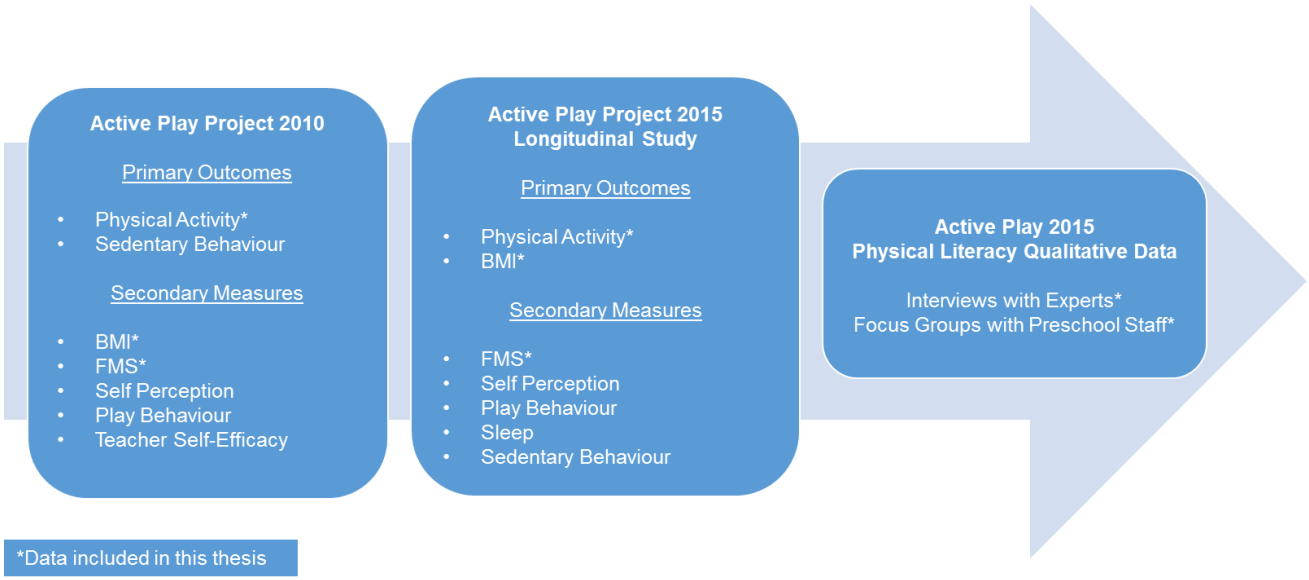
PA and fitness, alongside high levels of sedentary behaviour and obesity (Boddy, Hackett, & Stratton, 2009; Fairclough, Boddy, Hackett, & Stratton, 2009; Stratton et al., 2007; Stratton et al., 2009). These findings indicated the need to establish health behaviours, such as participation in PA, from an early age. The project consisted of a six-week educational programme directed at preschool staff and children with the aim of increasing children's PA levels, developing FMS, strength, agility, co-ordination and balance, and increasing children's self-confidence. The assessment and findings of the APP were the basis of a 2012 unpublished PhD entitled *"Active Play and Sedentary Behaviour in Preschool Children. From Patterns to Intervention"* (O'Dwyer, 2012) and several subsequent publications (Foulkes et al., 2015; Foweather et al., 2014; O'Dwyer, Fairclough, Knowles, & Stratton, 2012; O'Dwyer, Fairclough, et al., 2013; O'Dwyer, Foweather, Stratton, & Ridgers, 2011). As part of this project, data was collected on the FMS competency of the children taking part. Due to unforeseen circumstances, this data could not be analysed within the timescales for the original project but presented an opportunity for a future programme of research.

1.5 Introduction to the Thesis

This thesis sought to exploit the untapped potential of the 2010 APP dataset through primary and secondary analysis of existing and original data in order to add to the existing evidence base (see Figure 1.1). Specifically, in Study One, FMS data from the 2010 APP was analysed to examine the FMS competency levels of English preschool children, whilst Study Two determined the effect of the 2010 APP intervention on FMS competence. In 2015, a five-year longitudinal follow-up of the original APP participants was conducted (Study Three) in order to determine whether developing competence at FMS may be protective against physical inactivity or obesity (Stodden et al., 2008; Lubans et al., 2010). In recent years, the concept of *"Physical Literacy"* has gained prominence in both research and policy among preschool and young children. Typically defined as being an individual's motivation, confidence, physical competence, knowledge and understanding in order to take responsibility for engaging in physical activities for life (Whitehead, 2016), with Edwards, Bryant, Keegan, Morgan, and Jones (2016) systematic review highlighting the number of physical

literacy publications having risen from one in 1998 to 29 in 2014. Improving FMS competency may help to develop the physical competence aspect of physical literacy among young children (Edwards et al., 2016), however, less is known about how to successfully enhance the other attributes of physical literacy among young children. As such, findings from studies One, Two and Three were subsequently presented to sector experts and practitioners working with preschool children as part of formative research to develop recommendations for the design of a developmentally-appropriate physical literacy programme for preschool children in early years settings (Study Four).

Figure 1.1 Research map of the Active Play Project



1.6 Organisation of the Thesis

Chapter Two (Literature Review) will provide a review and critique of the current literature relating to FMS among children, the health benefits of PA, the relationship between FMS and PA, the key findings of previous studies reporting FMS competency and defining and discussing physical literacy. This review will highlight 'gaps' within the current literature which have subsequently provided the rationale for the thesis. This chapter will also detail the aims and objectives of this thesis and the

methodological approaches that have been employed. **Chapter Three** presents Study One, a cross-sectional study examining the FMS competency levels of preschool children from Liverpool. Study Two, reported in **Chapter Four**, will assess the effectiveness of the APP in improving the FMS competency of preschool children. **Chapter Five** will report the findings of Study Three, a longitudinal examination of FMS competency of children who took part in the APP in 2010. In **Chapter Six**, Study Four presents the outcomes of semi-structured interviews with academics/practitioners within the field of children's PA and health, and focus groups conducted with preschool centre staff in order to produce recommendations for future physical literacy interventions. Finally, **Chapter Seven** will provide a synthesis of the findings from the four studies and their implications in relation to the major themes of the thesis, as well as providing recommendations for future research and policies.

1.7 Thesis Study Map

For the purposes of the reader each of the four studies in this thesis will be prefaced by a thesis study map, outlining the objectives and key findings of each study. The aim in presenting the 'map' which builds throughout the thesis is to aid demonstration whereby each study fits in with the overall thesis.

Chapter Two

Literature Review

2.1 Introduction

The purpose of this chapter is to review the literature associated with FMS, PA and obesity amongst preschool (ages 2-5 yr.) and primary aged (ages 5-11 yr.) children. This review will seek to: (i) describe fundamental movement skills, their role within child development, how they can be assessed, and their associated health benefits, (ii) review and critique the research in this field conducted to date, providing a clear rationale for this thesis and (iii) define and discuss the concept of physical literacy. Finally, this chapter will conclude with the aims and objectives of the thesis and an exploration of the methodological approaches that have been used within it.

2.2 Fundamental Movement Skills

2.3Defining Fundamental Movement Skills

FMS are an organised series of basic movements requiring the combination of movement patterns of two or more body segments (Gallahue & Donnelly, 2003), resulting in the activation of large muscle groups (Haywood & Getchell, 2009). FMS fall under three categories: i) stability, involving static or dynamic balance and weight transfer static, ii) object-control, requiring the control of an implement with any part of the body, and iii) locomotor, involving moving the body in a direction from one point to another. Considered to be the initial building blocks for more complex movements and in turn leading on to the acquisition of more specialised movement sequences (Gallahue et al., 2011), the mastery of FMS is seen as a prerequisite for successfully functioning in daily life or for participation in sport and physical activities requiring more advanced movement skills (Cools, De Martelaer, Samaey, & Andries, 2009).

2.4 Development of Fundamental Movement Skills

Early childhood (2-5 yr.) is seen as a "window of opportunity" for FMS development due to the rapid growth of the brain and neuromuscular maturation (Malina, Bouchard, & Bar-Or, 2004). Whilst all children develop a rudimentary fundamental movement pattern (Lubans, Morgan, Cliff, Barnett, & Okely, 2010), mature patterns of FMS are not acquired *"naturally"* through maturational processes (Clark, 2005). Rather, FMS instead need to be taught and practiced in order to develop successfully (Payne & Isaacs, 2002), using the appropriate practice, encouragement, feedback and instruction (Gallahue et al., 2011). The acquisition of FMS is influenced by a range of bio-psychosocial and environmental factors (Hardy, King, Farrell, et al., 2010; Iivonen et al., 2013), such as perceptions of competence (LeGear et al., 2012) and opportunities to practice FMS (Logan, Robinson, Wilson, & Lucas, 2012). Newell (1986) describes FMS as emerging within a dynamic system, wherein movement arises from the interactions between the individual, the environment and the task they are trying to complete. The acquisition of FMS can also be affected by the personal characteristics, motivation, prior experience and the community and cultural values of the individual (Gallahue et al., 2011). When given the necessary opportunities and appropriate encouragement, children have the ability to achieve FMS competence by age 6 yr. (Gallahue & Donnelly, 2003).

2.5 Assessing Fundamental Movement Skills

There are a number of assessment tools available for researchers to assess children's development of FMS, with assessments falling under the category of norm- or criterion-referenced. Norm-referenced (NR) tests compare the individual's performance to that of a normative group, quantifying their FMS competence. In comparison, a criterion-referenced (CR) test compares the individual's performance against themselves over time, allowing the performance of the skill itself to be measured. Whilst NR tests require minimal training for researchers, the tests are only able to provide information on a participant in relation to their peers and cannot be used to identify the cause of developmental deficiencies (Payne & Isaacs, 2002). Conversely, CR tests allows developmental assessment to be

carried out by comparing an individual's self-performance across a period of time. However, CR testing is deemed to be more complicated to execute than NR testing, due to the amount of training that is required of researchers (Payne & Isaacs, 2002) e.g. establishing agreed upon levels of inter- and intra-rater reliability prior to assessment taking place.

FMS competence can be evaluated by considering both process- and product-based characteristics of movement. Product-based measures of FMS are typically quantitative and focus on the end product or outcome of the movement, e.g. a time, speed or distance (Logan et al., 2012), with little regard as to how the movement itself was completed. Conversely, process-based assessments of FMS competence evaluate *how* a movement is performed and describe qualitative movement patterns (Logan, Barnett, Goodway, & Stodden, 2016). Thus, process-based measures allow researchers the opportunity to identify the developmental skill level of the child, rather than their physical growth or maturational status (Hardy, King, Farrell, et al., 2010), and can therefore be used to plan effective FMS programmes for young children. Assessments can be undertaken by researchers in situ or subsequently with video recording, with the latter offering greater precision in analysis as trials can be replayed and skills performed at high speeds can be watched in slow-motion playback. As a marker of physical competence, the assessment of FMS competence is able to provide researchers with information on a child's developmental level and can help to identify any children who have low levels of FMS competences, as well as monitoring competency levels over time. One of the most frequently cited measurement tools for assessing FMS competency among FMS literature is the Test of Gross Motor Development-2, with the Test of Gross Motor Development-3 currently under development.

2.6 Test of Gross Motor Development, Second Edition

The Test of Gross Motor Development–2 (TGMD–2) is a standardised test that measures gross motor abilities in children aged between 3 and 10 years of age, making it a suitable test for pre-school and primary children. The test can be used to identify children who may lag behind their peers in gross motor skill development, plan programmes to improve FMS in children showing developmental

delays and to assess changes as a result of ageing, experience, instruction or intervention (Ulrich, 2000). The test assesses 12 FMS, which are divided into two groups; locomotor (run, gallop, hop, leap, jump and slide) and object-control (strike, dribble, catch, kick, throw and roll). Participants are required to perform each of these skills twice, with competency assessed by whether a child has demonstrated a number of specified criteria for the observed skill. The absence or presence of a criterion is scored as either a zero or a one, respectively. These scores are then totalled, providing a total score, as well as allowing scores for both locomotor and object-control skills to be calculated and age equivalents to be derived (Cools et al., 2009).

The main strength of the TGMD–2 is that it requires limited time to administer (approx. 15-20 minutes) and requires commonly used and inexpensive physical education equipment e.g. bat, balls etc. in order to be carried out. The main weakness of the TGMD-2 is in its failure to evaluate any standalone stability skills. However, as a number of the included skills e.g. hop, broad jump and strike require participants to incorporate various aspects of balance and stability in order to be performed competently, that the TGMD-2 is still able to offer an indirect assessment of stability. Whilst the author of the test advises that a large amount of clear space is required for testing, measuring at least 60 feet x 30 feet (Ulrich, 2000), assessments can easily be carried out in either indoors for example in school halls or outdoors on playgrounds. Additionally the TGMD-2 author also advises that test reliability is an issue, with a 15% error built in to the test even at a coefficient of 0.95 (Ulrich, 2000), however, this only has potential implications if the test is being used for diagnostic purposes. Of note to researchers is the possibility that TGMD-2 performance may be affected by cultural differences, with Bardid et al. (2016) expressing caution in using the US norm references when assessing European children, due to the potential cultural differences between the Belgian sample observed and the US reference sample.

2.7 CHAMPS Motor Skill Protocol

Following on from the TGMD-2, the Children's Activity and Movement in Pre-School Study (CHAMPS) was subsequently developed. The principle aim of the CHAMPS was to examine the link

between motor skill competency and physical activity levels in pre-school children (Williams et al., 2009). As a result of this, the CHAMPS Motor Skills Protocol (CMSP) was produced - a protocol specifically designed for large-scale field-based studies of FMS within preschool children (Williams et al., 2009). The CMSP follows the same design as the TGMD-2 (Ulrich, 2000), in that it is process-orientated in its assessment of FMS. However, the CMSP authors made several changes to the assessment criteria, having felt that in its current form the TGMD-2 was not appropriate to assess competency levels in preschool children The criteria for several skills were not described in specific terms, making it difficult to assess whether the criteria were present or not and that additional criteria should be added to a number of skills (Williams et al., 2009). The CMSP assesses the same 12 FMS as the TGMD-2, with participants asked to complete each skill twice, following a demonstration, taking approximately 45 minutes (Williams et al., 2009). Movement characteristics for each skill are measured as either a 1 (present) or 0 (not present) and totalled, allowing researchers to compile a total, locomotor and object-control score.

The strength of the CMSP is that unlike other assessment protocols it has been specifically designed to assess the FMS competency of *preschool* children. With the majority of research into FMS competency taking place amongst primary children, it is useful for researchers to have a specific tool for measuring competency among preschool children, helping to increase the validity of their research. Furthermore, with the majority of FMS research within the literature being carried out *'in the field'*, the use of specifically designed field-based measurement tool is another advantage for researchers working in school environments. This specificity of design combined with the relatively small amount of FMS research among preschool children may help to explain why use of the CMSP is not as widespread among the literature as the TGMD-2.

2.8 Importance of Developing Competence in Fundamental Movement Skills

According to Stodden et al. (2008) there is a reciprocal and developmentally dynamic relationship between motor competency (MC), i.e. FMS competence, and PA during childhood (see Figure 2.1), with the authors suggesting that the relationship between MC and PA will strengthen over time

between early and late childhood. (Stodden et al., 2008). Seefeldt (1980) proposed that there might be a *"critical threshold"* for MC, above which children will be active and successful in applying FMS competency to PA, but below which they would be less successful and drop out PA at increased rates. However, among the literature this critical threshold has not been investigated or empirically defined. Using a mountain climbing as an analogy, Clark and Metcalfe (2002) described FMS as representing the *"base camp"* from which children begin their climb up the mountain of motor development, with children following different *"developmental trajectories"* as they complete this climb, due to differing individual constraints and environmental opportunities. This view is supported in the Stodden et al. (2008) model, with the authors suggesting that young children's PA may drive their FMS competency due to increased PA resulting in more opportunities to promote neuromuscular development, which in turn can promote FMS development (Fisher et al., 2005). Furthermore, early childhood is considered a "window of opportunity" for FMS development as young children have high levels of perceived competence (LeGear et al., 2012), with Stodden et al. (2008) reasoning that from a practical perspective, this confidence and fearlessness may encourage engagement and persistence in activities that foster FMS competence.

The Stodden et al. (2008) model hypothesises that young children will display variable levels of PA and FMS competency due to the differing experiences they have had e.g. socioeconomic status (Foulkes et al., 2015; Goodway et al., 2010) and parental influence (Barnett, Hinkley, Okely, & Salmon, 2013; Cools, De Martelaer, Samaey, & Andries, 2011), resulting in a weak relationship between PA and FMS competency at this early stage of development. Stodden et al. (2008) hypothesise further, believing that as children transition to middle and late childhood, the relationship between PA and FMS competency should strengthen, due to the individual and environmental constraints of early childhood compounding over time and resulting in this stronger relationship. Having proposed that moderately-to-highly skilled children will choose to engage in higher levels of PA, compared to children with lower levels of FMS competency and thus engaging in less PA, Stodden et al. (2008) stated that, in their opinion, FMS competency drives PA levels in children. However, the authors note that further longitudinal research is required in order to examine this relationship over time taking into account mediating variables that may interact with and

promote/demote the dynamic relationship between FMS competency and PA within their model. Indeed, one weakness of the Stodden et al. (2008) model is that it does not include other factors that may influence PA. Sterdt, Liersch, and Walter (2013) systematic review of correlates of PA among children and adolescents (3-18 yr.) identified 16 correlates that were consistently associated with PA, including perceived competence, self-efficacy and goal orientation/motivation. Furthermore, the review authors noted that with so many consistent correlates of PA observed in children and adolescents it further highlights how PA is a complex and multi-dimensional behaviour determined by numerous biological, psychological, sociocultural and environmental factors.

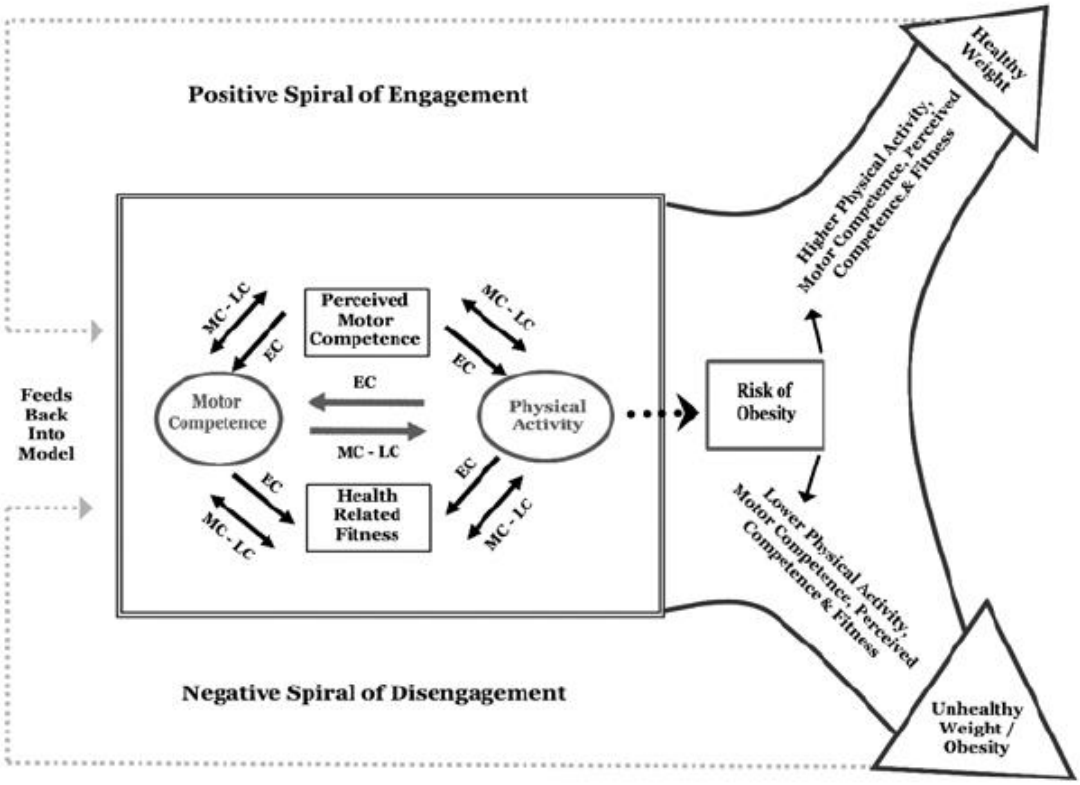


Figure 2.1 Stodden et al. (2008) model of developmental mechanisms influencing physical activity trajectories of children.

2.9 Fundamental Movement Skills and Participation in Physical Activity

Within the Stodden et al. (2008) model a lack of FMS competency is hypothesised to result in a negative spiral of disengagement in PA, due to children lacking the competence and confidence to move and failing to enjoy participating in activities where they feel that they will not succeed. When the model was first proposed in 2008 research was limited in exploring the association between FMS competency and PA, however, in recent years a number of studies have examined the strength of this relationship and how it changes over time. Lubans et al. (2010a) review of the associated health benefits of FMS competency among children and adolescents (4-16 yr.) included 13 studies using both product- and process-based measures of FMS competency, to examine the relationship between FMS competency and PA. Twelve of these studies (eleven cross-sectional and one longitudinal) reported a positive association between FMS competency and PA. However, the strengths of these observed positive associations were not reported by the review's authors (Lubans et al., 2010), meaning the magnitude of these observations could not be commented on. This relationship was further reviewed by Holfelder and Schott (2014), who examined 23 studies, again using product- and process-based measures of FMS competency, as well as motor abilities and motor coordination. Of the 23 studies included, 12 reported positive associations between FMS competency and PA, ranging from weak to strong in association strength (r values 0.10 to 0.92) (Holfelder & Schott, 2014). Whilst the findings of these studies indicated a potential cause-effect relationship between FMS competency and PA, supporting the Stodden et al. (2008) model, the review authors noted that this proposed relationship had yet to be conclusively demonstrated due to the limited experimental data available (Holfelder & Schott, 2014).

Similarly, Logan, Webster, Getchell, Pfeiffer, and Robinson (2015) reviewed 13 studies using process-based measures of FMS competency to explore the relationship between competency and PA engagement among children. Of the 13 studies included, 12 had found a positive correlation between FMS competency and PA, ranging from weak (r = 0.16) to moderate (r = 0.55) in strength. More recently, Figueroa and An (2016) reviewed 11 studies examining FMS competency and PA among preschool children (3-5yr.), with nine of the included studies using process-based measures of FMS

competency. Eight of the 11 studies were reported to have found significant associations between FMS competency and PA, however, as with the Lubans et al. (2010) review, the strength of the associations is not reported. The *r* values are only stated for one of the included studies, which reported low strength associations between PA and FMS competency ($r = 0.10$) and total MVPA and FMS competency ($r = 0.18$) (Fisher et al., 2005). The review authors also state that the included studies on average only met 3.6 out of the 7 study quality criteria established by the authors. These criteria included whether the study was a randomised control trial, and if PA was measured by accelerometry (Figueroa & An, 2016). Of note to other researchers investigating the relationship between FMS competency and PA is that the authors have penalised studies using process-based measures of FMS competency. The authors rationale for this penalty is such that product-based measures of FMS competency better facilitate the comparison of a child's performance to their chronological peers (Williams & Monsma, 2006). Whilst both process- and product- based assessments have advantages and disadvantages, product-based assessments do not provide the detailed level of information on the *quality* of the movement being assessed that process-based measures can obtain, allowing researchers to identify the specific aspects of movement that a child can improve upon. As such, this study's quality scoring system appears flawed, as studies that have provided detailed data on movement quality have been penalised for doing so. It could be argued however that data from process-based measures can be far more effective in helping to improve children's FMS competency, by highlighting specific movement criterion that need to be improved upon. Furthermore, the perceived negative view of process-based in comparison to product-based appears to be at odds with the review authors recommendation that future research should seek to design a product-based measures of FMS competency that can be integrated alongside process-based measures, as this would then capture the multifaceted FMS competency patterns and trajectories of preschool children (Figueroa & An, 2016).

It appears therefore that longitudinal studies would appear to be best suited to investigate the Stodden et al. (2008) hypothesis of a developmental trajectory between FMS competence and PA in comparison to cross-sectional studies. Barnett, Van Beurden, Morgan, Brooks, and Beard (2009) study looked at FMS competency as a predictor of adolescent PA among Australian children, having

measured six FMS at baseline (kick, catch, throw, hop, side gallop and vertical jump), whereby participants had a mean age of 10.1 yr. The results from the study found that whilst locomotor skill competency was not related to adolescent PA, object-control skill competency accounted for 3.6 and 18.2% of participation in MVPA and organised PA, respectively, during adolescence (mean age 16.4 yr.). Similarly, Lopes, Stodden, Bianchi, Maia, and Rodrigues (2012) study among Portuguese children reported that children with higher FMS competency at six years of age were found to have high self-reported PA levels 3 years later, in comparison to children with low and moderate FMS competency, whose PA levels had declined over this same period. Whilst these two studies may suggest a causal relationship between FMS competency and PA, only Barnett, Van Beurden, Morgan, Brooks, and Beard (2009) found FMS competency, specifically object-control competency, in childhood to be related to a variance in MVPA during adolescence.

Stodden et al. (2008) developmental model contends that the development of FMS competency is a primary underlying mechanism in promoting PA with associations strengthening as children age. However, much of the evidence, to date, is cross-sectional (Holfelder & Schott, 2014; Lubans et al., 2010) and there is limited longitudinal or experimental evidence examining these associations during childhood (Barnett, Van Beurden, Morgan, Brooks, & Beard, 2009; Barnett, Van Beurden, Morgan, Brooks, Zask, et al., 2009; Burgi et al., 2011), particularly across the period of preschool to late childhood. Further still, there is a lack of evidence examining this association among UK children. As such, there is a need for longitudinal research examining the strength of the associations between FMS competency and PA during early childhood in order to examine whether this relationship does indeed strengthen with age.

2.10 Fundamental Movement Skills and Weight Status

The development of FMS competency is purported to be a primary underlying mechanism in promoting PA and therefore shaping positive or negative trajectories of weight status among children (Stodden et al. 2008). As hypothesized by Stodden et al. (2008), data from the available literature at the time would seem to indicate that FMS competency is both a *precursor* and *consequence* of

childhood weight status. Okely, Booth, and Chey (2004) examined associations of FMS competency with measures of body composition (Body Mass Index: BMI) among 4363 Australian children and adolescents (9-16 yr.). Having assessed six FMS (run, vertical jump, throw, catch, kick, and strike) the results indicated that overweight children of both sexes were found to be less likely to have high levels of FMS competency, with FMS competency further found to be significantly related to BMI and waist circumference. When looking at the subsets of the FMS assessed, it was reported that non-overweight boys and girls were two to three times more likely to possess more advanced locomotor skills than overweight boys and girls. The authors noted these significant associations between locomotor skills and weight status suggest a key component of interventions to prevent weight gain may be that of increased locomotor skill competency. Studies among European children have also reported the same relationship between FMS competency and weight status. D'Hondt, Deforche, De Bourdeaudhuij, and Lenoir (2009) examined the relationship between BMI and motor competence, assessed using the Movement Assessment Battery for Children (MABC) (Smits-Engelsman, 1998), among 117 Belgian children between the age of 5 and 10 yr. The results showed that non-overweight and overweight children were significantly more competent at balance and ball skills compared to their obese counterparts. With no differences in competency observed between non-overweight and overweight children, the authors suggested that this may indicate a cut-off point from which differences in competency may appear. However, a limitation of this study was the use of the MABC (Smits-Engelsman, 1998), some aspects of which are performed seated, meaning that no displacement of extra body mass is required and that overweight/obese children may therefore have achieved higher scores that do not accurately reflect their true competency level. A further cross-sectional Belgian study of 954 children across consecutive age groups (5–7 yr., 8–9 yr., 10–12 yr.) (D'Hondt, Deforche, et al., 2011) examined motor coordination in relation to weight status using the product-orientated Körperkoordinationstest für Kinder (KTK) (Kiphard & Schilling, 2007). Overweight and in particular obesity were found to result in low motor coordination, with the largest effect for increased BMI seen on KTK test items requiring dynamic body coordination. Non-overweight children were found to have similar motor coordination levels across the observed age groups, whilst overweight and obese children in the 10-12 yr. group showed significantly lower motor coordination in comparison to the

corresponding 5-7 yr. group. These results indicate that BMI-related differences in motor coordination were more pronounced in children within older age groups. However, the authors of the study note that the cross-sectional design precludes any statements on causality from being made (D'Hondt, Deforche, et al., 2011).

Further longitudinal studies investigating the relationship between FMS competency and weight status are required, specifically during early childhood and adolescence as evidence on associations between competency and weight status among these age groups is currently not available (Robinson et al., 2015). Future longitudinal research should also take into account other factors that may affect the inverse associations observed between FMS competency and weight status, as hypothesised in the Stodden et al. (2008), namely those of PA, health related fitness and perceived competence.

2.11 Fundamental Movement Skills and Perceived Competence

Perceived competence is a factor in the Stodden et al. (2008) model, playing a role in mediating between FMS competency and PA. Namely, there is an indirect relationship between FMS competency and PA through an individual's perception of their own competence (Robinson et al., 2015). Babic et al. (2014) systematic review of PA and self-perceptions among children reported that children with higher levels of physical self-perception (perceived competence) were more likely to engage in PA than those children reporting low levels of physical self-perception. There is evidence to suggest that perceptions of physical competence may play a mediating role between FMS competency and PA among children and adolescents (Barnett et al., 2011; Barnett, Morgan, Van Beurden, & Beard, 2008). For example, perceived sporting competence mediates the relationship between motor skill proficiency and physical activity or fitness levels in adolescents (Barnett, Morgan, et al., 2008). However, among preschool age children perceived competence did not mediate the relationship between FMS and PA (Crane, Naylor, Cook, & Temple, 2015), which may be due to preschool age children's perceptions of their competency being higher than their actual competency levels (Stodden et al., 2008). LeGear et al. (2012) study among 260 Canadian preschool children (mean age 5 yr. 9

months.) assessed using the TGMD-2 (Ulrich, 2000) also reported that despite competency being low, children had positive perceptions of their own physical competence (LeGear et al., 2012). Barnett, Ridgers, and Salmon (2015) also used the TGMD-2 (Ulrich, 2000) to assess the FMS competency of 102 Australian children (aged 4-8 yr.) in their study investigating the associations between young children's perceived and actual ball skill competence and physical activity. Girls were found to have both lower perceived and actual object-control competence and were less active compared to boys, with actual object-control competence positively associated with perceived object-control competence, although this relationship did not differ by sex. Whilst neither actual nor perceived object-control competence were associated with MVPA. This led to the authors recommending that targeting young children's object-control skills should be a priority in any intervention, as in older children object-control skills have been found to be associated with PA (Barnett et al., 2015).

2.12 Fundamental Movement Skills and Fitness

The Stodden et al. (2008) model proposes that FMS competency will initially promote health related fitness (HRF) during early childhood, with HRF then mediating the relationship between FMS competency and PA in middle and late childhood due to an increase in fitness hypothetically facilitating continued engagement in PA for longer periods of time (Robinson et al., 2015). A systematic review by Cattuzzo et al. (2016) among children and adolescents reported strong evidence of a positive association between FMS competence and cardiorespiratory fitness (CRF) (r = 0.32-0.57) and muscular strength/endurance (r = 0.27-0.68). Two large Australian cohort studies have reported a positive relationship between FMS competency and cardiorespiratory fitness among adolescents (Barnett, Van Beurden, Morgan, Brooks, & Beard, 2008; Okely, Booth, & Patterson, 2001), in line with the Stodden et al. (2008) hypothesis that this association should strengthen with age. Whilst the majority of studies examining this relationship between FMS competency and HRF are cross-sectional in design, recent longitudinal and experimental studies have provided data indicating that there is an association between these two measures during childhood and adolescence

(Barnett, Van Beurden, et al., 2008; Matvienko & Ahrabi-Fard, 2010; Vlahov, Baghurst, & Mwavita, 2014).

2.13 Wider Benefits of Fundamental Movement Skills

Bar-Haim and Bart (2006) study among 88 Israeli preschool children examined the associations between motor competency and social participation, assessing motor competency through a 60 min battery of standardized assessments of balance, kinesthesia, imitation of postures, muscle tone, and visual–motor integration carried out at each child's home. The study found that children with low motor competency displayed a lower frequency of social play and higher frequency of social reticence in comparison to children with higher competency levels. Whilst a further study among Israeli preschool children, again using a battery of assessments covering visual–motor integration, fine motor accuracy, visual–spatial perception, kinesthesia, and imitation of postures, completed in the child's home, reported that preschool FMS confidence was associated with greater academic performance and social and emotional adjustment to the school environment (Bart, Hajami, & Bar-Haim, 2007). Likewise, a study amongst 325 Finnish teenagers (13 yr. at baseline) reported that FMS competency, assessed via The FMS Package (Kalaja, 2012), may contribute to better academic attainment among teenagers, albeit with a significant but weak association between the two measures (Jaakkola, Hillman, Kalaja, & Liukkonen, 2015).

2.14 Competence Levels – Preschool and Primary

Several studies have documented levels of FMS competence amongst preschool children (Barnett et al., 2015; Cliff, Okely, Smith, & McKeen, 2009; Goodway et al., 2010; Hardy, King, Farrell, et al., 2010; Robinson, 2011; Ulrich, 2000) and concluded that, as expected in young children, these skills are at the rudimentary stage of development. Ulrich (2000) reported low competency at FMS in a representative sample of 332 US preschool children (ages 3-5) as part of normative data collected for the TGMD-2. Hardy, King, Farrell, et al. (2010) assessed eight skills (run, gallop, hop, horizontal

jump; strike, catch, kick, throw) in situ using the TGMD-2 in a sample of 330 four-year-old children from New South Wales, Australia. Although the majority of children were found to be competent at the run, competence levels across the remaining seven skills (gallop, hop, horizontal jump, strike, catch, kick and throw) ranged from low to moderate. Both studies (Hardy, King, Farrell, et al., 2010; Ulrich, 2000) also provide detailed descriptive information on competency at the component level, which is useful for guiding teaching strategies to master individual skill components. Findings broadly indicated that competency was lowest for skills requiring the use of the arms, coordinated trunk movement and the transfer of body weight, and highest for locomotor skills requiring only leg movements (Hardy, King, Farrell, et al., 2010; Ulrich, 2000). Thus whilst descriptive data is available from preschool samples in Australia (Hardy, King, Farrell, et al., 2010; Okely & Booth, 2004) and the USA (Ulrich, 2000), data on FMS competence among European preschool children is lacking (Cools et al., 2009). Such data is important when considering international cultural differences, for example in the educational curriculum or traditional sporting pursuits available and thus may be reflected in levels of FMS competence (Bardid et al., 2016; Simons & Van Hombeeck, 2003).

This pattern of low competency has also been reported among primary aged children. A large-scale study from Australia examining FMS competency among 1045 primary school children assessed eight skills (static balance, run, vertical jump, kick, hop, catch, throw and side gallop) and reported low levels of FMS competence, with less than half of children rated as having achieved mastery or near mastery level for competence (Van Beurden, Zask, Barnett, & Dietrich, 2002). A further large scale Australian study (n = 1288) again reported low levels of FMS competency among the primary school children assessed (Okely & Booth, 2004). Whilst there are relatively few studies among English primary school children, Bryant, Duncan, and Birch (2014) reported that the majority of 281 English primary school children were classed as having non-mastery for six out of the eight FMS they were assessed on (kick, sprint, gallop, hop, balance, throw, catch and jump).

Children from areas of high deprivation have also been found to typically have lower levels of FMS development than children residing in areas of low deprivation. Goodway et al. (2010) assessed the FMS competency of 469 American preschool children from two highly deprived regions using the TGMD-2 (Ulrich, 2000), finding that children were developmentally delayed in both locomotor and

object-control skills. Furthermore, there was a significant effect for gender, with boys showing greater competency for object-control skills. Morley et al. (2015) investigated the effects of gender and socioeconomic status (SES) on motor proficiency in 369 English children (age 4.3-7.2 yr.) using the Bruininks-Oseretsky Test of Motor Proficiency, Second Edition (Bruininks & Bruininks, 2005). Proficiency was found to be low, with girls outperforming boys in fine motor skills and boys outperforming girls for the catch and dribble. Whilst, high SES children significantly outperformed middle and low SES children for total, fine and gross motor proficiency. As such, it may be that children residing in areas of high deprivation may require more instruction and *practice* of FMS in order for them to achieve the same competency levels as their peers from areas of low deprivation. With a lack of research on FMS competency among UK preschool children from deprived areas there is a need to further examine the FMS competency of children from these areas of high deprivation. If evidence is found that children from highly deprived areas are developmentally delayed then resources can be allocated accordingly and interventions designed to concentrate on the development of FMS competency, taking into account both gender differences and SES (Morley et al., 2015).

2.15 Sex Differences

A number of studies have examined sex differences in FMS competence amongst young children using in situ observations (Barnett et al., 2015; Hardy, King, Farrell, et al., 2010) or video analysis (Cliff et al., 2009; Goodway et al., 2010; Robinson, 2011; Spessato, Gabbard, Valentini, & Rudisill, 2012) of performance at the TGMD-2. Barnett et al. (2015) and Hardy, King, Farrell, et al. (2010) assessed FMS competency in 102 and 330 Australian young children, respectively. Both studies reported boys to have higher levels of object-control competency than girls. Similarly, Robinson (2011) and Goodway et al. (2010) assessed FMS among 119 and 469 American preschool children, respectively, also noting that boys outperformed girls at object-control skills. Moreover, a recent study of 560 Brazilian children aged 3-6 years provided further evidence that boys have higher competency for object-control skills (Spessato et al., 2012). However, Cliff et al. (2009) found no sex differences in object-control skill raw score in a small sample of 46 Australian preschool children.

