Physical activity, sedentary and playtime behaviours in children and adolescents with intellectual disabilities

Samantha Jayne Downs

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Abstract

Despite the wealth of research examining physical activity (PA) in children and adolescent without disability, there is a lack of research that has focussed on PA related to children and adolescents with intellectual disabilities (ID). The evidence that does exist in this area suggests that children and adolescents with ID are less active than their non-ID peers. The school environment offers numerous opportunities to engage in PA regularly, yet to date, school-based research focussing on PA in children and adolescents with ID is limited. Thus, the primary aim of this thesis was to investigate PA, sedentary time (ST) and playtime behaviours in children and adolescents with ID.

Four study chapters are included in the thesis. Study 1 used uniaxial accelerometers to investigate habitual PA levels, sedentary behaviour and PA patterns in children and adolescents with severe and moderate ID. Results demonstrated that participants engaged in low amounts of PA, spent a large proportion of waking hours in ST and mainly engaged in short, sporadic bursts of PA.

Study 2 investigated the PA levels of children and adolescents with severe and moderate ID during playtime and PE contexts using direct observation techniques. Participants engaged in similar levels of moderate to vigorous PA (MVPA), and spent minimal amounts of time engaging in sport based activities during playtime and PE. At playtime participants spent the majority of time playing alone or in small groups and no participants engaged in any large group play.

Study 3 explored teachers' perceptions of PA engagement for children and adolescents with ID. Teachers reported that pupils prefer to engage in fun, unstructured activities. Parents and teachers were identified as key role models who can influence PA engagement for this population and teacher participants explained that pupils with ID have limited understanding around PA and the benefits to health.

Study 4 evaluated the effectiveness of a school-based PA intervention, delivered in two primary special educational needs (SEN) schools. The intervention demonstrated promising results, with an increase in accelerometer assessed MVPA levels between baseline and follow up of ~18mins. However, these findings were not statistically significant, possibly due to the small sample size involved. Minimum clinically important difference analysis suggested that changes in MVPA were likely to be beneficial to heath. Furthermore, qualitative data generated through teacher interviews highlighted positive intervention effects across the school.

Overall the studies presented in this thesis provide an overview of PA engagement and associated behaviours in children and adolescents with ID. The major findings presented suggest that children and adolescents with moderate and severe ID are not sufficiently active, and the SEN school environment may be an important area to target PA interventions. The current thesis has made a significant contribution to our understanding related to the PA in children and adolescents with ID and has highlighted a number of recommendations for future research.

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Declarations

I declare that the work contained within this thesis is entirely my own.

Publications directly based on the work described in the thesis

Downs SJ, Knowles ZR, Fairclough SJ, Heffernan N, Whitehead S, Halliwell S, Boddy LM. 2014. Exploring teachers' perceptions on physical activity engagement for children and young people with intellectual disabilities. *European Journal of Special Needs Education*. 29, 402-414.

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Oral communications

Downs SJ, Boddy LM, Knowles ZR, Fairclough SJ, Stratton G. Exploring opportunities available and perceived barriers to physical activity engagement in children and young people with Down syndrome. British Association of Sport and Exercise Sciences Student Conference. Cardiff, UK, 2013.

Downs SJ, Fairclough SJ, Knowles ZR, & Boddy LM. Investigating physical activity in children and young people with intellectual disabilities using objective methods. European College of Sports Science. Amsterdam, NL, 2014.

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Poster communications

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Taylor S, Knowles ZR, Fairclough SJ, Whitehead E, Boddy LM, & **Downs SJ.** A short bout physical activity intervention for children with intellectual disabilities – effects of, and teacher self-efficacy towards implementation. British Association of Sport and Exercise Sciences Student Conference. Liverpool, UK, 2015.

Poster communications derived from data contained within this thesis

Sharples F, Mathieson A, Knowles ZR, Fairclough SJ, Boddy LM, & **Downs SJ.** Do teacher interactions and use of equipment have an effect on the physical activity levels during recess in children with intellectual disabilities? British Association of Sport and Exercise Sciences Student Conference. Liverpool, UK, 2015.

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List of abbreviations

ADHD	Attention deficit hyperactive disorder
ASC	Autistic spectrum condition
BMI	Body mass index
DO	Direct observation
DS	Down syndrome
ID	Intellectual disabilities
Kg	Kilogram
LD	Learning difficulties
LPA	Light intensity physical activity
Min	Minutes
MLD	Moderate learning difficulties
MPA	Moderate intensity physical activity
MVPA	Moderate to vigorous intensity physical activity
PA	Physical activity
PMLD	Profound and multiple learning difficulties
S	Second
SEN	Special educational needs
SLD	Severe learning difficulties
VPA	Vigorous intensity physical activity
YPAPM	Youth physical activity promotion model

Glossary of Terms

Children and adolescents	People aged between 5 – 18 years.
Children	Children aged between 5 – 11 years.
Sedentary time	Sedentary time is described as an absence of whole body movement (Healy et al., 2008), where energy expenditure is very low (<2.0 metabolic equivalents [METs]) and usually includes activities which involve a sitting or lying posture (Salmon et al., 2003).
Physical activity	Defined as 'any bodily movement produced by skeletal muscles resulting in energy expenditure.' (Caspersen et al., 1985, p. 126).
Intellectual disabilities	Defined as 'a significantly reduced ability to understand new or complex information and to learn and apply new skills (impaired intelligence). This results in a reduced ability to cope independently (impaired social functioning), and begins before adulthood, with a lasting effect on development' (WHO, 2014).
Learning difficulties	'A person has a learning difficulty if – (a) He has a significantly greater difficulty in learning than the majority of persons of his age, or (b) He has a disability which either prevents or hinders him from making use of facilities of a kind generally provided in pursuance of the duty under subsection (1) for persons of his age. (1) A local education authority shall secure the provision for their area of adequate facilities for further education.' (Education Act, 1996, p. 7).

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Chapter 1

Introduction

1.1 The research area

Physical activities include a vast array of activities including walking, swimming, cycling, football, active play etc. Within this thesis physical activity (PA) is defined as 'Any bodily movement produced by the skeletal muscles that results in energy expenditure.' (Caspersen et al., 1985, p. 126). PA is associated with a range of mental (Department of Health, 2011) and physical (Ekelund et al., 2005) health benefits. The Chief Medical Officer (CMO) recommends that children and young people (5 - 18 years) should engage in a minimum of 60 minutes and up to several hours of moderate to vigorous intensity PA (MVPA) every day (Department of Health, 2011). Despite the established benefits of PA and suggested PA guidelines, many children do not meet the minimum recommended amount of PA (Griffiths et al., 2013). Moreover, while the majority of PA based research has focussed on the prevalence of activity, correlates, determinants and PA behaviours of healthy children and young people, few PA studies to date have focused on special populations such as children and adolescents with intellectual disabilities (ID) (Frey et al., 2008). Further, Sit et al. (2007) reports that different special population groups (i.e., ID, hearing impairments, physical disabilities, visual impairments) engage in different amounts of PA, perhaps due to the varying activity restrictions (Sit et al., 2007). As a result, investigating these populations separately is logical. ID can range in severity from mild through to profound and multiple ID. For the purposes of this thesis ID are defined as 'a significantly reduced ability to understand new or complex information and to learn and apply new skills (impaired intelligence). This results in a reduced ability to cope independently (impaired social functioning), and begins before adulthood, with a lasting effect on development.' (WHO, 2014).

Emerging evidence suggests that children and adolescents with ID do not achieve the recommended PA guidelines, reporting consistently lower levels of PA when compared to their non-ID peers (Hinckson and Curtis, 2013). These findings are in agreement with the limited previous research investigating PA in youth and adults with ID (Frey et al., 2008, Phillips and Holland, 2011). Hinckson and Curtis (2013) also noted that the majority of studies were conducted within the US and more studies were needed elsewhere. As a result, little is known about the habitual PA levels of children and adolescents with ID living within the UK. This data is needed to establish how active this group of the population are, whether they are at risk of inactivity related ill health, and to identify whether PA promotion interventions are needed.

It is important to highlight that PA can be engaged in within a variety of settings and at different segments of the day. The school environment is one of these settings, and in the UK between the ages of 4 - 16 years school education is compulsory (Roberts and Fairclough, 2012). The school environment offers children and adolescents structured compulsory (e.g., physical education (PE)), structured optional (e.g., after school and lunch time clubs) and informal (e.g., playtimes and active travel) opportunities to take part in regular PA (Fairclough et al., 2012), and therefore has potential to contribute to overall PA levels exhibited by this age group. When looking specifically at opportunities during school time (9am–3pm, Monday - Friday) research conducted in mainstream populations, particularly research investigating playtime and PE (Ridgers et al., 2012b, McKenzie and van der Mars, 2015) is well documented. However, there is a lack of research conducted in this area which focuses on children and adolescents with ID. Furthermore, Sit et al. (2007) describe

that more PA research conducted in special populations investigating different environments including PE and playtime is needed to better understand how these children and adolescents accrue PA. It is clear that the school environment is an important aspect of children and adolescents' day to day life, and has the potential to offer multiple opportunities to engage in PA. Further research is needed to explore PA engagement and opportunities available in special educational needs (SEN) schools for children and adolescents with ID in the UK, in turn this will improve researchers' understanding of where PA based interventions are needed and how they may be beneficial for this population.

1.3 Determinants of PA and theoretical framework

There are a number of determinants that influence PA behaviour including; biological, developmental, psychological, environmental, social and cultural factors (Sallis et al., 1992). Because of the number of influencing factors, behaviours amongst children and adolescents can be difficult to change. Welk (1999) outlines that there are clear differences between children and adults with regards to their motives and influences to engage in PA regularly, and suggests that these differences should be considered to aid understanding of their behaviour. Moreover, Sallis et al. (1992) describe how the importance of influencing factors may differ between different populations. Therefore, having an increased understanding of the correlates that directly and indirectly influence PA behaviours of a desired population is favourable in order to improve PA levels and effectively promote healthy lifestyles (Sallis et al., 1992). Theoretical frameworks are used to highlight and better understand these factors and behaviours which prevent or enable PA engagement. Moreover, studies that are centred on these models all aim to identify and understand

these influencing factors in a specific group, setting or context, which are used to address the research problem (Lyn, 2010). It is suggested that research groups will be more effective if these factors are considered and that researchers should strive to establish the reasons why a specific population is either unwilling or unable to participate in PA regularly (Lyn, 2010).

Various theoretical frameworks have been developed to understand and promote PA. The Youth Physical Activity Promotion Model (YPAPM) is a conceptual framework used to understand personal, social and environmental factors which influence PA behaviour in children and adolescents. The YPAPM was developed to draw on these influencing factors to assist researchers with the transition of theory to practice (Welk, 1999). This social-ecological framework allows enabling, predisposing and reinforcing factors associated with PA in youth to be acknowledged.

The studies within this thesis are underpinned by the YPAPM which is made up of three phases;

1. Considering behavioural and environmental issues to outline primary determinants of the given behaviour.
2. To identify and to categorise determinants into predisposing, enabling or reinforcing factors, and further organising them into order of importance for the given behaviour.
3. To draw on the influencing factors and barriers to PA engagement for youth and use them to aid the design of suitable PA interventions (Welk, 1999).

Figure 1.1 The youth physical activity promotion model (Welk, 1999) originally presented here cannot be made freely available via LJMU Digital Collections because of copyright issues. Figure 1.1 The youth physical activity promotion model (Welk, 1999) was sourced at WELK, G. J. 1999. The youth physical activity promotion model: a conceptual bridge between theory and practice. *Quest,* 51**,** 5-23.

Figure 1.1 The youth physical activity promotion model (Welk, 1999)

Phase one of the YPAPM underpins Studies 1 and 2 firstly, by examining the PA behaviours and sedentary time (ST) with regards to the participants' tempo of PA, whilst also exploring the relationship between social factors and PA levels, such as group size at playtime. Using direct observation techniques within different settings (playtime and PE) also outlined environmental issues and reinforcing factors, via peer or teacher interactions within both settings. These objective methods were further supported by qualitative investigation. Focus groups were used in Study 3 to explore teachers' perceptions on PA engagement for children and adolescents with ID; the YPAPM was used to develop a semi-structured focus group schedule to draw on influencing factors such as those described in phase two above. Key findings and influencing factors identified in Studies 1 – 3 were reflected upon and used to inform the design and implementation of the intervention study (Study 4) which is underpinned by the third phase of the YPAPM.

1.3 Organisation of the thesis

The central theme of this thesis was to investigate PA, ST and playtime behaviours in children and adolescents with ID. The thesis includes a literature review, four study chapters and a synthesis. Chapter 2 (literature review) critically examined current and relevant research outlining gaps in the evidence base providing a rationale and aims for the subsequent study chapters. Chapter 3 (Study 1) examined habitual PA and ST and investigated the tempo of PA in children and adolescents with ID. Chapter 4 (Study 2) investigated PA behaviours and contexts during playtime periods and PE lessons amongst children and adolescents with ID. Chapter 5 (Study 3) explored teachers' perceptions on PA engagement for children and adolescents with ID. Chapter 6 (Study 4) is divided into parts (Part A and Part B), collectively they used quantitative and qualitative methods to evaluate the effect of a pilot school-based PA intervention for children with ID carried out within two primary SEN schools. To conclude, Chapter 7 provides a synthesis of the results from the four study chapters and draws on their implications for the research area, finally providing recommendations for future research.

Prior to the start of each study chapter a 'thesis study map' is presented which demonstrates the objectives of the subsequent study, key findings of the previous study and outlines where each study fits into the overall thesis.

Below is an example of a thesis study map which would be presented before Study 1:

Study	Objectives
Study 1: Investigating habitual physical activity levels, sedentary behaviours and the tempo of physical activity in children and adolescents with intellectual disabilities	Objectives: • To objectively investigate habitual PA and sedentary behaviours of children and adolescents with ID. • To examine the tempo of PA by sex, age and disability.
Study 2: An investigation of physical activity behaviours and context during playtime and Physical Education lessons in children and adolescents with intellectual disabilities	
Study 3: Exploring teachers' perceptions on physical activity engagement for children and adolescents with intellectual disabilities	
Study 4: The evaluation of a pilot school-based physical activity intervention for children with intellectual disabilities attending special educational needs schools in the North West of England.	

1.3.1 Data collection time frame

Within the four study chapters there was some overlap in participant study samples details are presented in Table 1.1 below. Baseline data collected from new recruits in Study 4 was also used in Study 1 to bolster participant numbers within the cross-sectional analysis.

Table 1.1 Data collection time frame

Thesis chapter and study	Data collected	Time frame
Chapter 3, Study 1	Accelerometer	January 2013
Chapter 4, Study 2	Playtime and PE direct observation (DO)	January and February 2013
Chapter 5, Study 3	Focus groups	December 2012
Chapter 6, Study 4	Baseline, accelerometer and playtime DO	September 2013
	Post intervention, accelerometer, playtime DO and teacher interviews	January and February 2014 (accelerometer & DO) February and March 2014 (interviews)
	Follow up, accelerometer and playtime DO	May and June 2014

Chapter 2

Literature Review

2.3 Introduction

This review will draw on literature related to physical activity (PA) and its importance for health in children and adolescents, and specifically youth with intellectual disabilities (ID) to aid the readers understanding of the research area. To conduct the literature review a search of the following data bases was conducted; PubMed and Google Scholar. In addition, the reference list of key papers was revised to check for supplementary papers. A full systematic review was not conducted. Published evidence from cross-sectional, longitudinal and experimental research studies will be examined and discussed providing a clear rationale for the following research studies included within this thesis. As a result of the limited literature in PA and youth with ID this review will include literature and statistics from mainstream populations as well as ID populations. The literature review will cover a number of research areas in the following order: (1) PA and health in children and adolescents, (2) sedentary time (ST), (3) measurement of PA and ST, (4), the population, (5) PA and ID, (6) PA interventions for children and adolescents. Finally a summary and rationale will lead into the aims and objectives of the thesis.

2.2 Physical activity and health in children and adolescents

The World Health Organisation (WHO) (2010) states that chronic diseases kill more than 36 million people globally each year; of which the majority of deaths are due to cardiovascular disease (CVD), followed by cancer, respiratory diseases, and diabetes. Physical inactivity is a common risk factor for all four of these disease clusters, it is estimated that as a direct result of physical inactivity approximately 3.2million deaths occur annually (WHO, 2010). It is well established that PA has numerous benefits to health and regular engagement contributes to the prevention of various

chronic diseases and conditions for school aged children, for example; overweight and obesity, high blood pressure, poor bone health and reduced mental health (Janssen and LeBlanc, 2010). Further, cardiorespiratory fitness, an independent determinant of health, and in particular cardiometabolic health (Anderson et al., 2008), is the product of PA (Ortega et al., 2008). Also, more recently, improved cardiometabolic risk factors are associated with increased levels of moderate to vigorous physical activity (MVPA) in children and young people (aged 4 – 18 years) (Ekelund et al., 2012). In addition to the health benefits listed, PA and active breaks are associated with improvements in on-task behaviour during lesson time for children with and without disability (Jarrett et al., 1998, Mahar et al., 2006). More recently, Booth et al. (2013) reported a long-term positive association between MVPA on academic attainment in a large cohort (n = 4755) of UK adolescents.

Results from experimental studies indicate that even modest amounts of PA can have tremendous health benefits in high risk youngsters such as those who are obese (Janssen and LeBlanc, 2010). It is also reported that some PA engagement is better than none and more PA engagement is better than some (Powell et al., 2011). Current UK PA guidelines outline that children and young people between the ages of 5 – 18 years should engage in a minimum of 60 minutes and up to several hours of MVPA every day (Department of Health, 2011). Also, on at least 3 days per week children and young people should integrate vigorous intensity activities including those that strengthen bone and muscle. Finally children and young people should aim to reduce the amount of time spent being sedentary for extended periods of time (Department of Health, 2011). It is further suggested that the guidelines should be altered and modified where necessary to ensure appropriateness dependant on the

child or young person's individual needs and abilities. Children and adolescents who meet the recommended amounts of PA engagement may achieve short and long term health benefits. Health benefits include; maintaining healthy weight, improvements to cardiovascular health, bone health, cardiorespiratory fitness, self-confidence, social skills, muscle strength, and reductions in body fat and symptoms of anxiety and depression (Department of Health, 2011). In turn these benefits reduce the risk of chronic diseases and conditions described earlier. Despite these health benefits, many children and adolescents do not meet the minimum recommendations. One study collected data between May 2008 and August 2009 from a UK cohort of children aged 7 – 8 years, which suggested that only 51% of children met the CMO guidelines and boys (63% met guidelines) were reported to be more active than girls (38% met guidelines) (Griffiths et al., 2013). Hallal et al. (2012) described worldwide PA levels for a cohort of 13 – 15 year old adolescents from over 100 countries, reporting that ~80% of adolescents did not meet the minimum recommendation of 60minutes of MVPA per day. Hallal et al. (2012) suggested that advances in modern technologies (e.g., transportation, escalators and wireless telephones) have resulted in a reduction in the physical labour needed to complete a task (i.e., travelling to school) which in turn has been described to have impacted upon PA levels. Evidence of Negative changes in PA behaviours has been mounting over many years. For example, 10 years ago active travel to and from school was unfamiliar as it was increasingly replaced by sedentary alternatives (Boreham and Riddoch, 2001). As routinely active habits are replaced by sedentary alternatives providing opportunities to engage in activities in other aspects of the day is crucial.

2.3 Sedentary time

ST is described as an absence of whole body movement (Healy et al., 2008) where energy expenditure is very low (<2.0 metabolic equivalents [METs]) and usually includes activities which involve a sitting or lying posture (Salmon et al., 2003). In recent years the whole population's sedentary behaviours and specifically those involving long periods of sitting have increased (Hamilton et al., 2007). A typical day can offer many opportunities to accrue ST and for children this can occur in and out of school time for example during; leisure activities, playtime periods, travel time and meal times. Children and young people (6 – 19 years) are reported to spend approximately 6 – 8 hours each day engaging in sedentary behaviours (Froberg and Raustorp, 2014). Similarly to the reasons for the reduction in PA levels, Hamilton et al. (2007) suggest that globally time spent sedentary will continue to increase due to readily available appliances which promote sedentary behaviours, e.g., computers and television. This is a concern as in adult populations activities involving prolonged periods of inactivity have been associated with the increased risk of various chronic diseases including obesity, metabolic syndrome, type 2 diabetes and cardiovascular disease (Hamilton et al., 2007, Healy et al., 2008) The importance of reducing such behaviours has been noted for children and adolescents. For example, ST was associated with adiposity in a cohort of 9 -10 year old British children (Steele et al., 2009). Further, Sardinha et al. (2008) demonstrated a positive association between ST and insulin resistance and also highlighted the importance of decreasing sedentary behaviours in children to influence potential benefits on metabolic risk factors regardless of adiposity. However, conflicting evidence from a recent review, suggests that minimal evidence exists that supports an association between ST and individual and clustered cardiometabolic risk in children (Froberg

and Raustorp, 2014). Nevertheless, authors still advise that children and adolescents should be encouraged to reduce excessive periods of ST and particularly screen-based activities (Froberg and Raustorp, 2014).

The balance of evidence suggests that benefits gained from regular PA and reduced ST is of the up most importance for health and should be actively promoted in children and adolescents. Boreham and Riddoch (2001) describe how PA can develop into a habit and further discuss the idea of 'tracking', suggesting an active child is more likely to become an active adult compared to an inactive or low active child. Earlier research suggested that engaging in sport activities throughout youth might provide a platform for PA engagment in years to come (Malina, 1996). More recently, the evidence base demonstrated low to moderate tracking coefficients for PA from childhood to adulthood (Telama et al., 2005). However, PA promotion is still encouraged for school aged children and adolescents as PA engagement in childhood appears to influence PA in later years, and is described to be important for the promotion of public health (Telama et al., 2005, Telama, 2009). Moreover, children are more likely to choose active pursuits in the absence of sedentary options (Boreham and Riddoch, 2001). The CMO emphasises the need to intervene at a young age in order to maintain high amounts of PA into adulthood, essentially reducing the risk of morbidity and mortality from chronic diseases in later life (Department of Health, 2011), proposing that the benefits attained within childhood years have long lasting effects into adulthood.

2.4 Measurement of PA and ST

It is important to accurately classify children and adolescent's PA levels and ST and understand these in relation to health outcomes (Ridgers and Fairclough, 2011). In order to accurately assess the amount of time spent in these behaviours it is important that the methods used are valid and reliable (Evenson et al., 2008). A wide range of methods are available to measure PA and ST. Some of the methods regularly used in children and adolescents include self-report, interviews, focus groups, direct observation (DO), pedometers, heart rate monitoring and accelerometers (Sirard and Pate, 2001). Researchers are interested in capturing the frequency, intensity, duration and type dimensions when examining PA and ST in children and adolescents (Sallis and Patrick, 1994). However, no stand-alone method can accurately capture all these dimensions (Welk, 2002). For example, an accelerometer captures the frequency, intensity and duration of activities but it cannot detect the types of activities engaged in (i.e., sports, locomotion, active play etc.) or the context in which they occur. Furthermore, children and adolescents' PA patterns are sporadic in nature, with majority of moderate and vigorous intensity continuous bouts lasting less than 10 seconds (Bailey et al., 1995, Baquet et al., 2007). As a result, PA amongst this age group is difficult to measure (Rowlands et al., 2008). In addition to the nature of PA patterns, difficulties in accurately measuring PA in children and adolescents are also evident due to cognitive, physiological, and biomechanical differences and changes (i.e., maturation) (Corder et al., 2008). This section of the literature review will examine accelerometers and DO in more detail assessing their use with children and adolescents, and will also discuss the use of qualitative measures to explore PA and ST, as these methods will be adopted throughout the study chapters.

2.4.1 Accelerometers

Accelerometers provide objective assessments of PA and ST and can be used in a variety of field and laboratory based settings across all age groups including children and adolescents (Sirard et al., 2005, Evenson et al., 2008). Accelerometers are an attractive alternative to self-report and DO techniques, reducing recall bias and overcoming issues with language and literacy difficulties (Evenson et al., 2008). These devices are piezoelectric transmitters that capture accelerations of human movement (Ridgers and Fairclough, 2011). Accelerations can be monitored on one (uniaxial) or more (triaxial) dimensions (Corder et al., 2008) and are then converted in to a value, known as a 'count'. These counts are collected and stored using a pre-determined time interval, known as an 'epoch' (Sirard et al., 2005). After processing the data, a pre-defined intensity cut-point threshold is applied to the accumulated counts per epoch and researchers can classify each epoch into PA intensities (light, moderate and vigorous) or ST (McClain et al., 2008). Epoch and intensity cut-point thresholds options will be discussed in more depth later.

Numerous accelerometer devices are used to measure PA and ST, but the most commonly used device in children's PA research is the ActiGraph (ActiGraph LLC, Pensacola, USA) (Corder et al., 2008). ActiGraph have produced both uniaxial and triaxial accelerometers, for this project uniaxial accelerometers were used and will be discussed further. The ActiGraph uniaxial accelerometer, is a small, lightweight monitor which detects motion in a vertical plane (Sirard et al., 2005). Uniaxial accelerometers should be worn as close to the participant's centre of mass as possible, for example worn around the waist and placed on the hip or lower back (Trost et al., 2005). The monitors are able to collect and store large amounts of

acceleration data with minimal interference for participants' daily life (Nilsson et al., 2002). Allowing researchers to collected PA data over a longer durations of time (i.e. 7 days), gaining a representative assessment of an individual's habitual PA whilst causing minimal participant burden. One limitation of accelerometers is that they do not detect activity type (Ridgers and Fairclough, 2011), and they are also limited in their ability to monitor water based activities and detect non-weight-bearing and upper body activities i.e., cycling or throwing a ball when stationary (Rowlands, 2007), diary logs can be used to add more detail of when and why the monitor was and wasn't worn.

The epoch length chosen has important implications for accurate activity measurement, and in previous research studies epoch lengths have ranged from 1 to 60 seconds (Baquet et al., 2007, Corder et al., 2008, Trost et al., 1998). More recently, technological advances allow the processing of raw data. Children and adolescents PA patterns are of an intermittent nature, characterised by short bursts of vigorous intensity PA broken up with interludes of lower intensity activities (Bailey et al., 1995), as a result for children, a shorter epoch (<5 seconds) is the most appropriate. Longer epochs (i.e., 60 seconds), although used in a range of early accelerometer studies (e.g., Riddoch et al., 2004), fail to detect short bouts of intensive activity when summed over 60seconds, and therefore underestimating overall levels of PA (McClain et al., 2008).

A 'bout' or 'bouts' of PA are used to define an individuals' pattern or tempo of PA. A bout is a period of time whereby the individual maintains a particular intensity of PA for a pre-defined time, therefore the end point of the bout is when the individual

enters into a different intensity of activity (Berman et al., 1998). The importance of monitoring bout length relates to health benefits. For example, an investigation of prolonged and shorter bouts of PA in a large cohort (n = 2109) of adults demonstrated no differences between MVPA of <10min or >10min bouts for CVD risk factors (Glazer et al., 2013). Authors suggested that this finding supports the notion, that small amounts of PA are better than none (Glazer et al., 2013), however PA recommendation suggest that adults should accrue MVPA in bouts of 10mins or more (Department of Health, 2011). Further, one study by Janz et al. (2005) suggests a positive association between continuous VPA bouts of at least 5 minutes and reduced adiposity in a cohort of 378 children aged 5.6 years at baseline. These findings emphasise the importance of investigating bout length in various intensities in addition to habitual PA. However, due to limited research in children and adolescents findings remain unclear (Rowlands et al., 2008).

The most common approach to convert accelerometer activity counts into activity intensities (i.e., sedentary, light, moderate and vigorous) is the use of intensity cut-point thresholds (Trost et al., 2011). Cut-points are determined by a single regression equation whereby an individual's activity counts are used to estimate energy expenditure (Bassett et al., 2012). Numerous sets of ActiGraph intensity cut-points have been developed for use within children and adolescents (e.g., Freedson et al., 2005, Mattocks et al., 2007, Evenson et al., 2008). To ensure accuracy when comparing studies, consistency of data collection and processing methods is necessary (Trost et al., 2011). Therefore Trost et al. (2011) conducted a study comparing 5 independently developed ActiGraph intensity cut-points to establish the most accurate criteria for use within children and adolescents. Of the 5 criteria

Evenson et al's. (2008) cut points (Table 2.1) were deemed the most appropriate cut-points providing accuracy for sedentary, light, moderate and vigorous activity levels across all ages of children and adolescents (Trost et al., 2011). It was suggested that the Evenson et al's. (2008) ActiGraph youth specific cut-points, should be used as the standardized approach for accelerometer data reduction to determine sedentary and PA intensities for this population (Trost et al., 2011).

Table 2.1 Sedentary time and physical activity intensity cut points defined by Evenson et al. (2008)

Activity intensity	**Cut points count per minute (cpm)**
Sedentary	≤100cpm
Light	101-2295cpm
Moderate	2296-4011cpm
Vigorous	≥4012cpm

A number of ActiGraph models have been developed since 2005 (GT1M, GT3X and GT3X+) which offer different technical advances (i.e., memory size, battery life and epoch setting) (Robusto and Trost, 2012). Advances such as increased memory size allowed researchers to select shorter epochs, which in turn enabled studies to capture and report the 'true' nature of PA exhibited by children and adolescents. (Robusto and Trost, 2012) investigated the agreement between ActiGraph models for use with children and adolescents, assessing total vertical axis counts, total vector magnitude and time spent in MVPA. It was concluded that the GT1M, GT3X and GT3X+ provided strong agreement and were yielded "interchangeable", and therefore are

suitable to use a combination of the models within the same study (Robusto and Trost, 2012).

2.4.2 Direct observation

DO is another objective method which is commonly used amongst children and adolescents to assess PA and ST, and can be used in various settings (McKenzie et al., 1992). Whilst direct observation offers rich data with regards to the lesson or playtime context for example, it is limited as it does not directly measure the intensity of PA in relation to energy expenditure (McNamee and van der Mars, 2005). However, unlike accelerometry DO provides information on the type of activity engaged in and energy expenditure can be estimated with the use of specifically designed tools (McNamee and van der Mars, 2005), such as the System for Observing Fitness Instruction Time (SOFIT) (McKenzie et al., 1991a). McKenzie and van der Mars (2015) highlighted other advantages of DO, including; high internal validity and low participant burden, whilst limitations include; intensive and time consuming observer training processes and potential participant reactivity (i.e., participants may react differently when being observed). Nevertheless, DO is described as the gold standard of PA assessment with regards to recognising the physical and social contexts in which the observations occur (McKenzie and van der Mars, 2015).

Numerous tools have been developed using consistent, validated PA level coding systems (McKenzie and van der Mars, 2015). The PA coding system included 5 levels (lying, sitting, standing, walking and very active) which were initially used in the SOFIT tool to assess Physical Education (PE) in school (McKenzie et al., 1991a).

Following SOFIT additional tools have been developed and have adopted the PA coding system to assess PA and associated behaviours in different settings. These tools are highlighted by McKenzie and van der Mars (2015) and include; the System for Observing Play and Leisure in Youth used to observe PA in school activity areas (SOPLAY;(McKenzie et al., 2000)), the System for Observing Play and Active Recreation in Communities used to observe PA in park and recreation settings (SOPARC; (McKenzie et al., 2006)), the System for Observing Children's Activity and Relationships during Play used to observe PA and play behaviours at school during playtime (SOCARP; (Ridgers et al., 2010c), and the Behaviors of Eating and Activity for Children's Health: Evaluation System used to observe PA and additional variables in the home environment (BEACHES; (McKenzie et al., 1991b). Moreover, the PA level coding system has been validated for assessment in children with disabilities (Faison-Hodge and Porretta, 2004, Sit et al., 2013), though DO literature within this population is limited. McKenzie and van der Mars (2015) highlighted this gap in the literature suggesting the potential for using DO to explore how PA during playtimes may be mediated by youth with specific disabilities. DO tools offer researchers the opportunity to assess PA levels and associated behaviours in various environments, providing reliable results which is important as different contexts can impact on PA and sedentary behaviours differently, further highlighting numerous opportunities and settings for researchers to intervene within (McKenzie and van der Mars, 2015).

Some of the study chapters within the current thesis objectively investigated PA and ST during the school environment. Therefore DO tools that assess playtime and PE periods were used to examine participants PA levels, ST and associated behaviours

during these periods and will be described further. The SOFIT tool was used to assess PA, lesson context (i.e., management, fitness, skills, knowledge and game play) and instructor behaviour (i.e., in and out-of-class PA promotion) within PE (McKenzie et al., 1991a) and the SOCARP tool is used to assess PA and play related behaviours (i.e., group size, activity type and physical/social peer interactions) within playtime periods (Ridgers et al., 2010c). The two tools were both deemed reliable and valid measures for use within children and adolescent populations (Ridgers et al., 2010c, McKenzie et al., 1991a). Furthermore, although continuous duration sampling is the "gold standard" (van der Mars, 1989) it is not always possible. As a result an alternative, reliable, method known as momentary time sampling (van der Mars, 1989) is used. Both systems use a 20 second momentary time sampling system, whereby the trained observer observes the participant for 10 seconds and on the 10^{th} second the observer records the participant's PA and associated behaviours allowing the observer 10 seconds to do so before the process begins again.

2.4.3 Interviews and focus groups

Qualitative measures are regularly used as an alternative or additional method when conducting research (Smith and Caddick, 2012). Such measures enable researchers to build on knowledge and explore participants' experiences of certain topics and are increasingly used in PA based research (Munroe-Chandler, 2005). The use of qualitative methods are encouraged within PA research and add valuable detail as a result of the in-depth information that can be gained via the various methodologies (Munroe-Chandler, 2005). Interviews are one of the most common qualitative methods used by sport and exercise scientists, and can employ a semi-structured

approach by using a pre-planned interview schedule which usually includes open ended questions to encourage rich and descriptive detail (Smith and Caddick, 2012). An alternative method is conducting focus groups which usually consist of 5 – 8 participants per group; this method allows group discussion and interaction about a specific topic(s). Similar to interviewing, a semi-structured approach can be used when conducting focus groups which are facilitated by the researcher (Smith and Caddick, 2012). In comparison to interviews, focus groups allow researchers to collect data on numerous participants during one session, perhaps making it a more efficient method; further, Munroe-Chandler (2005) suggests that focus groups may become the favoured qualitative method of choice for PA based studies as a result of the greater understanding of specific topics. However, focus groups have a number of limitations. For example, when discussing topics which are particularly sensitive to the participants (e.g., overweight and obesity), participants may feel reluctant and anxious to open up in the presence of others (Munroe-Chandler, 2005), in which case interviews may be a more appropriate method. Both interviews and focus groups have been previously used in school based PA research in adult and child/adolescent populations (Vickerman and Blundell, 2011, Boddy et al., 2012) and have also been used alongside quantitative measures (Coates and Vickerman, 2010).

Due to the advantages and disadvantages of the various quantitative and qualitative methods described above, the research presented within this thesis employed a mixed method design.

2.5 The population

The language and terminology used varies across different health sectors when referring to individuals with disabilities, for example, the health services use the term 'disabled' whilst the education sector use the term 'special education needs' (SEN) to define a child with learning difficulties (LD) (Ofsted, 2010). In the current thesis schools that were involved in the research are defined as SEN schools, and enrol pupils with LD which are either defined as having moderate learning difficulties (MLD) or severe learning difficulties (SLD). Within current PA literature the term intellectual disabilities (ID) is regularly used when investigating this population (Hinckson and Curtis, 2013). Thus, the following terms will be used throughout the current thesis; SEN school will be used to define the school setting, ID or children and adolescents with ID will be used when referring to the whole cohort, and MLD and SLD will be used as subgroups to differentiate the pupil's severity of ID. This section will go on to explain these terms further.

In the UK the term ID is increasingly used however currently LD is most common and frequently used, as a result it is important for the reader to gain a broader understanding of LD. LD includes an array of difficulties, conditions and disabilities which can vary in the level of severity (mild to profound) examples include; Autistic spectrum condition (ASC), Down syndrome (DS), behavioural emotional or social disorders, attention deficit hyperactive disorder (ADHD), physical, sensory and cognitive impairments etc. (Emerson et al., 2010). Some LD are not categorised under the term ID, for example, dyslexia is a LD and can vary in severity but it is not classified as an intellectual disability.

The definition of LD is presented in Part one Section 15 (6 and 7) of the Education Act 1996.

'A person has a learning difficulty if –

(c) He has a significantly greater difficulty in learning than the majority of persons of his age, or

(d) He has a disability which either prevents or hinders him from making use of facilities of a kind generally provided in pursuance of the duty under subsection (1) for persons of his age.

(2) A local education authority shall secure the provision for their area of adequate facilities for further education.'

(Education Act, 1996, p. 7)

For numerous reasons, including the use of various terminologies and multiple diagnoses, it is difficult to report the prevalence of LD in the UK (Emerson et al., 2010). However, it is estimated in 2011 that in England approximately 1,191,000 people had LD, with around 286,000 aged between 0 – 17 years and the prevalence being higher amongst boys (180,000) compared to girls (106,000) (Emerson et al., 2010). The unequal boy: girl ratio observed amongst this population may be related to specific conditions, such as ASC where a higher prevalence is reported in boys (3.3:1, boy: girl) (Baird et al., 2006). Furthermore, similar prevalence rates estimated by Ofsted (2010), reported that in England more than 1.7 million school-age children (1 in 5 pupils) are identified as having SEN, however, only pupils who require additional support are given a statement of SEN (Ofsted, 2010). Similar to LD, SEN include a range of additional needs, not just those classified as ID, making it difficult to calculate precisely how many children and adolescents with SEN statements have

ID. In 2010 however 2.7% of pupils were reported to have received a statement of SEN, with a greater proportion of pupils (18.2%) being identified as having SEN but provided with no statement (Ofsted, 2010). Further, within early childhood years SLD is more apparent and therefore more likely to be identified than MLD (Emerson et al., 2010) perhaps suggesting that these figures may be underestimated.

The current thesis will focus on children and adolescents diagnosed with MLD and SLD, who were also classed as having ID. In the study chapters some children and adolescents were diagnosed as MLD or SLD only; others had additional diagnosis(s) or condition(s) for example DS or ASC.

2.5.1 Intellectual disabilities

Any condition that damages development of the brain can be the origin of ID, ID is defined as 'a significantly reduced ability to understand new or complex information and to learn and apply new skills (impaired intelligence). This results in a reduced ability to cope independently (impaired social functioning), and begins before adulthood, with a lasting effect on development' (WHO, 2014). A review article by Jenkins (2012) which explores the role of nurses for older individuals with ID, highlighted that similar to that of the general population, people with ID are living longer. As a result, those with ID are expected to have greater physical and mental needs suggesting the role of care givers, e.g. carers and nurses, is crucial (Jenkins, 2012). Furthermore, the increased physical and mental needs for these older individuals are linked to a number of health risks outlined by Haveman et al. (2010) including; obesity, osteoporosis, gastrointestinal conditions, oral health conditions, hypertension and cardiovascular disease. Some specific disabilities and conditions,

such as DS, fragile X and cerebral palsy, are linked with specific health risks e.g., DS is associated with congenital heart defects (Evenhuis et al., 2001). Moreover, when compared to individuals without disability, individuals with ID experience significantly higher rates of morbidity, mortality and health inequalities (Phillips and Holland, 2011). Considering the increased risks related to poor health, the importance of regular PA engagement is even more evident for those with ID. In recent years more associations between PA engagement and health benefits for individuals with ID have become apparent. For example, researchers reported a positive association between single bouts of moderate intensity aerobic exercise and inhibitory control and neurocognitive function in a cohort of 20 children with ADHD (Pontifex et al., 2013). Perhaps benefits to health achieved via regular PA engagement could help to improve the overall quality of life for those with ID, especially given the reduced life expectancy and increased health complaints compared to those without ID.

2.5.2 Autistic spectrum condition

In the current thesis several participants had additional diagnoses, of which ASC was the most common, and in some studies defined half of the sample. As a result Studies 1 and 2 included additional subgroups when exploring the data; ASC and non-ASC. The prevalence of ASC has increased and the reason for the increase is unclear; the latest figures suggest that 1.1% of the UK population may have ASC (Baird et al., 2006). Autism is described by NICE (2011) as differences and impairments impacting on reciprocal social interaction and social communication, combined with restricted interests and rigid and repetitive behaviours. The phrase ASC is used when a child or young person has been diagnosed with autism (NICE,

2011). Garcia-Villamisar and Dattilo (2010) highlighted the importance of recreational activities to improve quality of life for individuals with ASC. However, with regards to PA engagement, Pan and Frey (2006) reported that children and adolescents with ASC exhibit low levels of PA when compared to their peers without ASC. Both studies emphasis the need to promote PA, and provide opportunities that enable children and adolescents with ASC to make active lifestyle choices.

2.6 Physical Activity and ID

In comparison to the vast body of literature that has focused on children and adolescents without disability, PA research that has focussed specifically on populations with ID is scarce. The body of literature decreases further when looking at specific age groups with ID, such as children and adolescents (<16 years). Similar to youth without disability many health benefits have been associated with PA engagement for those with ID including, psychosocial (Heller et al., 2011), balance, muscle strength, quality of life (Bartlo and Klein, 2011), neurocognitive function, inhibitory control (Pontifex et al., 2013) and motor performance (Giagazoglou et al., 2013). Yet PA levels among children and adolescents with ID are low (Rimmer and Rowland, 2008). In the UK, to date one PA study has been conducted within the ID population using objective methods (Phillips and Holland, 2011). Phillips and Holland (2011) conducted a cross sectional study based in the East and South-East of England, whereby uniaxial accelerometers (ActiGraph GT1M) were used to investigate the sedentary and PA levels of 152 individuals (mean age 33.6 years) with ID comparing those with and without Down syndrome (DS). PA levels were low amongst the whole sample with the lowest levels reported for participants' with

DS; further, no participants met current PA guidelines. As a result, it was concluded that individuals with ID may be at an increased risk of developing chronic diseases associated with inactivity (Phillips and Holland, 2011). Although the sample size for the study was impressive, the age range was vast (12 - 70 years), and only 7 participants were aged between 12 – 15 years, therefore the study's findings may not be particularly representative of children and adolescents with ID.

Hinckson and Curtis (2013) conducted a systematic review, including 30 studies, to explore measurement of PA in children and adolescents with ID. The review reported agreement across the studies included describing low PA engagement amongst the population. Further, it was suggested that children and adolescents with ID were significantly less active than children and adolescents without ID (Hinckson and Curtis, 2013). Of the 30 articles 5 were based in Europe (1 UK based) and authors highlighted the need for more studies examining PA in children and adolescents with ID to be conducted outside the USA. The review outlined differences between study methodologies including both quantitative (i.e., accelerometry, questionnaires, direct observations) and qualitative (i.e., interviews) methods. Authors reported that objective methods provided the most consistent PA results. However, due to compliance issues when using objective methods in this population it is unclear as to what PA assessment method is most appropriate (Hinckson and Curtis, 2013).

Sample sizes within the majority of current PA studies conducted in this population are small (Ogg-Groenendaal et al., 2014, Hinckson and Curtis, 2013). For example, in a review article by Hinckson and Curtis (2013) participant samples ranged from

n= 7 to n= 997, and over 60% of the studies included (n=30) had <30 participants with ID. Moreover, Ogg-Groenendaal et al. (2014) reviewed the quality of studies and defined a sample of ≥30 participants to be of moderate quality in relation to the size of study population, and studies were not excluded from the review on the basis of a small sample as there was appreciation of recruitment difficulties. Nevertheless, UK based studies exploring PA in youth with ID suggest that studies with larger samples are needed to ensure that findings are representative of the whole population (Bingham et al., In Press, Boddy et al., In Press). In mainstream literature that used accelerometers, compliance issues were a reoccurring problem which can reduce initially small sample sizes further (Rowlands, 2007). To date PA research in ID populations have not investigated compliance issues, however Boddy et al. (In Press) highlighted it as a gap in the literature with scope for future researchers to explore the effect of some accelerometer compliance strategies i.e., reward systems/incentives within ID populations.

A recent study by Einarsson et al. (2015) examined the PA levels and patterns of Icelandic children and adolescents with and without ID. Ninety-four participants with mild to severe ID and 93 were age and sex matched peers without ID. Participants with ID were from special educational needs (SEN) schools (62%) and inclusion schools (38%). ActiGraph accelerometers (GT1M) and questionnaires were used to assess PA levels and patterns. Findings demonstrated that participants with ID were significantly less active than their peers without ID, with 40% of participants without ID compared to no participants with ID meeting current PA guidelines. However, methodological differences between this study and other published studies, such as PA intensity cut points used, were highlighted as an issue

preventing researchers from making comparisons and between studies (Einarsson et al., 2015). Reverting back to section *2.3.1 accelerometry* of this thesis Einarsson et al. (2015) made reputable methodological decisions with regards to their choice of cut points and epoch length in that authors used the Evenson et al. (2008) cut points (Trost et al., 2011) and selected a 5 second epoch of data collection (McClain et al., 2008). Authors concluded that more PA promotion studies for children and adolescents with ID are needed; also, the need for appropriate opportunities made available for all children with ID regardless of their severity of ID was highlighted (Einarsson et al., 2015).

Pan and Frey (2006) assessed age related PA patterns using accelerometers and activity questionnaires in 30 children and young people (aged 10 – 19 years) with ASC. Findings suggested that irrespective of the time period or type of day (weekday vs weekend day) younger children (primary school aged participants) were more active than older groups (middle and secondary school age participants). However, data were collected using a 60 second epoch and continuous bouts in MVPA were only reported for 5, 10 and 20 minute durations which may have significantly underestimated PA levels (Nilsson et al., 2002, Baquet et al., 2007). Furthermore, Whitt-Glover et al. (2006) also used accelerometry to objectively examine patters of moderate PA (MPA) and vigorous PA (VPA) in children with DS (n = 28) compared to their unaffected siblings (n = 30) aged between 3 – 10 years. The study found that participants with DS engaged in less VPA and shorter bouts than their siblings, whereas, PA levels and bout length were similar for MPA. However, Whitt-Glover et al. (2006) only assessed MPA and VPA in relation to PA bouts, and different epoch length (30seconds) and PA intensity cut points (Strauss et

al. 2001) were used which limits comparability to other studies focussing on children without disability PA patterns. It is therefore suggested that further objective PA research is needed to examine PA patterning, using a 5 second epoch (maximum) and assessing shorter bout durations to gain a better understanding of children and adolescents PA engagement exploring how and when this population are active. This depth will allow researchers to design and implement better informed PA interventions at appropriate times (i.e., weekdays vs weekend days, in school vs out of school) for children and adolescents with ID.