Findings observed for sex differences among locomotor skills are mixed. Two studies reported that girls had a higher locomotor skill subtest score than boys (Cliff et al., 2009; Hardy, King, Farrell, et al., 2010). In contrast, Robinson (2011) found boys to be more competent at locomotor skills, while two other studies found no sex difference (Goodway et al., 2010; Spessato et al., 2012). Only Hardy, King, Farrell, et al. (2010) have investigated potential sex differences with regards to individual skills among preschoolers using process-based measures of FMS, though differences in skill components (performance criteria) were not explicitly examined. Amongst the four locomotor skills assessed in this study, girls were more competent at the hop, whilst no difference was found for the run, gallop or horizontal jump. Conversely, for the four object-control skills assessed, boys were found to be more competent at the strike, kick and overhand throw, although no difference was reported for the catch (Hardy, King, Farrell, et al., 2010). Taken collectively, the evidence examining skill competence in young children suggests that boys out-perform girls at object-control skills, though there is a lack of consensus in the literature regarding sex differences in locomotor skills. These findings are consistent with studies in primary school aged children (Bryant, Duncan, et al., 2014; LeGear et al., 2012; Okely & Booth, 2004; Van Beurden et al., 2002) and indicate that sex differences and low competence levels track into childhood and adolescence (Hardy, King, Espinel, Cosgrave, & Bauman, 2010; O'Brien, Issartel, & Belton, 2013), highlighting that both sexes may benefit from targeted interventions. Given the lack of research conducted in English children to date, it is important to establish whether similar levels of competence and sex differences are evident before developing targeted interventions.

2.16 Interventions to Increase Fundamental Movement Skills

Studies from England (Foulkes et al., 2015) and internationally (Barnett et al., 2015; Cliff et al., 2009; Goodway et al., 2010; Hardy, King, Farrell, et al., 2010; Robinson, 2011; Ulrich, 2000) have reported low levels of FMS competence among preschool and primary age children. Given the reported low levels of FMS competency and evidence that low competence FMS tracks over time (Hardy, King, Espinel, et al., 2010; O'Brien et al., 2013), there is a need for targeted interventions to improve FMS amongst young children.

In a systematic review of motor development interventions aimed at improving FMS competency amongst young children (<5 yr.), Riethmuller, Jones, and Okely (2009) reported that of the 17 included studies, 65% of which were controlled trials, more than half (60%) reported statistically significant improvements in FMS competency. However, the review highlighted that only three of the 17 studies (18%) were deemed to be of a high methodological quality, highlighting both the limited *quality* and *quantity* of interventions to improve FMS competency among children as well as the lack of high-quality *evidence* in this field. A more recent review by Veldman, Jones, and Okely (2016) has explored the efficacy of seven further interventions among young children (<5 yr.) published between 2007 and 2015. In contrast to the Riethmuller et al. (2009) review, 57% of the papers included were deemed to be of a high methodological quality, with six of the seven reporting significant intervention effects on FMS competency. Of note with regards to intervention design is that all of the included studies in the Veldman et al. (2016) review took place within the preschool setting, with the majority using trained members of staff/educators to deliver the intervention. Researchers may therefore need to consider training and upskilling setting staff as part of future interventions alongside the aspects aimed directly at the children themselves. Both reviews highlight the fact that no studies have evaluated the *effectiveness* of an FMS intervention amongst young children from the UK. Finally, only a limited number of studies from Australia and the US have focused on interventions among young children from deprived areas (Goodway & Branta, 2003; Hardy, King, et al., 2010a; Okely & Booth, 2004).

2.17 Physical Literacy

Recently, physical literacy has emerged as a focus of physical education, PA and sports promotion internationally (Giblin, Collins, & Button, 2014), with FMS identified as being a key element of physical competence, an important aspect of physical literacy. The term *"physical literacy"* (PL) is widely understood to relate to an individual's capacity for a physically active lifestyle (Longmuir & Tremblay, 2016), with Whitehead (2013) definition of PL as being the motivation, confidence, physical competence, knowledge and understanding that underpin one's values and responsibilities

for life-long purposeful activity and pursuits, commonly cited among the literature. PL has four interconnected and essential elements: motivation and confidence (affective domain), physical competence (physical domain), knowledge and understanding (cognitive domain) and engagement in physical activities for life (behavioural domain) (International Physical LiteracyAssociation, 2014). Therefore, it would be expected that a physically literate child would have the motivation, confidence, knowledge, skills and fitness necessary to enjoy a physically active lifestyle as well as being committed to healthy habitual movement behaviours, in line with recommended guidelines relating to regular PA and limited sedentary behaviour (Longmuir & Tremblay, 2016).

Whilst the *concept* of PL has grown within the literature, so too has the need to be able to monitor it over time. Whilst there are a number of assessments available to measure PA or sedentary behaviour, little is known about how best to enhance PL. With this in mind, it has been suggested that future research is needed in order to help identify methods of monitoring physical activity, in order to better understand the development of PL, alongside the development of methods to help improve and support the progress of PL (Longmuir & Tremblay, 2016). As a relatively new concept, the development of effective interventions and initiatives to promote PL during the early years will require appropriate design and planning phases, informed by robust research methodologies. In order to help bring about these changes, the views and opinions of experts in child PA would be beneficial in order to help develop these future strategies for monitoring and improving PL during childhood. Likewise, given that Veldman et al. (2016) review of motor skill interventions noted that all of the included studies took place within preschools, it would be of value to gain the views and opinions of preschool setting staff in regards to their perceptions on intervention design and implementation.

2.18 Summary

FMS are a vital part of a child's development, allowing children to progress to more complex movements that will allow them to function successfully in daily life and take part in varied sporting and physical activities (Cools et al., 2009). Previous research has demonstrated links between FMS development and its importance to children's physiological, social and psychological development

(Gallahue et al., 2011). Further research in this area is vital, specifically among UK children as data on FMS proficiency and FMS interventions is dominated by research from Australia and North America. Such research also needs to be of *high methodological quality* and, where possible, incorporate follow up data as part of a longitudinal design, as well as exploring the relationship between FMS, PA and weight status proposed by (Stodden et al., 2008). If significant associations can be found between the development of FMS in pre-school children and PA levels and health markers in late childhood, this will be able to provide an evidence base for health promotion, changes to curriculum and both local and national policy relating to FMS competency and PA. To this end, it is important that future research in this area focuses on; i) the development and assessment of preschool targeted FMS intervention strategies ii) longitudinal research studies investigating the effects of these interventions on preschool children as they progress into primary and adolescence alongside correlations between FMS and other markers of health and PA and iii) the development of interventions and initiatives to promote and improve PL among young children.

2.19 Aims & Objectives

The specific aims of the thesis are to:

a) To document the level of FMS competency of preschool children from a highly deprived area of Northwest England.
b) Determine the effectiveness of a six-week Active Play intervention on FMS competency among preschool children from a highly deprived area of Northwest England.
c) Examine the relationship between FMS competency, PA and weight status over a five-year period between preschool and late primary among children from a highly deprived area of Northwest England.
d) To gain the thoughts and opinions of experts and practitioners in order to help inform the development of an appropriate intervention to increase the PL of preschool children

These aims will be achieved through the following objectives:

- To document through a cross-sectional study the level of FMS competency of preschool children living in a highly deprived area of Northwest England, examining competency at a component and criterion level and with reference to differences by sex.
- To assess the effect of a 6-week preschool intervention on children's FMS competency.
- To document through a five-year longitudinal study the change in FMS competency from preschool to late primary and the associations between FMS competency, PA and weight status over this period.
- To document via a qualitative study the thoughts and opinions of preschool experts and practitioners on the concept of PL, in order to produce recommendations for the design and delivery of future interventions aimed at improving the PL of preschool children.

2.20 Methodological Approach

The research design of this thesis combined a mixture of three quantitative and one qualitative study. Studies One to Three have used rigorous quantitative data analysis to explore FMS competency, with Study Two employing data analysis methods that have adjusted for school-level clustering in order to explore the influence of a number of factors that may be associated with and/or affect FMS competency. Study Four is a qualitative examination of the factors that may affect the development of PL within the preschool environment and how best to inform the design and implementation of a proposed intervention to improve PL within the preschool setting. The inclusion of a qualitative study sequentially following on from quantitative studies has provided the opportunity for contextual information to be collected to expand on the quantitative data findings. Furthermore, this approach of combining both quantitative and qualitative studies produces 'a more complete picture' by combining information from both of these data sources (Denscombe, 2008). At thesis planning stage a qualitative study was always seen as an important inclusion however its location within was not set. The thesis

structure of incorporating the formative qualitative work at the end of a thesis is perhaps in itself novel. Typically within the literature formative work is used to inform the design and implementation of interventions e.g. Boddy et al. (2012) and McCann, Knowles, Fairclough, and Graves (2016). This approach was undertaken in order to inform future intervention based research developing PL among preschool children.

2.21 Ethical Considerations

Due to the nature of the research being carried out a number of ethical considerations were taken into account:

- Parents and children invited to take part were made aware of the planned research project(s)
- Gatekeepers/parents/children were made aware that they were under no obligation to take part in the research, with no negative connotations if they decide not to take part
- Participants were given the opportunity to ask the lead researcher/research team questions about the research
- All participants were given contact details of the lead researcher/research team including phone number and email address
- The use of codes to ensure the confidentiality of schools, pupils and interviewees
- The ownership and storage of data collected
- The necessity of informed consent; schools and interviewees and parental passive consent for children

Gatekeeper consent for studies two and three was first obtained from school head teachers, then from parents/carers and in the last instance, the children themselves. Although parents/carers may have given consent for their child to take part in the study, the final decision to take part was ultimately up to the child.

2.22 Ethical Approval

All studies contained within this thesis received full ethical approval from the Research Ethics Committee within Liverpool John Moores University:

- Study One: 09/SPS/027
- Study Two: 09/SPS/027
- Study Three: 15/SPS/014
- Study Four: 16/SPS/010

Chapter Three

Fundamental Movement Skills of Preschool Children in Northwest England

The main outcomes of this study have been published in *Perceptual & Motor Skills*: Foulkes, J. D., Knowles, Z., Fairclough, S. J., Stratton, G., O'Dwyer, M., Ridgers, N. D., & Foweather, L. (2015). Fundamental movement skills of preschool children in Northwest England. 121(1), 260-283.

3.1 Thesis Study Map: Study One

Study	Objectives
Study One: Examining the fundamental movement skill competency levels of preschool children form Northwest England	**Objectives:** • **Report detailed FMS competence data among a sample of preschool children from a deprived area of Northwest England** • **To investigate sex differences in FMS and their respective components.**
Study Two: Effect a school-based Active Play intervention on fundamental movement skill competency among preschool children	Objectives: • To examine the effectiveness of a six-week Active Play intervention on FMS competency in 3-5 yr. old children from a deprived area of Northwest England
Study Three: Is Fundamental Movement Skill Competency Important for Keeping Children Physically Active and a Healthy Weight?	Objectives: • To determine the role of fundamental movement skills in promoting physical activity and healthy weight status as children progress from early to late childhood.
Study Four: Towards the Development of a Physical Literacy Intervention for Preschool Children: The Perspectives of both Experts and Practitioners	Objectives: • To gain the thoughts and opinions of experts and practitioners to help inform the development of an appropriate intervention to increase the physical literacy of preschool children.

3.2 Introduction

FMS are considered the initial building blocks of more complex movements (Gallahue et al., 2011), with the development of FMS competence noted as an important prerequisite for daily life skills and participation in sports and physical activities (Cools et al., 2009; Stodden et al., 2008). Previous studies using process-based measures of FMS have reported low levels of competence among UK (Bryant, Duncan, & Birch, 2013), Canadian (LeGear et al., 2012) and Australian (Okely & Booth, 2004; Van Beurden et al., 2002) primary school aged children. The suboptimal levels of FMS competence in older children highlights a need to examine the preschool years (2-5 yr.), considered a critical phase for FMS development, as a failure to make advancements during this stage may result in a child having lower competency later on in their development (Gallahue & Donnelly, 2003). Several international studies have documented FMS competence among preschool children (Barnett, Ridgers, & Salmon, 2014; Cliff et al., 2009; Goodway et al., 2010; Hardy, King, Farrell, et al., 2010; Robinson, 2011b; Ulrich, 2000) and concluded that, as expected in young children, these skills are at the rudimentary stage of development. Findings broadly indicate that competency is lowest for skills requiring the use of the arms, coordinated trunk movement and the transfer of body weight, and highest for locomotor skills requiring only leg movements (Hardy, King, Farrell, et al., 2010; Ulrich, 2000). However, whilst descriptive data is available from preschool samples in Australia (Hardy, King, Farrell, et al., 2010; Okely & Booth, 2004) and the USA (Ulrich, 2000), data on FMS competence among English preschool children is lacking.

Previous international studies from Australia (Barnett et al., 2015; Hardy, King, Farrell, et al., 2010) and America (Goodway et al., 2010; Robinson, 2011) have reported boys as having higher levels of object-control skill competency than girls, highlighting sex differences in FMS development. However, there is only limited evidence on the effect of SES on FMS competency among preschool children (Goodway et al., 2010; Morley et al., 2015). Goodway et al. (2010) found that American preschool children residing in two highly deprived regions were developmentally delayed in both locomotor and object-control skills. Similarly, Morley et al. (2015) study among English children (age 4.3-7.2 yr.), found that high SES children outperformed middle and low SES children for total, fine

and gross motor proficiency following assessment using the Bruininks-Oseretsky Test of Motor Proficiency, Second Edition (Bruininks & Bruininks, 2005). Further information on FMS competency levels among English preschool children from areas of high deprivation may be of importance for future interventions. If there is further evidence that children from these deprived areas are developmentally delayed compared to their peers residing in areas of low deprivation, resources can be allocated accordingly and interventions designed and implemented that take into account these SES differences.

To the authors' knowledge, no previous study has assessed FMS competency in European preschool children from low SES using process-orientated (technique-based) measures and video-analysis. Further, no empirical study in young children has examined sex differences in all of the major individual object-control and locomotor FMS at the component level. Therefore, the aims of this study are to (i) report detailed FMS competence data among a sample of preschool children from a deprived area of Northwest England and (ii) to investigate sex differences in FMS and their respective components. It was hypothesised that boys will show greater competence at object-control skills than girls, though no sex differences were expected for locomotor skill competency.

3.3 Methods

Participants and settings

Baseline data for this study were drawn from the Active Play Project, which has been described in detail elsewhere (O'Dwyer, Fairclough, et al., 2013). Briefly, the project was funded by the Local Authority in response to a growing awareness of the need to establish health behaviours, such as participation in PA, from an early age (Boddy et al., 2009; Boddy, Hackett, & Stratton, 2010). The project consisted of a six-week educational programme directed at preschool staff and children with the aim of increasing children's PA levels, developing FMS, strength, agility, co-ordination and balance, and increasing children's self-confidence. Baseline data collection took place over two phases, with six schools assessed in October 2009 and the remaining six assessed in March 2010. This

design was used in order to maximise recruitment and to control for the influence of any seasonal variation (Kolle, Steene-Johannessen, Andersen, & Anderssen, 2009).

Twelve preschools located in Liverpool, a large urban city in Northwest England, were randomly selected and invited to participate in the study. Due to funding requirements, each preschool was situated in a neighbourhood within the highest 10% for national deprivation (i.e. most deprived) (Department of Communities and Local Government, 2010). These preschools were selected in order to help address health inequities and improve indicators of child health such as childhood obesity (12.2% of five year olds were obese) and physically active children that were significantly worse than the national average (Association of Public Health Observatories, 2009). Each preschool was attached to a SureStart children's centre, the role of these centres was to provide advice, support and services for parents and carers of children aged 5 yr. or under who resided in the most disadvantaged parts of England (Children, Schools and Families Committee, 2010). All twelve preschools agreed to participate in the study. At the time of data collection, all three and four year old children in England were entitled to 15 hours of free preschool education for 38 weeks of the year. Classes occurred from Monday to Friday, starting at 09:00 and finishing at approximately 15:00. Preschools were required to follow the Early Years Foundation Stage curriculum (Department for Children, Schools and Families, 2008), which emphasised play-based learning and development in six main areas (personal, social and emotional development; communication, language and literacy; problem solving, reasoning and numeracy; knowledge and understanding of the world; physical development, and creative development).

All children aged 3-4.9 yr. old from the 12 preschools were invited to participate (n = 673). To participate in the study active consent was required, which involved parents providing informed written consent, demographic information (home postcode, child ethnicity and child's date of birth) and medical assessment forms. All children were eligible to participate, however, those diagnosed with health or co-ordination issues that could affect motor development e.g. dyspraxia or intellectual disabilities, were excluded from analysis. Of 240 children who provided full parental consent, 168 children (M age = 4.65 yr., SD = 0.58; 54.1% boys; 25.8% Overweight/Obese; 80.9% White British; 93.6% lived in low SES area) completed FMS assessments and were included in the final analysis.

Reasons for missing or incomplete data included absence from testing days and children unexpectedly having to return to class prior to completion of all skill assessments due to curricular demands.

Measures

Fundamental Movement Skills - Testing followed the protocol laid out in the Test of Gross Motor Development-2 (TGMD-2) (Ulrich, 2000), which is specifically designed and validated for use with children aged 3-10 yr. (Ulrich, 2000). The TGMD-2 measures the performance of 12 FMS, including six locomotor (run, broad jump, leap, hop, gallop and slide) and six object-control (overarm throw, stationary strike, kick, catch, underhand roll and stationary dribble) skills. Prior to data collection field testers were trained by a senior member of the research team (LF) who has significant experience in administering the TGMD-2, through in-situ observation. Children completed the TGMD-2 in small groups (2-4) led by two field testers, in either school halls or on school playgrounds, dependent on available facilities. The first tester was responsible for recording each trial, using a tripod mounted video camera (Sanyo, Japan), while the second provided a verbal description and single demonstration of the required skill. Children performed each skill twice. If a child did not understand the task correctly (for example, running in the wrong direction) then they were given a further verbal description of the skill and asked to repeat the trial. The twelve skills were completed in a standardised order, taking approximately 35-40 minutes per group.

All video recordings were transferred to DVD for subsequent video analysis. Skill competence was assessed using The Children's Activity and Movement in Preschool Study Motor Skills Protocol (CMSP; (Williams et al., 2009), which was developed using the TGMD-2 (Ulrich, 2000) and has an identical protocol. The CMSP is a process-orientated assessment, evaluating each skill based on the child's demonstration of specific movement components, such as *"arms move in opposition to legs, elbows bent"* (see Tables 1 and 2of (Williams et al., 2009). The CMSP was selected for the assessment of FMS as its additional performance criteria and alternate scoring methods improved assessment sensitivity (Williams et al., 2009). The CMSP has demonstrated high reliability (R=0.94), interobserver reliability (R=0.94) and concurrent validity when compared with the TGMD-2 (R=0.98) (Williams et al., 2009). In the present study all analyses were completed by a

single trained assessor (JF) who received 30 hours of training from a member of the research team experienced in conducting video analysis (LF). Inter-rater reliability was established prior to assessment using pre-coded videotapes of 10 children, with 83.9% agreement across the twelve skills (range 72.9-89.3%). Likewise, intra-rater reliability was established using pre-coded videotapes of a further 10 children, with test-retest conducted one week apart, with 91.9% agreement established across the twelve skills (range 89.0-96.0%). Whilst there is no accepted minimum level of percentage agreement, 80-85% agreement has been previously deemed to be acceptable (van der Mars, 1989). If the assessor was unsure whether a child had met a performance criteria then the footage was viewed by both JF and LF, with final scoring agreed upon between the two.

In line with the CMSP's (Williams et al., 2009) assessment criteria, for each skill and during both trials, individual components (ranging from 3 to 8, dependent upon the skills) were marked as being absent (0) or present (1). The only exceptions to this scoring system were components 4 and 5 of the throw and strike, whereby hip/trunk rotation was scored as differentiated (2), block (1) or no rotation (0), whilst the catch identified a successful attempt as having been "*caught cleanly with hands/fingers*" (2) or "*trapped against body/chest*" (1). If a skill component was successfully demonstrated in both trials, then it was classed as present. Following the outcome measures of the CMSP (Williams et al., 2009), the number of skill components classed as present were summed to create a total score, whilst locomotor and object-control scores were created by summing the number of components present within each subscale.

Anthropometry - Body mass (to the nearest 0.1 kg) and stature (to the nearest 0.1 cm) were measured using digital scales (Tanita WB100-MA, Tanita Europe, The Netherlands) and a portable stadiometer (Leicester Height Measure, SECA, Birmingham, UK), respectively. Body mass index (BMI, kg/m^2) was calculated and converted to BMI-z scores using the "LMS" method of analysis (Cole, Bellizzi, Flegal, & Dietz, 2000).

Analysis - Data were analysed using SPSS v20.0. Descriptive statistics were calculated by sex and reported as means (± SD) and median (± IQR) for normally (decimal age, total score, locomotor score, object-control score, BMI score and deprivation level) and non-normally distributed (individual skill scores) data, respectively. Normality was assessed using the Kolmogorv-Smirnov test and the

interpretation of histogram and q-q plots. Transformation did not improve distribution, therefore sex differences in individual skill scores were examined using Mann-Whitney U tests and differences in total, locomotor and object-control scores were examined using independent t-tests. Sex differences in competence level for individual skill components were tested using chi-square analysis. Univariate ANCOVAs were conducted to examine sex differences in total and subscale scores, controlling for age, deprivation score (home postcode data was entered into 'Geoconvert', a free online tool that calculates indices of multiple deprivation based on income, employment, education, health, crime, access to services and living environment) and body mass index *z* score. However, differences between adjusted and unadjusted models were negligible and therefore all results are presented unadjusted. Statistical significance was set at $p < 0.05$.

3.4 Results

Table 3.1 presents descriptive statistics and sex differences for the study sample. There were no significant sex differences in age, deprivation level or anthropometric variables. Competency levels were found to be low among both sexes for all skills, with median scores of less than half the maximum achievable scores for both boys and girls, with the exception of the run, slide and leap, with greater competency found for locomotor skills in comparison to object-control skills. No significant differences in either total ($p = 0.411$) or locomotor ($p = 0.108$) score were observed between sexes. However, a significant difference in object-control score was found ($p = 0.002$), with boys showing greater competence than girls.

Table 3.1 Mean (SD) age, deprivation level, BMI, BMI-z score, total score, locomotor score and object-control score for boys and girls.

Score	Boys (*n* =91)		Girls (*n* =77)		
	Mean	**SD**	**Mean**	**SD**	***p***
Age	4.70	0.61	4.59	0.53	.21
Deprivation Level (IMD)	1.49	1.11	1.38	0.88	.51
BMI Score	16.67	1.67	16.55	1.63	.65
BMI-z score	0.71	1.08	0.57	0.93	.39
Total Score	27.59	7.05	26.74	6.24	.41
Locomotor Score	15.76	4.0	16.75	3.94	.11
Object-Control Score	11.84	4.18	9.99	3.32	.002*

Note. – IMD: Indices of multiple deprivation score; BMI: body mass index; IOTF: International Obesity Task Force age- and sex-specific weight for height z scores. Maximum scores possible for total, locomotor and object-control skills are 71, 32 and 39, respectively; *Significant sex difference ($p \leqslant .05$).

Table 3.2 provides data on individual skill scores. For object-control skills, boys scored significantly higher than girls in both the throw (z = -1.97, p = 0.049) and kick (z = -4.20, p = <0.001). For locomotor skills, girls scored significantly higher than boys in the run (z = -2.00, p = 0.046), hop (z = -2.57, p = 0.010) and gallop (z = -2.98, p = 0.003). No further sex differences were found.

Table 3.2. Median (IQR) individual fundamental movement skill scores among boys and girls.

Skill	CMSP Score	Boys (*n* = 91) Median (IQR)	Girls (*n* = 77) Median (IQR)	*p*
Throw	7	1 (0, 2)	1 (0, 1)	.05*
Strike	8	3 (2, 4)	3 (2, 4)	.19
Kick	7	3 (2, 5)	3 (2, 3)	<.001*
Catch	6	1 (0, 2)	1 (0, 2)	.69
Roll	6	1 (1, 2)	2 (1, 3)	.12
Dribble	5	0 (0, 1)	0 (0, 1)	.91
Run	6	4 (3, 5)	5 (4, 6)	.05*
Jump	5	2 (1, 3)	2 (1, 3)	.68
Leap	3	2 (1, 2)	2 (2, 2)	.73
Hop	6	1 (0, 2)	2 (1, 3)	.01*
Gallop	7	3 (3, 4)	4 (3, 4)	.003*
Slide	5	4 (2, 5)	3 (1, 5)	.25

Note. — CMSP: Maximum score attainable on the Children's Activity and Movement in Preschool Study Motor Skills Protocol (Williams, et al., 2009); IQR: Inter-quartile range; * Significant difference ($p \leq .05$).

Tables 3.3 and 3.4 provide descriptive information on the proportion of boys and girls successfully demonstrating competency at individual skill components. Significant sex differences were observed for seven of the 35 locomotor skill components (see Table 3). Boys were significantly more competent than girls for two components, the first of which required the use of the arms during the run (C1) and the second related to maintaining correct body position during the slide (C2). Four of the components girls were found to be significantly more competent at required correct leg movement/feet placement, during the run (C4), hop (C2 and C5) and gallop (C4), with competency levels ranging between 16.6% and 22.9% higher than boys. Girls were also found to be significantly more competent for an additional criterion of the run (C6). Both boys and girls showed high levels of competence (≥80.0%) for the following components: run (C2 and C3), leap (C2), gallop (C1 and C5) and slide (C1). Conversely, low levels of competence (≤30%) were observed for both sexes for skill components in the jump (C1 and C2), hop (C4 and C6), gallop (C6) and slide (C2), with even lower competency levels (≤5.0%) observed for the jump (C4), leap (C3), hop (C3), gallop (C2 and C3) and slide (C3).

Boys were more competent than girls for each of the five object-control skill components that showed a significant sex difference (see Table 4). Boys were significantly more competent for three components of the kick requiring coordination of the legs (C1, C2 and C5), with competency levels between 20.9% and 33.8% higher than that of girls. Boys showed further significant differences in competency relating to trunk movement (throw, C2) and body position (strike, C2). Low competence was observed for the majority of components, with competency levels of ≥50% for both sexes found in only eight of the 39 object-control skill components; strike (C2, C5, C6 and C7), kick (C2, C4 and C6) and roll (C4). Competence levels were found to be ≤30% for both sexes in at least one component of each object-control skill; throw (C1, C2, C3, C6 and C7), strike (C2), kick (C4) catch (C1), roll (C2 and C6) and dribble (C3 and C4). Whilst a further six components had competence levels of ≤5.0% for both sexes; throw (C4), strike (C4), catch (C3 and C4) and dribble (C2 and C5).

Table 3.3 Proportion (%) of boys and girls demonstrating competency of skill components for locomotor skills.

Skill Component	Boys (%) *n* = 91	Girls (%) *n* = 77	*p*
Run			
C1. Arms move in opposition to legs, elbows bent[a]	73.6	53.2	.01*
C2. Brief period of suspension (both feet off the ground)[a]	100.0	100.0	+
C3. Narrow foot placement; lands on heel or toe; not flat footed[a]	90.1	89.6	1.00
C4. Length of stride even; path of movement horizontal[b]	40.7	63.6	.01**
C5. Nonsupport leg flexed to approximately 90 degrees[a]	79.1	89.6	.10
C6. Eyes focused forward[b]	31.9	55.8	.003**
Jump			
C1. Preparatory: flexion of both knees; arms behind body[a]	29.7	23.4	.46
C2. Arms extend forcefully; forward and upward to full extension above the head[a]	11.0	2.6	.07
C3. Take-off and landing on both feet simultaneously[a]	67.0	66.2	1.00
C4. Take-off on both feet simultaneously; landing non-simultaneous[b]	1.1	2.6	‡
C5. Arms move downward during landing[a]	44.0	54.5	.23
C6. Balance maintained on landing[b]	31.9	41.6	.25
Leap			
C1. Take off on one foot; land on opposite foot[a]	74.7	80.5	.48
C2. Brief period of suspension (both feet off the ground)[a]	92.3	87.0	.38
C3. Forward reach with arm opposite the lead foot[a]	2.2	1.3	‡

Hop

C1. Non-support leg swings forward in pendular motion to assist force production[a]	1.1	6.5	‡
C2. Foot of non-support leg remains behind body[a]	18.7	37.7	.01*****
C3. Arms flexed; swing forward together to produce force[a]	1.1	2.6	‡
C4. Weight received (lands) on ball of foot[b]	23.1	20.8	.86
C5. Takes off and lands three consecutive times on preferred foot[a]	54.9	74.0	.02*****
C6. Takes off and lands on three consecutive times on non-preferred foot[a]	23.1	27.3	.66

Gallop

C1. Assumes initial position facing forward[b]	92.3	96.1	‡
C2. Arms (elbows) flexed and at waist level at take off[a]	0.0	2.6	N/A
C3. Step forward with lead foot; step with trail foot to a position adjacent to or behind lead foot[a]	2.2	3.9	‡
C4. Heel-toe action of lead foot[b]	41.8	58.4	.05*****
C5. Brief period of suspension; both feet off the floor[a]	93.4	97.4	‡
C6. Maintains rhythmic pattern (four consecutive gallops)[a]	8.8	16.9	.18
C7. Final position facing forward[b]	81.3	90.9	0.12

Slide

C1. Body turned sideways; shoulders aligned with line on floor to initiate[a]	94.5	83.1	.03*****
C2. Steps sideways with lead foot; slides trail foot next to lead foot[a]	24.2	28.6	.64
C3. Arms used to assist leg action[b]	0.0	0.0	N/A
C4. Body maintained in sideways position moving to right[b]	61.5	55.8	.56
C5. Body maintained in sideways position moving to left[b]	71.4	55.8	.05

C6. Minimum of four continuous step-slide cycles to right[a]	59.3	53.2	.52
C7. Minimum of four continuous step-slide cycles to left[a]	53.8	51.9	.93

Note .— a Skill component present in both the TGMD–2 (Ulrich, 2000) and CMSP (Williams, *et al* ., 2009). b Skill component only present in CMSP. *Significant difference ($p < .05$). **Significant difference ($p < .01$). ‡Performance criteria did not meet the assumption of the chi-squared test. + Not applicable as competency for boys/girls = 100%. N/A: Not applicable as competency for boys/girls = 0%.

Table 3.4 Proportion (%) of boys and girls demonstrating competency of skill components for object-control skills.

Skill Component	**Boys (%)** ***n*** **= 91**	**Girls (%)** ***n*** **= 77**	***p*** **=**
Throw			
C1. Wind-up initiated by downward movement of hand/arm[a]	7.7	11.7	.54
C2. Hip and shoulder rotated so that nonthrowing side faces target[a]	23.1	7.8	.01*****
C3. Steps (weight transferred) onto foot opposite throwing arm[a]	5.5	2.6	‡
C4. Differentiated trunk rotation (2)[b]	0.0	0.0	N/A
C5. Block trunk rotation (1)[b]	46.2	35.1	.19
C6. Timing of release/flight of ball appropriate (late release = downward flight; early release = upward flight)[b]	23.1	19.5	.71
C7. Arm follows through beyond release (down and across the body)[a]	13.2	5.2	.14
Strike			
C1. Dominant hand grips bat just above nondominant hand[a]	36.3	32.5	.72
C2. Nonpreferred side of body faces imaginary "pitcher"; feet parallel[b]	72.5	51.9	.01*****
C3. Steps (transfers weight) onto foot opposite dominant hand to initiate strike[a]	12.1	5.2	.20
C4. Differentiated trunk rotation (2)[b]	0.0	0.0	N/A
C5. Block trunk rotation (1)[a]	67.0	59.7	.41
C6. Arm action/plane of bat movement horizontal[b]	57.1	57.1	1.00
C7. Ball contacts bat[a]	51.6	62.3	.22
C8. Swings through ball (action does not stop at ball contact)[b]	44.0	31.2	.12

Kick			
C1. Rapid and continuous approach to ball[a]	42.9	9.1	<.001**
C2. Elongated stride or leap immediately prior to ball contact[a]	58.2	32.5	.001**
C3. Nonkicking foot placed even with or slightly in back of ball[a]	63.7	54.5	.29
C4. Leg swing is full; full backswing and forward swing of leg[b]	18.7	11.7	.30
C5. Backswing coordinated with forward action of non-kicking leg[b]	92.3	71.4	0.001**
C6. Ball contacted with instep of kicking foot (shoe laces)[a]	60.4	51.9	.34
C7. Kicks through ball; leg action does not stop at ball contact[b]	33.0	24.7	.31
Catch			
C1. Preparatory: hands in front of body; elbows flexed[a]	25.3	23.4	.92
C2. Arms extend toward ball as it moves closer[a]	45.1	37.7	.42
C3. Ball caught cleanly with hands/fingers (2)[a]	2.2	0.0	N/A
C4. Ball trapped against body/chest (1)[b]	1.1	0.0	N/A
C5. Ball tracked consistently and close to point of contact[b]	24.2	19.5	.59
C6. Doesn't turn head/close eyes as ball approaches[b]	31.9	39.0	.43
Roll			
C1. Ball arm/hand swings down/back of trunk; chest/head face forward[a]	30.8	40.3	.26
C2. Foot opposite ball hand strides forward toward cones[a]	7.7	1.3	‡
C3. Bends knees; lowers body[a]	30.8	37.7	.44
C4. Arm action in vertical plane[b]	65.9	64.9	1.00
C5. Ball held in fingertips[b]	23.1	33.8	.17
C6. Ball released close to floor; bounces less than 4 inches high[a]	4.4	7.8	‡

Dribble			
C1. Arm action independent of trunk[b]	34.1	32.5	.96
C2. Ball contacted with one hand at about belt/waist height[a]	2.2	1.3	‡
C3. Pushes ball with fingertips (does not slap at ball with flat hand)[b]	17.6	11.7	.39
C4. Ball contacts surface in front of or to the outside of foot on preferred side[a]	8.8	15.6	.27
C5. Controls ball for four consecutive bounces; feet not moved to retrieve ball[a]	3.3	1.3	‡

Note .— a Skill component present in both the TGMD–2 (Ulrich, 2000) and CMSP (Williams, *et al* ., 2009). b Skill component only present in CMSP. N/A: Not applicable as competency for boys/girls = 0%. *Significant difference ($p < .05$). **Significant difference ($p < .01$). ‡Performance criteria did not meet the assumption of the chi-squared test.

3.5 Discussion

This study examined FMS competency in preschool boys and girls living in a low SES area of North-West England. Low competence levels were found across all skills, with boys and girls failing to achieve even half the possible scores available for the majority of skills, with the exception of the run, leap and slide, with children performing better at locomotor skills than object-control skills. No significant sex differences were observed for either total or locomotor score, though boys were found to have a significantly higher object-control score than girls. These findings support the study's hypothesis and are consistent with previous research in young children (Barnett et al., 2014; Hardy, King, Farrell, et al., 2010). Furthermore, sex differences were observed for individual skill scores, with boys more competent at the throw and kick and girls more competent at the run, hop and gallop. Whilst at the component level, girls were more proficient at components requiring correct leg movement/feet placement, with boys more proficient at components requiring coordination of the legs and correct trunk movement/body position. These findings are able to add to the limited evidence base that is available on FMS competency among preschool children from low SES areas.

Little research has documented the FMS competency of typically developing young children (aged 2-5 yr.) (Cools et al., 2009). This is despite the preschool years having been described as a critical period for FMS development (Gallahue & Donnelly, 2003; Hardy, King, Farrell, et al., 2010). In the present study, competence scores were found to be low across all skills, with the exception of the run, leap, and slide. Whilst direct comparisons between international studies are not possible due to methodological (different FMS assessment tools) and cultural differences (Simons & Van Hombeeck, 2003), the findings of low competence in the present study are in agreement with previous research (Barnett et al., 2014; Cliff et al., 2009; Goodway et al., 2010; Hardy, King, Farrell, et al., 2010; Robinson, 2011; Ulrich, 2000). As expected, both sexes demonstrated lower competency levels among object-control skills in comparison to locomotor skills. This finding is also consistent with previous research (Hardy, King, Farrell, et al., 2010; Ulrich, 2000) and reflects the greater complexity of learning object-control skills, which require more sophisticated visual-motor requirements, as well as enhanced coordination and stability of the limb and trunk (Hardy, King, Farrell, et al., 2010). The low competency at FMS observed in this study and others may reflect the developmental status expected of the young child. For example, Butterfield, Angell, and Mason (2012) assessed the object-control competency of 186 5- to 14-year-old American schoolchildren using the TGMD-2 (Ulrich, 2000). They reported that competency levels increased rapidly between the ages of 5 and 10 yr. but prior to 5 years of age there was a very low probability of children displaying competency. Thus, whilst children may have the *potential* to demonstrate competence at FMS by six years of age (Gallahue & Donnelly, 2003), observed competence levels suggest that preschool children are typically only at the initial or elementary stages of FMS development (Gallahue & Donnelly, 2003) and require further practice, encouragement and instruction to reach mature patterns of movement before primary school.

The analysis of skill competence at the component level further extends the available evidence and revealed that few children demonstrated competency in several locomotor and object-control skill components. Of concern from a developmental perspective was the number of skill components within both the locomotor and object-control subscales that showed competence levels to be below 5% for both sexes. These included the leap (C3), hop (C3), gallop (C3), catch (C3) and

dribble (C2 and C5), with a further six skill components where competence scores of 0% were observed; gallop (C2), slide (C3), throw (C4), strike (C4) and catch (C3 and C4). Broadly, this suggests that competence levels were lowest in components requiring the use of the arms, coordinated trunk and limb movements, contralateral actions and the transferring of weight – patterns consistent with descriptive data from Australian (Hardy, King, Farrell, et al., 2010) and North American (Ulrich, 2000) young children collected using the TGMD-2. Analysing skill competence at the component level provides information on the specific component(s) of a skill that are lagging or deficient, which can subsequently be used to guide instructional practices. Young children may therefore require more tailored instruction and practices in order to demonstrate control of more complex skill components, whilst given the overall low competence levels found it would appear that both locomotor and object-control skills should be targeted.