Literature that explores the opportunities available for children and adolescents with ID to engage in regular PA is rare, however, a number of studies have explored this topic and focussed on specific conditions such as DS. For example, Downs et al. (2013) explored opportunities available and perceived barriers in a small cohort of children and young people (aged between 6 – 21years) with DS. Interviews were conducted with eight families. Results suggested that PA opportunities for the participants with DS were limited, particularly those outside of school, parents reported that opportunities were either not available or perhaps they were not aware of them (Downs et al., 2013). Furthermore, the few PA opportunities available for children and young people with DS were associated with the lack of support for parents, for example, parents expressed that they felt they had not received appropriate information with regards to what opportunities were available for their child with DS. It was also suggested that support was more apparent at a younger age (<5years) but decreased when the child started primary school (Downs et al., 2013). In mainstream populations, accelerometer data reported that high active children maintain their activity levels throughout the week whereas lower active children

exhibit lower levels of MVPA and increased ST on weekend days compared to week days (Fairclough et al., 2014). However, when examining PA levels and ST in the segmented school day, Fairclough et al. (2012) report that both high and low active children were most active outside of school (before or after school time) but the biggest differences between low and high active participants was observed out of school time. Similarly, pedometer data reported by Cox et al. (2006) demonstrated that the high active participants were most active outside of school yet low active participants were more active during school hours. Thus, authors agree that opportunities to be active outside of school (before/after school and at weekends) may be key contributors to overall PA levels within children and adolescents (Cox et al., 2006, Fairclough et al., 2012, Fairclough et al., 2014).

To date, studies that have investigated PA engaged in by children and adolescents with ID and the opportunities available during school (i.e., PE, playtime lunch time clubs and programmes) and outside of school (i.e., active commuting, after school clubs) are scarce. Furthermore, although researchers are aware of the low PA levels engaged in by children and adolescents with ID (Hinckson and Curtis, 2013), because of the limited literature, it is difficult for researchers to determine how and when this population accrue the activity. The school environment, and in particular PE and playtime periods, offer a substantial amount of time for children and adolescents to engage in active pursuits (Ridgers et al., 2006). In the UK, information derived from SEN schools in Merseyside, it is estimated that 195 hours of playtime opportunities (based on 2 x 30 minute playtimes a day, 5 days a week, 39 weeks a year) and 78 hours of PE opportunities (based on 2 hours per week, 39 weeks a year) are available to children and adolescents with ID each year. Alongside

contributions to overall PA levels, in mainstream populations previous research also demonstrates positive associations between playtime and class room behaviour (Barros et al., 2009). Similarly PE is not implemented to simply offer an opportunity for PA in curriculum time. PE lessons aim to integrate a range of physical activities and develop competence, promote prolonged bouts of PA, provide opportunities to engage in competitive sports and activities and finally promote healthy lifestyles (Department for Education, 2013). Whilst the importance of teaching appropriate skills and knowledge is linked to the increase in PA opportunities in PE, it is suggested that by integrating specific PA goals into lesson plans PE would contribute further to overall PA (Fairclough and Stratton, 2005). Moreover, given the difficulty of accessing physical activities and general lack of opportunities available for children and adolescents to be active outside of school (Downs et al., 2013), opportunities to be active in school should be maximised. However, evidence conducted in these segments of the school day investigating how active children and adolescents with ID are is limited and warrants further investigation. One study in China conducted by Sit et al. (2007) investigated the PA of children with various disabilities (including mild ID) during PE and playtime contexts. The SOFIT tool was used to assess PA levels in both PE and playtime. Participants engaged in similar amounts of MVPA in both contexts with MVPA engaged in for around half of the observation time in both PE (50%) and playtime (57%) periods (Sit et al., 2007). In mainstream populations, during PE pupils were reported to spend ~30% of the lesson engaging in MVPA (Fairclough and Stratton, 2005) and ~60% of time engaging in MVPA during playtime periods (Ridgers et al., 2010c). Further, similar to Sit et al's. (2007) findings comparable amounts of MVPA at playtime have been also been observed in children and adolescents with ID in UK based studies which

used the SOCRAP tool (Bingham et al., In Press, Boddy et al., In Press). However, ID severity has either varied (MLD and SLD) between studies or has not been outlined, and therefore it is difficult to make comparisons. It is suggested that future studies investigating PE and playtime segments, should outline specific details of the participants details (i.e., type and severity of disability) in order to improve understanding in specific groups, and therefore inform where and what kind of interventions are needed and appropriate.

2.7 PA interventions in children and adolescents

As previously discussed, children and adolescents engage in low amounts of PA and high amounts of sedentary behaviours (Griffiths et al., 2013). Considering that children and adolescents with ID exhibit lower levels of PA compared to those without ID, there is a clear rationale to promote PA within this population. To date, no PA intervention studies have been conducted working specifically with children and adolescents with ID in the UK. However, previous interventions have been implemented for this population or specific cohorts of the population (i.e., ASC, ADHD and DS) examining a number of different outcomes, including; challenging behaviour (Ogg-Groenendaal et al., 2014), motor performance and balance (Giagazoglou et al., 2013), and PA, dietary habits and overall health in New Zealanders (Hinckson et al., 2013). Results from these interventions were mostly positive demonstrating benefits for children and adolescents with ID in different ways, which will be discussed in more depth shortly. The school setting offers multiple opportunities for children to be active (Ridgers et al., 2006, Engelen et al., 2013). School-based PA interventions have become increasingly popular within mainstream (McKay et al., 2015) and SEN settings (Giagazoglou et al., 2013). Those

conducted in mainstream populations have intervened in an array of areas (e.g., skill based, nutrition focused) including those targeted at PA and ST (i.e., Fairclough et al., 2013). In comparison, interventions directed at children and adolescents with ID, have focused more on specific skills, for example balance (Giagazoglou et al., 2013) and have not targeted PA and ST *per se*. As a result perhaps previous school-based PA interventions implemented in mainstream settings would make a trustworthy example to base the design of a school-based PA intervention for use with SEN schools. Thus, intervention studies directed specifically at those with ID will be discussed initially leading onto further discussion which explores the school-based intervention studies implemented within mainstream settings.

2.7.1 PA interventions in children and adolescents with ID

Challenging behaviours such as self-harm, aggression, disruptive behaviour and hyperactivity are commonly displayed amongst many individuals with ID (Ogg-Groenendaal et al., 2014). These types of behaviours are said to be up to 5 times more likely amongst those with ID compared to their non-ID peers (Emerson and Einfeld, 2011). Challenging behaviour is not only a concern for the individual but can also be burdensome for caregivers and immediate support networks (Lundqvist, 2013). As a result, approaches to reduce the levels of these behaviours exhibited by individuals with ID are needed. Ogg-Groenendaal et al. (2014) conducted a systematic review to investigate the effect of exercise (i.e., interventions involving leisure based PA) interventions on challenging behaviours for individuals with ID. The review conveyed interventions in a positive light with regards to reducing challenging behaviours amongst the ID population, with no significant differences reported between low and high intensity exercise interventions (Ogg-Groenendaal et

al., 2014). However, methodological issues (i.e., studies presenting incomplete data) were outlined as a concern. It was concluded that exercise interventions offer many positive side effects to both physical and mental health for individuals with ID which may reduce care costs. Moreover exercise or PA could be used as a treatment for challenging behaviour in ID populations, many positives and minimal draw backs were highlighted across the studies (Ogg-Groenendaal et al., 2014). Furthermore, the findings of the review highlighted that for people with ID, group interventions were the most cost effective but suggest that individual interventions are more effective with regards to the primary outcome i.e., challenging behaviour or PA. Therefore, when intervening within a group environment (i.e., schools) in this population, researchers should be flexible and prepared to make adaptations based on individual participant needs and abilities. Authors further recommended that in order to assist the evaluation and effectiveness of studies researchers should provide in depth descriptions of methods (e.g., participants), intervention design (e.g., frequency) and present individual and group data (Ogg-Groenendaal et al., 2014).

Giagazoglou et al. (2013) conducted a randomised control trampoline intervention in an attempt to improve motor performance and balance amongst children with moderate ID (n = 18). The intervention involved a 12 week trampoline programme, 9 participants were assigned to the experimental group and attended daily individual trampoline sessions lasting ~20minutes. Each session was designed to be challenging whilst also enjoyable for participants and required participants to perform basic activities using equipment such as balls and balloons. In comparison, control participants continued with the usual school schedule. Findings reported that the experimental group demonstrated significant improvements in all motor and balance

tests, suggesting that the trampoline intervention was an effective method to improve functional outcomes (Giagazoglou et al., 2013). Though it should be noted that authors did not assess habitual PA, and therefore assumptions regarding the intervention benefits to overall PA levels cannot be made. Authors highlighted the importance of making interventions enjoyable with an interesting purpose to ensure adherence and therefore gaining full benefit of the intervention (Giagazoglou et al., 2013).

Research in New Zealand evaluated the effectiveness of a weight management intervention in a cohort of 22 overweight and obese children and adolescents with ID, assessing changes in PA and nutrition behaviours (Hinckson et al., 2013). The 10 week school-based intervention involved 2 x 2hr PA and nutrition based sessions each week and were led by a paediatric physiotherapist and dietician supported by teachers, senior management and social workers. Sessions involved two parts, part 1 was a family PA focused hour and in part 2 child participants and parents/carers were separated, with participants attending an 'active' session whilst parents/carers attended a nutritional or motivational session. Quantitative results showed a possible positive change in the six-minute walk-test, where participants walked 51 metres further at 24 weeks follow in comparison to baseline. No differences were reported for waist circumference or BMI. However, via proxy report and parent interviews a reduction in sweets and chocolate consumption was noted, further parents described a reduction in the amount of hospital visits and absences from school due to illness (Hinckson et al., 2013). Although these are valuable findings no increases in total PA or positive changes in participants' waist circumference or BMI were observed. The lack of PA intervention effects may be due to the methods used to measure PA,

and perhaps objective methods which assess habitual PA, such as accelerometers, would be more appropriate methods to capture overall changes to PA behaviours.

The interventions discussed above although not focussing on PA *per se*, demonstrated the potential for school-based interventions as an option to promote PA within children and adolescents with ID. The findings also highlighted that group interventions, where individual needs are considered, would be favourable (Ogg-Groenendaal et al., 2014), and enjoyment was described as a key facilitator whilst also potentially improving participant adherence (Giagazoglou et al., 2013). Finally, authors suggest that studies should include a detailed overview of methods and intervention design for the reference of future researchers (Ogg-Groenendaal et al., 2014), in order to aid the replication of previous studies and procedures used which is necessary to make study comparisons and offer supporting evidence (Sidman, 1960).

2.7.2 School based PA interventions in children without ID

Previous school-based PA interventions targeting children without ID have intervened in various aspects of the school day including; PE lessons, playtime periods, non PE based curriculum/lesson time, after school clubs and also at home via homework tasks (Van Sluijs et al., 2007). Van Sluijs et al. (2007) conducted a systematic review of controlled trials to investigate the effectiveness of interventions to promote PA in children and adolescents. Findings suggested that multilevel interventions, e.g. school-based interventions that include family or community involvement were most effective, especially in adolescent groups. However, due to limited evidence of PA intervention studies targeting children, findings for this age

group were inconclusive; authors suggested when intervening with children objective methods should be used to assess the overall PA intervention effects (Van Sluijs et al., 2007). School-based interventions are advantageous as they can impact on a large sample of children and adolescents at once and if successful, have the potential to be rolled out across a number of schools. Some of the intervention studies carried out within mainstream schools that demonstrated an increase in PA levels will be discussed further.

Van Sluijs et al. (2007) outlined one multilevel school-based PA intervention called the Child and Adolescents Trial for Cardiovascular Health (CATCH) which was effective in child populations. The larger CATCH program intervened in various aspects of the school day, promoting healthy lifestyles via promotion of good nutrition, increased PA, smoking prevention and cardiovascular heath (Perry et al., 1997). McKenzie et al. (1996) presented major PA findings associated with the CATCH PE aspect. CATCH PE aimed to promote children's enjoyment of MVPA engagement in PE lessons and provide additional skills that could be used out of school. Participating schools were instructed to deliver a minimum of 90 minutes of PE spread across at least 3 days each week whereby children had to engage in MVPA at least 40% of the lesson (McKenzie et al., 1996). Children who received the CATCH PE intervention increased their MVPA levels during PE from 37% (at baseline) to 52%; moreover they were reported to be more physically active during PE when compared to the control group who received no intervention (McKenzie et al., 1996). Despite positive changes in MVPA during PE, changes in habitual PA were not examined.

Playtime periods offer opportunity for PA. During school playtimes modifiable (i.e., equipment) and unmodifiable (i.e., the weather or environment) factors have been associated with ST and MVPA engagement (Ridgers et al., 2010c). Numerous school-based PA interventions have been implemented during playtime periods and offer promising results (e.g., Ridgers et al., 2010b, Engelen et al., 2013). Barton et al. (2014) compared a playground-based play intervention (with portable equipment provided) to a nature/field-based orienteering intervention (with a map and orienteering course provided) in primary aged children. Higher levels of MVPA were reported in the playground-based intervention (Barton et al., 2014). In contrast, Wood et al. (2014) assessed children's PA levels at playtime comparing play on the field (natural environment) to play on the playground. Results suggested that boys and girls engaged in higher amounts of MVPA during field based play. These findings contradict those presented by Barton et al. (2014) and it could be argued that changes in MVPA in both studies are as a result of the type of play rather than the environment *per se*, as, in Wood et al. (2014) study children were instructed to play normally.

Ridgers et al. (2010b) suggested that providing portable equipment (i.e., balls and skipping ropes) may be one way to increase PA levels during playtime periods based on research conducted in UK primary schools. Further, playground markings and physical structures (i.e., football goals and basketball hoops) are also described to positively impact MVPA and VPA levels during both morning and lunchtime playtime periods, although these levels were sustained at 6months up they decreased between 6 and 12 months post intervention (Ridgers et al., 2010a). Similar positive associations between portable equipment and PA levels have been reported outside

of the UK (e.g., Engelen et al., 2013). Alongside introducing a range of portable equipment, Engelen et al. (2013) also combined an adult-directed aspect to the intervention. Whereby parents and school staff (who had playground duties) participated in small and large group tasks and discussions. This allowed researchers to examine the adults' experiences of free play, and further discuss their (parent and teachers) views of the benefits of play and consequences of preventing play and risk taking for children (Engelen et al., 2013). Although adults were not directed to positively encourage active play, the combined approach proved to be successful, reporting increases in PA levels during playtime periods (Engelen et al., 2013). The adult-directed intervention approach is potentially an appropriate method to use when working in SEN settings. As previous research reports that having a strong support network is a key reinforcement factor for PA engagement for children and young people with DS (Downs et al., 2013). Furthermore, children and adolescents with SEN from mainstream and SEN schools highlighted that fellow peers and, in particular, PE teachers had a positive influence on their experiences during PE (Coates and Vickerman, 2010). As a result, in addition to introducing portable equipment and increasing field based play it is suggested that greater amounts of involvement by teachers and school staff at playtime within SEN schools, may have a positive impact on PA levels for children with ID.

An alternative intervention approach is to target the whole school day. This approach has shown promising results demonstrating positive outcomes for multiple health outcomes for children and adolescents in numerous studies (Perry et al., 1997, Pate et al., 2005, Fairclough et al., 2013, McKay et al., 2015). Previous interventions which have focussed on the whole school day have included primary aims which

usually target specific health outcomes (i.e., cardiovascular health promotion (McKenzie et al., 1996)) and as a result target improvements to overall PA levels.

In the UK Fairclough and colleagues developed and implemented a 20 week school-based PA and nutrition intervention; known as the Children's Health, Activity and Nutrition: Get Educated! (CHANGE!) project (Fairclough et al., 2013). The project aimed to promote healthy weight through a curriculum based intervention with focus on PA and healthy eating demonstrating promising results. ActiGraph data showed a significant between group difference in light PA (LPA) at 10 weeks follow-up, reporting a daily increase in LPA of ~21minutes observed by the intervention group from post intervention to follow-up compared to the control group. The CHANGE! model included no specific PA direction which may explain why increases in higher intensity PA levels did not occur. However, it was reported that the CHANGE! intervention was successful in positively influencing body size outcomes, showing reductions in waist circumference and BMI z-scores (Fairclough et al., 2013).

Another school-based intervention known as the Action Schools! BC (AS! BC) intervention also reported positive intervention effects, and represents a promising intervention design. AS! BC was a school-based PA intervention model developed by McKay and colleagues in Canada and targeted primary school aged children. The intervention model was described by Naylor et al. (2006); intervention schools were instructed to integrate 150mins of PA each week in addition to scheduled PE, and were either assigned the liaison school (LS) or champion school (CS) condition. Briefly, teachers from LS received weekly contact with the AS! facilitator who provided in-class support and demonstrated activities; also, storage bins were

provided and filled with enhanced playground and teacher resources that supported the Action plan. Whereas, in CS storage bins included basic resources and support was provided by one trained school teacher known as the 'champion teacher', rather than an external AS! facilitator and therefore no in-class support was received for CS school teachers (Naylor et al., 2006). Control schools were primary schools who received no intervention. An evaluation of phase one of AS! BC presented results from questionnaire (PAQ-C) and pedometer counts (McKay and Services, 2004). Seven day pedometer assessment data suggested that AS! BC had a positive effect on PA levels, demonstrating significant increases in the number of steps recorded in both intervention school conditions compared to the control school condition. Results from PAQ-C data, which predominantly assessed PA levels engaged in during school time, demonstrated the most positive influence on PA levels was observed by pupils in LS (+33%). CS and control schools also saw increases in PA levels by 25%; the increase in control schools was explained by these schools reporting high activity levels at baseline (McKay and Services, 2004). Furthermore, via self-report a significantly greater amount of PA was delivered in LS (+67min/week) and CS (+55min/week) compared to control schools, with no significant differences reported between LS and CS schools (Naylor et al., 2006). The AS! BC model proved to be a particularly effective school-based PA intervention. In addition to the short term PA effects described above follow up data demonstrated increases in PA, cardiovascular fitness, bone health and healthy eating (McKay et al., 2015). The intervention success resulted in the AS! BC model being rolled out across other schools and is now implemented in every school district in British Columbia (McKAY et al., 2013). However, limitations in relation to both the measures used to assess PA levels in the AS! BC studies should be noted. For

example pedometers do not allow for researchers to classify the intensity of PA engaged in, whilst participant recall issues, particularly for children, and social desirability are reported as limitations in self-report methods such as questionnaires (Sirard and Pate, 2001). Accelerometers are described to be the more sophisticated and desirable objective measure to assess PA levels (Sirard and Pate, 2001) and would allow researchers to examine segments of the school day and compare weekday to weekend day data. Therefore, perhaps a combination of methods, i.e., accelerometer and questionnaires would have been favourable.

It should be highlighted that intervention studies which included specific PA goals and targets for teachers and school staff to achieve have demonstrated greater increases in PA levels. For example, the CATCH and AS! BC interventions instructed intervention schools to deliver a specific amount and intensity of PA and reported positive results in relation to PA engagement and delivery (McKenzie et al., 1996, McKay and Services, 2004). In comparison the CHANGE! intervention instructed schools to promote PA via various curriculum based lessons, but no guidelines were provided on the amount of intensity of PA that should be delivered (Fairclough et al., 2013). Though improvements in LPA were noted by Fairclough et al. (2013), it is suggested that if intervention models aim to strive for a specific PA goal then PA targets should be set and made clear to schools and staff.

2.8 Rationale

Given the low levels of health-enhancing PA observed amongst children and adolescents with ID and the limited published PA focussed evidence, there is a clear rationale for further research in this area. Furthermore, it is clear from the evidence

and the schedule of a typical school day/week that the school environment offer many opportunities to engage in PA, yet how much PA promotion is conducted throughout the school day within SEN schools is unknown. However, research conducted within mainstream schools suggests that with appropriate intervention PA levels and sedentary behaviours can be improved (Van Sluijs et al., 2007, McKay et al., 2015) it is thought that more SEN school-based PA promotion would be welcomed. Based on findings described in the literature review, using a mix method approach to assess PA and sedentary behaviours in this group would be favourable, and was adopted within the study chapters presented in this thesis which aimed to investigate PA, ST and playtime behaviours in children and adolescents with ID.

Study 1 investigated how and when children and adolescents with ID were physically active. The use of accelerometers provided opportunity to investigate specific segments of the school day (Fairclough et al., 2012), and allowed researchers to examine patterns of PA including assessment of bout duration (>5seconds) (Baquet et al., 2007) of which is currently unknown amongst children and adolescents with ID. Study 2 used DO to explore different aspects of the school day in relation to PA and ST behaviours which allowed the researchers to better understand PA and play behaviours exhibited by children and adolescents with ID in various contexts (McKenzie and van der Mars, 2015). Collectively, Studies 1 and 2 offered informative research which provided a base of evidence to aid the development and design of a school-based PA intervention that was suitable for children with ID. In addition, Study 3 used qualitative methods (focus groups), which added the depth and descriptive details necessary to ensure the appropriateness of the intervention design for the SEN school settings, this

information would not have been depicted via the objective methods alone (Smith and Caddick, 2012). Finally, study 4 evaluated the effect of a school-based PA intervention which aimed to increase MVPA levels. Targeting primary SEN schools enabled the PhD candidate to reach a large number of children and adolescents with ID.

2.9 Thesis aims and objectives

The primary aim of this thesis was to investigate PA, ST and playtime behaviours in children and adolescents with ID.

Study one: 1. To objectively investigate the habitual PA levels and sedentary behaviours of children and adolescents with ID. 2. To examine the tempo of PA by sex, age and disability.

Study two: 1. To investigate PA and play behaviours during playtime of children and adolescents with ID. 2. To examine the PA and lesson context during PE lessons in children and adolescents with ID.

Study three: 1. To explore teachers' perceptions of barriers and facilitators to PA engagement for children and adolescents with moderate to severe ID within the school environment. 2. To examining influencing PA factors including enabling, reinforcing and predisposing factors.

Study four (part a): To evaluate the effect of the school-based PA intervention on habitual sedentary and PA behaviours and play behaviours at playtime in children with severe ID.

Study four (part b): To retrospectively, explore the self-efficacy and confidence of teachers in relation to the delivery of the school-based PA intervention.

Thesis study map

Study	Objectives
Study 1: Investigating habitual physical activity levels, sedentary behaviours and the tempo of physical activity in children and adolescents with intellectual disabilities	Objectives: • To objectively investigate habitual PA and sedentary behaviours of children and adolescents with ID. • To examine the tempo of PA by sex, age and disability.
Study 2: An investigation of physical activity behaviours and context during playtime and Physical Education lessons in children and adolescents with intellectual disabilities	
Study 3: Exploring teachers' perceptions on physical activity engagement for children and adolescents with intellectual disabilities	
Study 4: The evaluation of a pilot school-based physical activity intervention for children with intellectual disabilities attending special educational needs schools in the North West of England.	

Chapter 3

STUDY 1

Investigating habitual physical activity levels, sedentary behaviours and the tempo of physical activity in children and adolescents with intellectual disabilities

Study 1 originally presented here to page 74 cannot be made freely available via LJMU Digital collections because of the authors intention to publish. Study 1 is original work of the authors.

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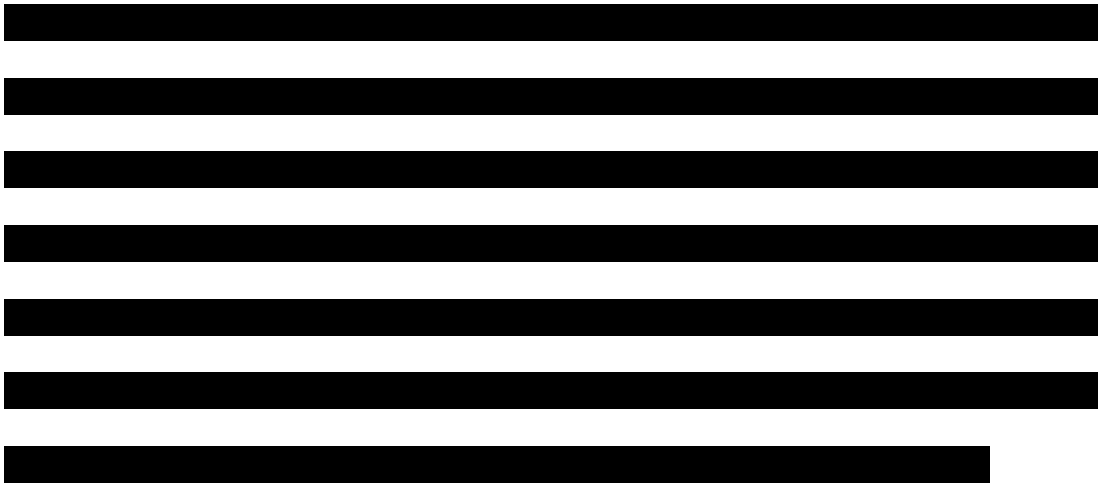

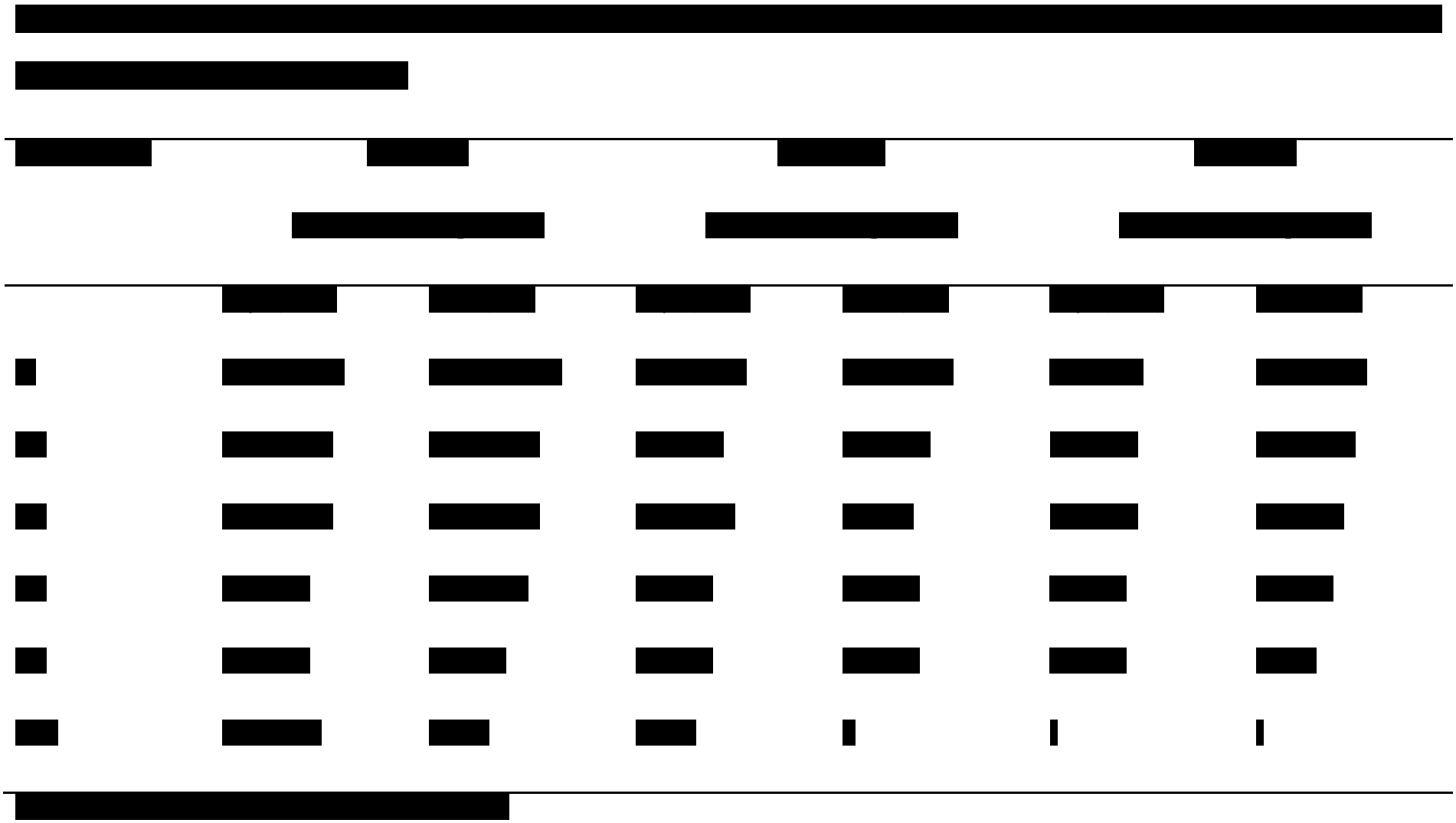

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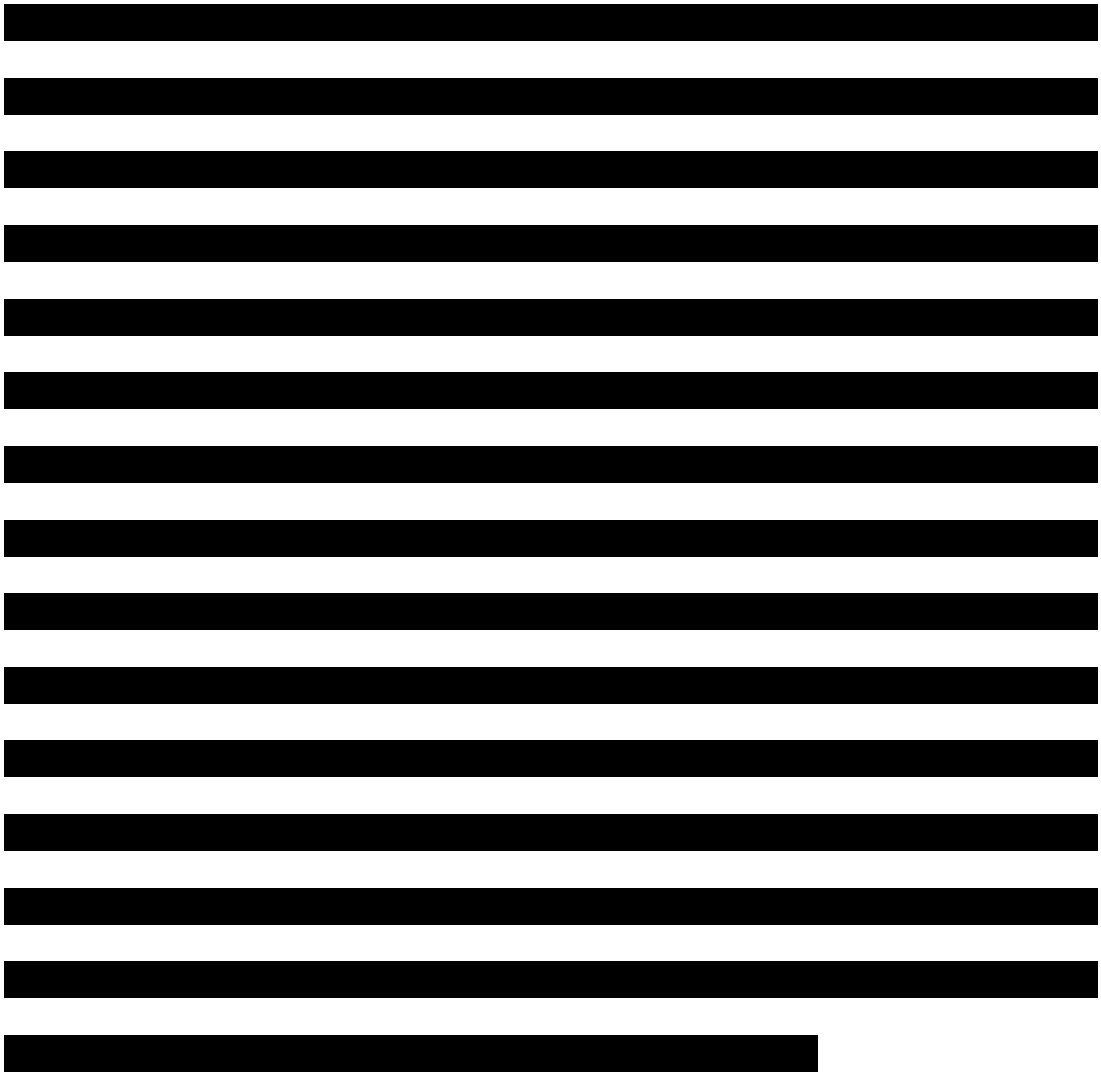

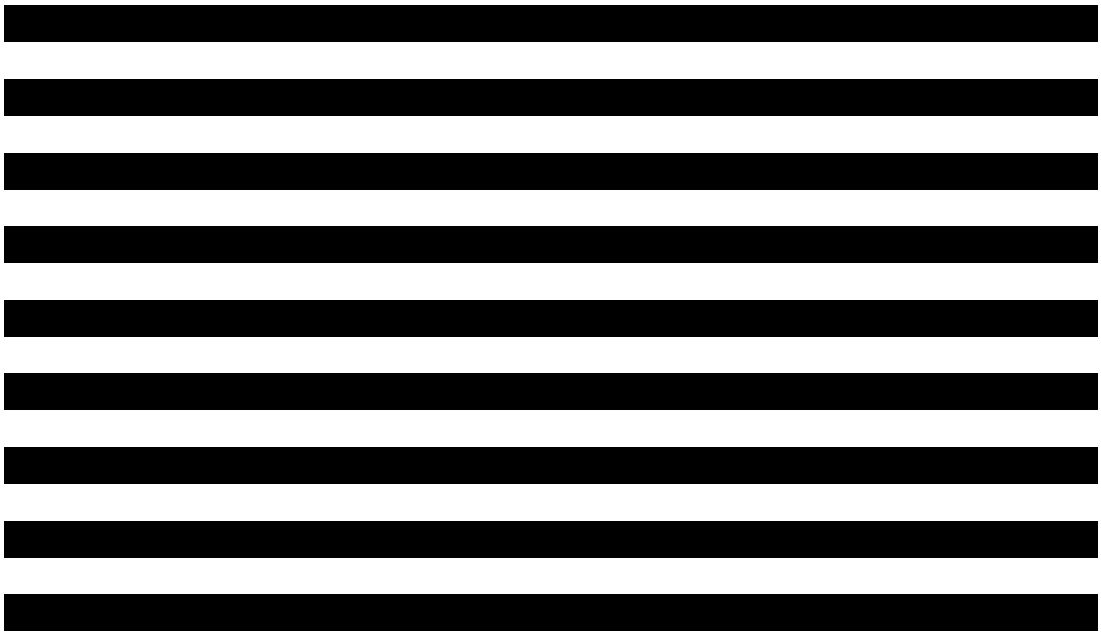

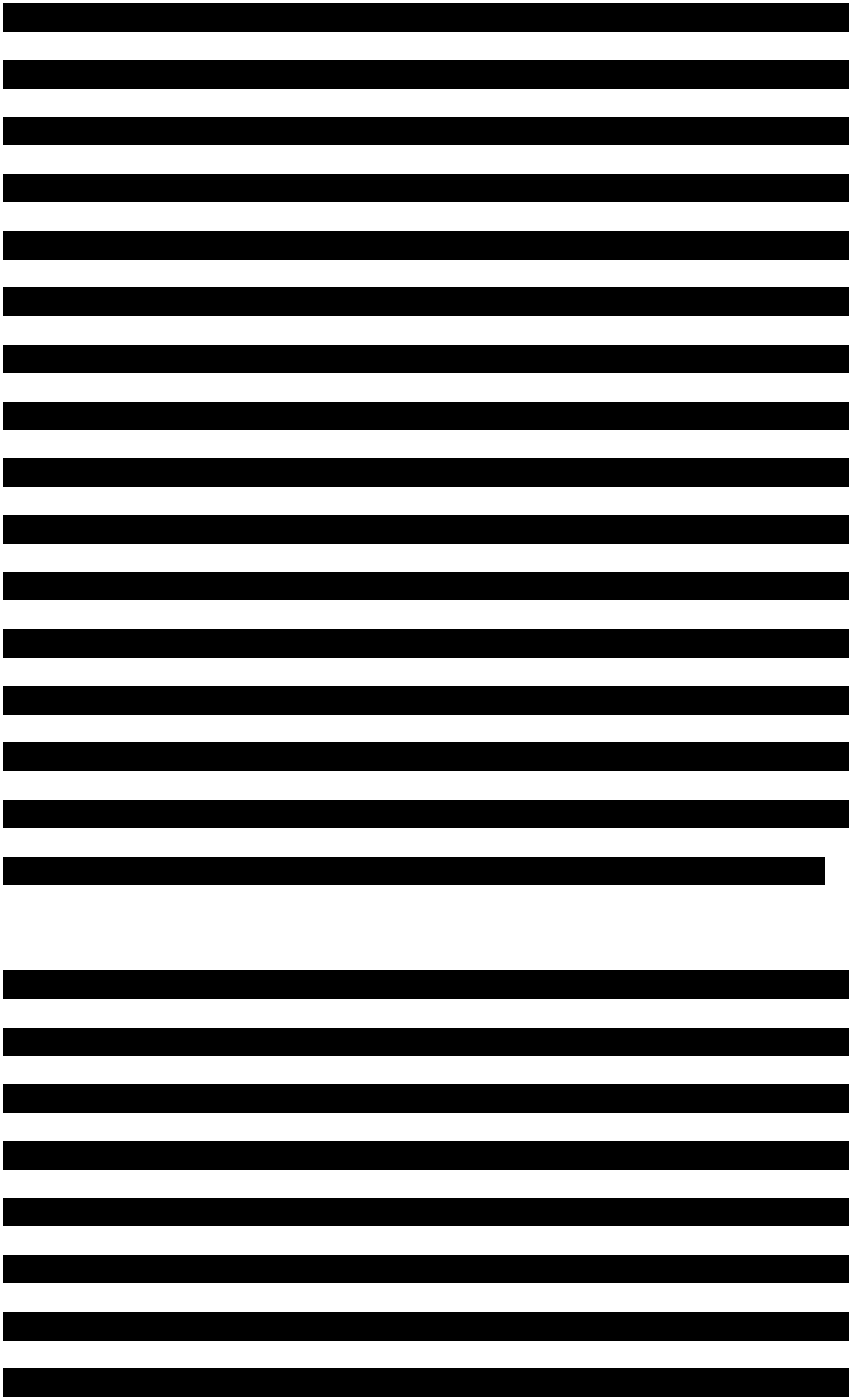

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Thesis study map

Study	Objectives
Study 1: Investigating habitual physical activity levels, sedentary behaviours and the tempo of physical activity in children and adolescents with intellectual disabilities.	Objectives: • To objectively investigate habitual PA and sedentary behaviours of children and adolescents with ID. • To examine the tempo of PA by sex, age and disability. Key findings: - Participants in this study did not engage in enough PA to benefit health. - The tempo of PA for this sample of children was of a similar nature to children without ID. - The majority of participants PA were made up of short sporadic bursts of activity with the amount of continuous bouts decreasing as the intensity and duration increases.
Study 2: An investigation of physical activity behaviours and context during playtime and Physical Education lessons in children and adolescents with intellectual disabilities.	Objectives: • To investigate PA and play behaviours during playtime of children and adolescents with ID. • To examine the PA and lesson context during PE lessons in children and adolescents with ID.
Study 3: Exploring teachers' perceptions on physical activity engagement for children and adolescents with intellectual disabilities.	
Study 4: The evaluation of a pilot school-based physical activity intervention for children with intellectual disabilities attending special educational needs schools in the North West of England.	

Chapter 4

Study 2

An investigation of physical activity behaviours and context during playtime and Physical Education lessons in children and adolescents with intellectual disabilities

4.1 Introduction

The importance of physical activity (PA) for children and adolescents with intellectual disabilities (ID) is clearly outlined within the previous chapters. PA can be engaged in via a range of activities, at various segments of the day within a number of settings. The school environment provides a number of opportunities for children and adolescents to engage in regular PA (Jago and Baranowski, 2004). Opportunities to be active within school time include; playtime (morning, lunch and in some cases afternoon), Physical Education (PE) lessons and lunch time clubs. In non-ID populations, children are consistently reported as being more active on weekdays (school week days) rather than weekend days (Fairclough et al., 2014). In comparison, research investigating children and adolescents with ID report no differences between in and out of school periods with regards to their level of PA engagement (Einarsson et al., 2015). Results from Study 1 of this thesis support this notion, reporting no differences between week and weekend day activity levels which may be explained by the low PA levels observed by this population as a whole (Hinckson and Curtis, 2013), regardless of the day of the week.

The amount of playtime and PE opportunities available for children and adolescents with ID in UK SEN schools each year was outlined in the literature review (Chapter 2), suggesting approximately 195 hours of playtime opportunities and ~78 hours of PE opportunities are provided throughout the school year. Collectively these periods offer opportunities to significantly contribute to overall PA levels. Moreover, opportunities to be active outside of school are not as easily accessible for ID populations, with a number of barriers apparent that prevent regular PA engagement

outside of school time, including lack of independence, lack of support, and transport issues (Downs et al., 2013). As a result, it is important that opportunities to be active within school time are maximised. Further, Ridgers et al. (2006) describes the school setting as an ideal environment to promote PA. Given the lack of PA opportunities out of school for children and adolescents with ID the school setting is perhaps even more suitable for this population. However, the low levels of habitual PA reported in Study 1 of this thesis may suggest that improvements to PA levels at all parts of the day are needed.

School playtimes provide children and adolescents with some free time within an informal and unstructured setting that offers an opportunity to be active. Furthermore, the benefits gained during playtime periods are not all associated with PA as such; for example, for children without ID, improvements in class room behaviour have been linked to playtime (Barros et al., 2009) highlighting the importance of playtime periods. A recent review article examining PA specifically during school recess by Ridgers et al. (2012b) described research comparing those with and without SEN to be unclear. The inconsistency in findings within children and adolescents with ID highlights a need for more, better designed studies in this area.

In the UK, PE is a compulsory part of the national curriculum within both mainstream and SEN settings and contributes to pupils' overall PA levels. The national curriculum for PE aims to integrate a range of PA and develop competence, providing opportunity to engage in sustained bouts of PA, participate in competitive

sports and activities and to promote healthy lifestyles (Department for Education, 2013). Children and adolescents with SEN were reported to enjoy taking part in PE lessons (Coates and Vickerman, 2010). Additionally the increases in PA gained via PE provide potential benefits to physical, mental and social wellbeing (Department of Health, 2011). As a result, engagement in PE for children and adolescents with SEN is crucial for encouraging PA throughout life (Coates and Vickerman, 2010). However, a number of barriers for pupils with SEN related to their participation in PE have been highlighted including; inadequate facilities, lack of trained staff, inappropriate curricula, and lack of inclusive provision (Rimmer and Rowland, 2008, Vickerman and Blundell, 2011). Investigating specific periods of the school day, such as playtime and PE lessons, offers the potential to increase researchers' understanding of play behaviours, activity levels, lesson context and interactions of children and adolescents with ID within these segments. Such findings would aid researchers to address the low PA levels and be particularly informative when designing and implementing school based PA interventions.

Ridgers et al. (2012b) outlines the need for more studies using objective methods, such as accelerometry or direct observation, to examine PA behaviours during recess in adolescents. Direct observation techniques have been widely used within mainstream populations to assess both playtime periods (Ridgers et al., 2012b) and PE periods (McNamee and van der Mars, 2005). A recent article examined play behaviours of children with SEN using the System for Observing Children's Activity and Relationships during Play (SOCARP). Key findings suggest that children with Autism spectrum condition (ASC) engaged in more solitary play and less group play compared to other SEN groups. Moreover, the ASC group spent the majority of their

time engaging in sedentary based activities (58%) (Bingham et al., In Press). Though these findings are valuable the sample size was small (n = 22) and authors suggested that future studies should include larger samples (Bingham et al., In Press). The System for Observing Fitness Instruction Time (SOFIT) is a direct observation tool used to examine the quality of PE, assessing PA levels, lesson context and teacher behaviour (McKenzie et al., 1991a). SOFIT has been used to assess PE periods in mainstream (McKenzie et al., 1996) and special populations including groups with hearing problems, mild ID, physical disabilities and visual impairments (Faison-Hodge and Porretta, 2004, Sit et al., 2007) and reported low amounts of MVPA engagement during PE lessons. The lowest PA levels were observed within participants with physical disabilities and the varying levels of PA between disability groups were described to be a result of differences in lesson context and teacher interactions (Sit et al., 2007). There is a gap in current literature that focusses specifically on children and adolescents with moderate and severe levels of ID. Furthermore, Phillips and Holland (2011) report lower PA levels amongst those with higher levels of ID severity which highlights the importance of further investigation in moderate and severe ID subgroups.

Thus, the aim of this study was to investigate PA and play behaviours during playtime and examine the PA and lesson context during PE lessons in children and adolescents with ID.

4.2 Methods

4.2.1 Participants

Prior to the start of the study full institutional ethical approval was granted by Liverpool John Moores University ethical committee (ethics numbers 12/SPS/033). Three SEN schools within North-West England, UK provided gatekeeper consent and agreed to take part within the study, schools involved were; one primary SEN school (4 – 11 years) and one secondary SEN school (11 – 18 years) who enrol children and adolescents with severe intellectual disabilities (SLD) (n = 18), and a specialist sports SEN secondary school (11-18 years) which enrol children and adolescents with moderate intellectual disabilities (MLD) (n = 19). Participant and parent/carer information packs were distributed by the three participating schools to all students aged between 5 – 15 years. Full parental/carer consent was provided for thirty nine children and adolescents with ID (mean age 11.5years, n = 31 boys). All data collection took place during January and February 2013.

The PhD candidate conducted full training for additional members of the research team on site at LJMU in the PA laboratory. Training was completed for anthropometrics and in both observation techniques (SOCARP and SOFIT) and the appropriate level of inter-observer reliability was achieved between the PhD candidate and each member of the research team for each tool (minimum interclass correlation coefficient of 0.8 for each component).

4.2.2 Anthropometrics

Anthropometric data collection sessions were conducted on school sites. Data were collected for body mass to the nearest 0.1kg (Seca, Bodycare, Birmingham, UK), stature and sitting stature to the nearest 0.1cm (Seca, Bodycare, Birmingham, UK) using standard techniques (Lohman et al., 1988). Participants' body mass index (BMI) and BMI Z-scores were calculated (Cole et al., 1995). Also, participants' date of birth, the measurement data and anthropometric data were used to calculate somatic maturation (years to peak height velocity) for each participant using standard regression equations (Mirwald et al., 2002).