A number of individual, family and environmental factors have been associated with FMS competence (Barnett et al., 2013; Cools et al., 2011) and may have contributed to the study findings. Children in the present study were recruited from low SES areas and consequently may have fewer opportunities to engage in physical activities which foster FMS or may lack safe outdoor spaces in which to do so (Giagazoglou, 2013; Goodway et al., 2010). However, competence levels were only marginally lower than those reported in similar-aged counterparts from more representative SES samples (Hardy, King, Farrell, et al., 2010; Ulrich, 2000). Previous cross-sectional studies among preschoolers have found positive associations between FMS competence and objectively measured light, moderate-to-vigorous and total daily PA (Burgi et al., 2011; Cliff et al., 2009; Fisher et al., 2005; Foweather et al., 2014; Iivonen et al., 2013; Williams et al., 2008). This relationship is considered bi-directional, with participation in PA thought to drive gains in FMS competence through a “positive feedback loop” (Barnett et al., 2011). For example, Williams et al. (2008) study of 198 preschool children using the CMSP (Williams et al., 2009) alongside accelerometer data observed that the associations between FMS competency and PA were more significant at the extremes of their distribution, highlighting that the most active participants also had the highest FMS competency levels and vice versa. As discussed previously, the present study formed part of the APP; wherein valid accelerometer was obtained for a sub-sample of 99 participants and used to examine

associations between FMS and PA in a recent publication (Foweather et al., 2014). The study found that that 86% of these children met the recommended PA guidelines and that both locomotor and object control skills were positively but weakly associated with various intensities of PA on weekdays and weekends. If these findings are extrapolated to the present sample, which was somewhat larger (n=168), this suggests that the majority of children are gaining a sufficient dose of PA. The low levels of FMS competence observed implies that the type and quality of preschool children's PA experiences (structured or unstructured) may not be sufficient for the levels of neuromuscular development necessary to reach mature patterns of FMS. However, future research is needed.

The family and home environment is also important for FMS development, with parents potentially influencing their child's PA behaviours through direct (e.g. providing adequate equipment, outdoor access), and indirect (modelling behaviour, providing encouragement) actions. In a large study (n=846) examining FMS performance in relation to family context among Belgian 4-6 yr. old children, Cools et al. (2011) observed positive associations between father's PA levels and boys' FMS competency levels, alongside a further positive association between girls FMS competency and the provision of equipment. Likewise, Barnett et al. (2013) also noted that prior to adjustments for age, the provision of equipment in the home environment showed a positive association with FMS competency for both locomotor and object-control skills among 76 three-to-six yr. old children.

The facilities and equipment provided in preschools and the childcare setting may also affect FMS development. Brown et al (2009) found that children in preschools or childcare settings with larger playgrounds and increased availability of balls and objects engaged in more moderate-to-vigorous PA. School/daycare settings that promote physically active play through enabling outdoor environments (e.g. provision of balls, beanbags and hoops, etc.; longer periods of active and/or outdoor play) may therefore facilitate improvements in FMS. Whilst active play provides an opportunity for children to practice FMS, instruction and encouragement are also necessary for children to reach mature patterns of FMS (Gallahue et al., 2011). Parents, preschool educators and structured early childhood programmes can therefore play a key role in promoting FMS development but intervention deliverers may need additional training and support (Riethmuller et al., 2009).

Among the mixed results that have been reported in the literature, the current findings support those studies that have found no sex difference in locomotor score (Goodway et al., 2010; Spessato et al., 2012). Although girls were more competent than boys at the run, hop and gallop, this did not translate into a significant sex difference in overall locomotor score. Consistent with previous research in young children (Barnett et al., 2014; Goodway et al., 2010; Hardy, King, Farrell, et al., 2010; Robinson, 2011; Spessato et al., 2012), boys in the present study showed greater competency for object-control skills than girls, and performed better at the overarm throw and kick (Hardy, King, Farrell, et al., 2010). Evidence indicates that similar patterns exist among older children (LeGear et al., 2012; Bryant et al., 2013; Okely & Booth, 2004; Van Beurden et al., 2002) and adolescents (Hardy, King, Espinel, et al., 2010; O'Brien et al., 2013), indicating that sex differences in object-control skills are established in early childhood and may track into later childhood and adolescence.

During the preschool years the physical characteristics of boys and girls are very similar, meaning that physiological differences are unlikely to affect FMS competency, therefore these differences may be due to the influence of socio-cultural or environmental factors. Boys and girls likely participate in differing games and physical activities that may contribute to observed sex differences in competence. For example, Barnett et al. (2013) found an inverse association between participation in dance classes and object-control skill competence amongst preschool girls. Evidence from the wider Active Play research project (Foweather et al., 2014) showed that boys were more active than girls and had higher object-control skill competency, suggesting that levels of PA may also explain sex differences. Whilst boys and girls show competence at differing skills, the low competence levels observed across the sample suggest that future preschool interventions should target a broad array of FMS. Nevertheless, girls may require additional or specific approaches in early childhood (2-4 yr.) to help them develop object-control skills. The component level analysis provides precise information that can assist with the design of instructional programmes and targeted activities so that both boys and girls can achieve developmentally-appropriate levels of competence. For example, in a session to improve running, boys could be given additional instructions and activities to assist them with keeping their eyes focused forwards, whilst girls worked on moving their arms in opposition to the legs, with their elbows bent.

The strengths of this study include the use of a validated process-based measure, allowing a detailed analysis of competency for each of the twelve skills assessed, to that of an individual component level. Whilst two previous studies have reported a component level analysis among preschool children (Hardy, King, Farrell, et al., 2010; Ulrich, 2000), the present study is the first to explore sex differences at the component level. Furthermore, the use of video analysis, allowing slow-motion and repeated playback, alongside a single assessor gives confidence in the precision and consistency of measurement. A limitation of this study was the 25.0% participation rate of those initially invited to take part in the study (n = 673). Parents were required to provide active consent, which may have influenced study recruitment. Whilst 240 children (35.6% response rate) were recruited to the study, the final sample size (n=168) reflects the challenges of FMS data collection with younger populations in a busy preschool setting. A further limitation is that with all of the participants recruited from areas of low SES, this limits the generalizability of the results. Future research would benefit from the approach taken by Morley et al. (2015), collecting data from low, middle and high SES children, allowing for a direct comparison of competency levels between these varying groups.

With the preschool years being a key developmental stage for the acquisition and development of FMS, the findings of low competence and sex differences in object-control and locomotor skills among the children assessed highlights the need for improvements in competency, especially when increased competence has been associated with a range of health and fitness benefits (Lubans et al., 2010; Rodrigues, Stodden, & Lopes, 2015; Vlahov et al., 2014) and in helping to prevent declines in PA (Barnett, Van Beurden, Morgan, Brooks, & Beard, 2009; Holfelder & Schott, 2014; Stodden et al., 2008). Additionally, these findings also provide a clear rationale for preschool interventions aimed at increasing FMS competency among preschool children. Further research will be beneficial not only to help monitor current levels of competence amongst low SES preschool children, but in helping to develop targeted interventions that will increase overall competency and help to reduce observed sex differences in competency.

Chapter Four

Effect of a Six Week Active Play Intervention on Fundamental Movement Skill Competence of Preschool Children: A Cluster Randomised Controlled Trial

The main outcomes of this study have been published in *Perceptual & Motor Skills*: Foulkes, J. D., Knowles, Z., Fairclough, S. J., Stratton, G., O'Dwyer, M., Ridgers, N. D., & Foweather, L. (2017). Effect of a six week active play intervention on fundamental movement skill competence of preschool children: a cluster randomised controlled trial. 124(2):393-412. doi: 10.1177/0031512516685200

4.1 Thesis Study Map: Study Two

Study	Objectives
Study One: Examining the fundamental movement skill competency levels of preschool children form Northwest England	Objectives: • Report detailed FMS competence data among a sample of preschool children from a deprived area of Northwest England • To investigate sex differences in FMS and their respective components. Key Findings: • Overall competence found to be low among both sexes • Competency higher for locomotor skills than for object-control skills • Boys significantly more competent at object-control skills in comparison to girls • Boys were significantly more competent than girls at the kick and overarm throw, while girls were significantly more competent at the run, hop, and gallop
Study Two: Effect a school-based Active Play intervention on fundamental movement skill competency among preschool children	**Objectives:** • **To examine the effectiveness of a six-week Active Play intervention on FMS competency in 3-5 yr. old children from a deprived area of Northwest England**
Study Three: Is Fundamental Movement Skill Competency Important for Keeping Children Physically Active and a Healthy Weight?	Objectives: • To determine the role of fundamental movement skills in promoting physical activity and healthy weight status as children progress from early to late childhood.
Study Four: Towards the Development of a Physical Literacy Intervention for Preschool Children: The Perspectives of Experts and Practitioners	Objectives: • To gain the thoughts and opinions of experts and practitioners to help inform the development of an appropriate intervention to increase the physical literacy of preschool children.

4.2 Introduction

Early childhood (2-5 yr.) is seen as a "window of opportunity" for FMS development due to the rapid growth of the brain and neuromuscular maturation (Malina et al., 2004), alongside higher levels of perceived competence (LeGear et al., 2012). When given the necessary opportunities and appropriate encouragement, children have the developmental capability to achieve mature performance of FMS by age 6 yr. (Gallahue & Donnelly, 2003). However, studies from England (Foulkes et al., 2015) and internationally (Barnett et al., 2015; Cliff et al., 2009; Goodway et al., 2010; Hardy, King, Farrell, et al., 2010; Robinson, 2011; Ulrich, 2000) report low levels of FMS competence among preschool and primary age children. Furthermore, children from areas of high deprivation typically have subordinate levels of FMS development than children residing in areas of low deprivation (Goodway et al., 2010; Morley et al., 2015). As such, it is perhaps not surprising that within the previous thesis chapter English preschool children living in areas of how deprivation were found to have low FMS competency. Given the sub-optimal levels of FMS competence and evidence that low FMS tracks over time (Hardy, King, Espinel, et al., 2010; O'Brien et al., 2013), there is a clear need for interventions to improve FMS amongst young children living in deprived areas.

Whilst all children develop a rudimentary fundamental movement pattern over time, mature patterns of FMS do not develop "naturally" through maturational processes (Clark, 2005). In order for these skills to develop, children should receive instruction and be practiced (Payne & Isaacs, 2002). In a systematic review of motor development interventions amongst young children, Riethmuller et al. (2009) found that almost 60% of the 17 studies included observed statistically significant improvements in FMS competency at follow up, although only three studies were deemed to be of high methodological quality (Connor-Kuntz & Dummer, 1996; Ignico, 1991; Reilly et al., 2006). This review was recently updated by Veldman et al. (2016) whereby seven additional studies were identified. Six studies reported positive intervention effects on FMS performance, with five of these interventions delivered by setting staff. However, both reviews reported that no studies have evaluated the effectiveness of interventions on FMS among young children from England. In addition, there is limited evidence from studies targeting children from areas of high deprivation. Goodway and Branta

(2003) examined the effect of a twelve-week researcher-led motor skill intervention in disadvantaged US based preschool children. Compared to controls, children in the intervention group had significantly higher locomotor and object-control skill scores post-intervention, highlighting that interventions among deprived children can be successful in improving FMS competency.

Therefore the aim of this study was to examine the effectiveness of a six-week Active Play intervention on FMS competency in 3-5 yr. old children from a deprived area of England (Department of Communities and Local Government, 2010). The Active Play programme has been reported in detail elsewhere (O'Dwyer, Fairclough, et al., 2013). This study aims to report the effect of the Active Play programme on FMS competency. It was hypothesised that participation in the intervention would result in significantly higher FMS competency levels at post-test and six-month follow up, when compared against a comparison condition. Interaction effects of sex were also explored given reported sex differences in fundamental movement skill competence (Foulkes et al., 2015; Goodway et al., 2010; Hardy, King, Farrell, et al., 2010; Robinson, 2011).

4.3 Methods

Study design, participants and settings

This study followed the guidelines in the Template for Intervention Description and Replication (TIDieR) (Hoffmann et al., 2014) and Consolidated Standards of Reporting Trials (CONSORT) (Campbell, Piaggio, Elbourne, & Altman, 2012). A cluster randomised controlled trial was conducted to evaluate the effect of a six-week Active Play educational programme on children's PA levels, sedentary behaviour and fundamental movement skill competency. The trial occurred across two academic years (from October 2009 to November 2010). This design aimed to maximise recruitment and control for the influence of seasonal variation on PA by assessing participants at different time points during the data collection period (Carson & Spence, 2010; Rich, Griffiths, & Dezateux, 2012). Assessments were conducted at baseline, immediately following the six-week Active Play intervention and again at 6-month follow-up (see Table 4.1).

Table 4.1 Active Play project timeline.

	Data Collection and Intervention Delivery			
	Baseline	**6 Week Intervention**	**Post-Test**	**Follow Up**
Phase 1	Oct 2009	Oct – Nov 2009	Dec 2009	July 2010
Phase 2	Mar 2010	Apr – May 2010	Jun 2010	Nov 2010

In line with the project funding requirements, the 12 preschools within Liverpool (a large urban city in Northwest England), attached to a Surestart children's centre were invited to take part in the study. SureStart children's centres are a facility for advice, support and delivery of services to parents and carers of children aged five years or under living in the most disadvantaged parts of England (Children, Schools and Families Committee, 2010). Each of the 12 preschools were situated within neighbourhoods ranked in the most deprived decile for deprivation nationally at the time of the study (Department of Communities and Local Government, 2010). All 12 preschools agreed to take part in the study, with six allocated to Phase 1 (Academic Year 1) and the remaining six allocated to Phase 2 (Academic Year 2). Preschools were randomly allocated to either the intervention (n = 6) or comparison (n = 6) group. Randomisation was achieved through having a member of the research team draw folded sheets of paper (each marked with a preschool's code) from a non-transparent bag. Allocation alternated between groups, with the first, third and fifth preschool placed into the intervention group. This randomisation procedure was acceptable for samples of $n \leq 60$ (Portney & Watkins, 2000). Neither participants nor researchers were blinded to the experimental group, with the exception of the researcher undertaking video assessment of FMS competency.

All children aged 3-4.9 yr. attending the 12 preschools were invited to participate in the study (n = 673). At the time of the study, all three and four year old children in England were eligible to receive 15 hours of free preschool education for 38 weeks of the year. Four year old children were either attending under this offer or had recently commenced full time compulsory education (i.e., Monday to Friday, between the hours of 09:00 and 15:00). Active consent was mandatory for those wishing to participate; parents provided informed written consent, demographic information (home

postcode, child ethnicity and child's date of birth) and completed medical assessment forms. All invited children were eligible to participate, however, children who, by parental self-report, had previously been diagnosed with health or co-ordination issues that could affect their motor development were excluded from the analysis.

Intervention

Preschools randomised to the intervention group received the full Active Play Programme, which included professional development for staff, session delivery, post-programme support, and an Active Play resource pack. The Active Play programme was a service provided by the Sport and Leisure Directorate of Liverpool City Council. Active Play aimed to increase young children's PA, FMS competency, self-confidence, strength, agility, co-ordination and balance (strength, agility, coordination and balance were not measured as part of the scientific evaluation). The intervention was designed by an expert in programme delivery (a former Physical Education teacher who has written and delivered inclusive resources and training packages for the Youth Sports Trust, Sports Coach UK, the English Federation of Disability Sport and major companies), and implemented by a team of three Active Play practitioners. These practitioners held several sports coaching qualifications, had attended professional development workshops on delivering active play programme, and had accumulated over 10 years of coaching experience between them.

The intervention was designed using elements of the socio-ecological model (Brofenbrenner, 1979; Brofenbrenner & Morris, 1998, 2006; Copeland, Kendeigh, Saelens, Kalkwarf, & Sherman, 2012) and targeted known mediators and moderators in the child's social environment (Hinkley, Crawford, Salmon, Okely, & Hesketh, 2008). Specifically, the intervention identified that the child's teacher and their preschool environment were key agents for PA promotion and programme sustainability, and targeted them accordingly. Early childhood educators have previously indicated that they would benefit from more training around PA and movement skill activities that could be implemented in preschool environments (Gehris, Gooze, & Whitaker, 2015; Tucker, van Zandvoort, Burke, & Irwin, 2011). Thus, the intervention was structured around the provision of staff

development opportunities and on-going support for preschool educators (i.e., teachers and teaching assistants).

In order to fit with the school calendar and local authority budget, each intervention preschool received weekly Active Play sessions lasting up to 60 minutes for a six-week period (~360 minutes in total). Active Play sessions were delivered as part of an educational programme aimed at staff and children within the preschool setting, and followed a 2-2-2 delivery approach. Model instruction from a Local Authority Active Play practitioner occurred for the first two weeks of the programme (with the preschool staff observing), followed by co-instruction between preschool staff and the Active Play practitioner for two weeks. For the final two weeks, preschool staff independently instructed sessions with the support of the Active Play practitioner. This type of experiential learning is a process through which the learner (i.e., the preschool educator) is able to construct knowledge, skill and value directly from an experience within the environment (Marlow & McLain, 2011). In order to support staff implementing the intervention, preschools also received a comprehensive Active Play resource pack, which was aligned with the principles of the UK preschool curriculum (Department for Children, Schools and Families, 2008). It consisted of 20 activity cards (see Table 4.2 and Appendix One for examples), a user manual containing topics such as "Getting Activity at the Right Level" and "Including all Children", sample lesson plans, signposting information to useful online/print resources and information sources and a A3 poster that promoted active play. At the end of the six-week intervention, preschool staff were encouraged to continue with independent delivery and integrate the programme into current practice. Additionally, preschool staff received an on-demand email and telephone service for additional support, where necessary, whilst the programme was on going. This included ideas for additional games or assisting with active fun days. The Active Play programme was disbanded in 2012 due to Government funding cuts and is no longer publically available.

Comparison

Due to the length of the planned follow up (6 months) and comparison schools interest in the initiative, comparison schools received the Active Play resource pack after baseline assessments had been completed. However, no professional development, session delivery or post-programme support

were provided. Further, comparison preschools were instructed to continue with their existing PA curriculum. At the time of the project, the Early Years Foundation Stage Curriculum (Department for Children, Schools and Families, 2008) guidelines placed an emphasis on play-based learning and development in six main areas (personal, social and emotional development; communication, language and literacy; problem solving, reasoning and numeracy; knowledge and understanding of the world; physical development, and creative development).

Table 4.2 Description of example Active Play cards.

Card	Content
Warming up: Exploring bodies	Introduce children to warming their bodies up for activity and explore body parts. Children move around like buzzing bees, when the sound cue is given they touch a body part.
Dance: Free flow and motifs	Explore dance and movement using stories, combining a chorus where the group moves together and verses where the children explore and express themselves.
Gym: Jumping gym	Explore different ways of jumping. Children participate in bunny hops and standing jumps. Introduce a rope on the floor to make the activity more difficult.
Games: Sending with accuracy (targets)	Explore precision and co-ordination. Practise target games individually, in pairs, or as a group. e.g. draw targets on walls and aim for your favourite e.g. different fruits
Cool down: Child on child massage	Introduce children to positive touch through massage, whilst cooling their bodies down after exercise

Measures

Fundamental Movement Skills.- FMS competency was assessed using the same methodology as outlined in Chapter Three. Namely, the 12 FMS included in the TGMD-2 (Ulrich, 2000) were completed twice by each child, in either a school hall or outside on school playgrounds, with a video recording made of each trial. A single trained assessor then conducted subsequent video analysis, using the CMSP (Williams et al., 2009) to assess FMS competency, resulting in a total, locomotor and object-control score for each child.

Anthropometry.- Body mass (to the nearest 0.1 kg) and stature (to the nearest 0.1 cm) were measured onsite using calibrated digital scales (Tanita WB100-MA, Tanita Europe, The Netherlands) and a portable stadiometer (Leicester Height Measure, SECA, Birmingham, UK), respectively. Body mass index (BMI, kg/m^2) was calculated and converted to BMI z-scores (Cole, Bellizzi, Flegal, & Dietz, 2000b).

Analysis.-Descriptive data were analysed using SPSS v22.0 (IBM Corporation, New York). Descriptive statistics were calculated by sex and random group assignment (comparison or intervention) to describe the baseline characteristics of participating children, including weight categorisation (Cole et al., 2000) and deprivation level (Department of Communities and Local Government, 2010). Independent t-tests were used to assess group differences at baseline, with the exception of the proportion of children within the most deprived decile for deprivation, which was analysed using a chi-square test. An intention to treat analysis was used, whereby all participants that completed FMS assessments at baseline and subsequently participated in either post-test or follow-up measurements were included in the respective analyses.

MLwiN v2.30 (Centre for Multilevel Modelling, University of Bristol, UK) was used to perform the main analysis, which comprised of multilevel linear regression analyses to examine intervention effects on the dependent variables (total, locomotor and object-control scores). Multilevel models effectively analyse the hierarchical nature of non-independent, nested data by taking into account the dependency of observations (Goldstein, 1995). A 2-level data structure was used to account for children being nested within their individual schools, whereby children were classed as being the first level unit of analysis, with preschool the second. Analysis of the intervention effects

between baseline and post-test, and baseline and follow-up were conducted separately (J. W. R. Twisk, 2006). Initially, a 'crude' analysis determined the intervention effect adjusting for baseline dependent variable score only, whilst the second analysis further 'adjusted' for sex, baseline decimal age and BMI z-score (Barnett, Van Beurden, Morgan, Brooks, & Beard, 2010; Clark, 2005; Cliff et al., 2012; Goodway et al., 2010; Jones, Okely, Caputi, & Cliff, 2010). Additionally, sex interactions were explored in order to determine whether the intervention effects differed between boys and girls. Regression coefficients in each model were assessed for significance using the Wald statistic with one degree of freedom. Statistical significance was set at $p<0.05$, and at $p<0.10$ for the sex interaction term in line with Twisk (2006).

4.4 Results

Figure 4.1 details the flow of participants through the study. In total, 162 children (68%) of the 240 whom provided full parental consent met the inclusion criteria for this study (i.e., complete baseline data for age, BMI, gender and FMS) and were subsequently included in the final analysis. Participant retention ranged from 89% (post-test) to 63% (follow up) in the control group, whilst the intervention group's retention rate ranged from 73% (post-test) to 86% (follow up). Missing or incomplete FMS data was due to children being absent on testing days or having to return to class on instruction from their teacher in order to complete curricular activities.

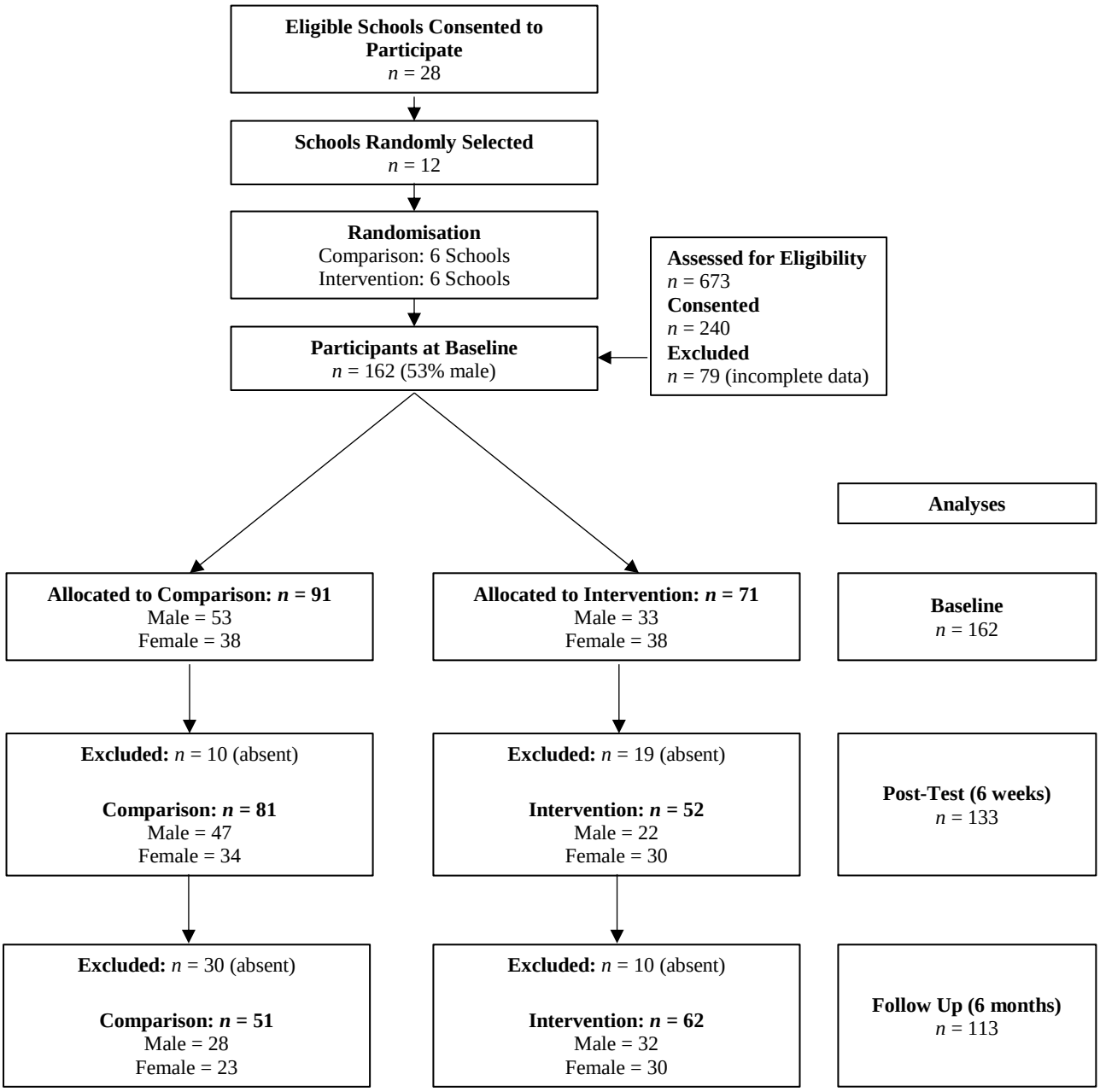


Figure 4.1 Flowchart of schools and particpants through the study.

Baseline characteristics for the study participants (*M* age 4.64 yr., *SD* = 0.58; 53.1 % boys; 25.3% overweight/obese; 80.8% White British; 93.4% lived in a low socio-economic area) are shown in Table 4.3 Competency levels were found to be low for all children at baseline, especially for object-control skills, although children within the intervention group had significantly higher total (t (160) = -2.16, p = 0.03) and object-control scores (t (160) = -2.32, p = 0.03) in comparison to children within the control group. Boys within the intervention group had significantly higher (t (84) = -2.0, p

= 0.04) total FMS score than comparison boys at baseline, whilst intervention girls had a significantly higher object-control score (t (74) = -2.01, p = 0.04) than comparison girls at baseline.

Intervention Effects

No significant intervention effects on total, object-control or locomotor score between baseline and post-test or baseline and follow-up (see Table 4.4) were observed. However, small, positive intervention effects were noted for total (β = 1.45, 95% CI -0.34 to 3.24, p = 0.11) and object-control (β = 1.01, 95% CI -0.22 to 2.24, p = 0.11) scores in the adjusted model between baseline and post-test, though any positive effects had diminished at follow-up.

Sex Interaction Effects

Table 4.5 shows the results of the sex interaction analyses between baseline and post-test and baseline and follow-up. Between baseline and post-test, a significant interaction (p=0.09) was observed for locomotor score in the crude analysis, but this was attenuated after adjusting for covariates. No other significant sex interactions were observed.

Table 4.3 Baseline descriptive characteristics for intervention and comparison children (Mean ± SD).

Measure	Comparison (n=6 preschools)			Intervention (n=6 preschools)		
	Boys (n=53)	**Girls (n=38)**	**Total (n=91)**	**Boys (n=33)**	**Girls (n=38)**	**Total (n=71)**
Age (yrs)	4.7±0.6	4.5 ±0.6	4.6 ±0.6	4.7 ±0.7	4.7±0.5	4.7±0.6
Stature (cm)	108.7±6.2	105.9±5.7	107.6±6.1	107.4± 5.5	107.6±4.8	107.8±5.1
Body Mass (kg)	19.9±3.7	18.7 ±3.1	19.4 ±3.5	19.3 ±2.9	19.1 ±2.5	19.2 ±2.7
BMI (kg/m^2)	16.7 ±1.7	16.7±1.8	16.7±1.8	16.7 ±1.6	16.5±1.4	16.6 ±1.5
IMD Score‡	90.0	91.7	90.7	96.8	97.1	97.0
Total Score‖	26.2± 7.1*	25.8 ±6.6	26.1 ±6.9**	29.4 ±7.1*	27.5 ±5.9	28.4 ±6.5**
Object-Control Score‖	11.1±4.2	9.2±3.1*	10.3±3.9**	12.8±4.2	10.7±3.4*	11.7±3.9**
Locomotor Score‖	15.2±3.9	16.7±4.4	15.8±4.2	16.6±4.3	16.8±3.6	16.7±3.9

‡Indices of Multiple Deprivation score; percentage of children living within the highest tertile for deprivation.

‖Maximum attainable score: Total score 73; object-control score 39 and locomotor score 34. *Significant difference (p<0.05) between same sex. **Significant difference (p<0.05) between .

Table 4.4 Multilevel analysis of the effectiveness of the Active Play Project intervention between baseline and post-test and baseline and six month follow-up on fundamental movement skills.

Outcome Measure	Crude Model[a]		Adjusted Model[b]	
	β (95% CI)	***p***	**β (95% CI)**	***p***
Post-Test				
Total	1.40 (-0.37, 3.17)	0.12	1.45 (-0.34, 3.24)	0.11
Object-Control	0.73 (-0.51, 1.97)	0.24	1.01 (-0.22, 2.24)	0.11
Locomotor	0.57 (-0.82, 1.96)	0.42	0.46 (-0.9, 1.82)	0.80
Follow-Up				
Total score	0.21 (-1.83, 2.25)	0.84	0.31 (-1.31, 1.93)	0.71
Object-Control skills	0.33 (-1.56, 2.22)	0.73	0.48 (-1.07, 2.03)	0.55
Locomotor skills	0.29 (-0.72, 1.3)	0.57	0.12 (-0.93, 1.17)	0.82

Note.– β = beta coefficient. CI = confidence intervals. [a]Adjusted baseline score.[b]Further adjusted for sex, BMI-*z* score and and age.

Table 4.5 Multilevel analysis exploring interaction effects by sex between baseline and post-test and baseline and six month follow-up.

Outcome Measure	Intervention*gender[a] (crude model) β (95% CI)	*p*	Boys[b] β (95% CI)	*p*	Girls[b] β (95% CI)	*p*
Post-Test						
Total Score	1.18 (-2.36, 4.72)	0.51	n/a	n/a	n/a	n/a
Object-Control Score	-0.83 (-3.24, 1.58)	0.48	n/a	n/a	n/a	n/a
Locomotor Score	1.84 (-0.33, 4.01)	0.09*	-0.51 (-2.26, 1.24)	0.57	1.36 (-0.34, 3.06)	0.12
Follow-Up						
Total Score	-1.07 (-4.28, -2.14)	0.51		n/a	n/a	n/a
Object-Control Score	-1.63 (-4.18, 0.92)	0.21		n/a	n/a	n/a
Locomotor Score	0.48 (-0.96, 2.96)	0.63		n/a	n/a	n/a

Note. - β = beta coefficient. CI = confidence intervals.[a]Adjusted for baseline score. [b]Further adjusted for BMI-*z* score and age. n/a = no significant interaction, follow up analyses not concducted.*Significant difference (p<0.1).

4.5 Discussion

This is the first randomised controlled trial to examine the effectiveness of an FMS intervention amongst English preschool children. Against the comparison group, the Local Authority designed and implemented six-week Active Play intervention in preschool settings had no significant effects on total, locomotor or object-control score at either post-test or six-month follow up. Whilst this intervention was effective at increasing the proportion of time that children spent active during the Active Play sessions (O'Dwyer, Fairclough, et al., 2013), the programme design and components did not support significant developments in children's FMS.

The findings indicate that the programme did not significantly increase FMS scores, though a trend was observed for beneficial effects on locomotor skills in girls. There may be a number of reasons for these results with the first being attributed to programme duration whereby two recent systematic reviews reported that the majority of effective programmes ran for two months or longer (Riethmuller et al., 2009; Veldman et al., 2016). The volume of programmes is also important whereby Donath, Faude, Hagmann, Roth, and Zahner (2015) reported significant improvements in skill competency following a 6 week intervention, but sessions were delivered twice weekly and were focused on object-control skills only. Further, specialist sports coaches delivered the 'Active Play' intervention, which has practical implications for delivering programmes both at scale and over the longer term. Nevertheless, taken together the results suggest that a greater dose of the Active Play programme is needed to lead to a significant improvement in young children's locomotor and object-control skills.

Other factors may have also contributed to the lack of substantial programme effects on FMS such as staff training components (Dwyer, Higgs, Hardy, & Baur, 2008), staff's prior experiences (Derscheid, Umoren, Kim, Henry, & Zittel, 2010), the quality of delivery, and the programme curriculum (Bellows, Anderson, Gould, & Auld, 2008). The Active Play intervention included a 2-2-2 week experiential learning training model that began with Active Play specialists delivering the programme and ended with the preschool staff independently delivering sessions. Amongst existing literature, there is no clear consensus on the *amount* or *type* of training that is required in order to effectively train preschool staff to improve children's FMS competence. However, recent successful interventions have utilised either a one-day workshop (Hardy, King, et al., 2010a; Piek et al., 2013) or a series of brief workshops (Jones et al., 2011) as professional development activities for preschool staff. Unlike the Active Play programme, these occurred prior to programme implementation, and included a blend of practical and theoretical components – the latter may have been useful in indoctrinating preschool educators' into the Active Play programme philosophy and enhancing their knowledge and understanding of the programme content. Whilst the present study did not incorporate measurement of intervention fidelity, the absence of intervention effects at 6-month follow-up indicates that preschool staff may not have integrated the programme to that of their existing practice.

The Active Play specialist practitioners did offer an on-demand support service for preschool staff after the initial six-week programme but more structured support, such as mentoring or direct supervision, or opportunities for collaboration with peers (e.g. communities of practice), could be considered by programme planners.

It is also possible that the Active Play curriculum, which targeted PA, sedentary behaviour and 12 different FMS, was too broad in scope, particularly given the short duration of the intervention. For example, the intervention reported by Jones et al. (2011) focused on only five skills over a longer period of time and was able to bring about greater improvements in competency. It is important to note that the Active Play programme was, however, effective at increasing levels of moderate-to-vigorous PA (O'Dwyer, Fairclough, et al., 2013). The curriculum activities and resource cards were designed to provide opportunities for children to explore and try different FMS whilst engaging in moderate-to-vigorous physically active play. However, young children may require more targeted and focused skill-development activities, with approaches utilising direct instruction, guided discovery or deliberate practice alongside the provision of positive feedback (Gallahue & Donnelly, 2003; Payne & Isaacs, 2002). As such, it is not surprising that previous interventions reporting improvements in FMS competency have included opportunities for instruction and practice (Donath et al., 2015; Draper, Achmat, Forbes, & Lambert, 2012; Goodway, Crowe, & Ward, 2003; Jones et al., 2011), indicating that these should play a role in the design of any future FMS interventions. Conversely, the intervention may have also benefited from a more holistic, PL led approach, targeting the wider constructs of PL; motivation, confidence, knowledge and understanding, rather than focusing solely on physical competence i.e. physical activity and FMS. Previous studies have suggested that as movement competency encompasses components besides FMS, interventions aimed solely at increasing FMS competency might not help the development of body coordination, resulting in poor movement competence (Ericsson, 2008; Rudd et al., 2016). Whilst further research in this area is required, targeting additional aspects of physical development outside of FMS may be beneficial in increasing overall FMS competency and in turn increasing PA levels, in accordance with the Stodden et al. (2008) model.

The strengths of this cluster-randomised controlled trial include the use of a validated process-based measure of FMS, assessed using video analysis by a researcher blinded to the group allocation. Further, the study included a follow-up assessment that allowed an examination of long term programme effects. A lack of follow-up data has been noted as a limitation of previous studies e.g. Lai et al., 2014; Riethmuller et al., 2009. A limitation of the present study was the 68% participation rate at baseline of children eligible to take part (n = 240) and further decreases in participant numbers at post-test and follow-up due to children leaving the baseline school and incomplete FMS data, highlighting difficulties of data collection with young children within a preschool environment. Furthermore, this study could have been strengthened by the inclusion of a process evaluation in order to provide further data on the intervention fidelity (whether the intervention was delivered as intended) and dose (the quantity of intervention implemented) (Moore et al., 2015). This would have helped in identifying whether the limited intervention effects were due to faults in the intervention design or because it was not properly implemented

Despite the lack of significant effects of the Active Play intervention on FMS competency among young children from deprived areas, these findings have important implications for both research and practice. This is the first study to examine the effectiveness of an intervention to promote FMS competency among young children from England. The results suggest that this Active Play intervention may have needed to run for longer and/or with a greater frequency of session delivery in order to be effective. Future research is needed to answer these questions and further investigate appropriate intervention duration/dosage, effective training for setting staff, greater instruction and practice of FMS and how these can then be achieved in applied settings. In time these changes may also help to inform educational practice and changes to curriculum and educational policy relating to children's FMS development during the preschool years, helping to provide children with the basic movement skills required to lead them on a path towards lifelong physical literacy.

Chapter Five

Is Fundamental Movement Skill Competency Important for Keeping Children Physically Active and a Healthy Weight?