4.2.3 Playtime observations using the System for Observing Children's Activity and Relationships during Play (SOCARP)

The SOCARP instrument was used to observe PA levels and play behaviours during playtime on school sites. Observations were scored live during playtime. A 20 second time sampling method was adopted, which involved 10 seconds of observation followed by a 10 second recording period (Ridgers et al., 2010c). Between 2 and 10 participants were observed each playtime. In both primary and secondary SEN schools pupils are provided with the opportunity to attend a range of lunch time clubs (e.g., computer club, choir, art etc.), as a result the PhD candidate was unable to predetermine the participant observation order. Therefore as the playtime began the PhD candidate noted which participants were on the playground with a description of what they were wearing (i.e., black hat or red coat), the PhD candidate then directed each observer to which participant they were to observe. When the first observations were complete, and if there was enough time remaining,

the observer would then be given a second participant to observe. This process continued until the end of playtime. Each participant was observed for a 5 minute period which amounted to 15 observations. A 10 minute observation period would have been preferable (Ridgers et al., 2010c) but was not possible due to school time, space, weather and resource limitations. A predefined scoring sheet was used for SOCARP to classify PA level, group size, activity type and verbal and physical interactions at every observation time point. All observations were conducted outdoors during playtimes at lunchtime. Adverse weather conditions resulted in the cancellation of multiple testing sessions which were rearranged for the next available date. The PhD candidate checked and organised the data into a master spreadsheet, calculating the proportion of time (minutes and percentage) spent in different activity intensities (lying, sitting, standing, walking and very active), types of activities (sport, games, sedentary and locomotion) and group sizes (alone, small, medium and large) which were then retained for analysis. Activity levels were divided into sedentary (lying and sitting), light physical activity (LPA) (standing) or moderate to vigorous physical activity (MVPA) (walking and very active) groups.

4.2.4 Physical Education observations using the System for Observing Fitness Instruction Time (*SOFIT)*

The SOFIT instrument was used to examine PA, lesson context and interactions during PE lessons. To be consistent with the procedures adopted for SOCARP data collection the same 20 second time sampling approach (10 second observe, 10 second record) was used; however, for SOFIT each participant was observed for 10 continuous minutes which amounted to 30 observations. SOFIT also uses a

predefined scoring sheet to classify PA, lesson context and interactions at every observation time point during PE lessons (McKenzie et al., 1991a) and all participants were observed live. In the secondary schools multiple PE lessons would be delivered at the same time so the PhD candidate directed observers to a specific PE lesson and pointed out which pupils needed to be observed within that lesson, observers would complete the 10 minute observation one participant at a time before moving on to the next participant. Each participant was observed once with between 1 to 6 participants observed each lesson. A total of twelve different lessons were observed which were scheduled at different times of the week and lasted between 60 – 105 minutes. After deducting time for participants to change etc. teaching time varied from 40 – 75 minutes. Lessons involved a range of activities including; dance, basketball, circuits (fitness and skill based stations), fitness suite, trampolining, games (i.e. parachute, musical bumps), bowling, skills based session (i.e. hopping, skipping, jumping), swimming/water play. Similar to SOCARP procedures, the PhD candidate organised data and calculated the proportion of time (minutes and percentage) spent in different activity intensities (lying, sitting, standing, walking and very active), lesson context (management, knowledge, fitness, skills, games and other) and teacher interactions (In-class PA promotion, out-of-class PA promotion and no promotion) which were then retained for analysis. Once again activity levels were divided into sedentary (lying and sitting), light physical activity (LPA) (standing) or moderate to vigorous physical activity (MVPA) (walking and very active) groups.

4.2.5 Statistical analysis

After examining the distribution of data and normality was established, parametric statistical analyses were conducted to examine SOCRAP and SOFIT variables. One-way analysis of variance (ANOVA) was used to examine differences in anthropometric variables between boys and girls. One way multivariate analysis of covariance (MANCOVA) was used to investigate differences in playtime behaviours examining PA intensities, the type of activity and group size by sex (MANCOVA 4.1), age group (MANCOVA 4.2) and ID group (ASC vs non-ASC and MLD vs SLD) (MANCOVA 4.3 & 4.4), controlling for maturation, BMI, sex (except MANCOVA 4.1). MANCOVA was also used to examine differences during PE lessons investigating PA intensities, lesson context and interactions by sex (MANCOVA 4.5), age group (MANCOVA 4.6) and ID group (ASC vs non-ASC and MLD vs SLD) (MANCOVA 4.7 & 4.8), controlling for maturation, BMI, sex (except MANCOVA 4.5).

In order to examine the relationship between SOCARP PA intensities and SOFIT PA intensities partial correlations were completed (model 1) controlling for sex, BMI and maturation. Additional partial correlations were conducted to assess associations between SOCARP activity level and other SOCARP variables (model 2) and between SOCARP group size and SOCARP activity type variables (model 3), between SOFIT activity level and other SOFIT variables (model 4), and between SOFIT lesson context and SOFIT interaction variables (model 5). In all analyses adjustment was made for sex, BMI, and maturation.

An alpha value of $P \leq 0.05$ was used to represent statistical significance, and all analyses were conducted using SPSS V21 (SPSS Statistics, IBM).

4.3 Results

Anthropometric, BMI and maturation offset data for boys and girls and the whole sample is presented in Table 4.1.

Table 4.1 Mean ± SD for anthropometrics, BMI and maturation offset for boys and girls and the whole sample

	Boys (n = 31)	**Girls (n = 8)**	**F value**	**All (n = 39)**
Stature (cm)	142.6 ± 14.0	143.9 ± 18.7	.05	142.9 ± 14.8
Weight (kg)	47.3 ± 20.9	48.1 ± 23.6	.01	47.5 ± 21.1
BMI (kg/m²)	22.6 ± 7.5	22.1 ± 6.3	.02	22.5 ± 7.2
BMI Z-score	2.7 ± 2.7	2.6 ± 1.5	.00	2.7 ± 2.5
Maturation offset (years)	-2.6 ± 1.7*	-0.6 ± 2.0	8.55	-2.1 ± 1.9

*: significantly different between boys and girls (P = <0.05)

4.3.1 SOCARP data

Thirty-seven participants (31 boys) were included in the final SOCARP data analysis. Table 4.2 displays adjusted means for the percentage of the observation time spent in

SOCARP variables examining differences by sex and age group. No participants were observed playing in large groups (>10 participants). The MANCOVA analysis found no significant differences in SOCARP variables between boys and girls (P >0.05). Children in primary schools spent significantly more time playing alone (P <0.05) and significantly less time playing in small groups (2 – 4 participants) (P <0.05) during playtime than those in secondary school. Table 4.3 displays adjusted means for the percentage of the observation spent in SOCARP variables examining differences by ASC and non-ASC groups and MLD and SLD groups. Participants with ASC spent significant more time playing alone compared to their non-ASC peers (P <0.05), moreover with regards to the type of activity children with ASC spent more time engaging in sedentary types of activity (P <0.05) compared to the non-ASC group. Participants diagnosed with MLD spent significantly more time playing in small groups (P <0.05) and significantly less time playing alone (P <0.05) in comparison to participants with SLD.

4.3.2 SOFIT data

Thirty seven participants (30 boys) were included in the final SOFIT data analysis. Table 4.4 displays adjusted means for the percentage of the observation time spent in SOFIT variables examining differences by sex, age group. Similar to the SOCARP results the MANCOVA analysis found no significant differences in SOFIT variables between boys and girls (P >0.05). Primary school participants spent significantly less time in skill based lesson contexts (P <0.05) and significantly more time playing games (P <0.05) when compared to secondary school participants. Table 4.5 displays adjusted means for the percentage of the observation time spent in SOFIT

variables examining differences by ASC and non-ASC groups and MLD and SLD groups. MANCOVA analysis found no significant differences in SOFIT results between participants in ASC groups compared to those in non-ASC groups (P >0.05). Participants diagnosed with MLD spent significantly more time in knowledge (P <0.05) and management (P <0.05) based lesson contexts and spent significantly less time engaged in games (P <0.05) in comparison to participants with SLD.

4.2.3 Correlation data

There were weak, negative, non-significant associations observed between SOCARP and SOFIT sedentary behaviours (r (31) = -.102, P >0.05), LPA (r (31) = -.084, P >0.05) and MVPA (r (31) = -.033, P >0.05) variables (model 1). For model 2 a positive correlation was observed between SOCARP MVPA and time spent playing sport related activities (r (32) = .34, P = 0.05) and a negative correlation was observed between SOCARP MVPA and locomotion (r (32) = -.58, P <0.01). No other significant correlations were observed within model 2. For model 3 a positive correlation was observed between playing in medium sized groups (5 – 9 participants) and locomotion activities (r (32) = .36, P = 0.04). For model 4 a positive correlation was observed between SOFIT sedentary behaviours and management (r (32) = .41, P = 0.02), knowledge (r (32) = .42, P = 0.01) and out-of-class PA promotion (r (32) = .41, P = 0.02) and negative correlations were observed between SOFIT sedentary behaviours and time spent in engaging in games (r (32) = -.42, P = 0.01) and ‘no PA promotion’ (r (32) = -.45, P = 0.01). No significant correlations were observed between SOFIT LPA and other SOFIT variables (P >0.05), however, a negative correlation was observed between SOFIT MVPA and management (r (32) = -.49, P = 0.004) and a positive correlation was observed between SOFIT MVPA and ‘no PA promotion’ (r (32) = .34, P = 0.05). No other

significant correlations were observed in model 4. For model 5 a positive correlation was observed between knowledge and out-of-class PA promotion (r (32) = .71, $P < 0.01$) also a positive correlation was observed between 'other' activity types and in-class PA promotion (r (32) = .34, $P = 0.05$). No other significant correlations were observed within model 5.

Table 4.2 Percentage of observation time [SE] for SOCARP variables, adjusted for BMI, maturation and sex (except for sex analysis)

SOCARP component (% of observed time)	**Boys n = 31**	**Girls n = 6**	**F value**	***P* value**	**Primary n = 15**	**Secondary n = 22**	**F value**	***P* value**
Sedentary	7.2 [4.4]	17.4 [9.9]	.89	.35	19.7 [9.1]	1.4 [6.8]	1.75	.20
LPA	34.2 [4.8]	36.4 [11.0]	.03	.86	37.6 [10.3]	32.5 [7.8]	.11	.75
MVPA	58.4 [4.8]	46.2 [10.8]	1.06	.31	43.1 [9.9]	65.5 [7.4]	2.26	.14
Alone	49.5 [6.1]	34.2 [13.9]	1.02	.32	78.2 [11.6]*	25.8 [8.7]	8.91	.01
Small group	46.6 [6.4]	65.9 [14.5]	1.47	.23	12.3 [11.5]*	75.3 [8.7]	13.04	.001
Medium group	3.9 [2.9]	0 [6.6]	.30	.59	9.6 [6.1]	0 [4.6]	1.34	.26
Large Group	0	0			0	0		
Sport	3.4 [3.0]	11.3 [6.8]	1.16	.29	10.8 [6.2]	0.5 [4.7]	1.19	.28
Games	66.9 [6.2]	6.2 [14.2]	2.32	.14	56.2 [13.3]	67.7 [10.0]	.33	.57
Sedentary	7.8 [3.2]	16.2 [7.3]	1.11	.30	6.7 [6.8]	10.9 [5.1]	.17	.68
Locomotion	17.8 [5.2]	29.2 [11.8]	.78	.38	20.5 [11.1]	19.1 [8.4]	.01	.93

*: significantly different between boys and girls ($P = <0.05$)

Table 4.3 Percentage of observation time [SE] for SOCARP variables, adjusted for BMI, maturation and sex

SOCARP component (% of observed time)	ASC n = 19	Non-ASC n = 18	F value	*P* value	MLD n = 18	SLD n = 19	F value	*P* value
Sedentary	11.8 [5.7]	5.7 [5.8]	.56	.46	2.2 [7.3]	15.1 [7.0]	1.17	.29
LPA	28.1 [6.1]	41.4 [6.3]	2.26	.14	41.7 [8.1]	27.8 [7.8]	1.11	.30
MVPA	59.7 [6.2]	52.9 [6.4]	.58	.45	55.5 [8.1]	57.3 [7.8]	.02	.89
Alone	59.0 [7.4]*	34.4 [7.7]	5.20	.03	27.2 [9.5]*	65.8 [9.2]	6.17	.02
Small group	39.9 [8.0]	60.1 [8.2]	3.06	.10	71.6 [9.8]*	29.0 [9.5]	7.00	.01
Medium group	1.1 [3.8]	5.5 [3.9]	.63	.44	1.3 [4.9]	5.1 [4.7]	.23	.63
Large Group	0	0			0	0		
Sport	4.4 [3.9]	5.0 [4.0]	.01	.92	0 [4.8]	12.1 [4.6]	3.81	.06
Games	61.6 [8.2]	64.6 [8.4]	.07	.80	58.8 [10.6]	67.1 [10.2]	.23	.64
Sedentary	14.9 [3.9]*	3.2 [4.1]	4.16	.05	17.6 [5.1]	1.2 [5.0]	3.79	.06
Locomotion	20.3 [6.8]	19.0 [7.0]	.02	.90	27.3 [8.7]	12.4 [8.4]	1.09	.30

*: significantly different between boys and girls (*P* = <0.05)

Table 4.4 Percentage of observation time [SE] for SOFIT variables, adjusted for BMI, maturation and sex (except for sex analysis)

SOFIT component (% of observed time)	**Boys n = 30**	**Girls n = 7**	**F value**	***P* value**	**Primary n = 15**	**Secondary n = 22**	**F value**	***P* value**
Sedentary	21.8 [3.6]	17.3 [7.4]	.31	.58	23.5 [7.5]	19.3 [5.7]	.13	.72
LPA	22.8 [2.9]	31.2 [5.9]	1.61	.21	22.9 [6.1]	25.5 [4.6]	.08	.78
MVPA	53.9 [3.7]	51.5 [7.6]	.22	.64	53.6 [7.5]	55.2 [5.6]	.02	.89
Management	33.3 [4.6]	37.7 [7.6]	.17	.68	29.1 [9.7]	37.5 [7.3]	.32	.57
Knowledge	5.2 [2.0]	1.4 [4.2]	.68	.42	0.5 [4.2]	7.3 [3.1]	1.16	.29
Fitness	16.2 [16.2]	8.5 [7.8]	.80	.38	11.7 [7.9]	16.9 [5.9]	.19	.67
Skills	8.5 [8.5]	17.0 [6.5]	1.40	.25	0 [6.1]*	19.4 [4.6]	6.18	.02
Games	36.1 [6.0]	35.3 [12.4]	.00	.96	62.1 [11.6]*	18.1 [8.7]	6.30	.02
Other	0.7 [0.5]	0 [1.0]	.36	.56	0.1 [1.1]	0.9 [0.8]	.25	.62
In-Class promotion	15.4 [2.7]	21.5 [5.5]	.99	.33	21.4 [5.6]	13.3 [4.2]	.94	.34
Out-of-Class promotion	0.1 [0.1]	0 [0.2]	.26	.61	0 [0.2]	0.2 [0.2]	.50	.49
No promotion	83.4 [2.6]	84.2 [5.4]	.02	.89	79.1 [5.5]	86.6 [4.1]	.82	.37

*: significantly different between boys and girls ($P = <0.05$)

Table 4.5 Percentage of observation time [SE] for SOFIT variables, adjusted for BMI, maturation and sex

SOFIT component (% of observed time)	**ASC n = 19**	**Non-ASC n = 18**	**F value**	***P* value**	**MLD n = 18**	**SLD n = 19**	**F value**	***P* value**
Sedentary	20.9 [4.6]	21.1 [4.8]	.00	.99	23.0 [6.0]	19.1 [5.8]	.15	.70
LPA	26.9 [3.7]	21.8 [3.8]	.90	.35	24.4 [4.8]	24.4 [4.7]	.00	1.00
MVPA	52.2 [4.5]	57.1 [4.7]	.56	.46	52.6 [5.9]	56.5 [5.7]	.16	.70
Management	42.0 [5.7]	25.8 [5.8]	3.84	.06	49.8 [7.1]*	19.3 [6.8]	6.99	.01
Knowledge	4.3 [2.6]	4.7 [2.7]	.02	.91	11.3 [3.1]*	0 [2.9]	6.99	.01
Fitness	12.0 [4.8]	17.7 [5.0]	.64	.43	11.7 [6.3]	17.7 [6.1]	.34	.57
Skills	7.3 [4.0]	13.1 [4.1]	.99	.33	16.7 [5.1]	3.8 [4.9]	2.39	.13
Games	34.3 [7.7]	37.7 [8.0]	.09	.77	11.0 [8.6]*	59.6 [8.3]	11.97	.002
Other	0.1 [0.6]	1.0 [0.7]	.97	.33	0 [0.8]	1.5 [0.8]	2.19	.15
In-Class promotion	14.7 [3.4]	18.6 [3.5]	.62	.44	13.0 [4.4]	20.0 [4.3]	.94	.34
Out-of-Class promotion	0 [1.1]	0.2 [0.1]	1.03	.32	0.2 [0.2]	0 [0.2]	.68	.42
No promotion	84.1 [3.4]	82.8 [3.5]	.07	.79	85.1 [4.4]	82.0 [4.2]	.18	.68

*: significantly different between boys and girls ($P = <0.05$)

4.4 Discussion

This is the first study to use direct observation techniques to investigate PA and play behaviours during playtime and examine the PA and lesson context during PE lessons of children and adolescents with moderate and severe ID. The outcomes of the systematic observations (SOCARP and SOFIT) provide some objective insights into children and adolescent's with ID PA behaviours during playtime and PE lesson periods. No differences were noted for sedentary behaviours, LPA and MVPA in playtime or PE lessons between any comparison sub groups. During playtime participants spent most time engaging in MVPA (56% of observed time), followed by LPA (35% of the observed time) and sedentary activities (9% of the observed time). The proportion of time spent engaging in MVPA at playtime is similar to that of earlier findings reported by Bingham et al., (In Press) who observed children and adolescents with SEN to spend 47% in MVPA during playtime. Similar MVPA levels engaged in at playtime (~60%) were observed by children without ID (Ridgers et al., 2011). Further, playtime values in this study are similar to our results of sedentary behaviours and PA levels observed in PE lessons (of the observed time 55% was MVPA, 24% was LPA and 21% was sedentary activities). This is the first study to conduct both playtime and PE observations on the same cohort of participants, focussing specifically on children and adolescents with ID. One study by Sit et al. (2007) used the SOFIT tool to assess PA levels in PE and playtime including children with a range of disabilities. Results for participants with ID demonstrated similar MVPA levels observed in PE (~50%) and playtime (~57%) contexts to those reported in this study. In the current study, although the proportion of time spent engaging in the various PA intensity levels were comparable between

playtime (SOCARP) and during PE lessons (SOFIT), no significant correlations were observed between playtime and PE lesson PA levels and sedentary behaviour.

For both SOCARP and SOFIT results no differences were observed between boys and girls, which concurs with the habitual PA accelerometer data reported in Study 1. This may be explained by the unequal sex subgroups which are also seen in previous research in youth with ID (Hinckson and Curtis, 2013). Research conducted in children and adolescents without disabilities assessing PA levels during recess demonstrates that boys typically engage in more PA than girls (Ridgers et al., 2012b). Further, it is reported that boys tend to engage in competitive sports whereas girls prefer to socialise with friends (walking and talking) (Boyle et al., 2003). A later article by Ridgers et al. (2011) supports this notion reporting multiple sex differences during playtime observations. Girls spent significantly more time in small groups, playground games, pro-social physical behaviours, standing and locomotion types of activities than boys, whereas boys engaged in significantly more MVPA, large groups, sports and antisocial behaviours than girls (Ridgers et al., 2011). Our results suggest that boys and girls spent a minimal amount of time playing sports during playtime or engaging in skill and fitness based activities in PE, with the most amount of time spent by the whole sample engaging in games at both playtime (64%) and PE (36%) periods. However, correlation analysis demonstrated a positive association between MVPA and time spent engaging in sport based activities during playtime. These findings suggest that playtime periods with relatively greater opportunities for sport based activities during playtime may predispose children to engage in MVPA. However barriers towards sporting or competitive activities have been previously reported within this population. For

example, Downs et al. (2013) described a lack of understanding and difficulty when following rules of sports, as barriers that may prevent children and young people with DS from engaging in certain sports, such as football. No large group play was seen by any participants within the current study. This finding is consistent with those reported by Bingham et al. (In Press) who found that participants with ID spent a small proportion of time engaging in large group play (9.9%) with the majority of time spent engaging in play alone (42.8%) and small group (40.8%). Within mainstream populations large group play is also associated with sports and MVPA (Ridgers et al., 2012b); however research comparing those with and without disabilities is inconclusive. The findings of this study suggest that sport based activities may drive levels of PA. The low levels of PA observed in children and adolescents with ID may be partly explained by a lack of engagement in sport or competitive activities, and an absence of large group play.

When comparing participants by age group (primary (5 – 11 years) and secondary (11 – 15 years)) it was observed that younger participants engaged in more lone play and less small group play than their older counterparts. This may be due to the increased levels of socialising by older participants during playtime. This concept is supported by Ridgers et al. (2011) who reported a reduction in the time spent playing alone and engaging in antisocial behaviours when in year 5 compared to year 6. Also, all participants within the primary school age group had SLD whereas only 4 participants within the secondary school aged group were diagnosed with SLD. Moreover, MLD participants engaged in less lone play and higher amounts of small group play compared to their peers with SLD. The differences in group size may be somewhat related to differences in communication ability. Individuals with SLD

tend to use a basic levels of communication usually using singular words and gesture to communicate. In comparison, those with MLD are described to have some language skills that enable them to express their day to day needs (Emerson et al., 2010). Therefore these findings may suggest that the differences in group size during playtime may be partly attributed to the level of ID severity rather than age group. Future research should aim to use similar samples of participants in relation to their level of ID.

Participants with ASC spent more time playing alone and engaging in more sedentary types of activities compared to their non-ASC peers at playtime. Engaging in sedentary types of activities supports previous findings by Bingham et al. (In Press) which reported children and adolescents with ASC to spend a large proportion of time in sedentary based activities (58%). Solitary play has previously been described by Holmes and Willoughby (2005), specifically for those with ASC, reporting that they played both alone and in the presence of others, but little interaction with others was observed (Holmes and Willoughby, 2005). Moreover, individuals with ASC have difficulty in socialising as the condition affects how individuals communicate and relate to others (The National Autistic Society, 2015). Due to the characteristics associated with ASC, the levels of lone play observed within the ASC group are unsurprising.

With regards to the lesson context during PE observations, when comparing age groups, younger participants who all had SLD, spent significantly more time in game based activities, while older participants who mostly had MLD, spent a greater

amount of time in skill based activities. Results by Sit et al. (2007) report that children with mild ID from elementary schools (primary) spent the majority of time in skill based activities (36.6%) with a small percentage of time spent in game play (3.4%). Differences in ID severity in primary school aged participants between studies though, make them problematic to compare. It is suggested that children and adolescents with ID should only be compared by age if they have similar levels of ID severity, and perhaps primary school participants with mild ID in Sit et al. (2007) study would make a better comparison group for the older participants within the current study due to their levels of ID severity. As mentioned in the previous chapter (Study 1), if future research include participant samples whose ID range in severity, then perhaps including the ID severity into the analysis model as a covariate would help by controlling for at least one of these factors. A negative correlation was observed between sedentary behaviours and game based activities within PE lessons, suggesting that when participants engaged in game based activities little sedentary behaviours were observed and for this sample of children and adolescents game based activities were associated with more engagement in LPA and MVPA SOFIT variables. In contrast, Sit et al. (2007) reported associations between increased sitting time and game play in children with physical disabilities during PE, which highlights the importance of researchers and teachers acknowledging not only the severity but also the type of disability participants have. Further, if the targeted SEN school enrols pupils with different disabilities with varying individual needs, the lesson context and delivery methods need approaching differently to ensure PA outcomes are maximised, and that all pupils receive suitable education throughout PE.

The Department for Education (2013) state that for the whole population, PE should aim to ensure that pupils have the ability to perform well in a range of physical activities, engage in sustained amounts of PA, take part within competitive sports and activities and lead healthy and active lifestyles. During PE lessons, participants with MLD were observed spending more time in management and knowledge based lesson contexts and less time in game based lesson contexts than their peers with SLD. Also, SOFIT sedentary time was positively correlated with management and knowledge based lesson contexts, and SOFIT MVPA was negatively associated with management based lesson contexts. The context of a PE lesson is driven by the class teachers who play an important role in youth achieving PA goals (Fairclough and Stratton, 2005). Though this study showed management and knowledge based lesson contexts to negatively impact on the PA levels accrued during PE, these contexts are needed to ensure that the PE national curriculum aims are reached. As, skill and knowledge based lesson are linked to the increase of opportunities both in- and out-of-class (Fairclough and Stratton, 2005). In the current study SOFIT MVPA was positively associated with 'no PA promotion' (i.e. no in- or out-of-class PA, fitness or motor skills promotion by the teacher), which could be due to the difficulties individuals with ID have related to filtering and understanding new and complex information (WHO, 2014). This is further supported by the positive correlations observed between SOFIT sedentary behaviours and out-of-class PA promotion. Collectively these findings are valuable for both school teachers and researchers to aid the design and implementation of PA interventions aimed to increase PA and reduce sedentary behaviours for pupils with ID.

4.4.1 SOCARP tool limitations

SOCARP is a reliable and valid tool that explores PA levels and behaviours during playtime periods (Ridgers et al., 2010c). Although the SOCARP tool explores interactions with other children it does not investigate peer and teacher interactions separately. Children and adolescents with ID who attend SEN schools need additional support throughout the school day and this is provided by teachers and additional support staff. As a result there is a high teacher to pupil ratio in comparison to that observed in mainstream schools, for the current study the typical teacher: pupil ratio would be 1: 3-6 (dependant on the pupils needs). Consequently, it is suggested that the SOCARP tool may not capture all PA related interactions, especially in SEN schools where more teachers are present during playtime that may positively or negatively influence the pupil's PA behaviours. One way of capturing this would be evolve the SOCARP tool to include items that specially focus on participant interactions with teachers and support staff. Also, the SOCARP tool allows researchers to score more than one interaction during a 10s observation period, other SOCARP variables are scored on the 10th second. This method makes interactions difficult to analyse, but also poses questions as to how you can relate the participants' interactions to other SOCARP variables. In order to relate interactions to different components of the SOCARP tool, such as PA levels, it is suggested that all components, including interactions, are scored on the 10th second. This concept needs further investigation. Finally, the SOCARP tool only accounts for portable equipment (such as bats and balls) and if such resources were readily available to pupils on the playground at the start of the observation period. This means that researchers cannot accurately associate the use of equipment with other SOCARP variables like PA and sedentary behaviours. Future researchers may want to consider

integrating an additional layer into the SOCARP tool which enables exploration into the use of equipment (fixed and non-fixed) at playtime in greater detail, especially in SEN schools where use of equipment is encouraged by staff and is generally becoming more accessible due to various funding bodies.

4.4.2 Limitations

Findings from the current study are valuable for schools, teachers and future researchers; however there were a number of limitations. Firstly, SOCARP observations were 5 minutes in length, 10 minutes would have been preferable, however, issues related to school time, space, weather, optional lunch time clubs and resources would have meant that if 10 minute observations were adopted for this study the sample size would have reduced significantly. Recruitment is difficult within this population and is not only seen throughout the current thesis, but also, within previous research conducted in this area (Hinckson and Curtis, 2013). Though comparable to previous research within ID populations, the final sample size was small especially when compared to observational studies within mainstream populations, the small sample size resulted in low statistical power and also limits the ability to generalise the findings to the target population as a whole. Within this study the participants were made up of both children and adolescents with MLD and SLD although both groups are under researched it is suggested that future studies focus on one sample per study or alternatively treat them as two separate groups. Having varying severity levels of ID within this study made it difficult to interpret SOCARP and SOFIT differences between age groups (primary vs secondary school participants) and potentially those within ASC and non-ASC subgroups.

4.5 Conclusion

PA and sedentary levels were similar for playtime and PE periods and no sex differences were observed within any playtime or PE activity levels and behaviours. Participants spent the greatest amount of time (~50%) engaging in MVPA within both playtime and PE which supports previous observation studies conducted in youth with ID. Game based activities were the most popular type of activity in playtime and PE periods and the least amount of time was spent playing sports. Sport based activities positively correlated with MPA however barriers are highlighted for children and adolescents with ID to partake in sport based activities. In general participants' favoured alone play and small group play and participants with ASC engaged in more lone play and sedentary based activities than non-ASC participants. No large group play was observed across the whole cohort. The severity and type of disability should be considered when promoting PA in SEN schools, researchers should treat participants' with MLD and SLD as separate subgroups especially when investigating by age and ASC/non-ASC. Finally it is suggested that adaptations made to the SOCARP tool may allow for greater examination of playtime behaviours in children and adolescents with ID particularly in relation to teacher interactions and use of equipment. Playtime and PE periods offer significant opportunities for children and adolescents with ID to engage in PA throughout the academic year, moreover these periods also provide school staff with multiple opportunities each week to promote PA.

Thesis study map

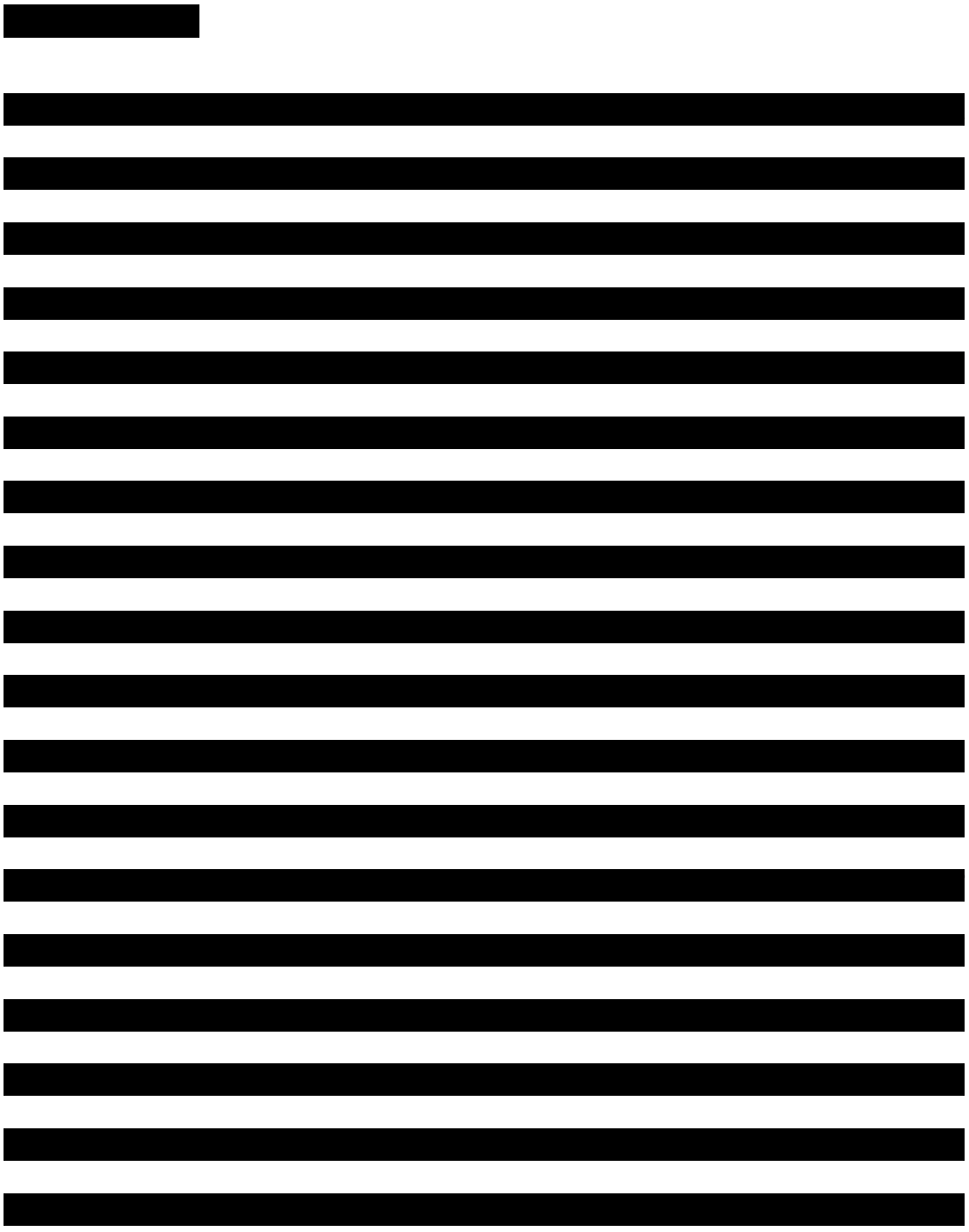
Study	Objectives
Study 1: Investigating habitual physical activity levels, sedentary behaviours and the tempo of physical activity in children and adolescents with intellectual disabilities	Objectives: • To objectively investigate habitual PA and sedentary behaviours of children and adolescents with ID. • To examine the tempo of PA by sex, age and disability. Key findings: - Participants in this study did not engage in enough PA to benefit health. - The tempo of PA for this sample of children was of a similar nature to children without ID. - The majority of participants PA were made up of short sporadic bursts of activity with the amount of continuous bouts decreasing as the intensity and duration increases.
Study 2: An investigation of physical activity behaviours and context during playtime and Physical Education lessons in children and adolescents with intellectual disabilities	Objectives: • To investigate PA and play behaviours during playtime of children and adolescents with ID. • To examine the PA and lesson context during PE lessons in children and adolescents with ID. Key findings: - Participants engaged in similar amounts of MVPA during both playtime and PE contexts. - During playtime and PE contexts participants engaged in minimal amounts of sports based activities. - During playtime participants spent the majority of time playing alone or in small groups and no large group play was observed by any participants.
Study 3: Exploring teachers' perceptions on physical activity engagement for children and adolescents with intellectual disabilities	Objectives: • Explore teachers' perceptions of barriers and facilitators to PA engagement for children and adolescents with moderate to severe ID within the school environment. • To examine influencing PA factors including enabling, reinforcing and predisposing factors.
Study 4: The evaluation of a pilot school-based physical activity intervention for children with intellectual disabilities attending special educational needs schools in the North West of England.	

Chapter 5

Study 3

Exploring teachers' perceptions on physical activity engagement for children and adolescents with intellectual disabilities

The main outcomes from this study have been previously published. Samantha J Downs, Zoe Rebecca Knowles, Stuart James Fairclough, Natalie Heffernan, Sarah Whitehead, Sofie Halliwell and Lynne Mary Boddy. (2014). Exploring teachers' perceptions on physical activity engagement for children and young people with intellectual disabilities. *European Journal of Special Needs Education 29*(3), 402 - 414.



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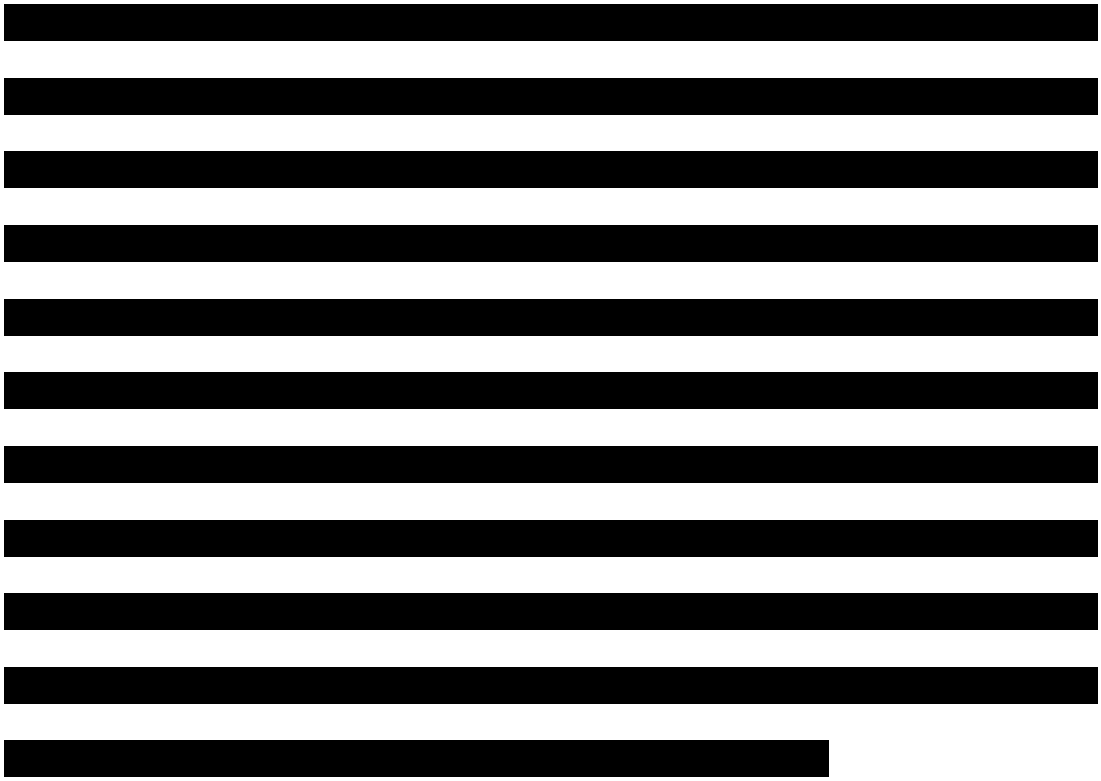

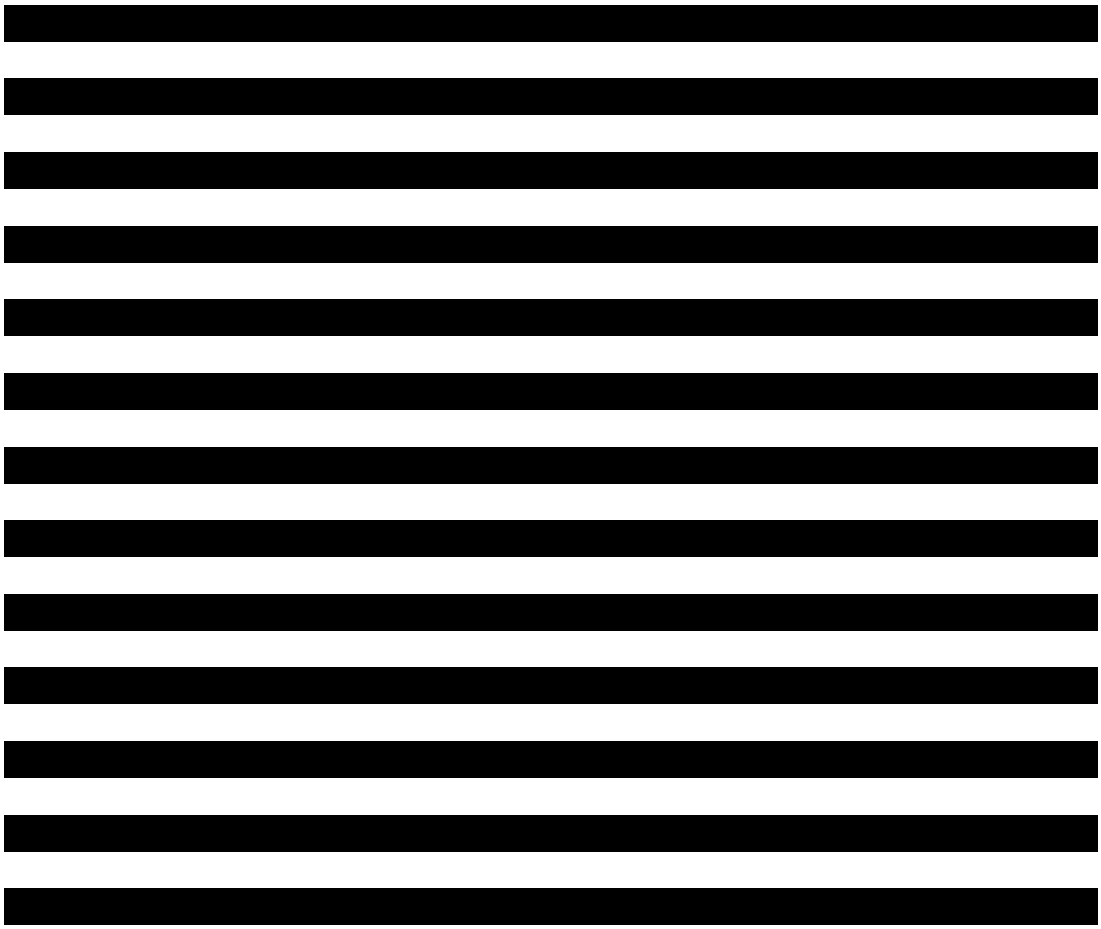

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Thesis study map

Study	Objectives
Study 1: Investigating habitual physical activity levels, sedentary behaviours and the tempo of physical activity in children and adolescents with intellectual disabilities	Objectives: • To objectively investigate habitual PA and sedentary behaviours of children and adolescents with ID. • To examine the tempo of PA by sex, age and disability. Key findings: - Participants in this study did not engage in enough PA to benefit health. - The tempo of PA for this sample of children was of a similar nature to children without ID. - The majority of participants PA were made up of short sporadic bursts of activity with the amount of continuous bouts decreasing as the intensity and duration increases.
Study 2: An investigation of physical activity behaviours and context during playtime and Physical Education lessons in children and adolescents with intellectual disabilities	Objectives: • To investigate PA and play behaviours during playtime of children and adolescents with ID. • To examine the PA and lesson context during PE lessons in children and adolescents with ID. Key findings: - Participants engaged in similar amounts of MVPA during both playtime and PE contexts. - During playtime and PE contexts participants engaged in minimal amounts of sports based activities. - During playtime participants spent the majority of time playing alone or in small groups and no large group play was observed by any participants.
Study 3: Exploring teachers' perceptions on physical activity engagement for children and adolescents with intellectual disabilities	Objectives: • Explore teachers' perceptions of barriers and facilitators to PA engagement for children and adolescents with moderate to severe ID within the school environment. • To examine influencing PA factors including enabling, reinforcing and predisposing factors. Key findings: - Pupils with ID enjoyed engaging in fun, unstructured physical activities. - Teacher participants identified themselves as playing an influential role on the PA engagement by children and adolescents with ID. - Pupils with ID were described to have a limited understanding around PA and the benefits to health.

Study 4: The evaluation of a pilot school-based physical activity intervention for children with intellectual disabilities attending special educational needs schools in the North West of England.	Objectives: • Evaluate the effect of the school-based PA intervention on habitual sedentary and PA behaviours, and play behaviours at playtime in children with severe ID. • To retrospectively, explore the self-efficacy and confidence of teachers in relation to the delivery of the school-based PA intervention.

Chapter 6

Study 4

The evaluation of a pilot school-based physical activity intervention for children with intellectual disabilities attending special educational needs schools in the North West of England

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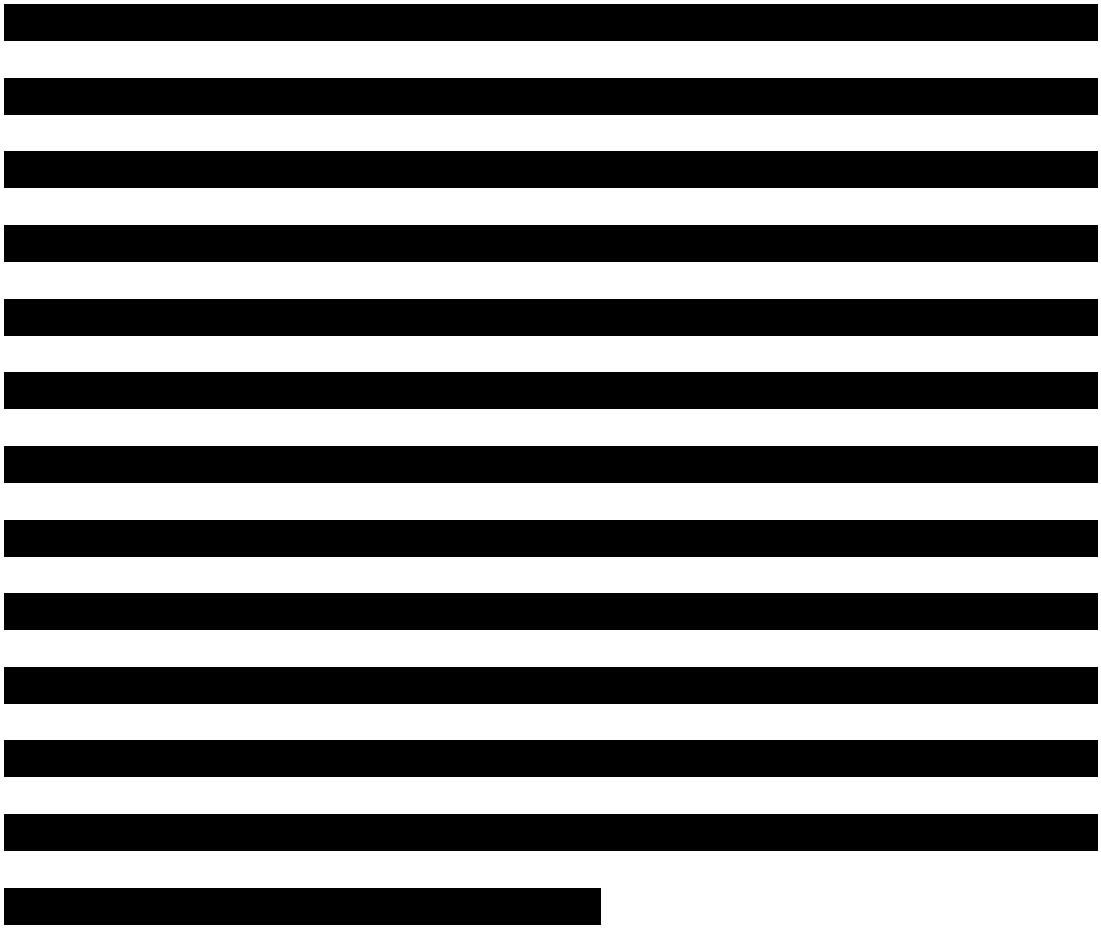