5.1 Thesis Study Map: Study Three

Study	Objectives
Study One: Examining the fundamental movement skill competency levels of preschool children form Northwest England	Objectives: • Report detailed FMS competence data among a sample of preschool children from a deprived area of Northwest England • To investigate sex differences in FMS and their respective components. Key Findings: • Overall competence found to be low among both sexes • Competency higher for locomotor skills than for object-control skills • Boys significantly more competent at object-control skills in comparison to girls • Boys were significantly more competent than girls at the kick and overarm throw, while girls were significantly more competent at the run, hop, and gallop
Study Two: Effect a school-based Active Play intervention on fundamental movement skill competency among preschool children	Objectives: • To examine the effectiveness of a six-week Active Play intervention on FMS competency in 3-5 yr. old children from a deprived area of Northwest England Key Findings: • There were no significant differences between-groups for total FMS, object-control or locomotor scores at post-test or follow up. • Intervention may have needed to run for longer and/or with a greater frequency of session delivery in order to be effective.
Study Three: Is Fundamental Movement Skill Competency Important for Keeping Children Physically Active and a Healthy Weight?	**Objectives:** • **To determine the role of fundamental movement skills in promoting physical activity and healthy weight status as children progress from early to late childhood.**
Study Four: Towards the Development of a Physical Literacy Intervention for Preschool Children: The Perspectives of Experts and Practitioners	Objectives: • To gain the thoughts and opinions of experts and practitioners to help inform the development of an appropriate intervention to increase the physical literacy of preschool children.

5.2 Introduction

In the Stodden et al. (2008) model it is hypothesized that the development of FMS competency is a primary underlying mechanism in promoting PA, with this association strengthening as children age. Furthermore, it is purported that this increase in PA brought about through increased FMS competency is able to shape positive or negative trajectories of weight status among children (Stodden et al., 2008). Data from cross-sectional studies in the literature would seem to support this theory, with findings indicating that FMS competency is both a *precursor* and *consequence* of childhood weight status (D'Hondt et al., 2009; D'Hondt, Deforche, et al., 2011; Okely et al., 2004). However, due to the cross-sectional design of these studies, this prevents any statements on causality from being made (D'Hondt, Deforche, et al., 2011). As such, longitudinal studies are needed to examine the developmental trajectory of FMS competence with PA and obesity as proposed in the Stodden et al. (2008) model.

At present, there is only a limited number of studies that have examined these longitudinal associations during childhood, particularly across the period of preschool to late primary (3-11 yr.). Two previous longitudinal studies found FMS competency to be a predictor of PA in children between primary age and adolescence (Barnett, Van Beurden, Morgan, Brooks, & Beard, 2009; Lopes et al., 2012), which may suggest a causal relationship between FMS competency and PA. Barnett, Van Beurden, Morgan, Brooks, and Beard (2009) study among Australian children from 10.1-16.4 yr. reported that adolescent time in MVPA was positively associated with childhood object-control competency, accounting for 12.7% ($p<.05$) of the variance. Furthermore, object-control proficient children were found to become adolescents with a 10% to 20% greater chance of participating in vigorous activity (Barnett, Van Beurden, Morgan, Brooks, & Beard, 2009). Lopes et al. (2012) study observing Portuguese children from 6-14 yr. found a negative correlation (0.05-0.49) between BMI and motor coordination, measured using the KTK (Kiphard & Schilling, 2007). Only Barnett, Van Beurden, Morgan, Brooks, and Beard (2009) have reported FMS competency, specifically object-control competency, in childhood to be related to a variance in MVPA during adolescence.

Among preschool children, previous studies using accelerometers have reported positive but weak associations between FMS competency and PA (Burgi et al., 2011; Cliff et al., 2009; Fisher et al., 2005; Iivonen et al., 2013; Williams et al., 2008). To the authors' knowledge, no previous longitudinal study has examined the influence of FMS competency in relation to PA (using MVPA) among English preschool children. Likewise, longitudinal studies investigating the relationship between FMS competency and weight status are also required, specifically during early childhood, as evidence on associations between FMS competency and weight status among this age groups is currently not available (Robinson et al., 2015). Longitudinal work by Bryant, James, et al. (2014) has explored the relationship between FMS competency, PA and weight status among English primary school children. Having assessed competency using the *"Move it Groove it"* protocol (Van Beurden et al., 2003) the authors found that current FMS competency was a better predictor of current weight status, whilst prior FMS competence was a better predictor of current PA, however, PA data was obtained from pedometers. As such, this is a limitation as FMS competency can only be looked at in relation to total PA, as pedometers cannot distinguish the intensity and duration of PA. Zask et al. (2012) longitudinal study looked at the effects of a movement skill intervention among Australian preschool children on FMS competency and PA, assessing competency using the TGMD-2 (Ulrich, 2000). After three years they reported no relationship between object-control skills and follow up MVPA, with the authors noting that this could have been due to a lack of MVPA data pre- and post-intervention to adjust for during analysis (Zask et al., 2012).

A recent study by Cohen, Morgan, Plotnikoff, Callister, and Lubans (2014) examined the associations between FMS competency and PA among primary school children (8-9 yr.) living in low SES areas. The authors noted that children living in low SES areas may be at greater risk of physical inactivity and other health inequalities (Cohen et al., 2014), however, there is little research regarding the relationship between FMS competency and PA among preschool children from deprived areas. Therefore, this study aims to examine the associations between FMS competency, objectively measured PA and weight status among preschool children living in a highly deprived area. Specifically looking at i) how FMS competency and MVPA change with age ii) how the association

between FMS and MVPA changes with age and iii) if preschool FMS competency is able to predict weight status at primary age.

5.3 Methods

Study design, participants and settings

This longitudinal study took place over a five-year period across 12 preschool/primary schools in Liverpool (a large urban city in Northwest England). Baseline assessments were conducted across two academic years, during October 2009 and March 2010. This approach was used in order to help maximise participant recruitment and minimise the influence of seasonal variation (Carson & Spence, 2010; Rich et al., 2012). Follow-up assessments were conducted between June and July 2015.

Baseline

Baseline data for this study were drawn from the 2010 Active Play Project, which has been reported in detail elsewhere (O'Dwyer, Fairclough, et al., 2013) and earlier in this thesis. In brief, the Active Play Project was a Local Authority funded programme in response to a growing awareness of a need to establish health behaviours, such as increased PA, from an early age. The project consisted of a six-week educational programme directed at preschool staff and children with the aim of increasing children's PA levels, developing FMS, strength, agility, co-ordination and balance, and increasing children's self-confidence. In line with the project's funding requirements, each of the 12 preschools invited to take part in the study were selected in order to help address health inequities and improve indicators of child health. Such as, childhood obesity (12.2% of five year olds were obese) and PA that were significantly worse than the national average (Association of Public Health Observatories, 2009). Additionally, each preschool was attached to a Surestart children's centre. The role of these centres is to offer advice, support and deliver services to parents and carers of children aged five years or under residing in the most deprived areas of England (Children, Schools and Families Committee, 2010). All 12 of the preschools approached were situated within neighbourhoods ranked in the most

deprived decile for deprivation nationally at the time of the study (Department of Communities and Local Government, 2010).

At the time of baseline assessments, all three and four year old children in England were eligible to receive 15 hours of free preschool education for 38 weeks of the year. Four year old children were either attending under this offer or had recently commenced full time compulsory education (i.e., Monday to Friday, between the hours of 09:00 and 15:00). All 12 preschools agreed to take part, with all children aged 3-4.9 yr. in attendance at each preschool invited to participate (n = 673). Active consent was mandatory for those wishing to participate, with parents/carers providing informed written consent, demographic information (home postcode, child ethnicity and child's date of birth) and completed medical assessment forms. All children were eligible to participate, however, children who, as identified by parental self-report, had been previously diagnosed with health or co-ordination issues that could affect their motor development, were excluded from subsequent analysis. In total, 240 children agreed to participate (mean age 4.5 yr., ± 0.6 yr.; 51.7% male).

Follow Up

Each of the 12 preschools who participated in the 2010 study were situated within a primary school. As such, it was expected that the majority of preschool children would go on to attend the respective primary school. Due to the long period between baseline and the proposed follow up, researchers collaborated with the Senior School Improvement Officer (SSIO) from the Local Authority. This was in order to speed up the recruitment process and allow for the identification of children who were now attending different primary schools (outside of the original 12) or had moved away entirely. Initially, the SSIO contacted the head teacher of each primary school, providing details on the study and inviting them to attend a meeting where the SSIO and members of the research team would be present. During this meeting the research team outlined the proposed study and what we be required should schools agree to take part, as well as answering any questions head teachers may have had. Head teachers who were unable to attend the meeting received an information pack outlining the project details. All 12 of the primary schools agreed to take part in the study, with gatekeeper consent obtained from each school's head teacher.

Having provided the SSIO with a list of the corresponding children who participated in the 2010 study, the SSIO was able to further provide each child's Unique Pupil Number, aiding in the tracking and identification of children. These pupil lists were then passed on to each of the 12 schools, allowing them to confirm which of the original participants were in attendance at their school. Of the 240 children who had participated in 2010, 181 children were identified as being in attendance across the 12 primary schools. All 181 children were invited to participate in the project and asked to return informed written parental consent and medical forms. In total, 131 children (mean age 10.0 yr., ± 0.6 yr.; 52.3% male) agreed to participate in the study (72.4% response rate; 54.5% of original 2010 participants). Both children and their parents/carer were made aware that children were free to withdraw from the study at any point, without providing a reason.

Measures

Fundamental Movement Skills.- FMS competency was assessed using the same methodology detailed in Chapter Three. In brief, each of the twelve FMS included in the TGMD-2 (Ulrich, 2000) were completed twice by each child, in either a school hall or outside on school playgrounds, with a video recording made of each trial. A single trained assessor then conducted subsequent video analysis, using the CMSP (Williams et al., 2009) to assess FMS competency, producing a total, locomotor and object-control score for each child.

Anthropometry.- Body mass (to the nearest 0.1 kg) and stature (to the nearest 0.1 cm) were measured onsite by trained research assistants, using calibrated digital scales (Tanita WB100-MA, Tanita Europe, The Netherlands) and a portable stadiometer (Leicester Height Measure, SECA, Birmingham, UK), respectively. Body mass index (BMI, kg/m^2) was calculated and converted to BMI-z scores using the "LMS" method for analysis (Cole et al., 2000b).

Physical Activity – PA levels were measured using hip-mounted uni-axial accelerometers (ActiGraph GT1M and GT3X+, ActiGraph, Pensacloa, FL) worn on participants right hip. As only uniaxial accelerometers were available for data collection during Active Play 2010, only 1-axis was used to collect PA data when using triaxial accelerometers during Active Play 2015. Children were asked to wear their accelerometer during all waking hours, with the exception of water-based

activities e.g. bathing or swimming for a period of seven consecutive days. Five second epochs were used, with periods of 20 minutes of consecutive zeros removed from the data as these were considered periods of non-wear time (Esliger, Copeland, Barnes, & Tremblay, 2005). Accelerometer data was reduced and analysed using ActiLife v6.0 (ActiGraph, Pensacloa, FL).Valid wear time was defined as a minimum of any three days, with at least nine hours of data recorded between 06:00h and 23:59h (waking hours). The rationale for this being to maximise the inclusion of participants included in the analysis, without losing reliability in the PA data, excluding participants who did not have valid weekend data would have resulted in a far lower number of participants. Age appropriate cut points were used, with Evenson, Catellier, Gill, Ondrak, and McMurray (2008) and Pate, Almeida, McIver, Pfeiffer, and Dowda (2006) cut points used at baseline, as recommended by (Janssen et al., 2013) due to Pate et al. (2006) being a better predictor of MVPA in the early years. Likewise, at follow up only Evenson et al. (2008) cut points were used, due to providing acceptable classification accuracy for all four levels of PA intensity (sedentary, light, moderate and vigorous) and being suited to children in late childhood (Trost, Loprinzi, Moore, & Pfeiffer, 2011). PA data was categorised into average minutes of daily MVPA for subsequent analysis. To account for seasonal variation in data collection periods, the mean temperature (mean of daily minimum and maximum, °C), rainfall (mm) and day length (sunrise to sunset; hrs.) of each monitoring period was calculated for each participant. Daily temperature and day length data were obtained from www.timeanddate.com and daily rainfall data from MET office records (http://www.metoffice.gov.uk/hadobs/hadukp/data/download.html).

Analysis - Data were analysed using SPSS v23.0 (IBM Corporation, New York). For descriptive analysis, results are presented as means ± standard deviation and median and inter-quartile range for non-normally distributed data. A 2 (baseline versus follow up) x 2 (normal weight versus overweight/obese) x 2 (boys versus girls) repeated measures ANCOVA was used to examine changes in FMS competency and PA with age, taking into account sex and weight classification differences. These were both adjusted for age, deprivation level (Department of Communities and Local Government, 2010), ethnicity (previous research has highlighted ethnic background can effect competency (Hardy, Reinten-Reynolds, Espinel, Zask, & Okely, 2012), intervention/control classification, accelerometer wear time and seasonal PA variation (mean temperature, °C; rainfall,

mm; and day length, hrs). Participants from intervention and control groups were included in the present study as it was not important to differentiate between these two groups for this study, however, models did adjust for participant's intervention status. Initially mixed linear models were run, adjusting for school level, however, school was found to have no effect. As such, linear models were run to examine if baseline FMS competency predicted follow up PA, whether baseline PA predicted follow up FMS competence and how the association between FMS competency and PA changed between baseline and follow up. Finally, binary logistic regressions were used to examine whether baseline FMS competency predicted follow up weight status (normal weight or overweight/obese), respectively. Statistical significance was set at $p<0.05$. Interactions by sex and weight were explored but none were found ($p>0.10$), thus regression models are presented at the group level.

5.4 Results

In total, 75 children (58%) of the 131 whom provided full informed consent at follow-up (31% of original Active Play participants) met the inclusion criteria for this study (i.e. complete baseline data and follow up data for age, BMI, gender, PA data and total FMS score) and were subsequently included in the final analysis. There were no significant differences in baseline characteristics between participants taking part in the present study and those not retained or excluded, except for deprivation score. A Mann-Whitney U test found that participants in the present study had a higher deprivation score (Md = 3.84, IQR = 1.01, 20.04, n = 75) than those excluded (Md = 2.79, 0.59, 4.85, n = 153).

Table 5.1 shows participant characteristics in 2010 (M age 4.58 yr. ± 0.48; 50.7% boys; 29.7% overweight/obese; 85.1% White British; 84.0% lived in a low SES area) and in 2015 at follow up (M age 9.98 yr. ± 0.49; 50.7% boys; 29.7% overweight/obese; 85.1% White British; 75.0% lived in a low SES area). There were significant increases ($p<.05$) in age, BMI, total, object-control, locomotor and deprivation scores between baseline and follow up, whilst MVPA (baseline M = 90.3 ± 24.5; follow up M = 69.0 ± 21.7) and monitor wear time (baseline M = 779.5 ± 101.2; follow up M =

695.4 ± 57.1) were found to significantly decrease (p<.05). Furthermore, there were significant (p<.05) differences in seasonal factors between baseline and follow up, with significant increases in daily temperature (baseline M = 9.9 ± 1.0; follow up M = 9.9 ± 1.0) and day length (baseline M = 11.7 ± 0.9; follow up M = 16.4 ± 1.2), and a significant decrease in rainfall (baseline M = 3.3 ± 2.0; follow up M = 1.5 ± 1.0).

At baseline, the only significant sex difference was for object-control score, with boys found to have scored significantly (p<.05) higher than girls. At follow up significant differences (p<.05) were observed between boys and girls for total (boys M = 40.11 ± 5.01; girls M = 36.24 ± 4.75) and object-control (boys M = 19.45 ± 4.05; girls M = 15.03 ± 3.62) skill scores and MVPA (boys M = 78.56 ± 23.55; girls M = 59.25 ± 14.30). When looking at differences between baseline and follow up descriptives by sex, all changes were significant with the exception of BMIz score.

How Does FMS Competency and MVPA Change with Age?

For descriptive purposes, Figures 5.1-5.4 show the individual level changes in FMS scores and MVPA between baseline and follow up. There was an overall pattern of increase for total, object-control and locomotor scores between baseline and follow up (see Figures 5.1-5.3). However, some differing trajectories were evident among participants: children who had lower scores at baseline appeared to show greater levels of improvement to follow up than their peers who had higher competency scores at baseline. However, in general competency scores were still found to be low, falling far short of the maximum attainable scores. Conversely, there was an overall pattern of decline for MVPA between baseline and follow up (see Figure 5.4).

Table 5.1 Baseline (Active Play 2010) and Follow up (2015) descriptive characteristics for participants (Mean ± SD; Median and inter-quartile range).

	Active Play 2010			Active Play 2015		
Measure	**Boys (n=38)**	**Girls (n=37)**	**Total (n=75)**	**Boys (n=38)**	**Girls (n=37)**	**Total (n=75)**
Age (yrs)	4.5 ± 0.6	4.6 ± 0.4	4.6 ±0.5	10.0 ± 0.6*	10.0 ± 0.4*	10.0 ± 0.5*
BMI (kg/m^2)	16.7 ± 1.8	16.6 ± 1.9	16.7 ± 1.8	18.5 ± 3.4*	18.7 ± 3.6*	18.6 ± 3.5*
BMI-z Score (IOTF)	0.7 ± 1.1	0.7 ± 1.1	0.7 ± 1.1	0.7 ± 1.1	0.7 ± 1.1	0.7 ± 1.1
MVPA (mins)	95.6 ± 22.8	84.9 ± 25.3	90.3 ± 24.5	78.6 ± 23.6*	59.3 ± 14.3*	69.0 ± 21.7*
Wear Time (mins)	780.3 ± 105.7	778.6 ± 97.9	779.5 ± 101.2	698.5 ± 57.3*	692.2 ± 57.4*	695.4 ± 57.1*
Total FMS‡	28.2 ± 5.9	26.41 ± 5.6	27.3 ± 5.8	40.1 ± 5.0*	36.2 ± 4.8*	38.2 ± 5.2*
OC Score‡	12.3 ± 3.8	9.5 ± 3.0	11.0 ± 3.7	19.5 ± 4.1*	15.0 ± 3.6*	17.3 ± 4.4*
LM Score‡	15.9 ± 3.7	16.9 ± 3.6	16.4 3.6	20.7 ± 2.3*	21.2 ± 2.9*	20.9 ± 2.6*
Temperature (°C)	9.8 ±1.1	10.1 ± 1.0	9.9 ± 1.0	15.5 ± 1.5*	15.4 ± 1.3*	15.4 ± 1.4*
Rainfall (mm)	3.3 ± 2.0	3.2 ± 2.1	3.3 ± 2.0	1.5 ± 0.8*	1.5 ± 1.1*	1.5 ± 1.0*
Daylength (hours)	11.7 ± 0.9	11.6 ± 1.0	11.7 ± 0.9	16.4 ± 1.1*	16.3 ± 1.3*	16.4 ± 1.2*
Median (IQR)						
Deprivation†	4.03 (1.1, 20.7)	3.4 (0.8, 19.8)	3.84 (1.0, 20.4)	47.0 (21.0, 59.5)*	53.0 (31.8, 59.0)*	50.5 (24.8, 59.0)*

Note: OC, Object-Control; LM, Locomotor; IOTF, International Obesity Task Force age- and sex-specific weight for height z scores. ‡Maximum attainable score: Total FMS score 71; object-control skill score 39; and locomotor skill score 32. †Deprivation rank score. *Significantlly different from baseline value ($p<.05$)

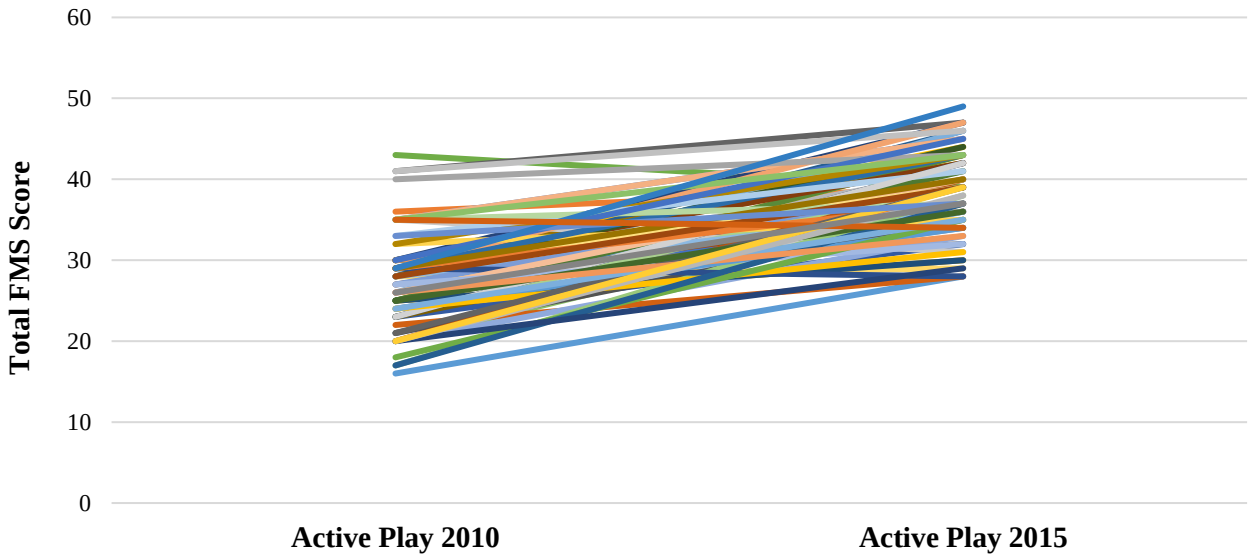


Figure 5.1. Individual changes in total FMS scores between baseline (Active Play 2010) and follow up (Active Play 2015). Maximum score attainable: 71.

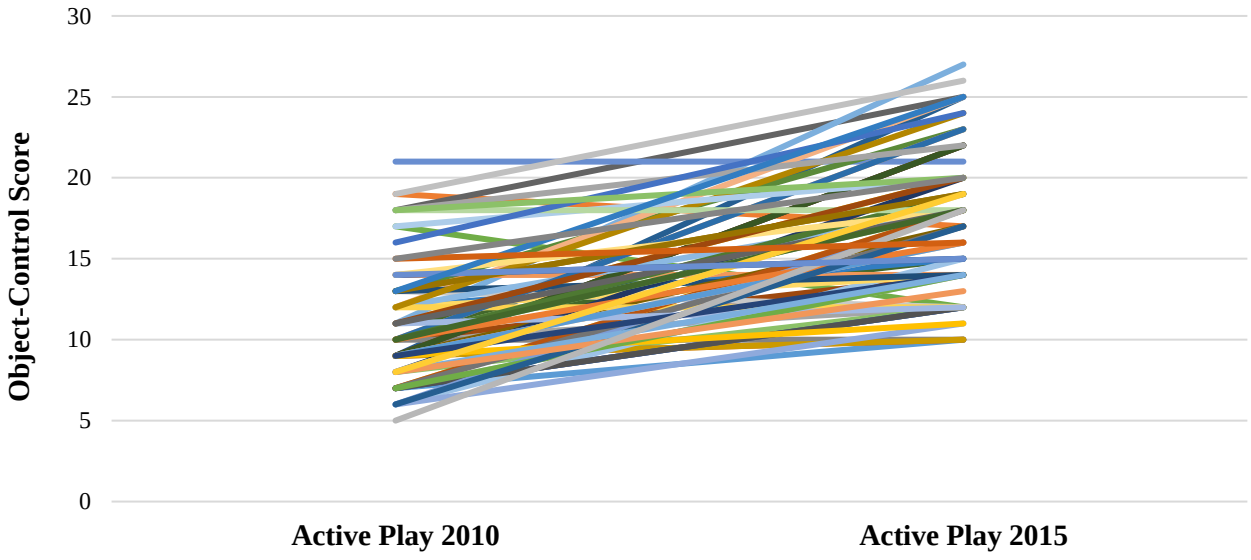


Figure 5.2. Individual changes in object-control scores between baseline (Active Play 2010) and follow up (Active Play 2015). Maximum score attainable: 39.

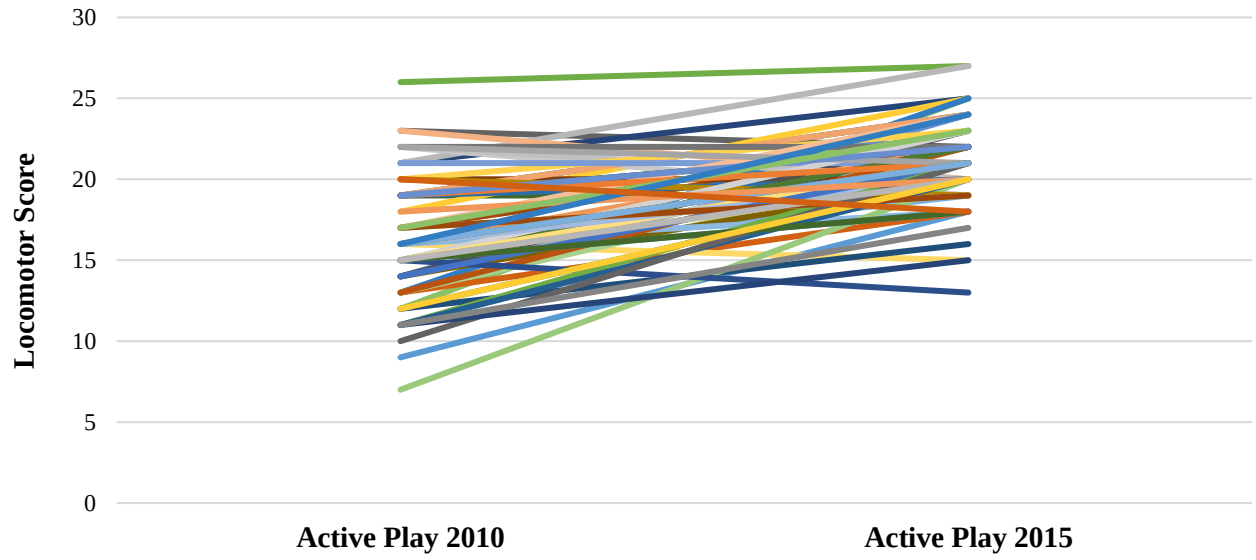


Figure 5.3. Individual changes in locomotor scores between baseline (Active Play 2010) and follow up (Active Play 2015). Maximum score attainable: 32.

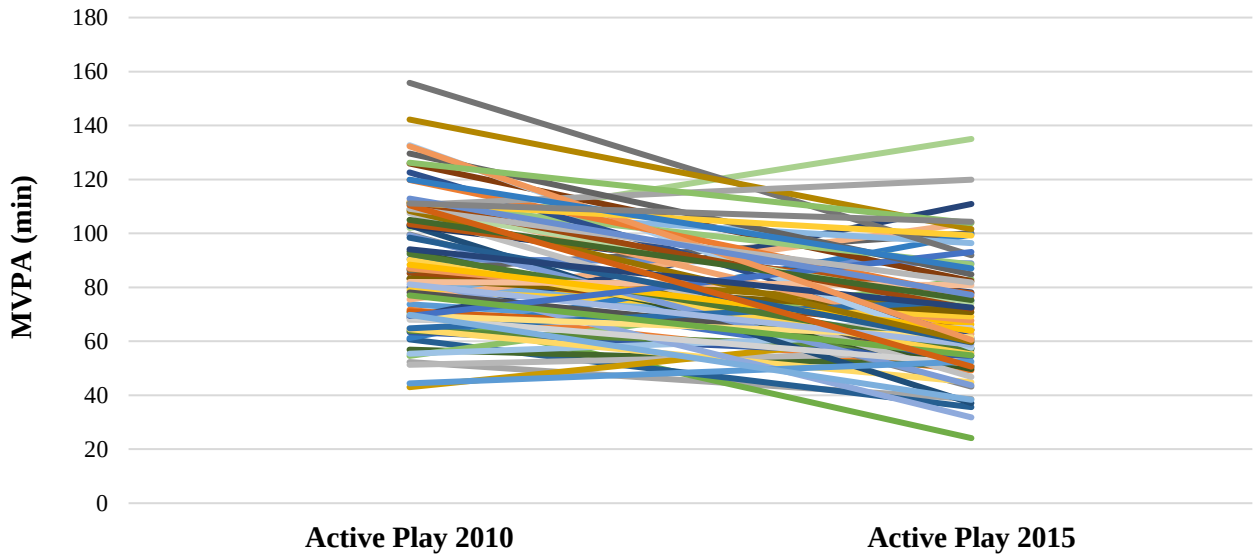


Figure 5.4. Individual changes in MVPA between baseline (Active Play 2010) and follow up (Active Play 2015).

Tables 5.2 and 5.3 provide descriptive statistics alongside a summary of the repeated measures ANCOVA for all three FMS competency scores and MVPA. Table 5.2 shows that participants in both weight categories (normal weight and overweight/obese) demonstrated an improvement in competency scores between baseline and post-test, with a main effect for time $p < .05$. Normal weight

participants had higher skill competency scores than their overweight/obese peers at both time points, although there was no significant effect for time*weight class (p>.05). For MVPA there was a significant effect for time*weight status (p <.05) between the two groups. Whilst both groups decreased their time spent in MVPA between baseline and follow up, there was a significantly greater decrease observed over time among overweight/obese children, with overweight/obese children spending less time in MVPA at follow up.

Table 5.2. Means, standard deviations and summary of repeated measures analysis for FMS competency scores and MVPA for normal weight and overweight/obese participants.

Score	Baseline (2010)		Follow Up (2015)		Repeated Measures ANCOVA			
	NW n = 52	OW/OB n = 21	NW n = 52	OW/OB n = 21	F_{Time}	p	$F_{Time \times Weight\ Class}$	p
FMS Score								
Total	27.65 ± 5.96	25.82 ± 5.10	38.73 ± 5.21	36.33 ± 6.97	21.85	<.001*	.000	.99
OC	11.31 ± 3.65	9.62 ± 3.34	17.58 ± 4.30	15.90 ± 6.08	21.33	<.001*	0.18	.67
LM	16.35 ± 3.77	16.24 ± 3.49	21.15 ± 2.52	20.43 ± 2.79	2.82	.01*	0.30	.59
MVPA[1]								
MVPA	88.33 ± 23.72	93.19 ± 26.91	71.40 ± 22.00	62.55 ± 21.11	1.31	.26	4.95	.03*

Note: OC, Object-Control; LM, Locomotor; NW, Normal Weight; OW/OB, Overweight/Obese. All analyses corrected for age, deprivation score, ethnicity and participation in intervention group.

[1]Further adjusted for weather and monitor wear time. *Significant at p<.05.

Table 5.3 reports the differences in competency scores and MVPA over time by sex. Both boys and girls significantly improved their competency scores between baseline and follow up, with a main effect for time (p<.05). There was a significant time*sex interaction (p<.05) for total and object-control scores, with boys having been found to have significantly greater increases in total and object-

control scores between baseline and follow up in comparison to girls. Boys spent more time than girls in MVPA at both time points, although this did not result in any significant differences. Both sexes spent significantly less time in MVPA at follow up compared to baseline (p<.05). No significant interactions were found.

Table 5.3. Means, standard deviations and summary of repeated measures analysis for FMS competency scores and MVPA among boys and girls.

Score	Baseline (2010)		Follow Up (2015)		Repeated Measures ANCOVA			
	Boys n = 38	Girls n = 37	Boys n = 38	Girls n = 37	F_{Time}	p	$F_{Time \times sex}$	p
FMS Score								
Total	28.21 ± 5.92	26.41 ± 5.57	40.11 ± 5.01	36.24 ± 4.75	37.89	<.001*	7.53	.007*
OC	12.34 ± 3.82	9.54 ± 2.98	19.45 ± 4.05	15.03 ± 3.62	26.43	<.001*	5.71	.02*
LM	15.87 ± 3.66	16.86 ± 3.58	20.66 ± 2.25	21.22 ± 2.89	15.46	<.001*	1.72	.19
MVPA[1]								
MVPA	95.57 ± 22.83	84.87 ± 25.27	78.56 ± 23.55	59.25 ± 14.30	13.86	<.001*	1.74	.19

Note: OC, Object-Control; LM, Locomotor; NW, Normal Weight; OW/OB, Overweight/Obese. All analyses corrected for age, deprivation score, ethnicity, participation in intervention group. [1]Further adjusted for weather and monitor wear time. *Significant at p<.05

Does Baseline FMS Competence Predict MVPA at Follow Up?

Results of the regression analyses examining FMS competency scores as predictors of MVPA at follow up are summarised in Table 5.4. Having controlled for intervention group alongside baseline

age, deprivation, ethnicity, sex, BMI-z and follow-up monitor wear time and weather, none of the FMS competency scores were found to be significant predictors of MVPA at follow up (p>.05). Total, locomotor and object-control skill score at baseline each predicted less than 1% of unique variance in MVPA at follow up.

Does Baseline MVPA Predict FMS competence at Follow Up?

Outcomes from regression analysing whether baseline MVPA predicted FMS competence at follow up are presented in Table 5.4. Having controlled for baseline monitor wear time and weather in addition to the stated covariates, baseline MVPA did not significantly predict FMS competency at follow up (see Table 5.4). Baseline MVPA predicted only 2% of unique variance in total FMS score. When sub-domains of FMS were examined, baseline MVPA predicted only 2% of unique variance in object-control competency score and 0.2% of unique variance in locomotor skill score.

How Does the Association Between FMS and MVPA Change Between Baseline and Follow Up?

The strength of association between FMS and MVPA at baseline is shown in Table 5.4. After adjustments, total and locomotor skill scores significantly predicted MVPA (p<.01). Total FMS score predicted 4.5% of unique variance in baseline MVPA; specifically, a one unit increase in total skill score is associated with a 1.04 min increase in baseline MVPA (95% CI, 0.20 to 1.9). When looking at the sub-domains, locomotor skill score predicted 3.3% of unique variance, with a one unit increase in locomotor score accounting for a 1.3 min increase in MVPA (95% CI, 0.06 to 2.61). However, object-control score was not found to be a significant predictor (p>.01), accounting for only 0.5% of unique variance in baseline MVPA.

When looking at the relationship between FMS and MVPA at follow up, a further regression controlling for stated covariates, found none of the three competency scores to be significant predictors of MVPA (p>.01) (see Table 5.4), indicating that the strength of association between FMS

and MVPA weakened over time. At follow up, total and locomotor scores had decreased in their level of prediction of unique variance to 2.5% and 0.5%, respectively. Whilst there was an increase in object-control score compared to baseline, now predicting 1.6% of unique variance in MVPA, this was not significant (p>.01).

Does Baseline FMS Competency Predict Follow Up Weight Classification?

The results of the binary logistic regression (see Table 5.5) show that (controlling for intervention group and baseline age, deprivation, ethnicity, sex, BMI-z score, monitor wear time and weather) none of the three skill competency scores significantly predicted follow up weight classification (i.e. non-overweight or overweight/obese).

Table 5.4. Results from linear regression examining associations between FMS scores and MVPA.

Predictor	β	SE	95% CI	*p*	r^2	sr_i^2
Baseline FMS and Baseline MVPA[1]						
Total	1.04	0.42	0.20 to 1.9	.02*	53.8%	4.53%
OC	0.62	0.78	-0.94 to 2.19	.43	54.1%	0.48%
LM	1.34	0.64	0.06 to 2.61	.04*		3.31%
Baseline FMS and Follow-up MVPA[2]						
Total	0.08	0.39	-0.69 to 0.85	.83	47.6%	0.04%
OC	0.30	0.70	-1.38 to 1.43	.97	47.6%	<0.01%
LM	0.13	0.65	-1.16 to 1.43	.84		0.04%
Baseline MVPA and Follow-up FMS[3]						
Total	0.04	0.03	-0.20 to 0.11	.19	26.6%	1.96%
OC	0.04	0.03	-0.01 to 0.09	.15	39.6%	2.04%
LM	0.01	0.02	-0.03 to 0.04	.69	18.2	0.21%
Follow-up FMS and Follow-up MVPA[4]						
Total	0.71	0.41	-0.12 to 1.54	.09	56.0%	2.46%
OC	0.75	0.55	-0.35 to 1.86	.08	56.0%	1.56%
LM	0.63	0.83	-1.04 to 2.30	.16		0.49%

Note: β, unstandardized regression coefficient; SE, standard error for β coefficient; 95% CI, confidence intervals for regression coefficient; r^2 total variance explained by baseline score and predictor variables; sr_i^2, squared semi-partial correlation coefficient, unique variance explained by baseline score; OC, Object-Control; LM, Locomotor. All models adjusted for intervention group and baseline age, deprivation, ethnicity, sex, and BMI-z score; [1] model additionally adjusted for baseline monitor wear time and weather; [2]additionally adjusted for follow-up monitor wear time and weather; [3] additionally adjusted for baseline monitor wear time and weather; [4]additionally adjusted for follow-up monitor wear time and weather.
*Significant at $p<.05$.

Table 5.5. Logistic regression of baseline FMS competency predicting the likelihood of being overweight/obese at follow up.

Predictor	B	SE	95% CI	Odds Ratio	*p*
Total	0.15	0.19	0.81 to 1.68	1.17	.41
OC	-1.95	3.00	0.00 to 50.97	0.14	.52
LM	1.42	2.04	0.08 to 225.57	4.12	.49

Note: β, regression coefficient; SE, standard error; OR, adjusted odds ratio; 90% CI, confidence intervals. All models adjusted for intervention group and baseline age, deprivation, ethnicity, sex, BMI-z score, monitor wear time and weather; *Significant at $p<.05$.

5.5 Discussion

To the author's knowledge, this is the first longitudinal study to examine the relationship between FMS competency, PA and weight status among English children living in areas of high deprivation throughout the period of early to late childhood. The main findings from the present study were that despite significant increases between baseline and follow up, FMS competency was still found to be low among participants at follow up. Boys were found to have significantly higher total and object-control scores than girls at follow up, whilst overweight/obese (OW/OB) children had lower competency levels than their normal weight (NW) peers for all competency scores at both baseline and follow up. There was a significant decrease in MVPA among both boys and girls between baseline and follow up, with a significantly greater decrease observed over time among OW/OB children. Associations between FMS competency and MVPA were found to be weak, with baseline FMS competency and MVPA failing to significantly predict follow up levels of MVPA and FMS competency, respectively. Likewise, baseline FMS competency was not found to be a significant predictor of child weight status at follow up. Furthermore, the association between FMS competency and MVPA was found to weaken over time; at baseline, total and locomotor skill competency scores were significant but weak predictors of MVPA. However, at follow-up skill competence did not predict MVPA.

Participants in the present study were found to have low FMS competency at baseline, with significant (p<.05) increases in total, object-control and locomotor competency scores observed at follow up. Similarly, Butterfield et al. (2012) noted a rapid increase in children's competency levels between the ages of 5-10 yr., with low competency levels expected prior to 5yr. However, despite this significant increase in competency scores among both boys and girls, competency levels at follow up were still found to be low. With previous studies having found that low FMS tracks over time (Hardy, King, Espinel, et al., 2010; O'Brien et al., 2013) these results are perhaps not surprising. Likewise, at follow up, boys were found to have significantly higher total and object-control competency scores than girls. This is in line with previous studies among primary school aged children that have noted boys as being more competent at object-control skills (Bryant, Duncan, et al., 2014; LeGear et al., 2012; Okely & Booth, 2004; Van Beurden et al., 2002). Most notably, Bryant, Duncan, et al. (2014) study among 281 English primary school children (M age 8.4 ± 1.6 yr.) reported boys to be more competent at kicking and catching, alongside overall low levels of competency among the children observed.

The findings of low competency in the present study may be related to the participants residing in areas of high deprivation with previous studies among children from highly deprived areas reporting low levels of competency. Goodway et al. (2010) noted that among 469 American preschool children from highly deprived areas that children had low competency in object-control and locomotor skills. Furthermore, the authors found boys to be significant more competent at object-control skills. Likewise, Morley et al. (2015) found low competency levels for motor proficiency among their sample of 369 low SES English children (age 4.3-7.2 yr.). Participants were found to have significantly lower motor proficiency in comparison to socially advantaged children, whilst boys within the study were found to have outperformed girls for the object-control skills, catch and dribble (Morley et al., 2015). Previous qualitative work by Goodway and Smith (2005) highlighted the issues of a lack of access to safe outdoor play, the availability of neighbourhood or family resources to access equipment and/or youth sports and limited physical activity role models as barriers to PA among disadvantaged children. If, therefore, children from low SES have less opportunities to engage in PA then this may result in them having fewer chances to practice FMS and thus lead to lower

competency levels. As such, children from low SES may require more instruction and practice of FMS in order for them to achieve similarly high levels of competency as their peers from areas of low deprivation. If further evidence is found to support that children from highly deprived areas are developmentally delayed then interventions could be designed and implemented to support the development of FMS competency of these children. However, in order to be successful, interventions may need to take into account gender differences alongside SES status (Morley et al., 2015). With previous findings of boys outperforming girls for object-control skills (Barnett et al., 2015; Foulkes et al., 2015; Hardy, King, Farrell, et al., 2010), interventions may need to ensure that girls are not disadvantaged in activities requiring object-control skills, whilst also ensuring that boys displaying high competency levels receive sufficient opportunities to continue their developing their competency levels (Goodway et al., 2010).

According to Stodden et al. (2008) model there is a reciprocal and developmentally dynamic relationship between FMS competency and PA during childhood, which should strengthen over time between early and late childhood. In the present study a significant association was found between FMS competency and PA at baseline, between total and locomotor competency scores and MVPA. These observed positive associations between total and object-control competency scores fall in line with previous studies examining associations between competency and PA among young children (Cliff et al., 2009; Fisher et al., 2005; Foweather et al., 2014; Williams et al., 2008). More specifically, at baseline in the present study a one unit increase in total skill score was associated with a 1.04 min increase in MVPA. Whilst this may not seem meaningful at first, if an effective intervention were to be put in place that helped improve children's competency scores by 5-10 points then this in turn could begin to have a practically meaningful effect on PA. Data from Ness et al. (2007) showed that a modest increase in PA of 15 min of MVPA was associated with a reduced odds of obesity of over 50% in boys and nearly 40% in girls. With the large decline in MVPA over time observed in OW/OB children in the present study, increasing FMS competency among these children could be one way to help reduce or begin to reverse this decline.

Likewise, the current study's findings of boys engaging in more MVPA and displaying greater object-control skill competency is consistent with the literature (Barnett et al., 2015; Hardy,

King, Farrell, et al., 2010; Hesketh et al., 2014; M. O'Dwyer et al., 2014; Van Cauwenberghe, Jones, Hinkley, Crawford, & Okely, 2012). However, in direct contrast to the Stodden et al. (2008) model, associations between FMS competency and MVPA were found to have weakened over time, with no significant associations found between competency scores and MVPA at follow-up. Whilst there was a small increase in the unique variance in MVPA accounted for by object-control score between baseline and follow up, this was still relatively low (1.56%) and was not significant (p>.05).

It is possible that this weakening of association could in part be due to the large decrease in time spent in MVPA observed between baseline and follow up among participants, with declines in MVPA having previously been reported across childhood (Ortega et al., 2013). This decrease in MVPA was especially true for OW/OB children, whereby a significant effect for time was observed, noting that there was a significantly greater change in their time spent in MVPA compared to their NW peers. Similar to that of the present study Cohen et al. (2014) examined the association between FMS competency and MVPA, using a process-based measure of FMS (TGMD-2) and accelerometry, among 460 low SES Australian primary school children (M 8.5 ± 0.6 yr.). Whilst their study found significant associations between locomotor and object-control scores and MVPA, their analysis did not control for covariates such as monitor wear time or weather conditions, as the present study has. Furthermore, Stodden et al. (2008) note that future research examining this relationship between FMS competency and PA should take into account mediating variables that may interact with and promote/demote the dynamic relationship hypothesized within their model. Factors such as SES (Foulkes et al., 2015; Goodway et al., 2010) or parental/carer influence (Barnett et al., 2013; Cools et al., 2011) are not currently included in the model (Stodden et al., 2008), but may influence and weaken the relationship between FMS competency and PA. Furthermore, Sterdt et al. (2013) recently conducted a systematic review and identified 16 correlates that were consistently associated with PA in children and adolescents. This highlights that PA is a complex and multi-dimensional behaviour, determined by numerous biological, psychological, sociocultural and environmental factors. As such, a more holistic model of motor competence may be needed in order to account for the large number of variables that can affect physical activity participation over time.

Looking at the early years as an important phase for FMS development and PA behaviours, the present study failed to find an association between baseline FMS competency as a predictor of follow up MVPA, or baseline MVPA as a predictor of follow up FMS competency. Whilst these findings seem to indicate that FMS competency was not important to PA, contradicting the Stodden et al. (2008) model, the influence of FMS competency on PA cannot be ruled out. Whilst Bryant, James, et al. (2014) longitudinal study among English primary school children reported that prior FMS competency was a better predictor of current PA, their study only measured follow up data after one year. Consequently, there might not have been as greater change in competency/PA levels as in the present study's five year timeframe. Bryant, James, et al. (2014) study also used pedometers to record PA and as such could only report on associations between FMS competency and total PA, without being able to identify any associations between FMS competency and specific intensities of PA. Lopes, Rodrigues, Maia, and Malina (2011) reported that among 6-10 yr. old children that FMS competency was an important predictor of PA. Similarly, Barnett, Van Beurden, Morgan, Brooks, and Beard (2009) found that children with object-control competency at late primary were more likely to be active in adolescence. However, both of these studies assessed PA using questionnaires, deemed less reliable than accelerometer data due to the potential issue of recall errors among participants, especially among children (Sirard & Pate, 2001). As such it is clear that further longitudinal work is required in order to examine this bi-directional relationship between FMS competency and PA proposed by (Stodden et al., 2008), specifically taking into account other external factors that may affect this relationship.

In the present study OW/OB children were found to have lower competency across all scores at both time points in comparison to NW children. These findings are in line with previous studies that have reported that BMI is negatively associated with FMS competency (Cliff et al., 2009; Erwin & Castelli, 2008; Graf et al., 2004; Lopes et al., 2012; Okely & Booth, 2004; Southall, Okely, & Steele, 2004). An increasing difference in FMS competency between OW/OB and NW children across ages has been documented in a previous cross-sectional study by D'Hondt, Deforche, et al. (2011), with NW children showing greater competency levels. In a more recent longitudinal study by D'Hondt et al. (2013) the authors reported a widening gap between OW/OB children's FMS

competency relative to their gender and age matched NW peers. The authors believed that this increasing difference in competency between OW/OB and NW children was mainly attributable to NW children showing greater improvements in competency over the short term, in comparison to their overweight/obese peers. However, previous studies among OW/OB children have reported that interventions incorporating regular PA as a central component resulted in short-term improvements in motor competency (Cliff et al., 2011; D'Hondt, Gentier, et al., 2011), indicating that it is possible for OW/OB children to increase their competency levels and narrow the competency gap between themselves and NW children. As such, it may be possible to reduce the competency gap between NW and OW/OB children in the present study. In order to do so, appropriate interventions would be required that address the deficiencies in FMS competency of OW/OB children, allowing these children to develop the required movement skills to engage in regular, health-enhancing physical activity (Cliff et al., 2012).

Finally, the present study found no association between baseline competency scores and follow up weight classification. As such, no inference could be made to support the Stodden et al. (2008) model hypothesis that the development of FMS competency is a primary underlying mechanism in promoting PA and therefore shaping positive or negative trajectories of weight status among children. The findings of previous studies examining the association between FMS competency and weight status support Stodden et al. (2008) assertion that FMS competency is both a *precursor* and *consequence* of childhood weight status. Okely et al. (2004) examined the association between FMS competency and BMI among 4363 Australian children and adolescents (9-16 yr.). The results indicated that OW children of both sexes were less likely to have high levels of FMS competency, with FMS competency further found to be significantly related to BMI. For object-control and locomotor competency, NW boys and girls were two to three times respectively more likely to possess more advanced locomotor skills than their OW peers. These findings may indicate that interventions aiming to prevent weight gain among children may benefit from focusing on increasing locomotor skill competency (Okely et al., 2004).

The main strength of this study was the use of a validated process-based measure of FMS competency (Williams et al., 2009), via video analysis by a single trained assessor, providing

confidence and consistency in the measurement of children's competency levels. Furthermore, the use of accelerometers allowed the opportunity to objectively assess participants PA. A limitation of the present study was the 58% participation rate of children approached to participate (n = 131), which only accounted for 31% of the original Active Play participants. This highlights the difficulties of trying to collect data from participants as part of a large scale longitudinal study, especially as the tracking of participants was not agreed upon at the start of the Active Play Project in 2010. Furthermore, the use of accelerometers to obtain PA data means that water-based or non-ambulatory activities cannot be recorded and so MVPA may have been underestimated, whilst a lack of agreement among researchers for accelerometry methodologies prevents direct comparison from being drawn between other studies.

This is the first longitudinal study of its kind to examine the associations between FMS competency, PA and weight status among English children. Despite the lack of significant associations found between FMS competency and MVPA, findings are able to contribute to that of the current literature. Firstly, the failure to find a strengthening association between FMS competency and MVPA over time contradicts the proposed Stodden et al. (2008) model of a reciprocal and dynamic relationship between FMS competency and PA. Secondly, low levels of competency at baseline and follow up and a significant decline in MVPA among children in this study draws attention to a need to intervene in this age group. Further longitudinal research is therefore required to continue to examine the associations between FMS competency and MVPA, among both high and low SES preschool children, allowing for additional comparisons to be made between these differing groups. The weak associations found in the present study also show how large amounts of variance in MVPA are explained by a number of different variables, outside of those measured in the present study, or put forward in the (Stodden et al., 2008) model. As such, this would indicate that more holistic interventions may be required, in order to control for as many external variables as possible e.g. children's motivation and confidence, in order to promote sustained participation in PA.

Chapter Six

Towards the Development of a Physical Literacy Intervention for Preschool Children: The Perspectives of both Experts and Practitioners

6.1 Thesis Study Map: Study Four

Study	Objectives
Study One: Examining the fundamental movement skill competency levels of preschool children form Northwest England	Objectives: • Report detailed FMS competence data among a sample of preschool children from a deprived area of Northwest England • To investigate sex differences in FMS and their respective components Key Findings: • Overall competence found to be low among both sexes • Competency higher for locomotor skills than for object-control skills • Boys significantly more competent at object-control skills in comparison to girls • Boys were significantly more competent than girls at the kick and overarm throw, while girls were significantly more competent at the run, hop, and gallop
Study Two: Effect a school-based Active Play intervention on fundamental movement skill competency among preschool children	Objectives: • To examine the effectiveness of a six-week Active Play intervention on FMS competency in 3-5 yr. old children from a deprived area of Northwest England Key Findings: • There were no significant differences between-groups for total FMS, object-control or locomotor scores at post-test or 6-month follow up • Intervention may have needed to run for longer and/or with a greater frequency of session delivery in order to be effective
Study Three: Is Fundamental Movement Skill Competency Important for Keeping Children Physically Active and a Healthy Weight?	Objectives: • To determine the role of fundamental movement skills in promoting physical activity and healthy weight status as children progress from early to late childhood. Key Findings: • FMS competency scores increased between baseline and follow up, although competency remained low. • Time spent in MVPA reduced between baseline and follow up

	• Significant associations between FMS competency and MVPA at baseline had dissipated at follow up • Baseline FMS competency failed to predict follow up MVPA or weight status
Study Four: Towards the Development of a Physical Literacy Intervention for Preschool Children: The Perspectives of Experts and Practitioners	**Objectives:** • **To explore perceptions and opinions of experts and practitioners to inform the development of an appropriate intervention to enhance physical literacy of preschool children.**

6.2 Introduction

As of 2016, the International Physical Literacy Association define physical literacy as being the *"motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for engagement in physical activities for life"* (Whitehead, 2016). In recent years PL has become much more focused on physical education, PA and sports promotion internationally (Giblin et al., 2014) and is widely understood to relate to an individual's capacity for a physically active lifestyle (Longmuir & Tremblay, 2016). Whilst FMS have been identified as a key element of physical competence and therefore PL, the limited intervention effects findings from Active Play in Study Two suggest that a wider focus considering all of the attributes of PL is necessary. However, given that PL is an abstract construct and there is still a lack of consensus regarding the conceptual underpinnings of PL (Longmuir & Tremblay, 2016), little is known about how best to measure or enhance PL in young children. With evidence from the literature demonstrating both FMS competency (Hardy, King, Espinel, et al., 2010; O'Brien et al., 2013) and PA (Jones et al., 2013) track over time, it would appear that children in Liverpool would also be "at risk" for lower levels of PL. As such, the preschool years would provide an ideal opportunity to intervene and help improve children's physical literacy and start them on the path to lifelong engagement in PA.

Whilst there are a number of assessment tools available to measure the individual aspects of PL, such as FMS competency and PA levels, there is no such assessment available that encompasses and combines the multiple components of PL. As such, this further adds to the issue of how researchers can best measure or seek to enhance PL in children. Although the Canadian Assessment of Physical Literacy (CAPL) (Longmuir et al., 2015) combines all aspects of PL and has established validity, objectivity and reliability, its validity has only been assessed among 8-12 yr. old children. Furthermore, the CAPL authors have also noted that additional research is required to enable the administration of the CAPL by persons who weren't part of the development team, alongside consideration of potential cultural variations that may affect the validity of the scoring system (Longmuir et al., 2015). As highlighted by Longmuir and Tremblay (2016) the demands that would be required of a fully comprehensive PL assessment tool would be in stark contrast to the resources e.g.

time, equipment, staff available in applied settings. Furthermore, the authors also suggested that future research is needed to identify effective methods to enhance PL and support the progress of an individual on their PL journey, helping to increase awareness of the individual and societal benefits of PL (Longmuir & Tremblay, 2016). In taking this forward, through conversing with experts from the field of children's physical activity and health, it may be possible to identify aspects of PL that could be improved upon among preschool children, alongside practical ideas for how to make these changes. Likewise, by consulting with staff working within children's centres it could be possible to find out how these proposed changes could be implemented in an applied setting.

Therefore, the aim of the present study is to qualitatively examine factors that may influence the development of physical literacy within the preschool environment and subsequently how best to inform the design and implementation of a proposed intervention to improve physical literacy within the preschool setting. In order to do so, this study will use a two-phase approach (Phase One and Phase Two), reporting the methods and results section for each phase separately. During Phase One of the study a number of experts within the field of children's physical activity and health and physical literacy will be recruited to undertake a semi structured interview to explore opinions on the design and implementation of a physical literacy intervention. Phase Two will then use focus groups to explore thoughts and opinions of children's centre staff as to the design and implementation of a physical literacy intervention, with staff further asked to comment on consensus outcomes from the experts during Phase One.

6.3 Methods

Philosophically a phenomenological approach was used, in order to explore, describe and analyse the meaning of individuals experiences (Marshall & Rossman, 2016), namely how expert's prior experiences had shaped their views on PL and intervention design. For the practitioners phenomenology allowed exploration of what it was like to 'be them', understanding their practice how they construct meaning and to understand this setting through which interventions may be appropriate. Methodologically, this qualitative study has utilised both semi-structured phone

interviews and focus groups. A semi-structured interview is conversational in nature, with the interviewer referring to an interview guide to make sure that relevant issues are covered, but allowing for questions to be modified for each interview as warranted by the responses or circumstances of the interviewee (Roller & Lavrakas, 2015). The interview can be flexible with open-ended questions and the chance to explore issues that arise spontaneously (Ryan, Coughlan, & Cronin, 2009). Unlike semi-structured interviews, focus groups have the potential to provide researchers with insights and an understanding of motivations/behaviours that can only be produced through a dynamic, interactive discussion format (Roller & Lavrakas, 2015). The focus group facilitator interacts directly with participants, providing opportunities for clarifying participant responses and probing for additional information, this direct interaction also allows the researcher to observe non-verbal behaviour that can provide further information (Kay, Lagana-Riordan, Pecko, Bender, & Millikan, 2015). Whilst focus groups have often been considered as less confidential for participants in comparison to other qualitative methods, such as one-to-one interviews, due to participants thoughts and opinions being openly shared in a group environment (Kruger & Casey, 2009), participants may feel supported by a sense of group membership (Sim, 2001).

Phase One Interviews

Participants

Participants for Phase One of this study were experts (academics/experienced practitioners) within the respective fields of physical literacy. Purposeful sampling was triangulated between the supervisory team in order to recruit individuals represented publically online as working as senior academics or as practitioners/researchers. Academics were required to hold a senior position within a university e.g. Senior Lecturer or Head of Department, and to have published work within the field of young children's physical activity and health and/or PL. Academics/practitioners/researchers were required to hold a position within a public or private organisation at either local or national level whose purpose was to increase children's physical activity, health or sports participation. Participants were identified through a series of online searches and were subsequently contacted via publicly available

(via internet or printed documents in circulation) email addresses. The e-mail explained the purpose of the study, requesting the experts to participate in a one-to-one semi-structured interview lasting approximately 30 minutes. Twenty-one experts (twelve academics) met the inclusion criteria. A participant information sheet, containing a consent form, was attached to the initial approach email, with participants requested to complete (digitally) and return to the researcher to confirm participation. There was no response from eight of the experts approached within a designated two-week timescale, with a further four agreeing to take part but unable to schedule a convenient time for interview. A total of nine participants agreed to take part in the study (six female; four British, two Australian, two American and one Canadian) within the timescale. Written informed consent was obtained for all participants (34.6% response rate). Participants comprised of both academics (seven) and practitioners (two).

Interview Guide

A semi-structured telephone interview was developed to explore experts' opinions on the concept of PL and their perspectives on the design and development of a future intervention aimed at improving preschool children's PL. Thematically, questions explored PL among preschool children, covering (in order), understanding of the term *"physical literacy"*, the physical environment and policy of a children's centre, training, intervention design and barriers to PL. Questions were structured to flow naturally from one section to another and keep participants engaged in the interview process. Initial thematic questions such as *"what does it mean to you when experts/practitioners use the term "physical literacy?"* were designed to put participants at ease before progressing on to more in-depth and challenging questions requiring them to draw on their own experiences and ideas for best/future practice. Upon receiving a participants completed consent form, the participant was then emailed a further two-page document one week prior to the interview date. This document contained details of the lead researcher's prior work, to add further context for the study, alongside the questions that would be asked during the interview e.g. "what does it mean to you when experts/practitioners use the term *"Physical Literacy"*?", "Who in your opinion should design a physical literacy intervention for young children?". This approach was used in order to help facilitate depth in participant responses to

questions, keep the interview efficient and reduce the burden on participants. This document also requested that participants did not discuss the questions or document itself with others. The full interview guide is available in the Appendix (Appendix Two).

Procedure

Interviews took place between February and April 2016. A single trained interviewer conducted each interview using Skype, with interviews lasting on average 45 min (range 00:32:39 – 01:13:14). Digital audio recordings were made of each interview (Call recorder for Skype, DVDVideosoft), these recordings were then transcribed verbatim.

Data Coding and Analysis

Interview transcripts (221 pages, Ariel size 12, double spaced) were imported into NVivo v10 (QSR International) for data handling and subjected to thematic analysis (Braun & Clarke, 2006). This process initially required the reading of each transcript in order to assign broad thematic codes, several of which were pre-defined prior to interviews taking place, namely: defining PL, the preschool environment, programme design and implementation and training for practitioners. These broad codes were then subsequently split into higher and lower order themes. Both inductive and deductive techniques were used to generate codes. In order to maximise the credibility and trustworthiness of the results, analyses and interpretation of the data, these were discussed and checked with the research team using a reverse tracking process from codes to transcript. Any disagreements were discussed and adjustments made only on full consensus. Data analysis outcomes were represented by Pen Profiles. These profiles allow themes from the data to be realised via a process allowing for examples of verbatim as opposed to more comprehensive (in number) and abridged (due to space) offerings from content analysis raw data themes e.g. Boddy et al. (2012); Mackintosh, Knowles, Ridgers, and Fairclough (2011); McCann et al. (2016). Verbatim quotations were taken directly from the interview transcripts in order to expand these profiles. Selected verbatim quotes were self-defining and self-delimiting and represented a single code/theme. For profile inclusion the threshold was set at a

minimum of three participants in consensus of a particular theme for, with themes/quotations of *n* = <3 deemed worthy of reporting presented within the subsequent results-based narrative or discussion.

6.4 Results

Defining Physical Literacy

A Pen Profile representing defining physical literacy is presented in Figure 6.1, with one higher order theme of *"Importance of physical literacy"* emerging from two higher order sub-themes of *"Foundation Stage"* (*n* = 4) and *"Overall Wellbeing"* (*n* = 3). Data revealed that six participants were able to give, without hesitation, a clear and consistent definition of what they understood physical literacy to be; namely that PL consisted of a number of differing components and was not just limited to physical competency, aligning with the most recent definition put forward by the International Physical Literacy Association (IPLA) (Whitehead, 2016). However, it was noted by a number of participants (*n* = 5) that there remains some confusion and misunderstanding as to the term "physical literacy". The importance of PL was also raised, being described as an important foundation for lifelong physical activity (*n* = 4) and key to overall wellbeing (n = 3). Only two of the participants disagreed with the concept of PL and offered negative views, namely that they were not *"too convinced about the term"* (KN_001) and believing that the term itself *"really is not new"* (PR_001).

Changes in Policy

Figure 6.2 presents four higher order themes relating to changes in national policy that participants would like to see implemented in order to bring about improvements in PL, an increased importance of physical literacy (*n* = 5), mandatory physical literacy (n = 5), greater funding and research (*n* = 3) and mandatory physical activity (*n* = 3). Two participants also commented on how they felt that a thorough understanding of the term was required at all levels in order for physical literacy to be effectively implemented, as participant ML_001 states:

"I think a clarity between what physical literacy is in theory and practice, from root to branch, so from policy all the way down to on the ground practitioners, a knowledge and understanding of it [physical literacy]."

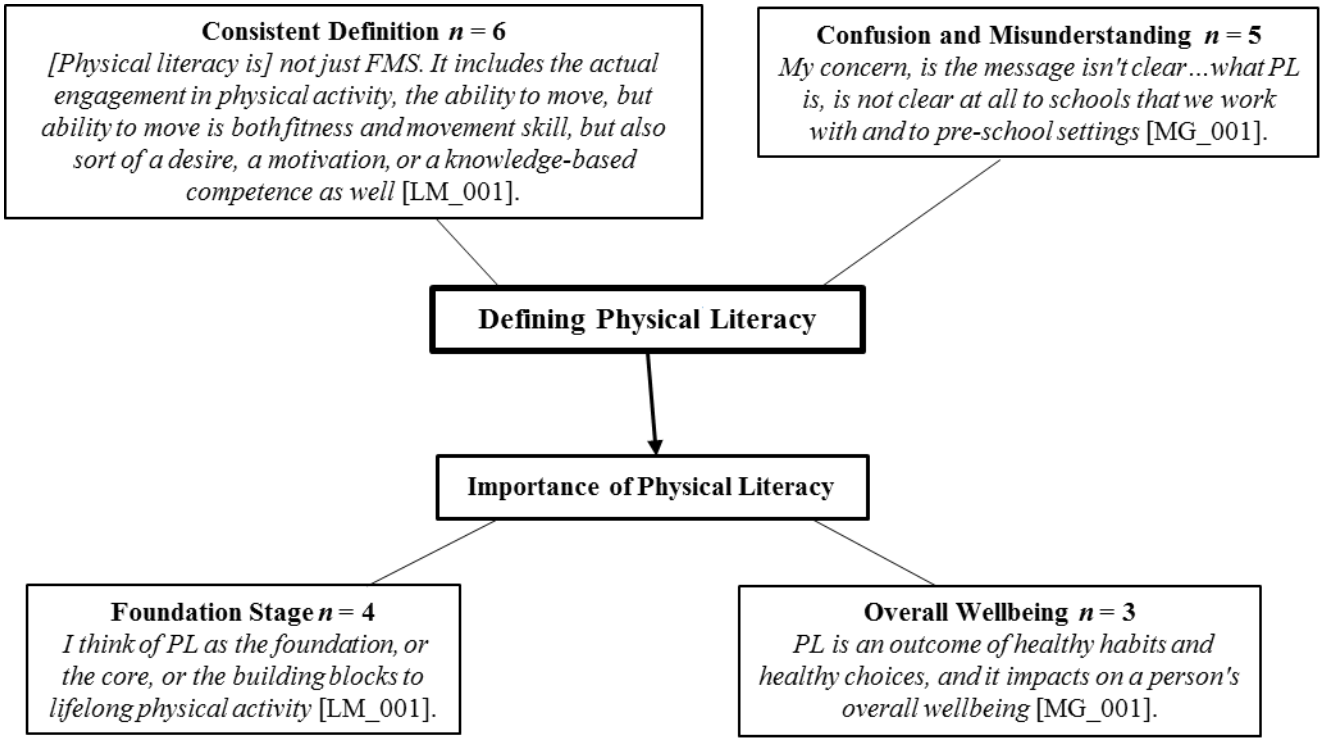


Figure 6.1 Pen Profile representing expert definitions of physical literacy.

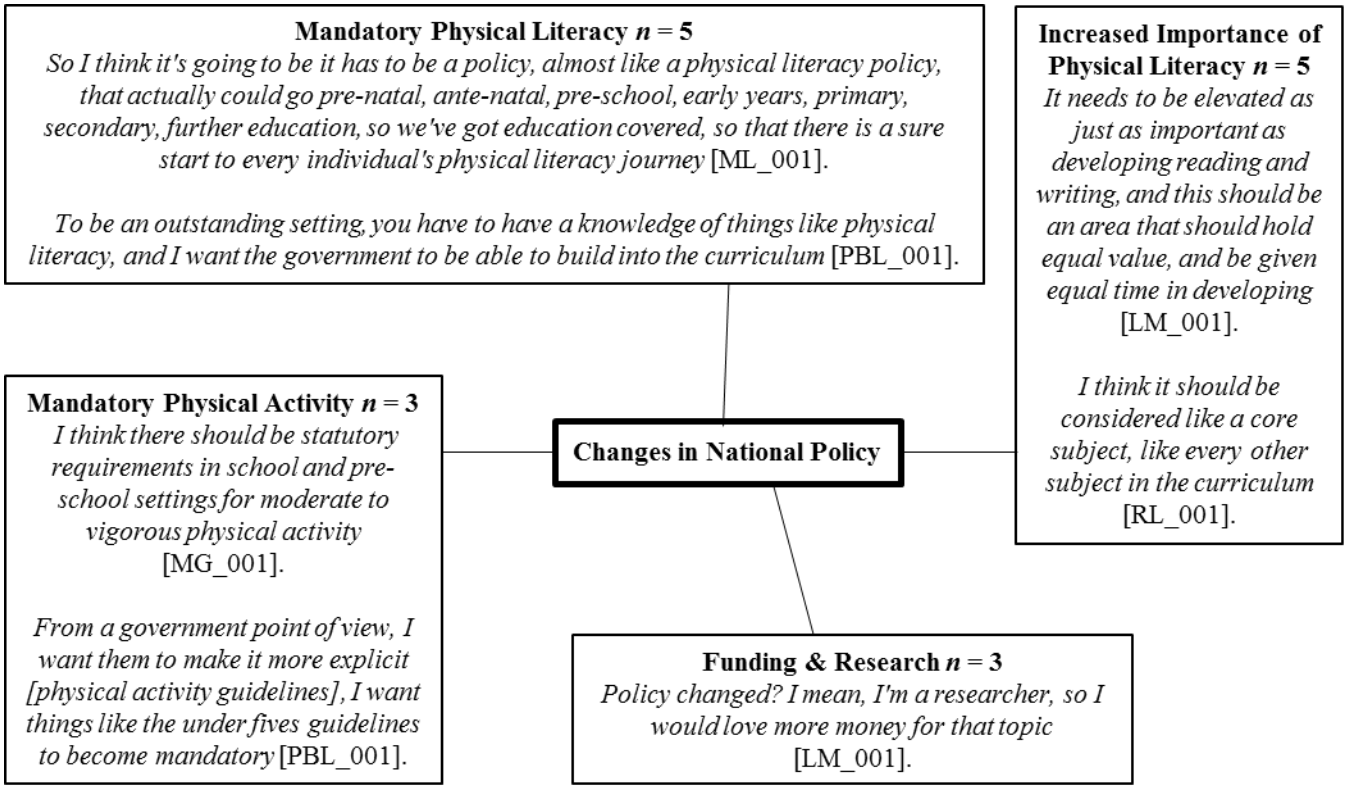


Figure 6.2 Pen Profile representing expert views on changes to national policy influencing physical literacy

Preschool Environment and Environmental Changes

Barriers to PL within the preschool environment are presented in Figure 6.3, with four higher order themes; a lack of understanding of the term physical literacy (*n* =4), finance (*n* = 3), parents and family (*n* = 3) and physical space (*n* = 3). Two participants also highlighted preschool setting staff as a barrier and *"the skill level of the staff and the lack of training that they've had"* [OT_001], with this lack of/access to training also noted by participant MP_001:

"They've [preschool staff] got a lot to teach, there's lots of things on, and they don't have the resources, they don't have the money, they don't have the access to professional development"

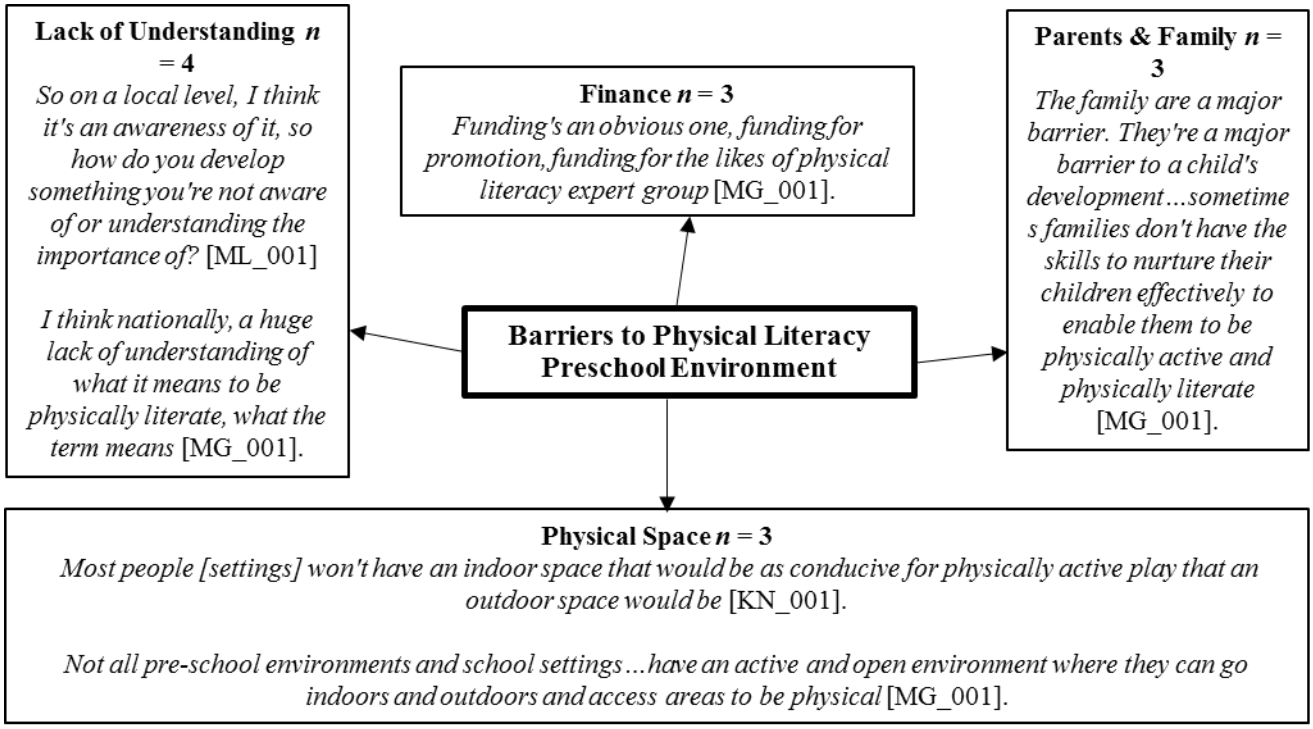


Figure 6.3 Pen Profile representing experts perceived barriers to physical literacy within the preschool environment.

Strategies to Increase Physical Literacy

Participants also suggested a number of changes that could be made in order to help bring about a positive change in children's physical literacy. Four higher order themes were identified as strategies to help increase physical literacy (Figure 6.4); learning through play (n = 5), limiting sitting time (n = 5), mandatory outdoor play (n = 4) and increased use of mobile play equipment (n = 3).

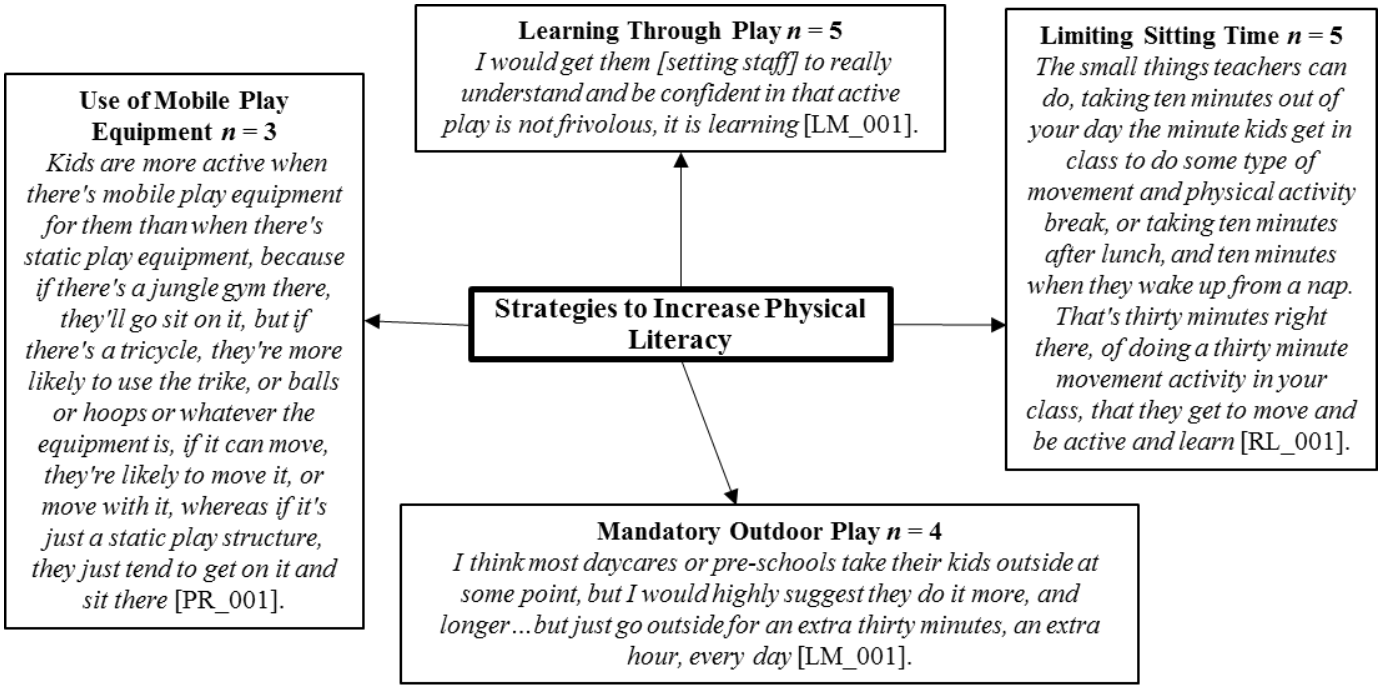


Figure 6.4 Pen Profile representing expert strategies to increase physical literacy.