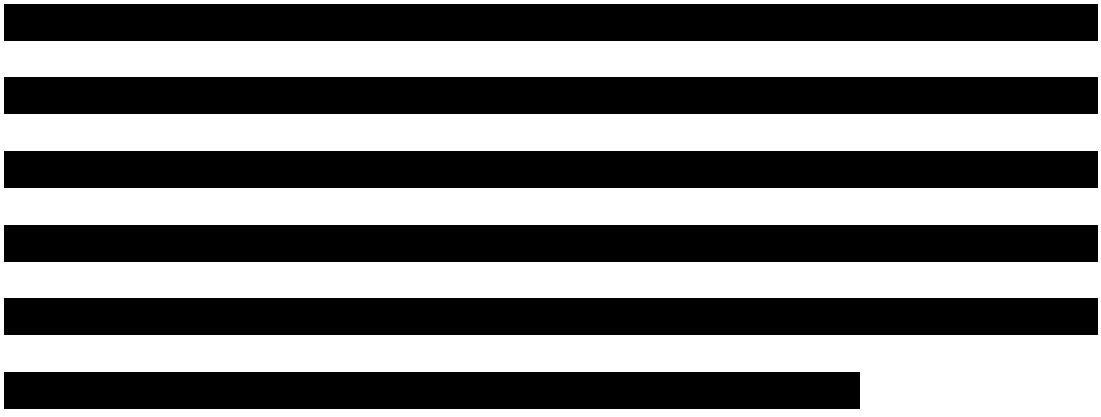

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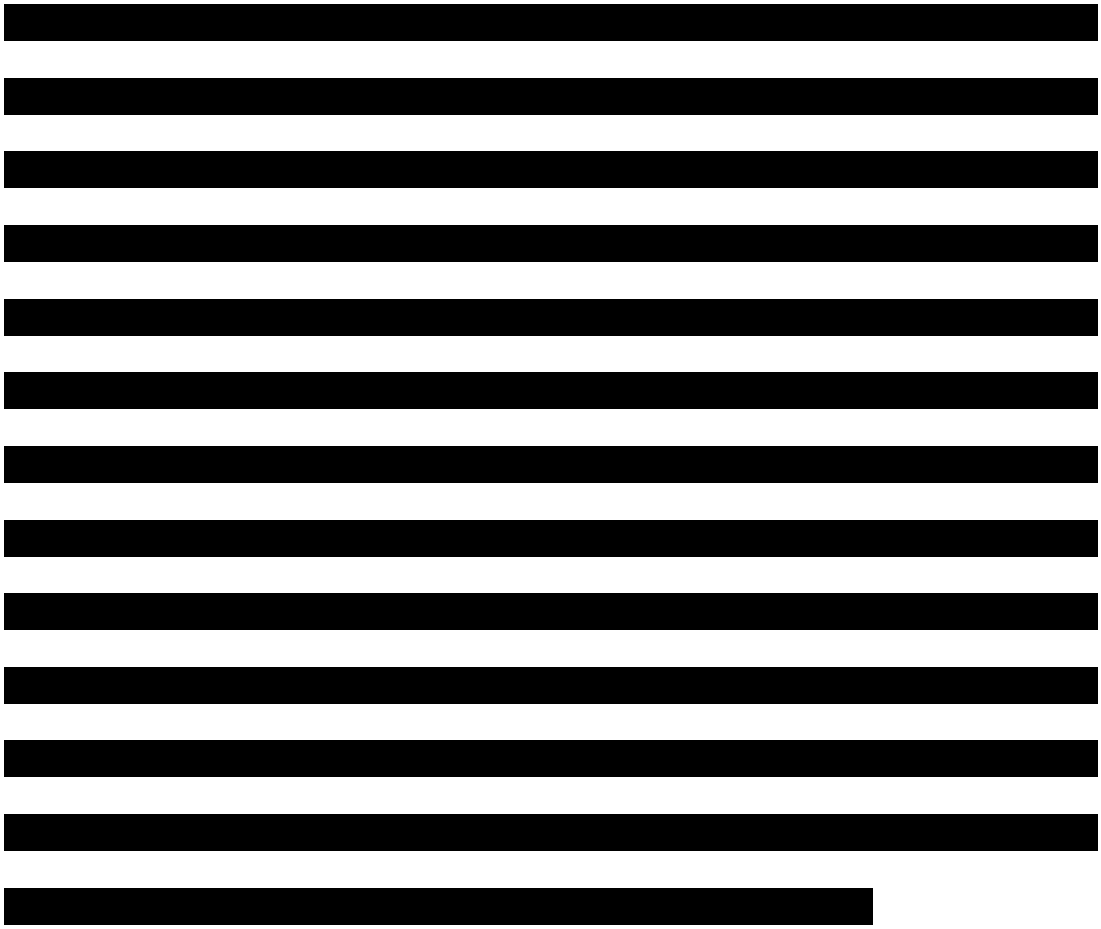

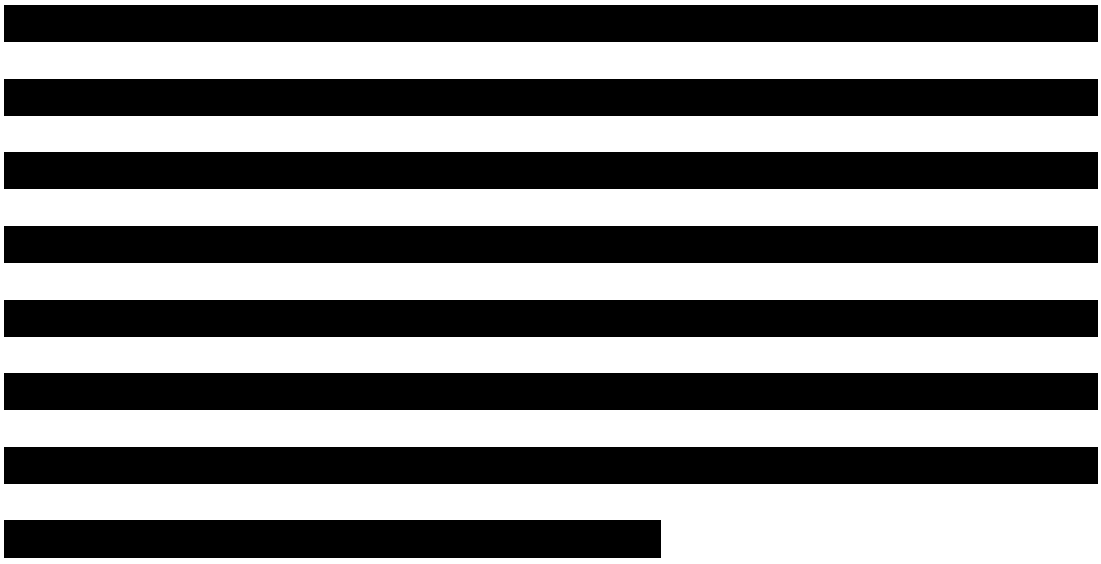

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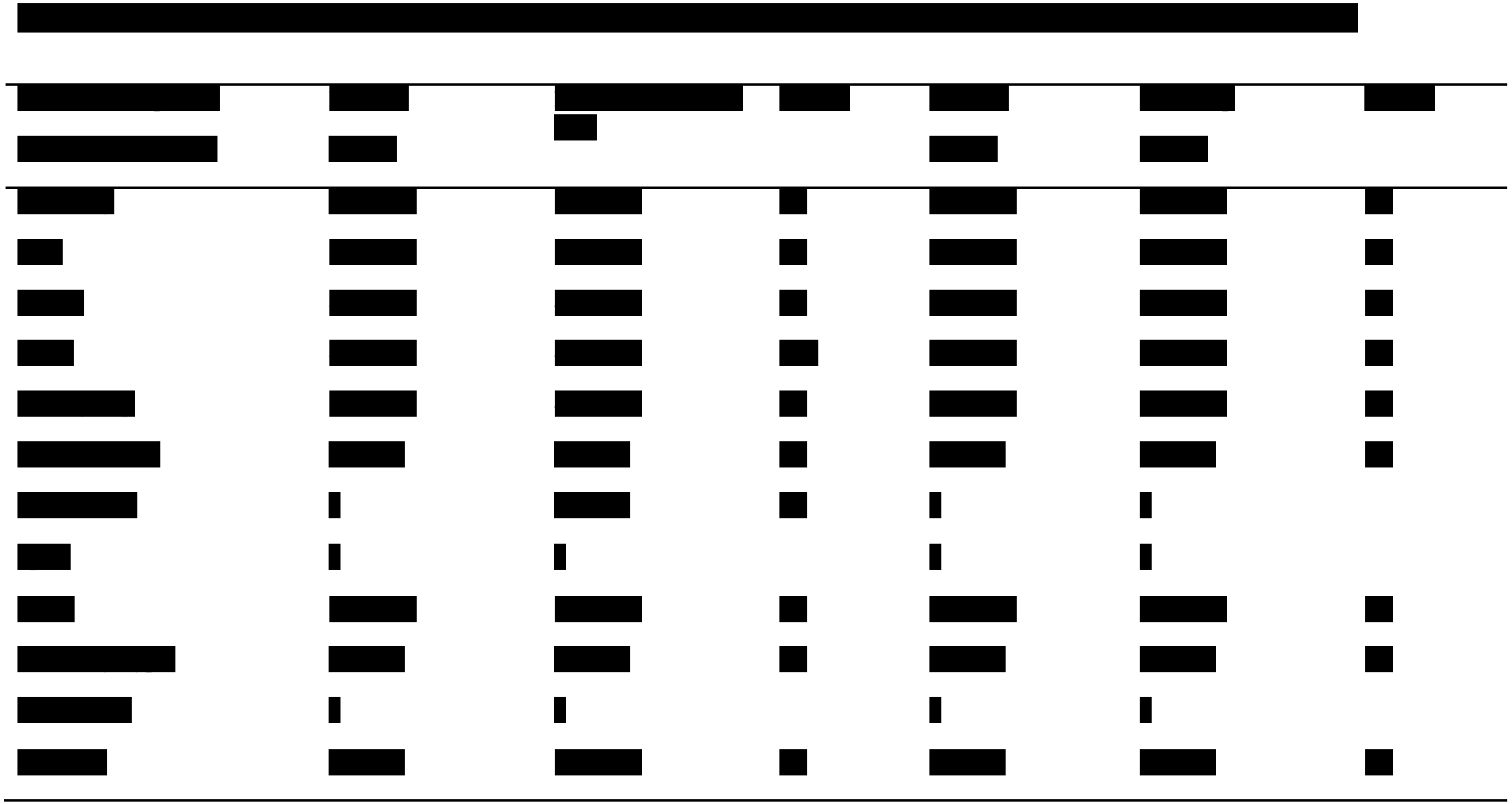

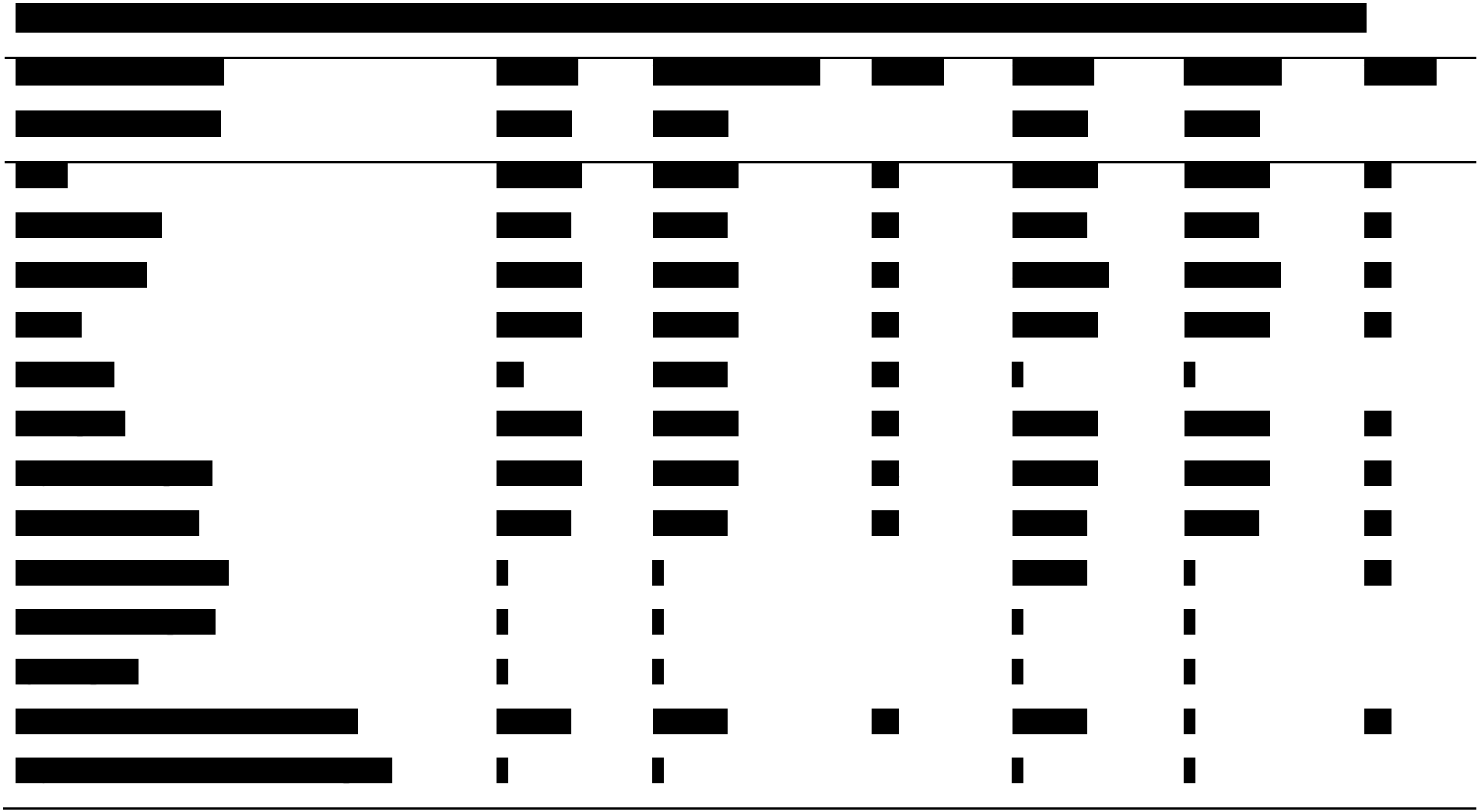

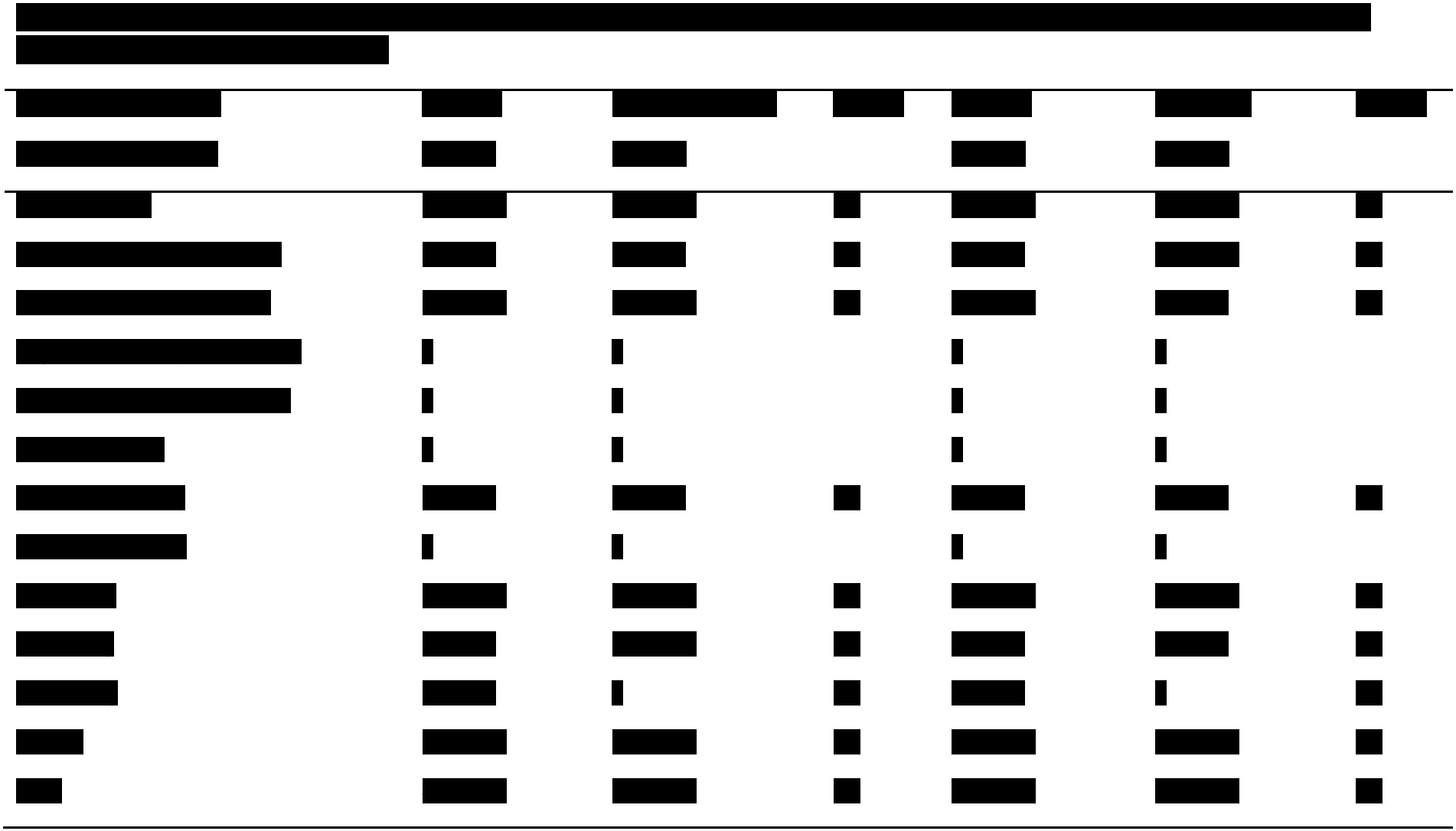

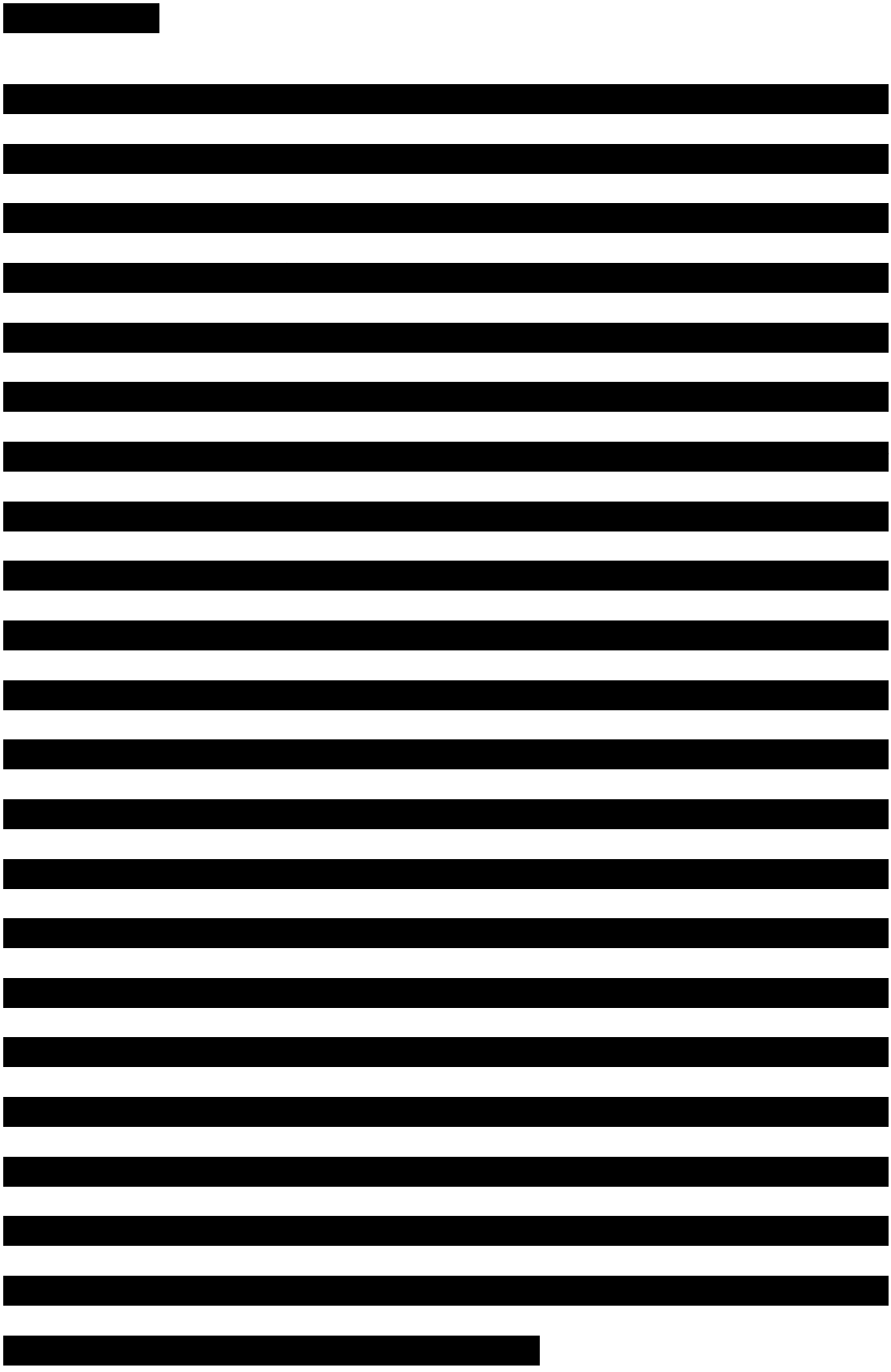

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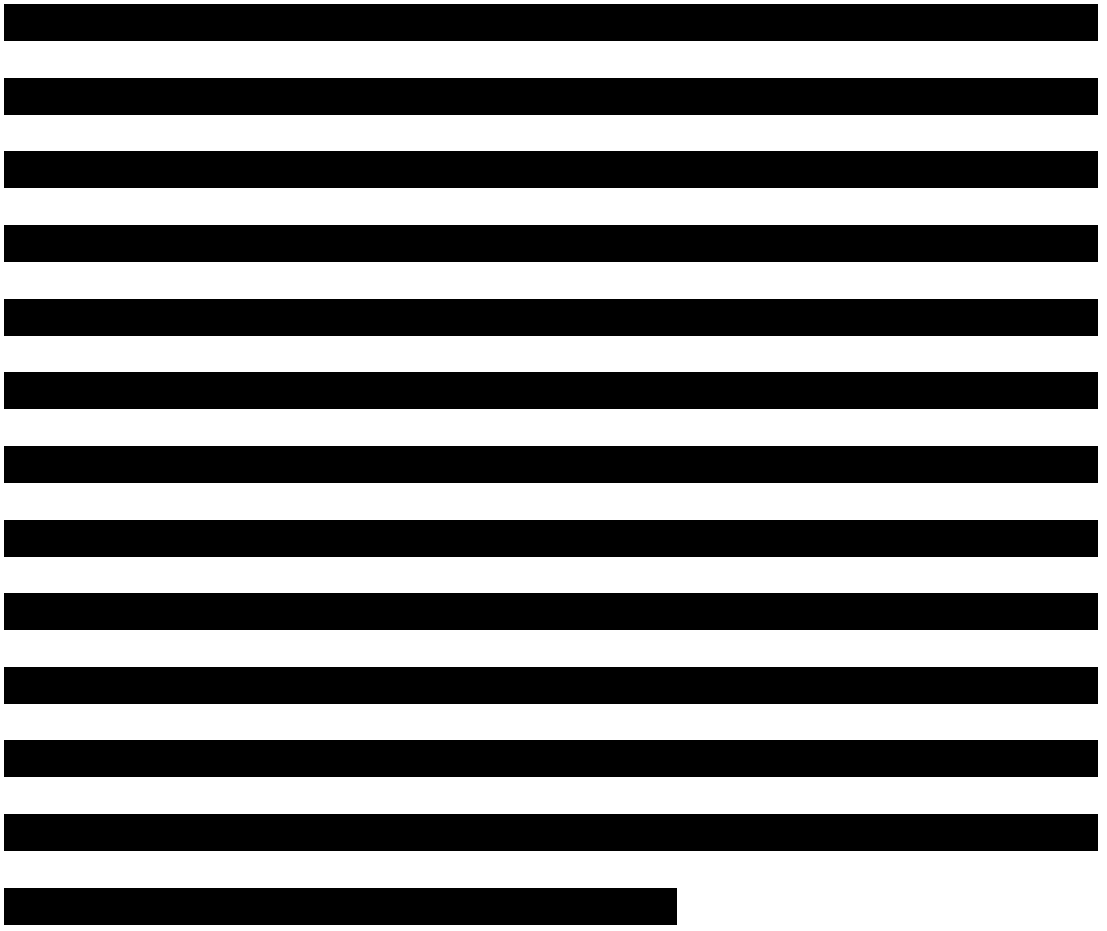