Training for Practitioners

Suggested training for preschool staff is presented in Figure 6.5, with four higher order themes and one sub-theme; child development and motor skills (*n* = 6), educational background (with an emerging sub-theme of lack of knowledge (*n* = 4), importance of physical activity (*n* = 3) and understanding of PL (*n* = 3). Figure 6.6 presents the ideas for training design for preschool setting staff that participants put forward, with five higher order themes: staff engagement (*n* = 6), resources (*n* = 3), online resources (*n* =3), first-hand experiences (*n* = 3) and professional development (*n* =3). All of the participants (*n* = 9) offered opinions on how they felt training should be delivered to staff, with further suggestions including time (*n* = 2), as training needs to be offered/carried out when it is convenient for preschools. For example:

"It [training] really needs to fit at the right time, rather than it's prescribed and it's rolled out, and some people'll take it, and some people don't." (PBL_001).

As well as positive feedback (*n* = 1) in order to help upskill and enable staff *"to share good practice"* (MG_001) and goal setting (*n* = 1) so setting staff can set *"Much more ambitious and much more creative goals around physical activity for the kids"* (KN_001).

Programme Design & Implementation

Participants perspectives on physical literacy programme design are presented in Figure 6.7, with four higher order themes: collaboration (*n* = 6), buy in from staff (*n* = 4), activities/experiences, and primary goals and four sub-themes; motor skills (*n* =4), adherence/engagement (*n* =3), physical activity (*n* = 3) and range of environments (*n* =3). Additionally, two participants felt it would be important to set goals for staff as well as for the overall programme, namely so that preschool staff could:

"…improve their own confidence and competence in being able to implement structured activity" (OT_001) and *"Could feel confident and competent to deliver this successfully for the rest of their careers, and …continue to evolve their understanding [of physical literacy]"* (MP_001).

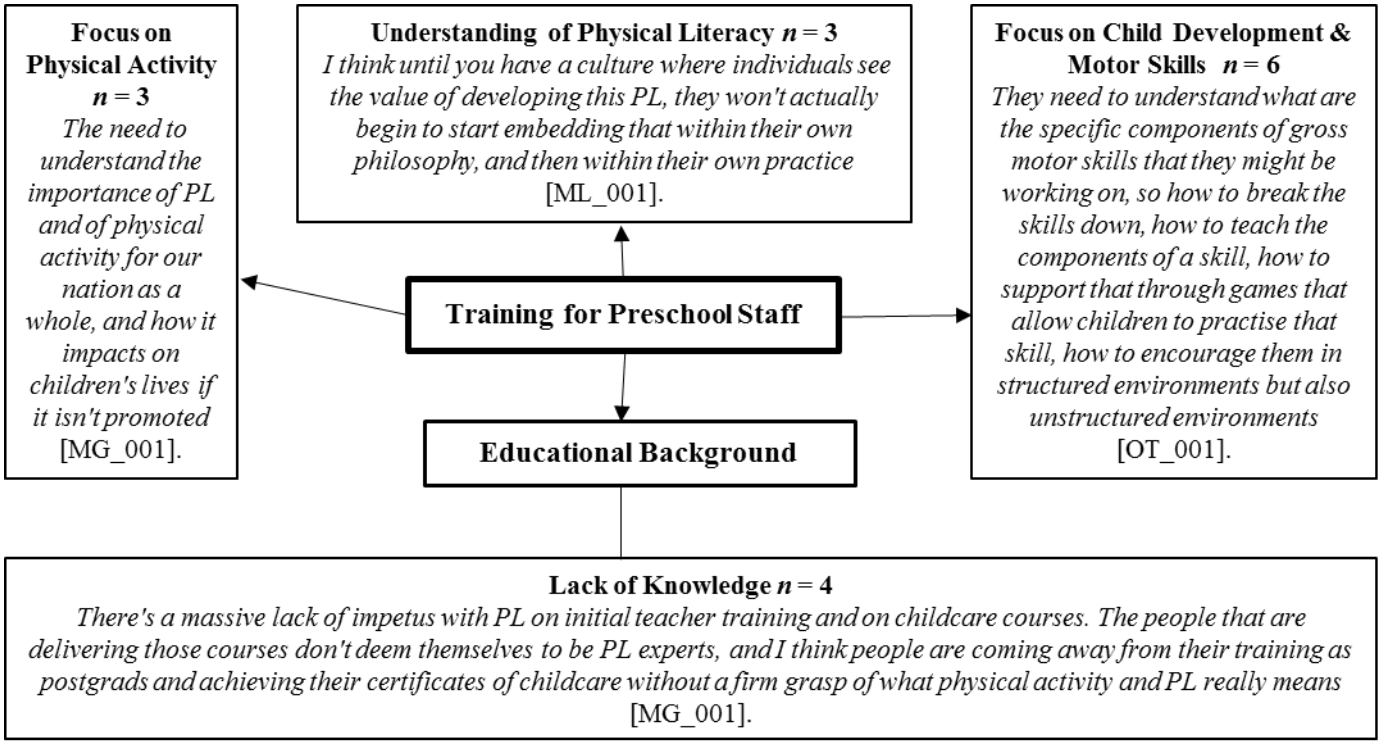


Figure 6.5 Pen Profile representing expert opinions on training for preschool staff.

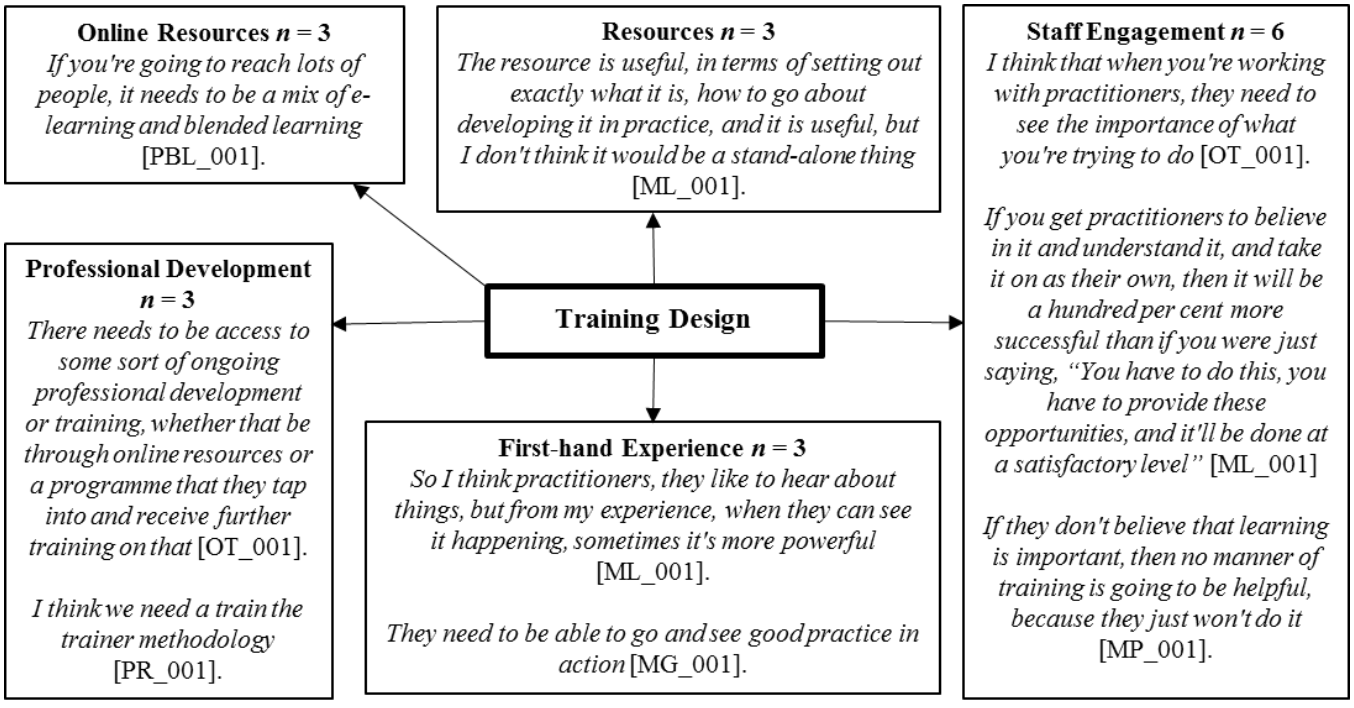


Figure 6.6 Pen Profile representing expert opinions on training design for preschool staff.

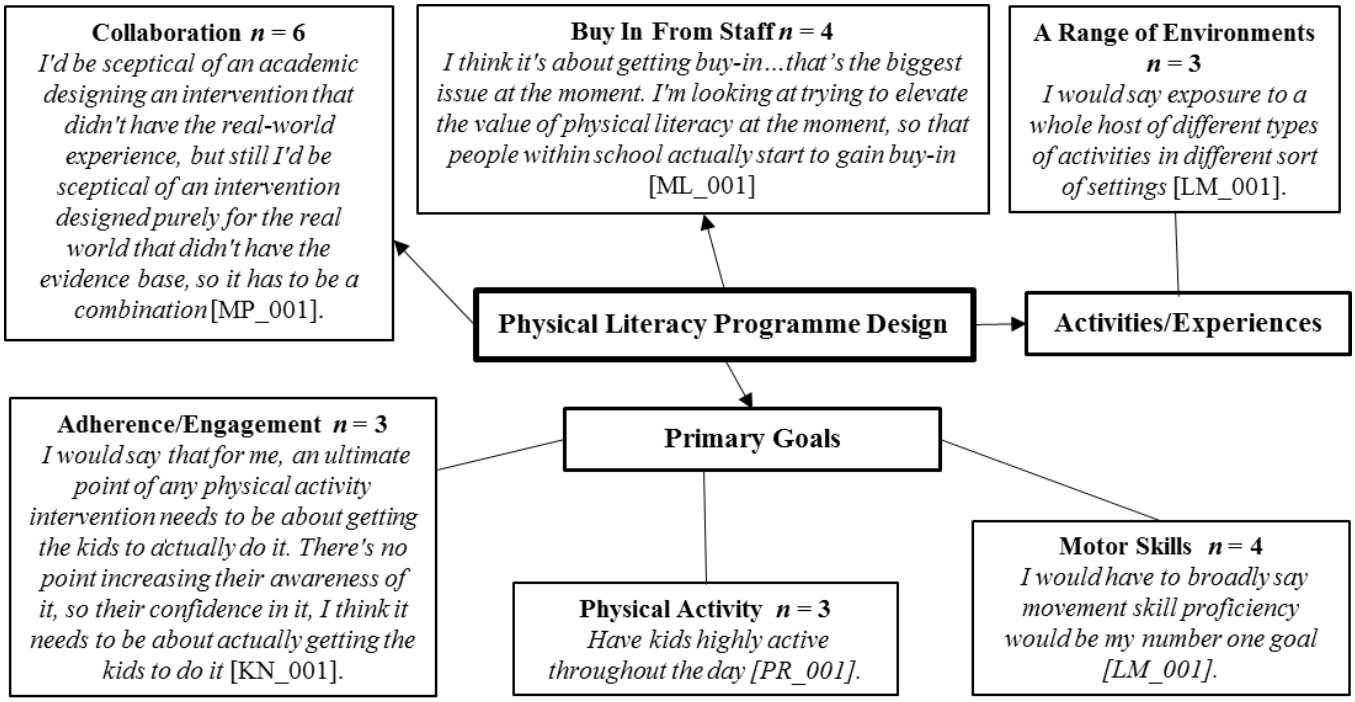


Figure 6.7 Pen Profile representing expert opinions on the design of a physical literacy programme design.

Figure 6.8 presents the programme components that participants would want to see within a PL intervention, with two higher order themes: intervention delivery and intervention duration and dosage and five sub-themes; targeting by sex (n =9), minimum duration (n =6), embedded in curriculum (n =6), staff delivered (n = 5) and flexibility (3). For intervention delivery the majority of participants believed that preschool staff should be responsible for delivering an intervention (*n* = 5), with a degree of flexibility in the programme for it to work effectively (*n* =3) and with unanimous agreement that any proposed intervention should not target children by sex (*n* = 9). The idea of an assessment tool being embedded into the programme was also suggested (n = 2) in order to assess children across time points *"It's about having evaluation points all the way through"* (PBL_001). Furthermore, the suggestion that an intervention would have to be "fun" was also put forward:

"it's got to be exciting, engaging, the children have got to be enthused, and it's got to be fun, and that's got to be for the children and the practitioner when they're delivering it [proposed intervention]" MG_001.

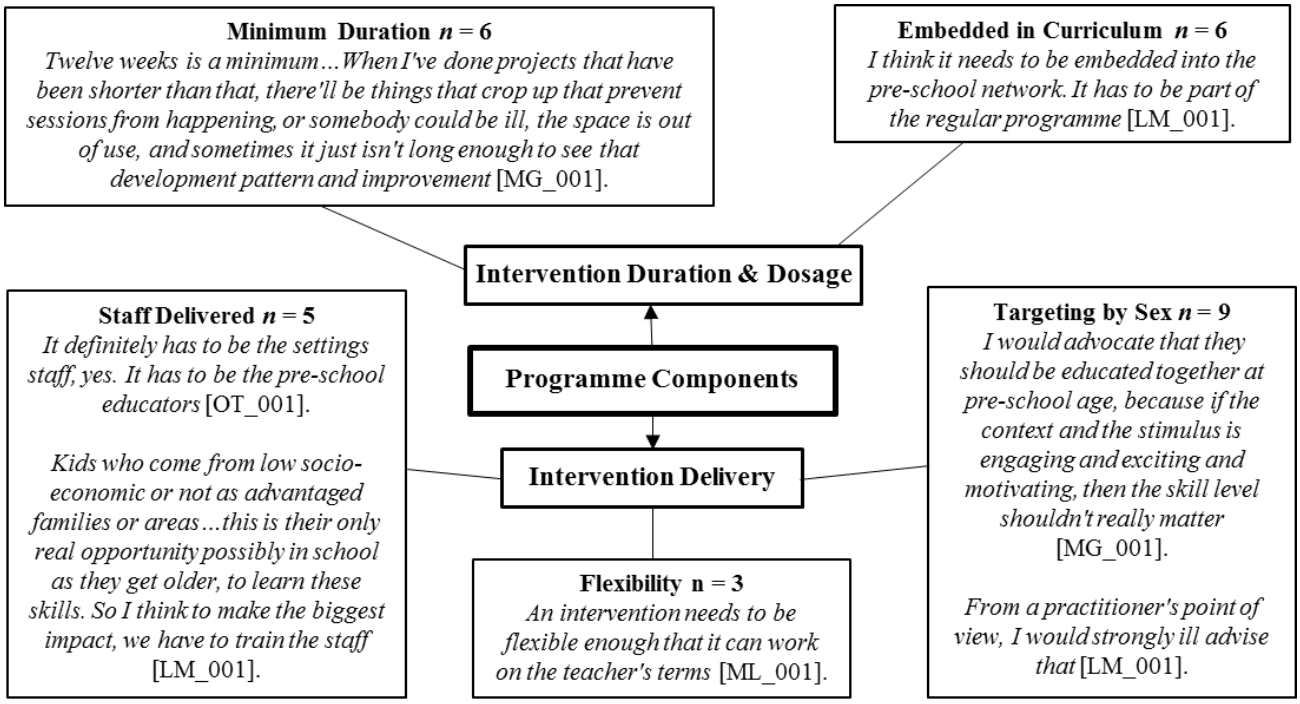


Figure 6.8 Pen Profile representing expert opinions on programme components.

The majority of participants felt that an intervention would have to be embedded into their current CC curriculum in order to be successful (n = 6), with a number offering their views on minimum duration to provide a positive effect (n = 6), ranging from four to six weeks to a year. However, two participants advised that the longer an intervention ran for then there is the possibility that its effects may be diminished:

"We saw that, and this is with researchers, not classroom teachers or other trained professionals, but we saw that the more intervention time, the dose, that the intervention gets a little bit weaker" (RL_001).

In summary, the results from Phase One demonstrate:

1. The majority of participants (*n* =6) were able to define what PL meant in a manner consistent with each other and that of the latest definition put forward by the IPLA.
2. Whilst being in agreement on definition, experts reported a perception of confusion and misunderstanding around the term (n = 6) amongst practitioners working within preschool/school settings.
3. Participants identified a number of perceived barriers to PL within the preschool environment (a lack of understanding of physical literacy (*n* = 4), finance (*n* = 3), parents and family (*n* = 3) and space (*n* = 3).
4. Participants were also able to offer their views on changes to current national policy and strategies that could be used to bring about improvements in PL, such as mandatory requirements for PL and PA as well as changes to preschool settings.
5. Participants were also able to provide a range of similar views and ideas on designing a PL intervention. Collaboration during the programme design stage and preschool staff being responsible for intervention delivery were suggested as key factors for a successful intervention.

In order to triangulate Phase One outcomes this consolidation work was shown to an independent external researcher who had previous experience in using Pen Profiles alongside the research team, typical of the Pen Profile technique (Boddy et al., 2012; Mackintosh et al., 2011). This approach brings transparency to the study, as data from interviews was reviewed by all members of the research team using a reverse tracking process from pen profiles to the verbatim transcripts, allowing for alternative interpretations of the data (Smith & Caddick, 2012). The results from Phase One were then used to inform the design of focus group guides for Phase Two, with a number of opinions and ideas for best practice suggested by the academics/practitioners during interviews subsequently illustrated to preschool setting staff in Phase Two.

Phase Two Focus Groups

Following on from Phase One, the purpose of Phase Two was to gain the perspectives of preschool staff on the feasibility and acceptability of future proposed PL interventions aimed at preschool children. As mentioned above, the Phase Two focus group guide was directly informed by the responses and subsequent results from the academics/practitioners during Phase One of the study. The focus group guide is available in the Appendix (Appendix Three).

Participants

Phase Two participants were educators/practitioners working within children's centres in Liverpool. The centres approached had all previously taken part in previous research with Liverpool John Moores University, specifically the Active Play Project (O'Dwyer et al., 2012; O'Dwyer, Fairclough, et al., 2013; O'Dwyer, Foweather, et al., 2013). Seventeen children's centre managers from across Liverpool were contacted via a publically available email address, explaining the purpose of the study and requesting three to five members of staff responsible for teaching and learning activities with 3-5 year old children, to take part in a focus group. This initial email included a participant information sheet giving full details of the study and a gatekeeper consent form for the centre manager to complete and return (electronically). This initial approach email also detailed that participating members of staff would receive a £20 shopping voucher for participating in a focus group. Four centre managers agreed to take part in the study (24.0% response rate), returning their informed consent for centre staff to participate. Upon receiving gatekeeper consent, centre managers were sent a follow up email containing a participant information sheet and consent form to be forwarded on to centre staff. A total of 19 preschool staff (17 female) agreed to take part across the four focus groups. The participant information sheet advised participants that they would be allowed to bring in their own notes to the focus group and in doing so, for the researcher, this would help gain a greater depth in participant responses to questions. Participants were also asked not to discuss the contents of these notes with other members of staff prior to the focus group taking place. A time and date that was convenient for the centre was then agreed upon between the centre manager and the lead researcher. One week prior

to the focus group taking place each centre received an email containing a two-page document, the first page containing a brief summary of the lead researcher's previous research work and the second, a list of the questions that would be asked during the focus group.

Procedure

Focus groups took place between June and July 2016. A semi-structured focus group guide was developed to explore the perspectives of preschool staff on the feasibility and acceptability of future proposed physical literacy interventions aimed at preschool children. The questions for this guide were directly informed by the responses and subsequent results from the academics/practitioners during Phase One of the study. The general dimensions of the focus group questions followed that of Phase One, with the same broad themes (understanding of the term *"physical literacy"*, the physical environment, training, intervention design and barriers to physical literacy) covered in the same order as the academics/practitioners, so as to aid in flowing naturally from one section to another. The initial thematic question remained, and was only slightly re-worded to *"what did it mean to you when you heard the term physical literacy?"* This question was designed to help stimulate discussion and interaction amongst the participants and help ease them into the format of the focus group before moving on to more in-depth questions where they would have to discuss their own working practices, details and thoughts. Prevalent ideas/thoughts on 'best practice' for children's centre (CC) staff that had been offered by the academics/practitioners were put to CC staff along with a verbatim quote for context. CC staff were then asked their opinion on these suggestions. For example, in regards to their centres current preschool environment, staff were asked if they felt PL could be improved by the provision of greater learning through play, mandatory outdoor play, mobile play equipment and limited seating time. The basis for these categories were that of consensus amongst experts/practitioners that these would bring about improvements in PL (see Figure 4). Focus groups were facilitated by a single trained researcher. Focus groups comprised of on average 5 members of centre staff (range 3-6 participants), with an average length of one hour and ten minutes (range 01:00:42 – 01:20:25), with all audio recorded using a digital Dictaphone. Homogenous groups were used for the focus groups as it is important for participants to feel that they have similar views on the

topics being discussed, furthermore they are aware that they share a common framework, making it easier to start a discussion (Ivanoff & Hultberg, 2006) and have the advantage that the participants can relate to each other's comments on their shared experiences (Kitzinger, 1994). Whilst heterogeneous focus groups may afford the opportunity for participants to share their experiences more freely and openly due to not having previously known each other, homogenous groups were used in the present study, as the goal was to look for a consensus in opinions among the focus groups. A flipchart was used during focus groups in order to help initiate discussion, with the researcher writing down participant's thoughts and ideas as they answered questions, aid participant recall and to clearly move discussion points forward from one section of the focus group to another. All focus group audio recordings were subsequently transcribed verbatim.

Data Coding and Analysis

The purpose of the focus groups was to afford opportunity to discuss the outcomes from phase one with small sample of potential beneficiaries/users. Representation of the focus group data was completed via the use of verbatim quotes taken from the focus groups transcripts (202 pages, Ariel size 12, double spaced) to illuminate aspects of consensus making and emergent themes within the focus group discussions.

Results

Defining Physical Literacy

Across each of the four focus groups, when participants were asked the opening question *"What does the term "physical literacy" mean to you?"* the initial responses were that this was a term that none of the participants were familiar with; *"I wasn't sure what it [PL] meant to be honest."* (Participant GCMH, Centre A), *"Physical development, you hear constantly, but physical literacy, I've not really heard"* (Participant MU, Centre A). When participants explored the term further it was clear that whilst no clear definition of the term itself was offered, the *literacy* aspect the definition led to a

number of participants speculating that this was in some way the principal component of PL, through either the use of terminology or using PA to help improve children's literacy, for example:

"I thought literacy, words, and how people perceive physical by reading" [Participant BV, Centre D].

"I initially took it to mean that doing physical activities actually enriched children's language and understanding skills." [Participant GCMH, Centre A]

This self-judged lack of knowledge surrounding the term *physical literacy* had led participants from each of the four centres to admit they had resorted to "Googling" the term *"physical literacy"* in order to gain a further understanding prior to the focus groups. One of the participants resorted to using Google because they found that within the term physical literacy the words *physical* and *literacy* were seemingly at variance with each other. This confusion was also raised by staff from two further centres. For example:

"…I can break it [physical literacy] up into physical activity, and I can break it up to literacy. The literacy part of it, I was thinking "Well, if you're literate, you're using words and books and speech, if you like, to enhance your environment, you know. But then I was thinking, "Well, how does that fit in with physical?" So then I was thinking "Well, maybe it means enhancing your physical world and your movement." [Participant GCMH, Centre A].

"At first, obviously, I thought something to do with being physical, but having literacy with it kind of didn't obviously tell me what it was. I had to go and look." [Participant MA, Centre C].

Once the discussion of participants surrounding the term were deemed at saturation point participants were then presented with the International Physical Literacy Associations (IPLA) most recent definition of PL. This definition was used due to the number of participants Phase One (see Figure 1) who were able to cite the IPLA definition or aspects of it when asked about their understanding of the

term PL. Participants were all in agreement that this definition was positive and they supported the idea behind the concept and recognised key aspects within it that would lead to a physically literate individual. For example:

"It's getting across why you need to take responsibility, why you need to have physical literacy, and then they go forward and do something about it, and it's having the confidence to join in, and to know what is important that they need to do" [Participant KSTN, Centre C].

However, whilst participants were broadly appreciative of the ideas put forward in the entirety of the IPLA definition of PL, they felt there were still issues with the translation of the definition itself to fellow staff and parents. The length of the definition was a concern for several participants, with it being described as *"Wordy"* (Participant GCMH, Centre A) and *"long-winded"* (Participant BV, Centre D), with the recommendation that *"it could be condensed"* (Participant GCMH, Centre A). One participant suggested that in order for the term to get across it would have to be far shorter:

"You'd need something that's just going to stand out more, don't you, like a saying? You know like… "Stop, look, listen when you're crossing the road" Do you know what I mean? Something like that, that's going to go, "Yes, ok" [Participant BV, Centre D].

Furthermore, focus group participants were unanimous in voicing their concerns that in its current from this definition was still difficult to understand, also expressing concern about using it to try and convey the concept of PL to parents. For example:

"I don't even think they'd [parents] understand a lot of that [IPLA definition], because I don't understand a lot of it myself" [Participant BV, Centre D].

Preschool Environment and Environmental Change

When asked to describe if they felt their current preschool environment was helpful in improving children's PL, only one centre expressed that they were happy with the current environment. Staff from Centre C went on to elaborate:

"I mean, we have got access to outdoor space. I mean, I'm personally happy with the environment. I think we've got everything we need, because the hall is so large, and because of the age of the children" [KSTN_MA, Centre C].

Conversely, the remaining focus groups felt that their current preschool environment was not helpful in improving children's PL. A lack of both indoor and outdoor space was mentioned as being prohibitive to enhancing children's PL in three of the centres:

"I'd like a bigger space, so that we could maybe do Movers and Groovers [physical activity session for children aged 18 months to four years] out here, instead of having to...Or maybe run some of the sessions outside. There just isn't a space that's just available for us" [GCMH, Centre A].

"We've only got a very small outdoor space in the children's centre. It's like a postage stamp. So there's not much you can do, and part of it's got a climbing frame in it, which is good, for children to learn to climb and jump and stuff like that, but for a large, like I had about twenty children in my group, so I couldn't fit twenty children here outside. We wouldn't be able to do that" [BV, Centre D].

"And there's nowhere to sort of bring it out to [large play equipment], because it's like, well, we haven't got enough space to put all our equipment and do that activity in that space" [BV, Centre D].

Alongside the issue of physical space to carry out activities, participants from three centres discussed how they also struggled with a lack of storage space for equipment. In one instance, following funding cuts, Centre B had to get rid of a large portion of their mobile play equipment due to no longer having the storage space for it. Similarly, another focus group participant (BV, Centre D),

mentioned how although within their children's centre they had the budget to buy additional equipment, they were concerned that if they did so that they would have nowhere to store it. As well as wanting to use an applicable space, the availability of storage facilities had also influenced one children's centre's decision to use external facilities to carry out activities:

"They do offer storage there [external facility], don't they? So that would be the big thing, carrying things back and forward, but they offer storage there, don't they?" [GCMH, Centre A].

All four focus groups reported how they used external facilities such as church halls (Centre B) or a local park (KSTN, Centre C) for what they considered to be physical activity primarily due to the lack of space in their centre.

Whilst participants from Centre B agreed about having had access to nearby school's facilities, these were not always available to them, due to being *"hired out"* to other organisations for activities such as *"summer camp or summer school"*, meaning the facilities were available during *"term time only."* Despite the use of external facilities being an aid to centres, during two of the focus groups staff were keen to note that the use of external facilities added a financial burden to the centre and were unsure whether this would be able to continue. For example:

"And we have to pay for that [large external hall]. That comes out of our budget. So if any of our budgets get slashed again, then maybe that will have to go" [BV, Centre D].

In addition to greater space, *"more storage"* was suggested by participants from two separate centres (BV, Centre D; YTKA, Centre B), whilst another simply replied "lots more money" (YTKA, Centre B). Following on from this, centre staff, as with the academic/practitioner's in Phase One, were asked the more theoretical question of *"what policies could be introduced to support physical literacy in preschools?"* Two of the focus groups raised the issue that there would need to be a specific target set for PL before it could become a priority within centres, and more importantly in turn allow funding

for PL. The issue of money was raised by three of the focus groups, with one participant answering simply *"more money"* (YTKA, Centre B) when asked which changes in policy could aid PL, with another participant discussing how *"…funding is so tight, we've got to justify everything that we do"* (GCMH, Centre A). One centre discussed in detail about how recent cuts in funding had affected them:

"When the ring fencing got taken from the council…that impacted on us…because then they could reduce our budget, whereas previously they couldn't. And all of that impacts, because in the past, if we had money that we needed to spend, we could then support other local nurseries" [YTKA, Centre B].

With the same participant's fellow staff member going on to say how they felt an increase in funding was required simply to keep centres open and offering services (YTKA, Centre B). Although these same participants were able to point out one positive effect that had resulted from cuts to their funding, allowing them to support younger children in their centre:

"A positive is that we now have more funding for two year-old children...But really, long-term, we're hoping that's going to be for all two year-olds, the same way three year-olds all get those opportunities" [YTKA, Centre B].

Following on from Phase One of the study, wherein the academic/practitioners were asked what changes could be made to the preschool environment in order to help bring about improvements in PL, four key suggestions arose: greater learning through play, mandatory outdoor play, an increase in mobile play equipment and limited sitting time (see Figure 6.4). Each of these suggestions were put in turn to the four focus groups in order to gauge their own thoughts and opinions on these suggestions. Firstly, participants were presented with the idea of increased learning through play, which was met with positive responses from all of the focus groups when asked if they felt this was appropriate, *"absolutely"* (KSTN, Centre C), *"definitely"* (KSTN_MA, Centre C), with one participant adding

"that's their way of learning anyway, especially in the early years" (KSTN, Centre C). Two of the focus groups discussed how they were already aware of the importance of this concept. For example:

"Most of us are nursery nurse trained, so we've understood play for many years. So we've never seen it as you just go and play and there's no learning opportunities from that. No, even our outside play outing is usually, large [gross] motor skills is always planned" [YTKA, Centre B].

With a participant from a separate focus group pointing out the importance of setting staff understanding the importance of play as a learning opportunity for children:

"It all comes down to training and education, because if you've got staff who don't realise, if they've never had the early education, the pre-school learning, then they'll go, "Oh yes, just give them a ball", and that's it" [BV, Centre, D].

Three of the focus groups also raised the issue that it is important to get the concept of play as a learning opportunity for children across to parents, as well as increasing the opportunities to do so within centres. For example:

"See, I think we've got it [learning through play], because we've had it drummed into us…but I think it's passing it on to the parents now, because as you said before, when they go outside to play, they just stand and watch them, instead of getting involved. So it's about teaching them now, "Look, this is the type of thing that you need to do" [BV, Centre, D].

The idea of mandatory outdoor play for children was met with a positive response from all focus groups, with staff saying that they would *"agree"* (KSTN_MA, Centre C) with this idea, believing that *"you should [have mandatory outdoor play]. I really think you should"* (BV, Centre D) and that it *"would make the difference"* (GCMH, Centre A). One participant also felt that outdoor play

"Can impact on behaviour as well. Some children need to be outdoors, and you can just see their behaviour improve" (YTKA, Centre B).

However, one participant was quick to note, as with the idea of learning through play, that the value of mandatory outdoor play would have to be demonstrated to parents:

"I do think that the message needs to go across that while the children are doing outdoor play, there is actually something intellectual going on, because otherwise people won't buy it. Schools wouldn't buy it, and parents wouldn't buy it. "Oh no, my child goes to school to learn. I don't want them running up and down". But if they knew what effect that had, like the two year-old climbing up and jumping off, if they knew what effect that has on their IQ level, then they would encourage it more" [GCMH, Centre A].

Whilst all of the focus groups supported the idea of mandatory outdoor play, participants were also able to highlight the difficulties in trying to implement this idea, with the issue of physical space recurring in this section:

"You know well-established nurseries now, some of them have not got continuous outdoor play, because they might be in a house with the pre-school upstairs...so they have to timetable that time" [GCMH, Centre A].

Similarly, financial restrictions in regards to mandatory outdoor play were also a potential concern among focus groups from centres B and C.

As a follow up question the focus group facilitator asked each of the focus groups whether they felt there would be any challenges from parents/carers regarding mandatory outdoor play, specifically in wet weather conditions. All four focus groups were unanimous in saying that they felt there would be resistance from parents in this regard. For example:

"They [parents] don't take to it [bad weather] very well at all. Because we run an outdoor session on a Friday, and we know if the weather's bad, we'll hardly be able to get anyone to come" [GCMH, Centre A].

An increase in mobile play equipment was also seen as a positive by the four focus groups, with a number of focus groups giving examples of how much children enjoy using mobile equipment and the increased levels of activity they see with this type of equipment. For example:

"We've always said children will like the boxes more, that the equipment comes in, because they're able to move it about and make it into what they want to make it into…So I think when they can move things around and make stuff out of it, the concentration and the confidence is there, isn't it, and they'll stay for longer, and they'll work co-operatively as well" [GCMH, Centre A].

In one focus group a participant discussed how children in their centre had even improvised their own mobile play equipment:

"We have a wooden trolley, if you like, to stack wooden blocks and things on, and they'll pick the blocks off that, they'll take the blocks off that, and two of them'll sit in it while the other one pushes them round in it. So they'll just use whatever's available as they see it, not necessarily for what it was made" [GCMH, Centre A].

When the issue of fixed down equipment arose in follow up questioning, as opposed to mobile equipment, participants from one focus group talked about how they disliked fixed equipment *"because I feel as though that doesn't, children's imagination, they can't, sort of it stifles their imagination a little bit."* [BV, centre D]. Another potential issue regarding fixed equipment discussed was that it may not be suitable for all age ranges. However, one of the focus groups were still particularly keen on fixed equipment and looking to invest in more (Centre C). The final suggestion

for improving physical literacy taken form the academic/practitioner group was the concept of limiting sitting time for children (see Figure 6.4). The response from all of the focus groups was positive, with participants from one focus group stating *"yes, definitely. I think some children need that in classes"* (YTKA, Centre B) and that children *"need like little breaks, don't they? Like little movement breaks"* (YTKA, Centre B). Whilst one participant went so far as to say that limiting sitting time *"should be mandatory"* (BV, Centre D). One advantage of limiting sitting time that was raised by staff from three focus groups was that limiting seating time or movement breaks could help *"get concentration to come back, and concentrate better"* (YTKA, Centre B):

"It's a bit limited because of space in classrooms, but I've seen different teachers use that, where in class, where children are quite distracted. You do it on days when it has been raining, and they haven't gone out. Kids ping in class if they haven't run outside for twenty minutes. Or if it's very windy outside, they come in pinging, which is quite weird, and quite often the teachers will get them up and get them doing something physical, because if they haven't done that, then they don't seem to sit and listen." [GCMH, Centre A].

As with other suggestions, there were participants who raised some concerns about how limited sitting time could be implemented, namely around the difficulties could face and how it would could affect children differently. For example:

"But those thirty children don't all learn the same way, do they? That's the hard thing, isn't it? Some children will sit and learn better sitting down in a place, but some children just won't" [GCMH, Centre A].

Training for Practitioners

As with the academic/practitioner interviews, the subject of the focus groups then moved to discussing what training would be required for preschool setting staff in order for them to help aid in

improving children's PL (see Figure 6.5). To begin with focus group participants were asked what skills or knowledge they felt were needed by staff in order to help promote PL. A range of responses were forthcoming from participants, with no definitive consensus. One participant discussed the importance of high quality training for staff prior to delivering a session(s):

"…how important it is for the staff to be highly trained and skilled and knowledgeable before they go out and deliver something to a group of parents and children. And also ideas as well, because sometimes you can sit there, and you've got all this training, but you think, "What am I supposed to be doing? I've got an hour here with ten two year-olds. I need some ideas", so sort of, you know when you went on" [BV, Centre D].

Another focus group looked at training for staff who may not understand the concept of PL:

"we understand, but perhaps some nursery staff maybe don't understand some of the concepts you've gone over. So it's basically training which would encompass that, and tell them why they need, and...I mean, it's difficult, you know, because I know how difficult the job of a nursery nurse is" [KSTN_MA, Centre C].

Additionally, these same focus group participants believed that a broader training programme including basic physical activity and exercises would be beneficial for all and that "*just the basics of why it's important [physical activity]. You know, what exercise"* [KSTN_MA, Centre C]. And similarly:

"Maybe educate them [setting staff] also about certain kind of activities, what it does to children, what it does to them, because every activity's different again, and there's so many" (KSTN_MA, Centre C)

One participant also described how they felt that for any training or knowledge to be effective then there had to be the support for it from centre managers: *"I think the managers need to be understanding the importance of it, so that it can cascade down to the staff members"* (BV, Centre D).

Questions then explored the specific details of how training for centre staff could be implemented. The first of these questions asked focus groups whether it would be more convenient for training for staff to take place on-site (within the children's centre) or off-site (at an external venue). One of the initial participant responses to this question described how they would favour a "variety of training approaches" (KSTN_MA, Centre B). Whilst all of the focus groups were receptive to the ideas of receiving training, there was not a clear consensus on whether on site or off site would be best. One focus group was particularly keen to stress that on-site training would be better for them *"because we can't always get out, and then if you did go out, would it be like one of us at a time, because you can't let everyone go, because the centre's got to still run"* [BV, Centre D]. Conversely, a differing focus group gave several reasons as to why they felt off-site training would suit them better:

"Off-site, because you tend to then get a mix of people coming from, say it was all training for children's centres, but they were coming from all different centres, we've all got different spaces, and you get to share ideas that way as well, whereas if it's just all the staff in this centre, you know, you've got new ideas" (GCMH, Centre A).

Despite the benefits that participants associated with off-site training, when asked a follow up question of whether there would be any difficulty in releasing staff to attend off-site training, again there was again a lack of consensus between focus groups. Whilst a participant from one focus group felt this would not be an issue (KSTN_MA, Centre C), other focus groups felt that this may be an issue, for example:

"If you're lucky, it's two [members of staff], so whatever type of training that it is, it kind of needs to come back with a package, because whoever goes on the training is going to have to then, if you like, share it with the others" [GCMH, Centre A].

Participants mentioned difficulties in allowing staff to attend off site training sessions, one possible solution when asked was a train-the-trainer approach. Here, a single member or small number of staff from a centre could attend a training session and on their return to the centre would be responsible for training up other members of staff in their centre. All of the focus groups were supportive, foreseeing it would mean staff would be discussing the contents of the training programme "*so it's kind of you're constantly talking about it [staff training]"* (KSTN, Centre C). Two of the focus groups also discussed how this was an approach to staff training that they had used previously or were currently using. Possible limitations to the train-the-trainer approach were also highlighted, with possible time constraints an issue for centre staff and budget limitations:

"But then sometimes it's finding that, the train the trainer, having that opportunity to come back and find the time to train up all the other staff, isn't it, and having resources and materials to say, "Look at this", because you come away thinking that was great, and then it starts to fade a little bit, doesn't it?" [GCMH, Centre A].

Whilst participants from two focus groups mentioned that only having one member of staff trained may lead to issues later on:

"But what if that member of staff leaves? What if that member of staff sort of goes on to somewhere else? You're left then with nobody to train the trainers" [BV, Centre D].

When participants were questioned further and asked what form training for staff should take, two main approaches were discussed. In two of the focus groups participants believed that there should be a practical element to training, for example *"it should be interactive, and you should be actually*

doing some of that physical activity" [GCMH, Centre A]. In addition, three of the focus groups felt that training should incorporate some kind of follow up for staff and not simply be a one off. For example:

"I think it's good to do that [have a follow up], because otherwise it can be a bit forgotten. So it would ensure that maybe something came of it…sometimes leave training, and you think, "Oh, that was really good. I want to do it". But sometimes you go back, and it's difficult, and it kind of goes to the back of your mind, and to be realistic, a lot of it won't be implemented. So it's kind of having support in place that it can be implemented, but not in a way forced, but because people want it to happen, because they know it's for the benefit" [KSTN_MA, Centre C].

Again, following on from Phase One of the study, whereby academics/practitioners had been asked the same questions relating to the knowledge/skills that preschool centre staff would require in order to improve PL (see Figure 6.5), three suggestions were put to focus group participants, taken from the consensus opinions of the academic/practitioners. These suggestions were put to each of the four focus groups, with participants offering their views and opinions on the three areas of knowledge academics/practitioners had felt were most important, namely; child development and motor competence, an understanding of PL and understanding the importance of PA. There was a positive consensus from all four focus groups in regard to the recommendation that staff should have an understanding of child development. Some participants felt that staff within their centre already had this knowledge and understanding. One participant was keen to point out that with the mandatory Early Years Foundation Stage (EYFS) Guidelines (Department for Education, 2014) that centres were now more aware of child development due to these mandatory guidelines:

"But I think with EYFS, which obviously the nurseries are using anyway, if the child is delayed, that would be getting picked up, and obviously children have a two year-old check as well, which is where most of our delays are picked up on, but it's usually speech and language delay" [YTKA, Centre B].

When the Phase One outcome that an understanding of physical literacy (see Figure 6.5) would be required by centre staff, all of the focus groups responded that they agreed with this and were open to the idea. These same issues were cited previously by the focus group, namely that *"the term is confusing"* (GCMH, Centre A). Participants again discussed how they felt that at present it would be difficult to try and convey this concept to other members of staff:

"I'm going to be realistic, I think that some staff, I'm not talking staff here, you know all over, they'd see that [physical literacy definition] and go, "Oh what are they on about?" There is that, and they instinctively kind of have a defensive, you know, and you have to be aware of that, because it exists, you know, and if you want to make a change, you've want everyone on board, and if something like a definition, you feel that might be a barrier to some people, you've got to deal with it, because it's no good saying, "Well, they shouldn't be". If some people are, they are. So I think it could, maybe they would have access to that definition, but it should also be put in different ways as well" [KSTN_MA, Centre C].

Two focus groups (Centres C and D) also reiterated that they would still struggle to get the concept of physical literacy across to parents. One participant felt the only way of getting the message across would be if there was a *"big push"* on physical literacy, similar to previous health-based initiatives, in order to attract people's attention, such as *"the Change for Life, it's so simple...everybody can relate to that"* (YTKA, Centre B). The final academic/practitioner suggestion that staff should have an understanding of the importance of physical activity (see Figure 6.5) was again met with a positive response by the focus groups. The predominant topic that arose was that of the importance in getting parents to understand how important PA is:

[On asking parents if they are physically active] *"Oh, we don't go to the gym. We don't run". "No, but you've vacuumed round the house, you've taken the kids to school, you've done a bit of shopping, you've walked to the shops, went to the park, had a bit of a kick about in the park, and it all mounts up"* [YTKA, Centre B].

Programme Design

The focus groups then shifted to asking participants about the design and implementation of an intervention aimed at improving PL amongst preschool children. Initially each of the focus groups was asked who they felt was best placed to design a PL intervention for young children. The consensus across the focus groups was that rather than being led by an academic(s) the programme design should be a collaborative effort, for example:

"I mean, you couldn't just have academics who had never seen, say, "Do this", not having seen. I mean, that just doesn't work, so you'd have to have people who were trying to design a programme going and watching groups as well initially, and then discussing and talking, and discussing what would work, saying what your aims and objectives are, and how to reach them, yes" [KSTN_MA, Centre C].

Participants from two of the focus groups felt that parents *"should be involved as well"* (BV, Centre D) in the programme design for it to be successful, with one participant stating, *"I think you've got to include parents, because…you really want it to start from there."* (YTKA, Centre B).

Focus groups were then asked what they felt should be the goal(s) of an intervention aimed at improving the PL of children within their centre. Responses varied across the four groups, with suggestions ranging from wanting a programme to *"help the children to be more school-ready"* (YTKA, Centre B), to wanting to see a programme *"make a difference to childhood obesity, or obesity in general, the family obesity"* (YTKA, Centre B), whilst another focus group felt that they would be looking to try and encompass all aspects of PL, as well as place an importance on emotional wellbeing:

"I think you've got to be in a good place to be able to think about eating healthy and doing exercise, so it's about, for me, because I'm coming from that part, it's about having good emotional wellbeing, feeling good, and then you're able to do actually anything" [KSTN, Centre C].

One area of consensus among the focus groups was that educating/engaging parents should be a primary goal of any intervention, with two focus groups detailing how important a factor they felt this was. For example:

"I think a primary goal would be as well, making the parents and the kids, making them educated, making parents the educators. They're ultimately responsible for their children's physical development" [BV, Centre D].

Focus groups were then asked to describe what activities or experiences they would like to see included in an intervention. Whilst one participant simply asked for *"access to equipment and ideas of what to do with them"* (GCMH, Centre A), three of the focus groups touched on the idea of wanting to have children do activities that were outdoors, or offered the opportunity to move in a different environment through access to swimming pools (YTKA, Centre B) or the park:

"I think, like when we go to the park, we're trying to sort of incorporate different things in the park, so I think that one would be good, if you could try and get something to go write in like a programme that you do in the park" [BV, Centre D].

Similarly, one focus group talked about being able to provide more activities in the children's centre through external practitioners i.e. dancing (Centre B), something they had done previously. Participants in one of the focus groups suggested that they would like to see a broader range of sessions that could be applied and specifically target children at different ages:

"As [fellow staff member] said, and she's right, you've got a Mum with a little baby, and you walk into a Play and Stay that's got two and three year-olds tearing round everywhere, it's not appropriate, and so they take the baby away, and then you don't see them again. So it needs to be specific, but groups for different ages as well" [BV, Centre D].

Only one focus group (Centre B) felt that intervention delivery should be the responsibility of an external practitioner:

"I think someone external, because to give it the real energy and commitment that it needs, because we've just got so many hats on at the moment, and it could be that they could be very highly trained in it, and go round the city, and then be able to tweak according to the needs in that area, so link with the children's centre staff to understand their area" [YTKA, Centre B].

Whilst one focus group dismissed the idea of using external practitioners due to cost (BV, Centre D), The consensus among the remaining focus groups was that an intervention would be delivered most effectively by setting staff:

"Because you've got a constant then. Parents like to know who they're coming in to, so do children, they like to see that familiar face all the time. We know ourselves, if one of us is off and someone else has got to cover it [a session], children go, "Oh, right", because they're at that age where they like structure, and they like continual, all that sort of thing. It's got to be the same person delivering that activity" [BV, Centre D].

Although these focus groups were happy that staff could deliver an intervention, they were clear to point out that the appropriate training and additional support would still be required. Likewise, one of the focus groups (Centre A) felt that there should be some form of follow up for staff, allowing them to monitor their own progression and receive further advice and support and for "*someone co-ordinating it [the intervention], that keeps you in touch with the people you did your training with,*

doesn't it, and keeps you in touch with whether you're doing it right," (GCMH, Centre A). When asked how long they felt an intervention would have to run for before a positive difference in PL could be observed, all of the focus groups felt that a long-term approach would be required.

One of the final questions in this section asked focus groups to describe the PL intervention they would design if they were given an unlimited budget. Some of the ideas touched on themes or suggestions for improvement from earlier on in the focus groups such as space, *"a large indoor [space] and a large outdoor [space]"* (GCMH, Centre A), *"a big hall and a big outside area"* (BV, Centre D), or being able to take children on activities outside of the centre such as a trip or going to a park (YTKA, Centre B). Likewise, the idea of being able to deliver a range of age appropriate sessions was mentioned again by one of the focus groups. With an unlimited budget one of the focus groups discussed how they would like to see more resources available as part of an intervention with additional session plans (BV, Centre D). The same focus group also felt training for staff would still be important as well as staff who are engaged and interested. The provision of resources or *"freebies"* for families was also mentioned by two focus groups, believing this would help interest people in the intervention, and in one instance it having been shown to work for a previous initiative (Centre C).

In summary, the results from Phase Two demonstrate:

1. None of the participants had heard the term *physical literacy* before agreeing to take part in the study. As such, it is not surprising that participants were unable to give an accurate definition of the term.
2. Having familiarised themselves with the term through the IPLA definition of PL (Whitehead, 2016) and discussion with the focus group facilitator, all of the participants were in agreement that the concept of PL was positive and one that they agreed with. However, participants were still clear that they felt it was a difficult term to understand and that it would be difficult to translate to colleagues and parents/carers in its current form.
3. Participants were in agreement with the recommendations that had been put forward by the academic/practitioners from Phase One. However, they were able to highlight potential issues

that might arise in a CC setting when looking implement to some of these ideas e.g. some parents may object to mandatory outdoor play if it means their child has to go out in the rain.

4. Participants were quick to point out how large a role parents/carers would play in any proposed intervention. These included getting parents to initially understand the concept of PL and understanding the importance of it, to gaining their input in the collaborative process of designing an intervention.
5. Only one of the focus groups felt that an intervention should be delivered by an external practitioner, as opposed to CC staff. Whilst the majority felt that CC staff were the best placed to deliver an intervention, this was on the proviso they receive adequate training and follow up support.

6.5 Discussion

The aim of this study was to explore the perceptions and opinions of experts and practitioners to inform the design of an appropriate intervention to enhance physical literacy of preschool children. This original study has taken a novel approach, seeking the opinions of CC staff following an exploration of factors related to intervention design proposed by leading academics/practitioners within the field of children's physical activity and health and physical literacy. This approach has allowed the researcher to feedback expert opinions and recommendations to the CC staff who may be expected to undertake and deliver a proposed intervention, and garner their views on the feasibility and possible effectiveness of these recommendations.

Defining Physical Literacy

A difference observed between the academic/practitioner group in Phase One and the CC staff in Phase Two was their respective understanding of the term *"physical literacy"*. Among the academic/expert practitioners there was a consensus of what it meant to be physical literate, in line with the definition put forward by the IPLA (Whitehead, 2016). This may not be that surprising

though, as in Edwards et al. (2016) recent review of definitions, foundations and associations of PL, the authors describe how 70% of the included studies referring to PL adopted a "Whiteheadian" perspective. However, whilst there may be some form of a consensus among the scientific literature, the term was unknown to all of the focus groups participants, with participants quick to point out that they had not seen or heard of the term prior to taking in this study. However, this perceived gap in understanding between the two groups had been identified by the academic/practitioner group during interviews. The majority of Phase One participants (*n* =5) noted how they felt there was still a great deal of confusion and that the term was *"commonly misunderstood"* (MP_001), with one participant identifying this issue among practitioners:

"When I started talking about it [physical literacy] with practitioners, they're all at different levels, but they could not quite comprehend what it meant, and why was the literacy part in it" [PBL_001].

One possible solution to address this lack of understanding among CC staff would be for researchers to provide CC with a simplified definition of what PL is. According to Longmuir and Tremblay (2016), the work of Margaret Whitehead is most commonly cited in relation to the concept of PL and in turn the IPLA definition. However, when the IPLA definition was shown to focus groups, participants were quick to point out that it was *"really confusing to read"* (YTKA, Centre B) and that *"we're professional, and we don't understand it."* (YTKA, Centre B). In order for the term PL to translate and be applicable to staff 'in real world settings' it was suggested that the definition would have to be shortened to that of a memorable phrase, perhaps comparable to previous campaigns aimed at children. An example given by one participant was *"Stop, look, listen when you're crossing the road"* (Participant BV, Centre D). This idea was also cited by a different focus group participant, who felt that advertising PL in terms of specified guidelines might help to get the message across, particularly in regards to parents, using PA as an example of how this could be employed:

"If you put up outside [children's centre] like an advertisement, "The government recommends that your child should have thirty minutes' activity a day. Come in here, and get your child's thirty

minutes"… parents might go, "Oh God, yes, the government are saying this is what my child needs. I know I can go and get there for free." [BV, Centre D]

An example of this simplified approach to defining physical literacy can be seen in the work undertaken by Sports Wales (SW). SW have produced their own simplified definition of physical literacy and provide a range of resources utilising this definition for families and professionals working with children from 0-16 yrs. of age (http://physicalliteracy.sportwales.org.uk/en/resources/), as can be seen in Figure 6.9.

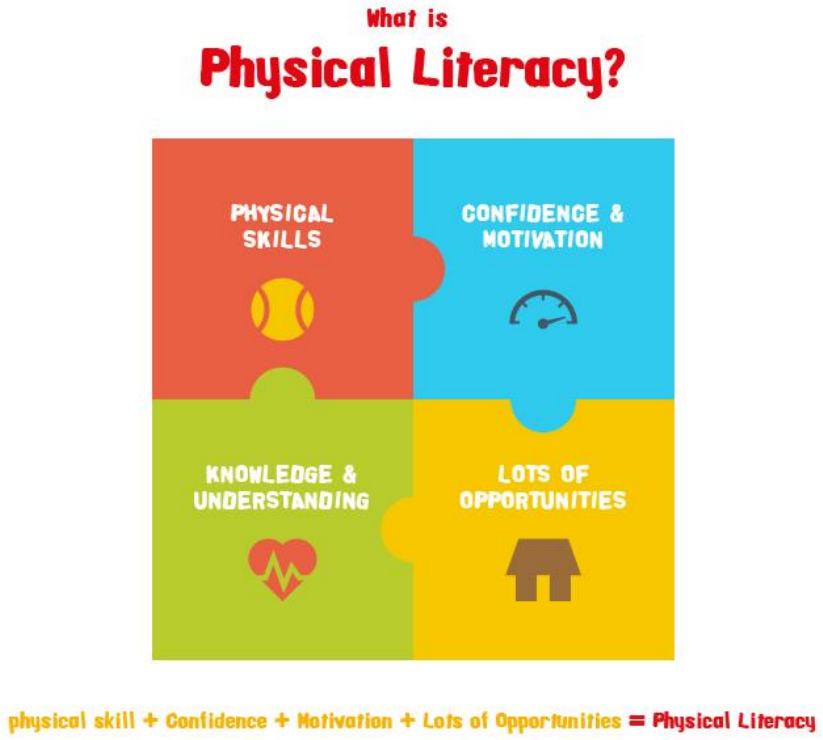


Figure 6.9 Sport Wales' physical literacy definition infographic.

However, whilst the SW definition and support materials may, in theory, be more appealing and easier to convey to CC staff, again there remains the issue that among the CC staff as participants in this study, none had seen or heard of the term PL before. Resources such as those produced by SW would seem to be helpful in raising awareness of the concept of PL to CCs, however this hasn't been

implemented nationwide. All four focus groups were aware of and in agreement with the current EYFS guidelines (Department for Education, 2014), which contain a number of aspects of physical literacy. One possible solution for increasing awareness of PL among CC staff could be to provide PL resources such as those provided by SW *alongside* the EYFS guidelines (Department for Education, 2014), making them easily available and translatable for CC staff Nationwide.

A further inductive theme amongst focus groups was the importance of being able to effectively convey the concept of PL to *parents* as well as staff. With one focus group participant noting how the current IPLA definition would not be suitable to try and present to parents, as in its current form it would *"add to confusion"* (MA, Centre C). Conversely, during Phase One discussions with academics/practitioners there was no mention of parental understanding of the term PL. Whitehead (2010) states that during the early years parents or principal carers are the most significant individuals in the development of PL and should be supportive and enthusiastic at all times in relation to PL. The finding that parents are important agents in enhancing PL is consistent with previous studies reporting that positive parental behaviours can increase children's FMS competency (Cools et al., 2011) and PA levels (Yao & Rhodes, 2015). As such with parents reportedly playing such an important role in children's physical literacy development, it is important that parents have an understanding of this concept in order to help further support the provision of any prospective physical literacy intervention their children would participate in.

Barriers to Physical Literacy

The space available within children's' centres was identified as a barrier to PL in both Phase One and Phase Two, with a lack of suitable indoor and/or outdoor space an issue for a number of CC. The differing physical space and facilities between CC would need to be considered for intervention design, with the data suggesting that due to the differing facilities available across CC, a "one-size-fits-all" approach to intervention delivery would not work. Instead, an intervention may have to offer guidelines that CC staff can adapt to their current setting, making use of the facilities they have available to them. A practitioner noted that they *"could do a lot in a confined space" (OT_001)* and

had seen pre-schools and educators where such practice had occurred. Further, it was maybe in fact more "*the behaviours of the staff and the teams within them"* [PBL_001]. This belief that setting-appropriate planning and preparation could compensate for a lack of facilities was also put forward by participants in Tsangaridou (2016) study among early childhood teachers. Likewise, it has been noted that a physically literate individual would have the ability to be physically active in a range of environments (Physical & Health Education Canada, 2014), further suggesting that the physical environment is a barrier that could be overcome. Whilst the consensus among focus groups in Phase Two was the need for more physical space in their children's centres, the practical reality is that this would not be feasible for the majority of centres. Therefore, providing staff with activities/experiences within an intervention that could be implemented indoors or outdoors and adaptable to fit a variety of spaces may help to provide a solution to physical space being a barrier to improved PL.

Funding was also discussed as a barrier to PL during both Phase One and Phase Two. Whilst Phase One discussion of finance revolved around funding for ideas such as the promotion of PL, Phase Two participants were more concerned with finances not being available to support *new* schemes or courses, with CC nationwide having been affected by a reduction in funding (4Children, 2012). Focus group participants discussed how in the present climate that without a designated target for PL, or a policy supporting its promotion, then it would be difficult to either prioritise PL within their centres or gain necessary funding. Whilst Phase One participants had discussed the issue of making PL mandatory within preschools through changes to national policy (see Figure 3), it was only focus group participants who explicitly stated a change in policy would be required in order to find the time/funding to stimulate change. This highlights a further difficulty in trying to implement a PL intervention in preschools, in that it may be difficult for preschools to allocate time towards a programme that is not set as a required targets. One solution to this problem may be to implement a PL intervention that would aid centres in meeting other mandatory guidelines, such as the EYFS (Department for Education, 2014). Namely the EYFS (Department for Education, 2014) includes physical development and personal, social and emotional development as prime areas for development during the early years, falling in line with the concepts outlined in the IPLA definition of PL (Whitehead, 2016). Furthermore, whilst current PA guidelines (Department of Health, 2011) are

not a target for preschools, increasing children's PL during preschool would better prepare children to be more physically active when they reach reception age and begin school. Dowda et al. (2009) noted that it was possible for preschools with differing levels of financial resources to promote PA, suggesting cost-effective ideas for preschools such as providing inexpensive portable playground equipment, limiting the number of children on the playground at one time, and limiting the number of children using fixed equipment. As such, one initiative may be to provide CC with a similar number of cost-effective suggestions that could aid in promoting PL.

Strategies to Increase Physical Literacy

Following Phase One of the study, four suggestions for how to help increase PL among children were compiled from the ideas put forward by academics/practitioners (use of mobile play equipment, learning through play, mandatory outdoor play and limited sitting time). These suggestions were met with positive responses from the four focus groups, who agreed that these were strategies they would support and felt could contribute to increasing PL. However, whilst focus groups participants were supportive, they raised a number of issues potential issues regarding these suggestions that would need to be considered in the design of an intervention hoping to incorporate them successfully.

Whilst all focus groups were in agreement with the academic/practitioners that mandatory outdoor play would aid in improving PL, the issue of physical space was again discussed in this context. Furthermore, as with the issue of defining PL, parents were again seen as a potential barrier in regards to implementing mandatory outdoor play, with all four focus groups discussing how they had faced objections from parents when wanting to take children outside in wet conditions. This is in line with previous research reporting restrictive behaviour from parents resulted in reduced child PA (Carver, Timperio, Hesketh, & Crawford, 2010; Schoeppe, Duncan, Badland, Oliver, & Curtis, 2013). With evidence showing that outdoor play is positively associated with PA and that children are more likely to move more outside compared to when they are inside (Brown et al., 2009), mandatory outdoor play could provide the opportunity for children to increase their PA levels and in turn enhance their PL. This could be especially important for children from areas of high deprivation, who

are more likely to be exposed to neighbourhood and home environments that are limiting to PA due to increased neighbourhood safety concerns (Kaushal & Rhodes, 2014; Tandon et al., 2012). However, a proposed intervention would need to incorporate activities that could take place indoors as well as outdoors, accounting for centres who may be restricted in terms of the physical space available but also in the event of adverse weather conditions which may prevent CC staff from taking children outside. With evidence showing that the provision of school physical education can result in increased engagement in and sustainability of PA (Ross, 2013), it would appear that increasing the amount of time preschool children get to spend in outdoor play would be beneficial.

Focus group participants felt the suggestions of increased learning through play and limited sitting time could be effectively implemented within a preschool setting and agreed that these were suggestions they supported and felt were achievable. The early childhood curriculum is deemed to be significant in the development of physical competence (Wainwright, Goodway, Whitehed, Williams, & Kirk, 2016), identified in the IPLA definition of physical literacy (Whitehead, 2016). Whilst more didactic, academic, and content-based approaches to preschool education may come at the expense of more child-centred, play-oriented and constructivist approaches to learning (Nicolopoulou, 2010), changes to the curriculum could provide children with further opportunities to progress on their PL journey. Whilst *free play* generally refers to self-directed activities that are fun, engaging, voluntary and flexible, with no extrinsic goals and often containing an element of make-believe (Sutton-Smith, 2001), *guided play* is a discovery-learning approach intermediate between didactic instruction and free play (Golbeck, 2001). Although changes to the curriculum would require time in order to design appropriate lesson plans or provide alternate teaching/learning tasks that could incorporate these approaches, there would be no additional financial costs for CC. This approach has been trialled in Wales, with the implementation of a holistic play-based learning continuum for children 3-7 yr. with specific subjects replaced by *areas of learning*, resulting in children who were independent, motivated active learners making good progress in the development of PL (Wainwright et al., 2016). Increased learning through play may also offer further opportunities for children to be active during the day, reducing the amount of time children spend in sedentary time and aiding in improving PA and FMS competency (Lopes, Santos, Pereira, & Lopes, 2012).

Training for Staff

Whilst the majority of academic/practitioners believed that CC staff require knowledge of child development and motor skills in order to help improve PL, some focus group participants felt that staff within their centres already had this knowledge and understanding. Similarly, focus group participants gave positive responses as to how the EYFS guidelines (Department for Education, 2014) have helped to further CC staff knowledge of child development and the developmental milestones that children are expected to meet. If the majority of CC staff already have a basic understanding of child development then it may be that training for staff included as part of a PL intervention can focus on wider aspects of the concept; physical competence, motivation and confidence and knowledge (Whitehead, 2016). Whilst these aspects were touched on in discussions during Phase One of the study, no specific recommendations relating to these aspects of PL were forthcoming. Combined with the CC staff lack of understanding of the term PL, it may be that these domains remain unconsidered and/or underdeveloped, especially in comparison to movement competency and PA. With evidence that children's motivation towards physical education and sport decreases with age (Chase, 2001), this indicates that may CC staff need to ensure that children maintain a positive attitude toward PA during this young age, in order to maintain this motivation as they progress on their PL journey. One way of helping to achieve increased motivation among children could be to provide lessons or activities that are task-oriented (Bryan & Solmon, 2012) or use of the TARGET framework put forward by Ames (1992), in order to create a mastery-oriented climate for children, or by engaging in child initiated play, as detailed in the EYFS (Department for Education, 2014). An intervention could again assist with this through the provision of resources for CC staff including suggestions for guided learning plans and task-oriented activities.

Similarly, staff engagement and confidence was discussed as being an important factor within training delivery by the majority of the academic/practitioners in Phase One (n =6), and being vital for staff to engage and believe in what they are being taught. Among the literature evidence shows that in early childhood education there is a need to provide teachers with professional development opportunities (Casbergue, Bedford, & Burstein, 2014; Han, 2012). Previous studies have reported that

professional development for preschool staff had a positive effect on curriculum and instruction (Casbergue et al., 2014; Han, 2012; Lonigan, Farver, Phillips, & Clancy-Menchetti, 2011; Yamauchi, Im, & Mark, 2013). In order to gain engagement from staff, training could seek to incorporate experiential learning in order for CC staff to gain practical experience. Experiential learning approaches are unique in that they allow trainees an immediate opportunity to practice newly introduced or developed skills as well as providing them with immediate feedback about their performance (Fabiano et al., 2013). Among the physical education literature there are a number of examples of training that have utilised experiential learning as well as interactive sessions, on-site coaching and group reflection in staff training (Coulter & Woods, 2012; Murphy & O'Leary, 2012; Petrie, 2010). As such, utilising these approaches in the staff training component of a proposed intervention may be an effective and efficient way to upskill staff and in turn facilitate greater increases in PL among preschool children.

Programme Design

The results of both Phase One and Phase Two of the study found a consensus among participants that the design of a PL intervention should be undertaken as a *collaborative* process and not simply informed by academics, as one focus group participant stated:

"I think it should be a mixture of people, people who know all about physical activity, as well as people who know what type of things would work with ages and stuff as well" [BV, Centre D].

Such sentiments have implications for the design process of an intervention, indicating that researchers may need to adopt a participatory research approach. Participatory research is the co-construction of research between researchers and the population affected by the issue(s) being researched and/or the decision makers who apply research findings (Jagosh et al., 2012). This design approach would appropriate with a consensus however among both Phase One and Phase Two participants that in order to have the best chance of success an intervention would have to be delivered by CC staff. By incorporating the views and opinions of CC staff during the design phase would allow

elements of flexibility to be incorporated into the intervention, as discussed by the academic/practitioner group (see Figure 6.8), allowing an intervention to work on a *"teacher's terms"* (ML_001). Of note, is previous research that has used this design approach in order to develop successful interventions aimed at increasing preschool PA (De Bock, Genser, Raat, Fischer, & Renz-Polster, 2013; Roth et al., 2015). With focus group participants discussing their belief that parents should be involved in the design of an intervention, including parents in the intervention design may provide an additional opportunity to educate parents on the concept of PL, an issue already previously raised by focus group participants. This is especially important given the role parents have in shaping their child's PA behaviours (Beets, Cardinal, & Alderman, 2010; Mitchell et al., 2012).

With regards to the duration and dosage of a proposed intervention, a number of academic/practitioners (n = 6) suggested minimum durations ranging from to six weeks to a year. Likewise, six participants within the academic/practitioner group discussed how they felt that an intervention should be embedded into the current curriculum of a children's centre and become *"part of the regular programme"* (LM_001). This long-term approach was also favoured by focus group participants, with suggestions that once an intervention was put in place *"that [it] would just continue maybe"* (KSTN_MA, Centre C) or that it should just be *"ongoing"* (BV, Centre D). Looking at components of PL, the literature reports a number of different findings in relation to such intervention duration. In Gordon, Tucker, Burke, and Carron (2013) meta-analysis of the effectiveness of PA interventions among pre-schoolers it was reported that interventions less than four weeks in duration had the largest effect on moderate-to-vigorous PA. However, the authors noted that the shorter duration resulting in the most effect may have been as a consequence of the intervention type i.e. environmental changes, and not as a result of the duration of the intervention. Likewise, Morgan et al. (2013) systematic review and meta-analysis of FMS interventions in youth that interventions ranged in duration from four weeks up to three years, with considerable variation in design as well as duration. These findings would seem to suggest that a preschool intervention should be designed with a long-term approach in mind, either through an initial programme of several weeks/months that could include elements that could gradually be embedded into a centres curriculum, or designed to fit in with the current curriculum from the outset. As mentioned previously, a collaboration intervention

design between researchers and CC staff (alongside other parties) could help to address this and identify the best approach, ensuring the longevity of the programme and its continued development within a centre.

Methodological considerations

The strength of the present study is that it has actively sought to gain the views and opinions of CC staff chronologically following those of academics and practitioners, allowing areas of dissonance and resonance between these two groups to be identified. Furthermore, the use of thematic analysis and allowed for the portrayal of the consistent themes in the academic/practitioner group, avoiding minority views expressed to be overstated. With regards to limitations, there was a relatively low number of children's centres who agreed to take part in focus groups for Phase Two of the study. As such, it is possible that the views expressed in these focus groups do not represent the opinions of CC staff across Liverpool. Likewise, in Phase One there was a greater number of academics (n = 7) than practitioners (n = 2), as such the views of practitioners within this field may have been underrepresented. It is also possible that there may have been bias among the academics/practitioners in Phase One, as the majority seemed to perceive FMS as a primary focus of PL ahead of the other domains identified in the IPLA definition (Whitehead, 2016), namely; motivation, confidence, knowledge and understanding. Unfortunately no objective data was gathered in relation to the space available to each of the CC. With the issue of physical space a constant issue this data could have added to the study as it would have been possible to examine whether focus groups who stated that space was an issue in their centre actually had more or less physical space in comparison to other centres.

Conclusions

Following the Phase One interviews and Phase Two focus groups a series of recommendations are presented to inform the design of a future intervention(s) aimed at improving PL among children:

1. The initial goal of a PL intervention should be to educate CC staff about the concept of PL and to ensure that they understand this concept fully. In turn, CC staff will be able to cascade this concept to CC staff and parents.
2. An intervention should be designed in its entirety as a collaboration with CC staff and other stakeholders who have the skills/knowledge to aid in the effective design and delivery of the programme
3. There should be flexibility in the intervention design to allow for variation between settings e.g. the physical space available or differing targets/priorities between centres.
4. Physical resources should be made available for CC staff, providing them with reference materials and ideas for activities that they can implement within their centre e.g. session plans and activity cards.
5. The intervention should be designed to fit within a centres current EYFS (Department for Education, 2014) mapped curriculum, in order to ensure that it will be feasible for it to continue in the long-term and can eventually be integrated into the curriculum itself.

Chapter Seven

Synthesis

7.1 Thesis Study Map

Study	Objectives
Study One: Examining the fundamental movement skill competency levels of preschool children form Northwest England	Objectives: • Report detailed FMS competence data among a sample of preschool children from a deprived area of Northwest England • To investigate sex differences in FMS and their respective components Key Findings: • Overall competence found to be low among both sexes • Competency higher for locomotor skills than for object-control skills • Boys significantly more competent at object-control skills in comparison to girls • Boys were significantly more competent than girls at the kick and overarm throw, while girls were significantly more competent at the run, hop, and gallop
Study Two: Effect a school-based Active Play intervention on fundamental movement skill competency among preschool children	Objectives: • To examine the effectiveness of a six-week Active Play intervention on FMS competency in 3-5 yr. old children from a deprived area of Northwest England Key Findings: • There were no significant differences between-groups for total FMS, object-control or locomotor scores at post-test or 6-month follow up • Intervention may have needed to run for longer and/or with a greater frequency of session delivery in order to be effective
Study Three: Is Fundamental Movement Skill Competency Important for Keeping Children Physically Active and Healthy	Objectives: • To determine the role of fundamental movement skills in promoting physical activity and healthy weight status as children progress from early to late childhood. Key Findings: • FMS competency scores increased between baseline and follow up, although competency remained low. • Time spent in MVPA reduced between baseline and follow up

	• Significant but weak associations between FMS competency and MVPA at baseline had dissipated at follow up • Baseline FMS competency failed to predict follow up MVPA or weight status
Study Four: Towards the Development of a Physical Literacy Intervention for Preschool Children: The Perspectives of Experts and Practitioners	Objectives: • To explore perceptions and opinions of experts and practitioners to inform the development of an appropriate intervention to enhance physical literacy of preschool children. Key Findings: • The initial goal of a PL intervention would be to educate CC staff about the concept of PL. • Any intervention should be designed in collaboration between CC staff and stakeholders with the skills/knowledge to aid in the effective design and delivery of the programme • There should be flexibility in the intervention design, allowing for the differing facilities available to centres • Physical resources should be made available to CC staff e.g. session pans and activity cards, providing ideas for activities they can carry out within their centre • The intervention should be designed to fit within a centres current curriculum, helping to ensure its long-term feasibility

7.2 Introduction

The aim of this thesis was to examine FMS competency, physical activity and obesity from early to late childhood. The objectives of the thesis were to a) document the level of FMS competency of preschool children from a highly deprived area of Northwest England; b) determine the effectiveness of a six-week Active Play intervention on FMS competency among preschool children from a highly deprived area of Northwest England; c) examine the relationship between FMS competency, PA and weight status over a five year period between preschool and late primary among children from a highly deprived area of Northwest England; and d) gain the thoughts and opinions of experts and practitioners in order to help inform the development of an appropriate intervention to increase the PL of preschool children.

7.3 Main Themes

FMS Competency in Preschool and Primary School Children

Overall, FMS competency was found to be low among participants at preschool (Studies One and Two), with participants on average scoring below half the attainable score for total, locomotor and object-control scores. Likewise, despite significant increases in FMS competency scores at late primary (Study Three), mean scores for total and locomotor scores were only just above half of that attainable, whilst for object-control competency less than half of the attainable score was achieved. Looking at competency over time there was an increasing difference between sexes; in comparison to girls boys were significantly more competent at object-control skills at preschool and by late primary boys had significantly higher competency scores for both total and object-control. Additionally, OW/OB children were found to have lower competency levels than their NW peers for all competency scores at both preschool and late primary. These findings of low competency are concerning when increased competency has been found to be associated with a number of health benefits (Lubans, Morgan, Cliff, Barnett, & Okely, 2010; Robinson et al., 2015; Vlahov et al., 2014). As such, the findings of low competency in this thesis highlight the clear need for effective

interventions to help increase FMS competency among preschool and primary children. In particular, interventions during preschool could help to provide children with increased FMS competency that could then be carried forward and hopefully maintained and improved upon during primary school and beyond. Such interventions would also be beneficial in helping to reduce the gap in competency seen between the sexes and between OW/OB children and their NW peers.

Factors Influencing FMS Competency

Looking at other external factors outside of those included in the Stodden et al. (2008) model, a potential factor that may have influenced FMS competency among children during preschool (Study One) and primary (Study Three) may be that children were, at the time of data collection, residing in highly deprived areas. Previous studies among children from such deprived areas have reported low levels of FMS competency (Goodway et al., 2010; Morley et al., 2015). Within the literature a number of explanations have been offered as to why children from deprived areas have lower competency levels, including having a lack of access to safe outdoor play environments, equipment and/or youth sports as well as limited PA role models (Giagazoglou, 2013; Goodway & Smith, 2005). This was echoed by children's centre staff in Study Four, with three of the four focus groups discussing how they felt their centre did not have enough space, as well as repeated mentions of how important parents are in influencing children's behaviour. These factors may also result in children from deprived areas having fewer opportunities to engage in PA, in turn having fewer opportunities to practice FMS, resulting in decreased competency. It is therefore of note that Study Three found there was a significant decrease in MVPA among both boys and girls between preschool and primary, with a significantly greater change observed over this period among OW/OB children.

The family and home environment may also prove important in developing FMS competency, with parents/carers having been reported as influencing their children's PA behaviours through both direct (e.g. provision of equipment, outdoor access and independent mobility) and indirect (modelling behaviour, positive encouragement) actions (Barnett et al., 2013; Cools et al., 2011). Likewise, the facilities and equipment available in preschool settings may also affect FMS competency levels. Preschools or childcare settings with larger playgrounds and greater provision of non-fixed equipment

e.g. balls, hoops, ropes etc. are known to have resulted in preschool children engaging in greater MVPA (Brown et al., 2009). Therefore it would appear that environmental factors, be it at home or within a preschool/school setting, alongside parental behaviours, may be additional factors that could be included in an updated version of the Stodden et al. (2008) model.

The Stodden Model

According to Stodden et al. (2008) developmental trajectories model hypothesises there is a dynamic relationship between FMS competency and PA, with lower competency resulting in a negative spiral of disengagement in PA, thus impairing FMS competency and resulting in an increased risk of unhealthy weight status. Findings in the present thesis showed that participants had low FMS competency during preschool (Study One) and although significantly increased, relatively low competency at primary (Study Three). With previous studies noting that low FMS competency tracks over time (Hardy, King, Espinel, et al., 2010; O'Brien et al., 2013) such results are perhaps unsurprising. Stodden et al. (2008) model hypothesises that the reciprocal and developmentally dynamic relationship between FMS competency and PA strengthens over time across childhood, however, the findings from this thesis (Study Three) showed that this relationship actually diminished over time. Whilst significant, albeit weak, associations between FMS competency and PA, specifically between total and locomotor scores and MVPA, were found at preschool, these associations had weakened by primary and there were no longer any significant associations. Similarly, the results from Study Three failed to find any associations between preschool FMS competency as a predictor of primary MVPA, nor baseline MVPA as a predictor of primary FMS competency. Likewise, no association was found between preschool FMS competency and primary weight classification. Consequently, such findings again fail to support the Stodden et al. (2008) model, whereby increased FMS competency increases the likelihood of achieving a healthy weight status.

Whilst the findings from this thesis do not support the Stodden et al. (2008) model, they may be able to help inform the development of future versions of the model. Stodden et al. (2008) noted that further longitudinal research would be required in order to examine the relationship over time,

taking into account mediating variables that may interact with and promote/demote the dynamic relationship between FMS competency and PA within their model. As such, the longitudinal work conducted in this thesis examining the Stodden et al. (2008) model is valuable in highlighting the need to include additional factors outside of those featured in the current model. (Sterdt et al., 2013) systematic review of 16 correlates that were consistently associated with PA among children and adolescents, including; SES, perceived barriers, parental support, support from significant others and time spent outdoors, topics which were discussed in Study Four. The findings from the (Sterdt et al., 2013) review further highlight how complex and multi-dimensional PA behaviour can be, giving further support to the idea that the Stodden et al. (2008) model should be expanded to include additional factors. In line with the conceptual model put forward by Loprinzi and Trost (2010) future iterations of the Stodden et al. (2008) model could look to include measures relating to parental PA levels, parents perceived importance of PA and parental support for PA. Whilst future interventions within preschools/schools could help to influence the factors currently featured in the Stodden et al. (2008) model e.g. FMS competency, PA, when children are outside of this environment i.e. at home, factors such as parental influence will play a dominant role in shaping a child's PA behaviour, and in turn their FMS development. As such, including measures relating to parental influence would be able to create a clearer picture of the factors affecting a child's motor development and would thus strengthen the model by introducing these important, and presently overlooked, correlates of physical activity.

Effective Interventions to Increase FMS Competency

Study Two found that the Active Play intervention had no significant effects on FMS competency of preschool children. This may have been due to the length of the intervention, six weeks, with two separate systematic reviews having identified that the majority of effective FMS interventions ran for a period of two months or longer (Riethmuller et al., 2009; Veldman et al., 2016). Likewise, the intervention may have also benefitted from an increased dosage as well as overall duration, alongside a different approach to staff training components, namely including training prior to the start of the intervention. Previous successful interventions have included either

one-day or a series of workshops as development activities for preschool staff prior to the implementation interventions (Hardy, King, Kelly, Farrell, & Howlett, 2010b; Jones et al., 2011; Piek et al., 2013). Looking towards future interventions it may be that a more holistic approach towards increasing PA and FMS competency is required, taking into account the various external factors that can affect these outcomes. With FMS an important aspect of the physical competence domain of PL, adapting a PL approach as a means of increasing FMS competency could be effective. However, the findings from Study Four make it clear that in order for any PL based intervention to be successful its initial goal would have to be to educate preschool staff around the concept and importance of PL and how improvements in PL can result in improved FMS competency and increased PA for children. In order to further support setting staff, physical resources should be made available to them as part of the intervention e.g. session plans and activity cards, such as those provided in the Active Play Project (see Appendix One), providing them with reference materials and ideas for activities that they can implement within their school/children's centre. Secondly, any intervention should be designed in collaboration between preschool staff and other stakeholders with the skills and knowledge to ensure the effective design and delivery of an intervention. Furthermore, by including preschool staff in the design element of the intervention it will allow for flexibility to be included within the intervention design, making it adaptable for differing schools/settings that may have a range of different environments or priorities e.g. physical space and equipment available.

7.4 Implications of Findings

The findings from this thesis indicate that with the low levels of FMS competency and sharp decline in MVPA observed that there is a clear need for interventions among preschool age children. However, the findings that the Active Play intervention was unsuccessful in bringing about significant improvements in FMS competency highlight the need for further research investigating the most effective forms of intervention design and delivery for increasing FMS competency, and in turn PA. This research should also focus on effectively training setting staff as part of any proposed intervention, as this was an emergent theme from Study Four, that if given the appropriate training

and opportunities, staff were willing to take on new concepts and ideas that could be implemented within their centres. Furthermore, it was felt that setting staff delivering an intervention would help to maintain the longevity and sustainability of any programme implemented.

7.5 Limitations

The greatest limitation of this thesis was the relatively small number of participants who were recruited for each study. At baseline in Study One there was only a 25.0% participation rate from the 673 children initially invited to take part in the Active Play Project. Participant numbers proceeded to decrease in each subsequent study, with a number of potential participants further excluded in Studies Two and Three due to missing/incomplete data. Whilst the number of participants in Study Three had fallen to 75 (31% of original participants) this highlights the difficulty of conducting longitudinal research and trying to track children over a long period of time. This was especially the case in this thesis as there was no agreement in place at baseline to continue to monitor and track the children who had originally taken part in the original 2010 Active Play Project. Study Three may also have been strengthened if there had been increased numbers of participants with complete PA data, as greater number of participants with both complete FMS and PA data would have offered the opportunity to more explicitly examine the relationship between FMS and PA over time. Similarly, if data on perceived competence and fitness had been collected at preschool and primary this would have afforded the opportunity to truly *test* the Stodden et al. (2008) developmental model by including all elements of the model.

Likewise, the relatively small number of participants who took part in Study Four may have affected the results of this study. Particularly in Phase One where practitioners may have been underrepresented in comparison to academics. It is also possible that there was further bias among the academics/practitioners in Phase One of Study Four, whereby the majority of participants expressed that FMS were a primary focus of PL ahead of the other domains, which is in contrast to the IPLA viewpoint, whereby all of the domains of PL are of equal importance.

7.6 Recommendations for Future Research

To more precisely determine the relationship between FMS competency, PA and weight status further studies using objective measures of FMS and PA are required, specifically among English children from a range of environments and SES levels. Longitudinal studies or those with additional, interspaced, regular data collection points would be best to monitor these relationships, and more specifically, how they change over time. Greater research is also required in order to establish effective interventions aimed at increasing FMS competency and PA, and in turn increasing the likelihood of a child maintaining a healthy weight status, as proposed by (Stodden et al., 2008). This may involve the development of interventions that encompass a number of variables that can effect FMS competency and PA, including improved training methodologies for preschool staff and educators.

7.7 Conclusions

This thesis has provided a unique exploration at FMS competency among preschool children from a highly deprived area of England. Furthermore, the thesis has looked at the effects of an intervention to increase competency and the change in competency as these children have progressed from preschool and on to late primary. This thesis has highlighted consistently low FMS competency among these children, with participants yet to reach a high level at competency. These findings demonstrate a clear need for interventions to help improve children's FMS competency when effectively designed to provide them with the movement skills to maintain a physically active lifestyle throughout their lifecourse. However, the findings that the Active Play Project 2010 did not result in significant increases in competency indicate that a different approach to intervention design and implementation may be required in order to increase competency. Likewise, the weak associations observed between FMS competency and MVPA over time are further indicative that there are variables outside of those measured in these studies that are influencing children's FMS competency and PA levels. As highlighted by experts in study four it may be that a more expansive approach to FMS competency is

required, looking to incorporate all aspects of PL, including motivation, confidence and knowledge and understanding alongside the physical components. Future research should look to examine the development of physical literacy interventions that can be implemented at the preschool stage of development, in order to equip children with the skills and knowledge to progress on to leading physically active lives.

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Appendix One

Active Play Activity Cards

Balance

Gym

Try... before main activity

- Explore balance with the group. What makes them feel still and strong
- What makes them feel wobbly?
- Explore 4 points (2 hands 2 feet) 3, 2 and 1 point (bottom or 1 leg)
- High / low / upside down / wide / narrow
- Explore strong / funny / curvy etc
- Explore joined up balances with a partner

More Accessible...

- Bigger base / closer to the floor

More Challenging...

- Introduce benches and chairs to vary levels in height
- Introduce wobble boards
- Try balancing with eyes closed

More space...

- Try combining balance on different parts of the body and introduce travel in different directions

Think all children...

- Some children may need to experience balance on the floor or being supported by an adult or a blanket or parachute. They may need to balance something. e.g. a bean bag

Try... after main activity

- Which part of the body is working?
- What does it feel like?
- What happens if you lean out of a balance?

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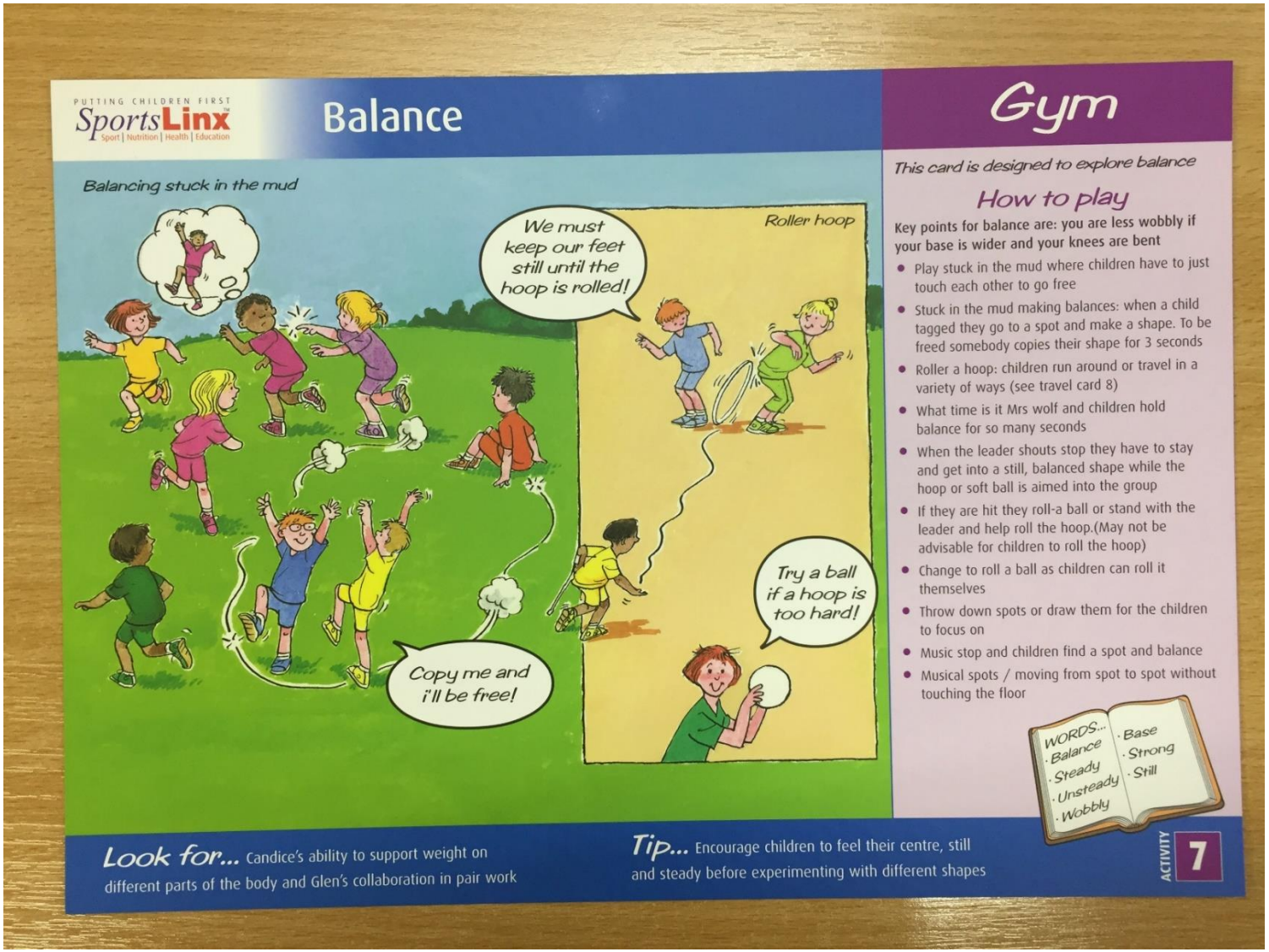
Liverpool Active City...

The City of Liverpool

ACTIVITY 7


PUTTING CHILDREN FIRST
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Balance
Gym
Balancing stuck in the mud
We must keep our feet still until the hoop is rolled!
Roller hoop
Try a ball if a hoop is too hard!
Copy me and i'll be free!
This card is designed to explore balance
How to play
Key points for balance are: you are less wobbly if your base is wider and your knees are bent
Play stuck in the mud where children have to just touch each other to go free
Stuck in the mud making balances: when a child tagged they go to a spot and make a shape. To be freed somebody copies their shape for 3 seconds
Roller a hoop: children run around or travel in a variety of ways (see travel card 8)
What time is it Mrs wolf and children hold balance for so many seconds
When the leader shouts stop they have to stay and get into a still, balanced shape while the hoop or soft ball is aimed into the group
If they are hit they roll-a ball or stand with the leader and help roll the hoop.(May not be advisable for children to roll the hoop)
Change to roll a ball as children can roll it themselves
Throw down spots or draw them for the children to focus on
Music stop and children find a spot and balance
Musical spots / moving from spot to spot without touching the floor
WORDS...
Balance
Steady
Unsteady
Wobbly
Base
Strong
Still
Look for... Candice's ability to support weight on different parts of the body and Glen's collaboration in pair work
Tip... Encourage children to feel their centre, still and steady before experimenting with different shapes
ACTIVITY 7

Traffic lights/travel

Gym

Try... before main activity

- Explore ways of safely moving around space with each other
- Introduce corresponding moves to green and red and amber to traffic lights at a slow calm pace

More Accessible...

- All together moving the same way

More Challenging...

- Directional changes – backwards / zigzagging etc

Less space...

- Use amber in traffic lights to expand the exploration of movements on the spot

Think all children...

- Some children may have more limited options of travelling but can move different body parts in different ways e.g. rolling their hands instead of rolling on the floor

Try... after main activity

- Link ways of travelling to composition by making up movement routines
- Let the children make up games relating to the colours
- Let the children direct games by controlling the coloured markers

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Liverpool Active City...

The City of Liverpool

ACTIVITY 8

PUTTING CHILDREN FIRST
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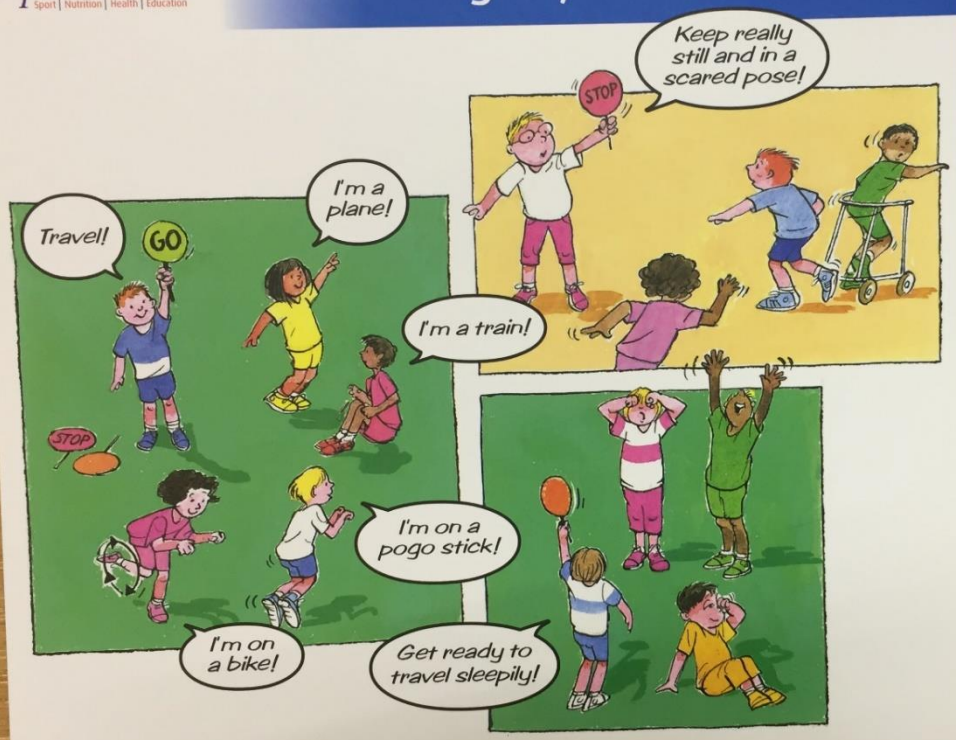
Traffic lights/travel



Gym

This card is designed to explore different ways of travelling

How to play

Green

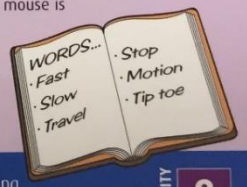
- Children travel in and out of each other
- Travel – fast and slow / high and low / giant and tiny steps / in a straight line and a bendy line
- Travel – animals / transport / moods / under the sea

Red

- children stop and resume a still pose exploring and discussing the way they will travel

Amber

- dictates move on spot. This may be a good time to give tips and help children expand their movement vocabulary. e.g. can you bend your knees when you take giant strides or can you use your arms to help you move in and out of each other
- Cars and caravans - a pair moves round with the caravan attached to the car. On change the pair change places. The car can have a ball as a steering wheel. Progress to groups moving together
- Cats and mice – similar to cars and caravans but the mouse is trying to escape from the cat



Look for... Dave's ability to start and stop efficiently and Natty's control over directional change

Tip... encourage children to run on the balls of their feet. Shortening and lengthening strides to go faster and slower. Introduce different jumps on amber in the traffic light game card

ACTIVITY 8

Striking

Try... before main activity

- Explore striking with different body parts i.e. feet, hands, head
- Striking from tees and balls suspended on string
- Give balls for children to feed themselves and progress to rolled balls

More Accessible...

- Strike bigger balls with feet or hands

More Challenging...

- Strike moving balls with smaller bats

More space...

- Saving Mowgli – play outdoors and encourage children to make up other related games

Think all children...

- Using STEP (page 7 of guide) to change activities will give more children a successful experience

Try... after main activity

- Progress speedy striker to encouraging the striker to score points by running between two markers
- Discuss which sports strike a ball e.g. cricket, golf tennis etc
- Introduce striking activities into a circuit
- Combine striking with targets (card 13)
- Penalty shoot out - with or without a goal keeper

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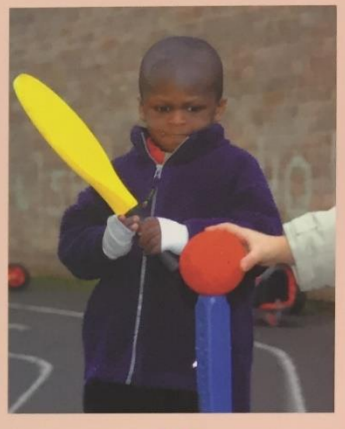
Liverpool Active City...

The City of Liverpool

Games



ACTIVITY 14

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Striking

Games

This card is designed to explore co-ordination through striking

How to play

1. Individually

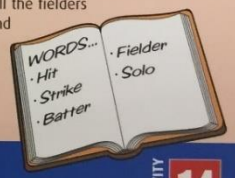
- children can explore with a variety of things to hit with...hands / feet / gloves / hand zones / bats / rackets etc
- Using a variety of balls.... Balloons / balsac balls / beach balls / Light weight / small / big / coloured and sound balls

2. In Pairs

- Saving Mowgli – in pairs one person strikes the ball and the other has to chase it and try and stop it reaching the (line) waterfall

3. group activity

- Speedy Striker – get group into pairs. Number 1 strikes and number 2 collects a ball. Strikers all strike their ball using a body part or bat and the fielders return one ball to their partner. Have a given number of turns and swap (progress to strikers counting number of jumps they can do before balls returned)
- Play snowball game from card 12 with balloons and encourage children not to catch but strike the balloon over a line to each other
- Solo speedy striker – 1 player strikes lots of balls, one at a time. All the fielders collect, return and change striker (groups of 5-7)



Look for... Gail's obvious preference for using her left hand and left foot, and Nadim's hand-eye co-ordination

Tip... Encourage children to keep watching the object while they strike it

ACTIVITY 14

Appendix Two

Interview Guides

Expert/Practitioner Interview Guide

Rationale	Research Question	Orienting Statement	Question	Follow Up/Prompts
Part One: Defining and understanding the importance of physical literacy				
Margaret Whitehead: *"Physical literacy can be considered as having the motivation, confidence, physical competence, knowledge and understanding that underpin one's values and responsibilities for life-long purposeful activity and pursuits"* Recent publications have provided both guidelines to help improve physical literacy (British Heart Foundation, 2015) and mandatory checks/requirements that preschool children will need to be meet (Early Years Foundation Stages Guidelines, 2015)	Explore experts differing opinions/ideas on what Physical Literacy is Knowledge and understanding of physical literacy What is the importance of physical literacy? What is the appropriateness of a physical literacy intervention for young children?	I would first like to talk about Physical Literacy in a broader sense	• What does it mean to you when experts/practitioners use the term *"Physical Literacy"*? • Why do you think that the promotion of physical literacy is important for young children? • What levels of physical literacy would you expect to see in young children?	Where does this come from? Whitehead definition? Perceived level vs. actual level
Part Two: Policy/Environment				

		It is fair to assume from the increasing body of literature that Physical Literacy is becoming a key research topic in relation to children's physical activity and health. With this in mind…	• What policies, if any, could be introduced to support the development of physical literacy in preschools? Local, i.e. in their settings (so they have control over them) or nationally	Difficulties faced when changing policy?
		In relation to preschool children's physical environment…	• What environmental changes could early years education providers make to improve preschool children's physical literacy? Tomorrow? Long-term?	Difficulties faced in changing physical environment?
Part Three: Training				
		With the majority of preschool interventions taking place in the preschool setting	• What knowledge and skills (expertise) do you think preschool setting staff require in order to improve	Where does this come from?

			children's physical literacy? • What type of training would be appropriate to upskill preschool setting staff in order to improve physical literacy?	 Delivered by? Duration? Offsite/onsite? Development plan?
Part Four: Intervention				
	Explore experts opinions/ideas on best practice for designing/delivering a Physical Literacy intervention	Moving on to the practicalities of delivering a physical literacy intervention	• Who in your opinion should design a physical literacy intervention for young children? • What would be the primary goal(s) of a physical literacy programme for young children (3-5 years)? • What activities and experiences would you include within an early years physical literacy intervention that can foster all	Rationale behind this Which would you say is most important? Rationale for this

			elements of physical literacy (motivation, confidence, commitment, physical competence, knowledge and understanding). • Who in your opinion should deliver a physical literacy intervention for young children? • What duration and dose of physical literacy intervention do you feel would be required to bring about a significant improvement in Physical Literacy? On what basis or grounds are you making that statement • Findings in previous research	Most Effective? Training for staff? Cost of external practitioners i.e. budget, longevity, sustainability Where do these figures come from / what are they based upon?

Previous research among young children has found that boys are more competent at object-control skills than girls. (Goodway et al, 2010; Hardy, King, Farell et al, 2010; Robinson, 2011; Spessato et al, 2012; Barnett et al, 2014)		When designing an intervention is it worth bearing in mind potential sex differences among young children	suggest that there may be merit to targeting boys and girls separately within an intervention? What do you think about this? • If you had an unlimited budget to create a physical literacy intervention, what would it look like?	Important to make preschool staff aware of gender differences? Aspects that could be implemented?
Part Five: Barriers				
		In a few sentences…	• What do you feel are the main barriers to improving physical literacy in preschools? Locally? Nationally? • How do you think that these barriers could be overcome? • If you could meet with the Minister of State for Children and Families what	

			changes would you ask for in order to help improve physical literacy?	

Perspectives of experts and practitioners on the development of a physical literacy intervention for preschool children

Expert/Practitioner Interview

Introduction

Hell my name is Jonathan Foulkes, I am a researcher from Liverpool John Moores University.

You recently agreed to take part in a telephone/Skype interview as part of a research project that is looking to inform the development of an appropriate intervention to increase the physical literacy of preschool children.

Is now a convenient time to conduct this interview?

If **Yes,** proceed.

Part One: Defining and Understanding the Importance of Physical Literacy

To begin with I would like to start talking about Physical Literacy in a broader sense.

"Physical literacy can be considered as having the motivation, confidence, physical competence, knowledge and understanding that underpin one's values and responsibilities for life-long purposeful activity and pursuits"

Margaret Whitehead

1. What does it mean to you when experts/practitioners use the term *"Physical Literacy"*?

- Where does this come from?
    - Whitehead definition?

2. Why do you think that the promotion of physical literacy is important for young children?

3. What levels of physical literacy would you expect to see in young children?

- Perceived level vs. actual level

Part Two: Policy / Environments

It is fair to assume from the increasing body of literature that Physical Literacy is becoming a key research topic in relation to children's physical activity and health. With this in mind…

4. What policies, if any, could be introduced to support the development of physical literacy in preschools? Local, i.e. in their settings (so they have control over them) or nationally

- Difficulties faced when changing policy?

In relation to preschool children's physical environment…

5. What environmental changes could early years education providers make to improve preschool children's physical literacy? Tomorrow? Long-term?

- Difficulties faced in changing physical environment?

Part Three: Training

With the majority of preschool interventions taking place in the preschool setting…

6. What knowledge and skills (expertise) do you think preschool setting staff require in order to improve children's physical literacy?

- Where does this come from?

7. What type of training would be appropriate to upskill preschool setting staff in order to improve physical literacy?

- Delivered by?
- Duration?
- Offsite / Onsite?
- Development Plan?

Part Four: Intervention

Moving on to the practicalities of delivering a physical literacy intervention…

8. Who in your opinion should design a physical literacy intervention for young children?

- Rationale behind this

9. What would be the primary goal(s) of a physical literacy programme for young children (3-5 years)?

- Which would you say is most important?

10. What activities and experiences would you include within an early years physical literacy intervention that can foster all elements of physical literacy (motivation, confidence, commitment, physical competence, knowledge and understanding).

- Rationale for this

11. Who in your opinion should deliver a physical literacy intervention for young children?

- Most effective?
- Training for staff?
- Cost of external practitioners i.e. budget, longevity, sustainability

12. What duration and dose of physical literacy intervention do you feel would be required to bring about a significant improvement in Physical Literacy? On what basis or grounds are you making that statement

- Where do these figures come from / what are they based upon?

When designing an intervention is it worth bearing in mind potential sex differences among young children…

13. Findings in previous research suggest that there may be merit to targeting boys and girls separately within an intervention? What do you think about this?

- Importance of making preschool staff aware of gender differences?

14. If you had an unlimited budget to create a physical literacy intervention, what would it look like?

- Aspects that could be implemented?

Part Five: Barriers

Finally, moving on to barriers that may affect the development of physical literacy…

15. What do you feel are the main barriers to improving physical literacy in preschools? Locally? Nationally?

16. How do you think these barriers could be overcome?

Final question, in a few sentences…

17. If you could meet with the Minister of State for Children and Families what changes would you ask for in order to help improve physical literacy?

Interview Completed

Thank you for your time

Appendix Three

Focus Group Guides

Practitioner Focus Group Guide

Rationale	Research Question	Orienting Statement	Question	Follow Up/Prompts
Introduction				
		Whitehead definition of Physical Literacy on Display throughout BHF Infographic on display throughout		
Part One: Defining and understanding the importance of physical literacy				
Margaret Whitehead: *"Physical literacy can be considered as having the motivation, confidence, physical competence, knowledge and understanding that underpin one's values and responsibilities for life-long purposeful activity and pursuits"* Recent publications have provided both guidelines to help improve physical literacy (British Heart	Explore practitioners differing opinions/ideas on what Physical Literacy is Knowledge and understanding of physical literacy What is the importance of physical literacy? What is the appropriateness of a physical literacy intervention for young children?	I would first like to talk about the idea of Physical Literacy in a broad sense **[Addressed to Group]** **[Addressed to Individuals]** **[Addressed to Group]**	• What does it mean to you when you hear someone use the term *"Physical Literacy"*? **[Flip Chart 1]** • Is the promotion of physical literacy important for young children? • What levels of physical literacy do you see among the children in your centre?	Have you heard this term before? Whitehead definition? If so, why? How are you measuring this?

Foundation, 2015) and mandatory checks/requirements that preschool children will need to be meet (Early Years Foundation Stages Guidelines, 2015)		**[Addressed to Group]**	• Is children's physical literacy a priority in your centre?	Do other aspects of the curriculum come first?
Part Two: Policy/Environment				
	Explore practitioners differing opinions/ideas as to policy and the preschool environment's effect on physical literacy	Recent research suggests that physical literacy is becoming more important in relation to children's physical activity and health. With this in mind… **[Addressed to Group]** **[Addressed to Group]**	• Do you think your centre's current physical environment is conducive to improving physical literacy? **[Flip Chart 2]** • What changes could be made to the physical environment of your centre to help improve children's physical literacy? **[Flip Chart 2]** • What policies, if any, could be introduced to support the development of	Current facilities: Outdoor space? Fixed/Mobile equipment? Playground markings? Tomorrow? Long-term? Difficulties faced in changing physical environment?

		A number of experts I spoke to gave me some of their ideas on how to change the preschool environment in order to help improve physical literacy. What are your opinions on these? **[Addressed to Group]**	physical literacy in preschools? Local, i.e. in their centre (so they have control over them) or nationally? Expert Ideas: • Greater learning through play • Mandatory outdoor play • Mobile play equipment • Limited seating time **[Flipchart 3]**	Difficulties faced when changing policy?
Part Three: Training				
		Within the scientific research, the majority of preschool interventions take place in the preschool setting **[Addressed to Group]**	• What knowledge and skills (qualifications) do you think setting staff require in order to improve children's physical literacy? **[Flipchart 4]** • What type of training do you	Have you received any training relating to physical literacy or similar? Delivery?

		Similarly I asked a number of experts for their opinions on training for centre staff. What are your opinions on these? **[Addressed to Group]**	think would be best to upskill your centre staff in order to help improve children's physical literacy? **[Flipchart 5]** Expert Ideas: • Child development & motor skill competence • Understanding of physical literacy • Understanding of physical activity **[Flipchart 6]**	Duration? Offsite/onsite? Development plan?
Part Four: Programme				
	Explore practitioners opinions/ideas on best practice for designing/delivering a Physical Literacy intervention Gain practitioners opinions on the ideas put forward by the expert group	Moving on to the practicalities of delivering a physical literacy programme Amongst yourselves… **[Addressed to Group]**	• Who do you think is best placed to design a physical literacy programme for young children? • What would be the primary goal(s) of a physical literacy programme in your centre? **[Flipchart 7]**	Setting staff? PE Coordinator? Academics? Necessary time/skills to do this? Which would you say is most important?

Previous research among young children has found that boys are more competent at object-control		**[Addressed to Group]** Some experts believe that improvements in physical literacy can be brought about in as little as six weeks, others see it as a more long-term programme to be implemented… **[Addressed to Group]** **[Addressed to Group]**	• What activities and experiences would you like to see included in a preschool programme? **[Flipchart 7]** • Who do you think should be responsible for delivering a physical literacy programme for preschool children? • How long do you think a physical literacy programme would have to run in your centre to bring about significant improvements in Physical Literacy? • If you had an unlimited budget to create a physical literacy intervention for your centre, what would it look like?	Refer to Whitehead example on board Try to cover as many aspects of PL from the definition Yourselves (setting staff)? External practitioners? Changes to curriculum? Staff engagement? Long-term development? Aspects that could be implemented?

skills than girls. (Goodway et al, 2010; Hardy, King, Farell et al, 2010; Robinson, 2011; Spessato et al, 2012; Barnett et al, 2014)			**[Flipchart 8]** • What about a limited budget? **[Flipchart 8]**	Aspects that could be implemented?
Part Five: Barriers				
		[Addressed to Group] **[Addressed to Group]** In a few sentences…	• What do you think are the 3 main barriers to improving physical literacy in your centre? **[Flipchart 9]** • How do you think these barriers could be overcome? **[Flipchart 9]** • If you could meet with the Minister of State for Children and Families what changes would you ask for in order to help improve physical literacy among preschool children?	

Focus Group Questions

Introduction

Firstly, thank you all thank for taking part in todays' focus group. The main theme of the focus group will be children's *"Physical Literacy"* and ideas about how we can seek to improve it.

Prior to these focus groups taking part I interviewed a number of experts and practitioners from within the field of children's physical activity and health on this topic of children's physical literacy. The answers they gave have helped to shape and inform the questions I will be asking you today, and in some instances I will be using direct quotes from these interviews, in order to gauge your opinions and promote discussion.

Throughout the focus group I will also be referring to the flipchart and writing down ideas and suggestions. This will help to aid the flow of the discussion and aid in the analysis of this session.

Before we begin I would like to ask if everyone is happy for this focus group to be recorded [audio]. **Yes** **No**

Yes

With regards to the format of the focus group, whenever possible can people try not to speak over each other as this makes it very difficult to transcribe what is being said and may result in important information being lost

Does anybody have any questions?

Yes **No**

No Proceed with the focus group

Begin by having participants introduce themselves individually for the purposes of identifying them during transcription.

Part One: Defining and Understanding Physical Literacy

To begin with, in this first section of the focus group we'll be looking at physical literacy in a broad sense and your understanding of what this means.

1. What does it mean to you when you hear someone use the term *"Physical Literacy"*? **[Flip Chart 1]**

   - Have you heard this term before? **[Flipchart 2]**
   - Whitehead definition? **[Flipchart 3]**

2. Is the promotion of physical literacy important for young children (3-5 yrs.)?

   - If so, why?

3. What level of physical literacy do you see among the children in your centre?

- How are you measuring this?

4. How does children's feature in your in your centre programming/curriculum

- Do other aspects of the curriculum come first?
- Is it a priority?

Part Two: Policy/Environments

So moving on to section two, we'll now look at policy and the preschool environment in relation to physical literacy; there are no definitions to work off in this section, just your own responses to questions.

Recent research suggests that physical literacy is becoming more important in relation to children's physical activity and health. With this in mind…

5. Do you think your centre's current physical environment is helpful in improving physical literacy? **[Flip Chart 5]**

- Current facilities:
- Outdoor space?
- Fixed/Mobile equipment?
- Playground markings?

6. What changes could be made to the physical environment of your centre to help improve children's physical literacy? **[Flip Chart 5]**

- Tomorrow?
- Long-term?
- Difficulties faced in changing environment?

7. What policies, if any, could be introduced to support the development of physical literacy in preschools?

A.Locally i.e. in your centre (staff have control of them)?

B. Nationally?

- Difficulties faced when changing policy?

8. Having asked a number of experts within this field for their views on how to improve the preschool environment to promote physical literacy they gave me a number of their ideas. I'd be interested to hear your opinions on these **[Flipchart 5, 6 & 7]**:

- Greater learning through play
- Mandatory outdoor play
- Mobile play equipment
- Limited seating time

Part Three: Training

Ok, so moving on again to section three where we'll be looking at training for preschool staff in order to help improve children's physical literacy. With the majority of preschool programmes taking place within the preschool setting…

9. What do you think setting staff need in order to improve children's physical literacy? Knowledge, skills, qualifications? **[Flipchart 8]**

    - Have you received any training relating to physical literacy or similar?

10. What type of training as a priority do you think would be best to upskill your centre staff in order to help improve children's physical literacy? **[Flipchart 8]**

    - Delivery?
    - Duration?
    - Offsite/Onsite?
    - Development Plan?

11. Again having asked a number of experts what kind of training they feel preschool staff require in order to aid them in improving children's physical literacy they were forthcoming with a number of ideas. I'd like to hear your opinions on these ideas. **[Flipchart 9 & 10]**:

    - Child development & motor skill competence
    - Understanding of physical literacy
    - Understanding of physical activity

Part Four: Programme

This next section we will move on to looking at the practicalities of delivering a physical literacy programme…

12. Who do you think is best placed to ***design*** a physical literacy programme for young children? **[Flipchart 11]**

If not considered by staff:

- Setting Staff?
- PE Coordinator?
- Academics

13. What would be the primary goal(s) of a physical literacy programme in your centre? **[Flipchart 11]**

    - Which would you say is most important?

14. What activities and experiences would you like to see included in a preschool programme? **[Flipchart 11]**

    - Try to cover as many aspects of physical literacy
    - Why?

15. Who do you think should be responsible for delivering a physical literacy programme for preschool children?

- Yourselves (setting staff)?
- External practitioners?

16. How long do you think a physical literacy programme would have to run in your centre to bring about a positive/identifiable improvement in Physical Literacy?

- Changes to curriculum?
- Staff engagement?
- Long-term development plan?

17. If you had an unlimited budget to create a physical literacy intervention for your centre, what would it look like? **[Flipchart 12]**

- Aspects that could be implemented?

18. What about a limited budget? **[Flipchart 12]**

- Aspects that could be implemented?

Part Five: Barriers

Moving on to our final section we'll look at potential barriers that may affect the development of physical literacy…

19. What do you think are the 3 main barriers right now to improving physical literacy in your centre? **[Flipchart 13]**

- Which is the main one?

20. How do you think these barriers could be overcome? **[Flipchart 13]**

21. If you could meet with the Minister for Children and Families what changes would you ask for in order to help improve physical literacy among preschool children?

Focus Group Completed

Thank you for your time