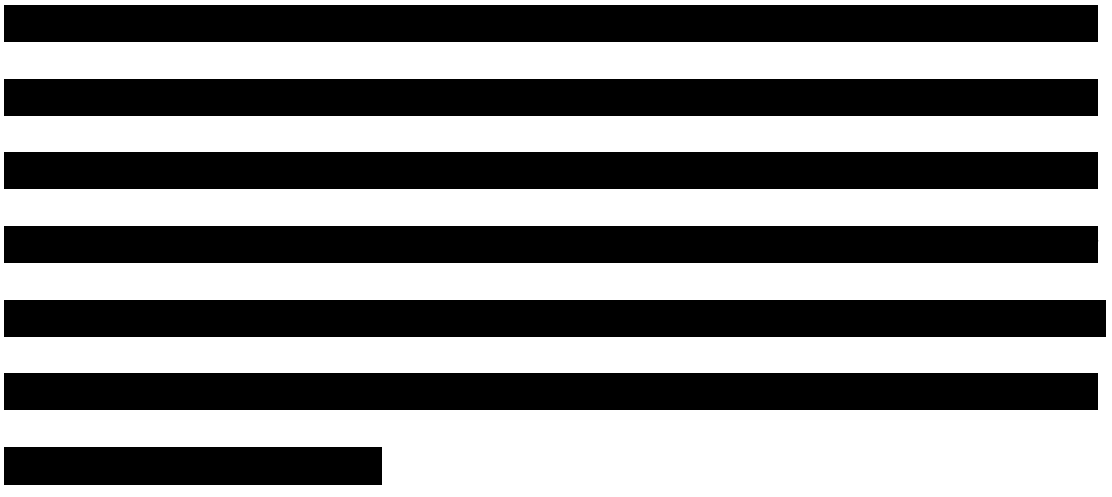

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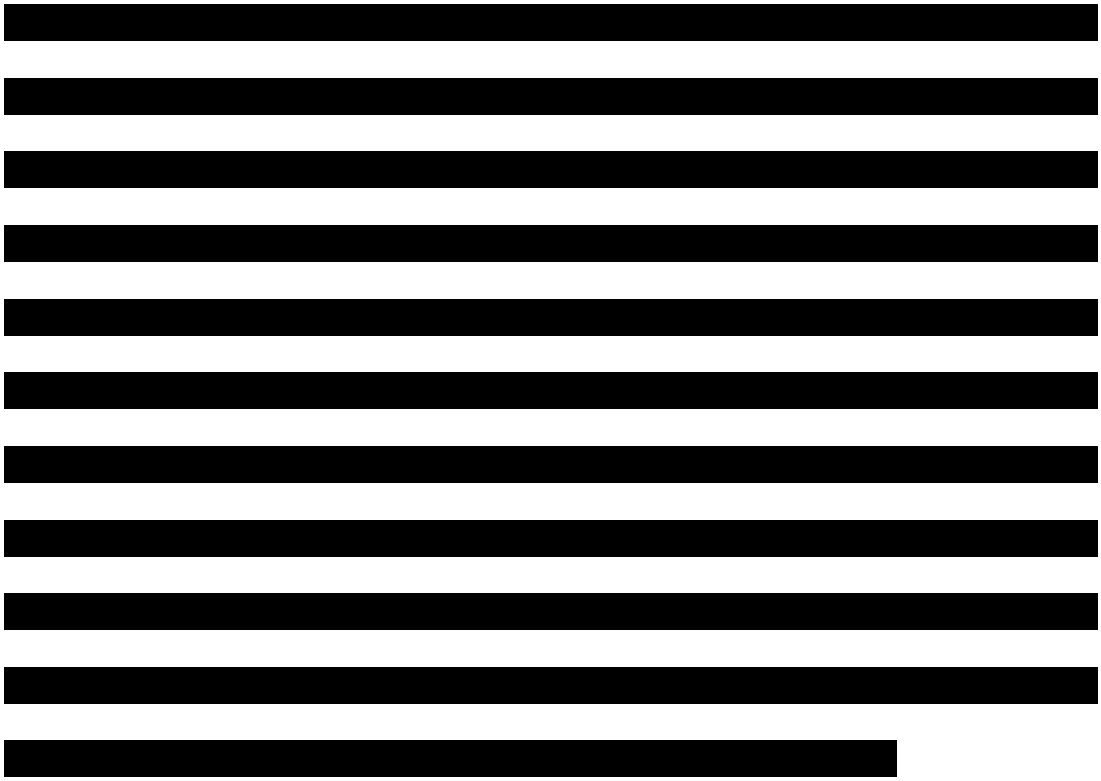

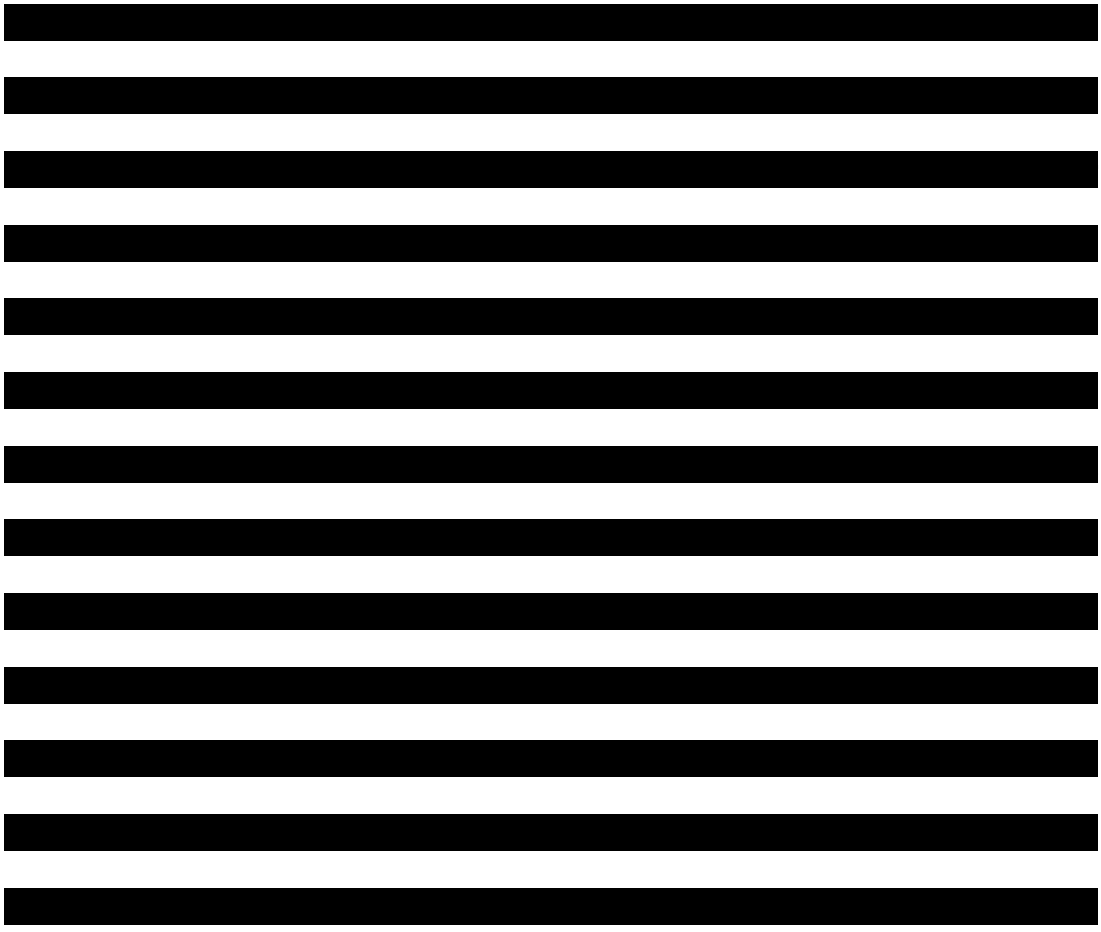

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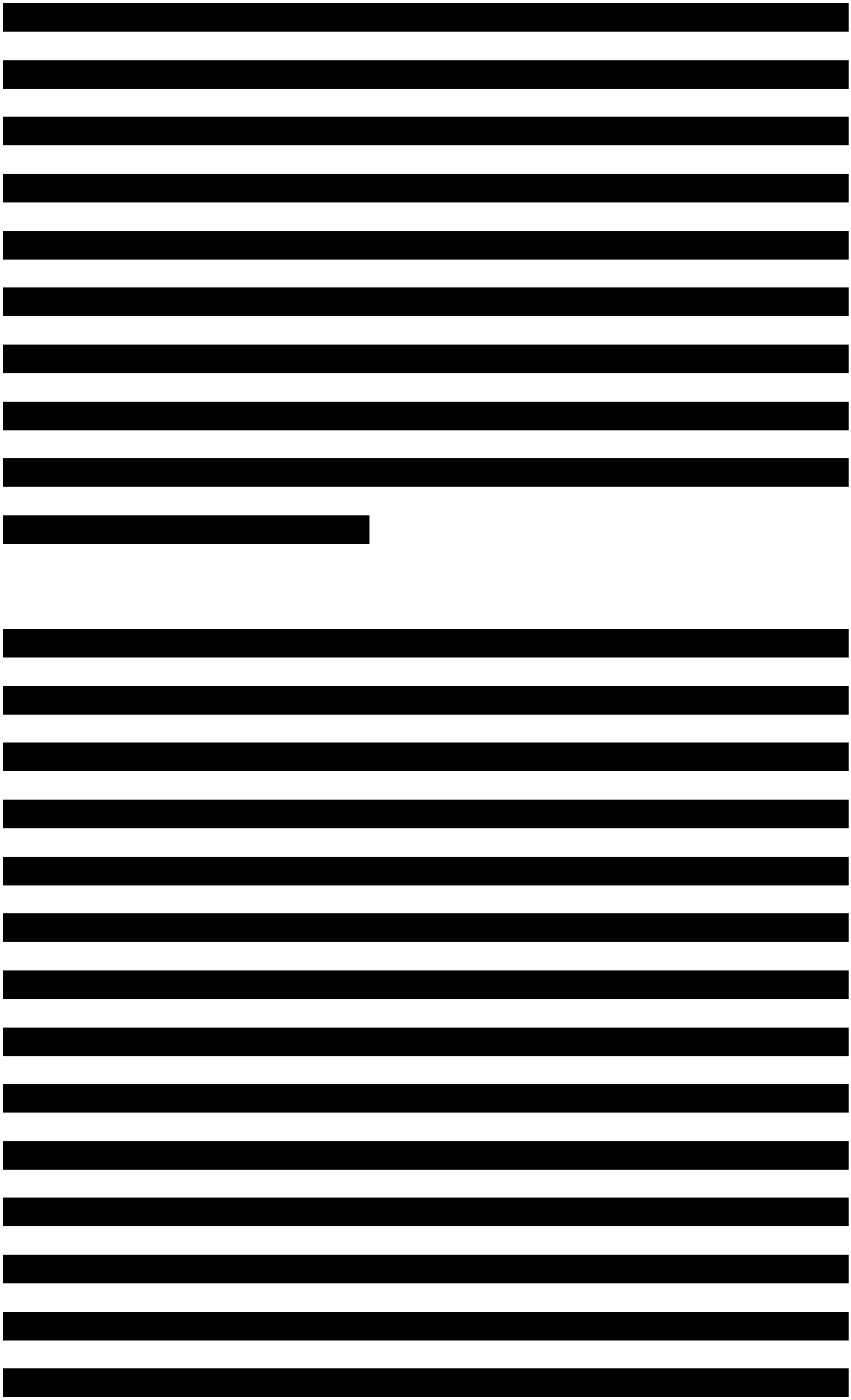

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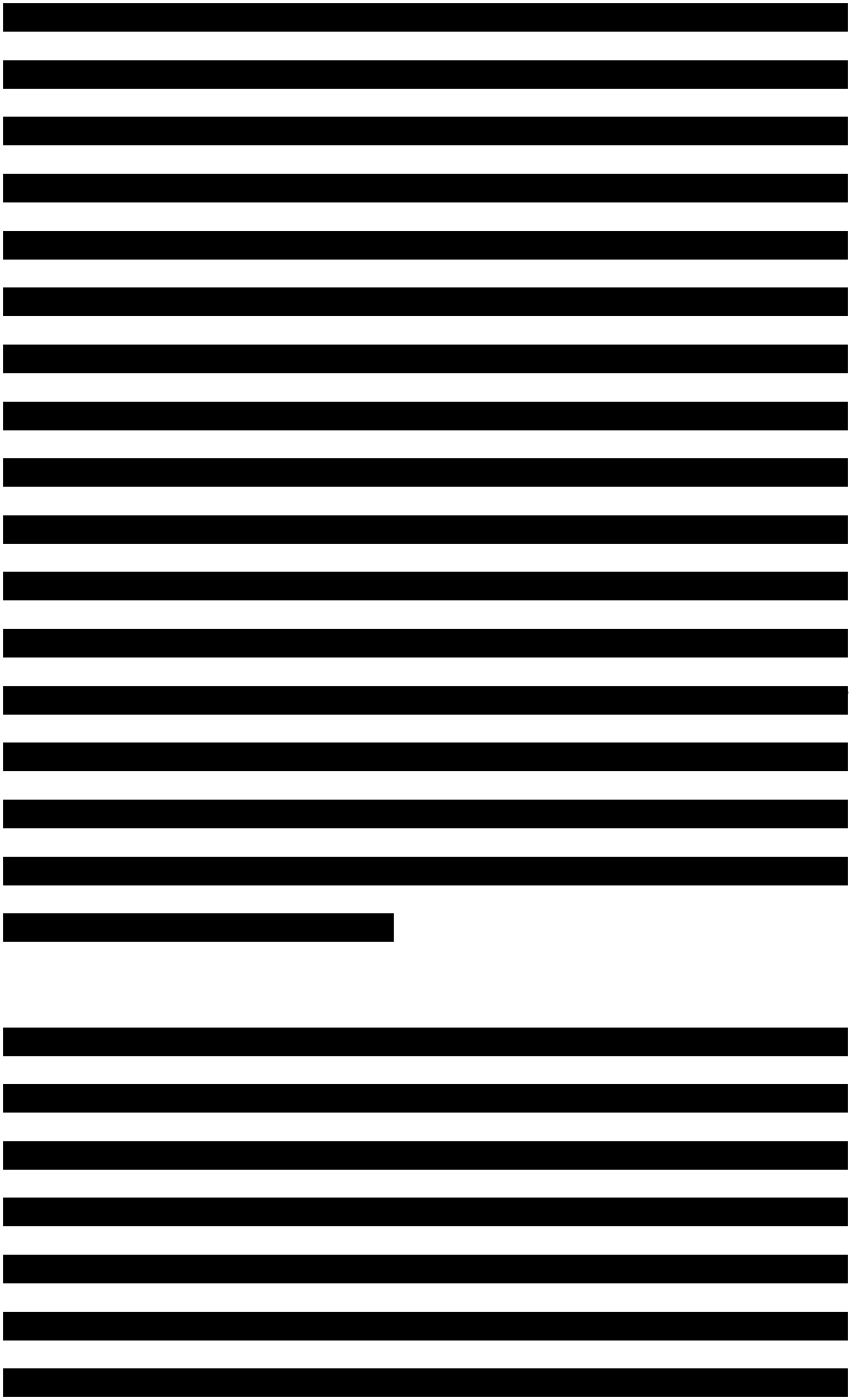

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Thesis study map

Study	Objectives
Study 1: Investigating habitual physical activity levels, sedentary behaviours and the tempo of physical activity in children and adolescents with intellectual disabilities	Objectives: • To objectively assess habitual PA and sedentary behaviours of children and adolescents with ID. • To examine the tempo of PA by sex, age and disability. Key findings: - Participants in this study did not engage in enough PA to benefit health. - The tempo of PA for this sample of children was of a similar nature to children without ID. - The majority of participants PA were made up of short sporadic bursts of activity with the amount of continuous bouts decreasing as the intensity and duration increases.
Study 2: An investigation of physical activity behaviours and context during playtime and Physical Education lessons in children and adolescents with intellectual disabilities	Objectives: • To investigate PA and play behaviours during playtime of children and adolescents with ID. • To examine the PA and lesson context during PE lessons in children and adolescents with ID. Key findings: - Participants engaged in similar amounts of MVPA during both playtime and PE contexts. - During playtime and PE contexts participants engaged in minimal amounts of sports based activities. - During playtime participants spent the majority of time playing alone or in small groups and no large group play was observed by any participants.
Study 3: Exploring teachers' perceptions on physical activity engagement for children and adolescents	Objectives: • Explore teachers' perceptions of barriers and facilitators to PA engagement for children and adolescents with moderate to severe ID within the school environment.

with intellectual disabilities	• To examine influencing PA factors including enabling, reinforcing and predisposing factors. Key findings: - Pupils with ID enjoyed engaging in fun, unstructured physical activities. - Teacher participants identified themselves as playing an influential role on the PA engagement by children and adolescents with ID. - Pupils with ID were described to have a limited understanding around PA and the benefits to health.
Study 4: The evaluation of a pilot school-based physical activity intervention for children with intellectual disabilities attending special educational needs schools in the North West of England.	Objectives: • Evaluate the effect of the school-based PA intervention on habitual sedentary and PA behaviours, and play behaviours at playtime in children with severe ID. • To retrospectively, explore the self-efficacy and confidence of teachers in relation to the delivery of the school-based PA intervention. Key findings: - The intervention showed promising results, MVPA levels demonstrated a trend towards increases between baseline and follow up of ~18 min•day^{-1}. - Due to low sample size findings were not significant, MCID analysis however suggested that increases in MVPA levels were likely to be beneficial to health. - Teachers responded well to the intervention demonstrating positive intervention effects across the whole school.

Chapter 7

Synthesis

7.1 Introduction

Individuals with ID engage in lower amounts of physical activity (PA), are at a greater risk of early mortality and have reduced quality of life compared to those without ID. Health inequalities observed in this population may be improved with regular engagement in PA. PA research, to date, in children and adolescents with ID is rare and significant gaps in the literature exist. Further, research conducted in mainstream populations highlights the importance of PA promotion in childhood and adolescence for better health throughout life. Gaps in the literature include; a lack of understanding of the PA patterns engaged in by children and adolescents with ID; how the SEN school environment contributes to PA and how potential opportunities to be active in the school day are used; in addition there is an absence of appropriately designed and implemented PA interventions and therefore there is a lack of studies that assess the effectiveness of school-based PA interventions for children with ID in the UK. Thus, the general aim of this thesis was to investigate PA, sedentary time (ST) and playtime behaviours in children and adolescents with ID.

7.1.1Recap of thesis

Four studies were included in the current thesis and a brief recap of each study will continue into a synthesis of the studies collectively. Study 1 (Chapter 3) provided evidence on habitual PA levels and ST and demonstrated the PA patterns of children and adolescents with ID. Habitual PA data emphasised the low PA levels exhibited by children and adolescents with ID and these findings were in agreement with previous studies (Phillips and Holland, 2011, Hinckson and Curtis, 2013). Study 1 was the first study to data that presents data on the PA patterns of children and

adolescents with ID. The observed PA patterns were of a similar nature to those observed in peers without ID, demonstrating short sporadic bursts of activity with few prolonged bouts of high intensity PA (Baquet et al., 2007). However, differences observed between children without ID (i.e., by sex and age group) were not apparent between participants in Study 1, and it was thought that this may be due to the generally low levels of PA engaged in by this population.

To expand the understanding of PA in this population, direct observation techniques were used in Study 2 (Chapter 4) to examine PA, play behaviours and lesson content during playtime and PE lessons. Participants engaged in similar levels of PA in both playtime and PE contexts (~50% of the observation time); this finding supports previous observation studies in youth with ID. Similar to Study 1, PA levels did not differ between boys and girls. Participants engaged in higher amounts of game based activities compared to sports during playtime and PE, and at playtime participants spent more time playing alone or in small groups in comparison to medium and large groups. Study 2 highlighted some weaknesses of the SOCARP tool used when examining playtime PA behaviours in children and adolescents with ID. It was suggested that adaptations made to the SOCARP tool (for example, recording equipment usage and staff interactions with pupils), may allow for more comprehensive investigations of playtime PA behaviours in children and adolescents with ID. The evidence provided in Study 1 and Study 2 suggested that the severity of disability should be considered when promoting PA in SEN schools, inferring when working with participants with MLD and SLD the two groups should be investigated separately.

Study 3 (Chapter 5) used qualitative methods to explore teachers' perceptions of the barriers and facilitators to PA engagement for children and adolescents with moderate and severe ID within the school environment. This study provided valuable, rich data that was used to inform subsequent thesis chapters. Similar to previous studies, findings suggested that pupils enjoy engaging in fun, unstructured physical activities that allow for progression of skills and promoted a sense of independence. Alongside parents, teachers acknowledged that they had an influence on PA engagement for their pupils. Also, a strong home-school link between parents and teachers was outlined as a potential key influencing factor for promoting PA and healthy lifestyles for children and adolescents with ID.

Collectively studies 1, 2 and 3, provide a clear rational for promoting PA within this population. The studies provide guidance for policy and practice in respect to designing and implementing appropriate interventions and education strategies to increase PA within this population. Thus, findings from Studies 1-3, in addition to other empirical evidence, were used to inform the design of a school-based PA intervention for children with ID. Study 4 (Chapter 6) of this thesis described the immediate and short term (10 weeks follow up) effects of a school-based PA intervention on habitual PA levels, ST and play behaviours in a cohort of children with severe ID. Study 4 also included teacher interviews that retrospectively explored teacher perceptions of the intervention and the self-efficacy and confidence of teachers and school staff in relation to the delivery of the school-based PA intervention. PA intervention effects were promising and demonstrated an increase in MVPA by 5 min•day^{-1} at post measures and ~17 min•day^{-1} at follow up measures. However, due to a small sample size and poor compliance to monitoring protocols,

the study lacked statistical power and therefore these potentially clinically meaningful intervention effects were not statistically significant. No changes in PA levels were observed at post intervention or follow up for playtime observations. However, children engaged in higher amounts of physical social peer interaction at post intervention compared to baseline but not at follow up. Moreover, numerous positive intervention effects were highlighted via the teachers who were generally efficacious towards implementing PA during school time. Teachers outlined the importance of researchers providing support and ideas for school staff to use when promoting PA as a key influence to achieving positive outcomes. The evaluation suggests that the SEN school environment can and should be used to help combat the particularly low levels of PA in this special population.

7.2 Key findings and implications for practice and research

Throughout this thesis objective assessments of PA levels and patterns examining varying intensities (LPA, MPA, VPA, MVPA and total PA) were outcome variables. Objective methods are commonly used amongst the mainstream population, and have also been reported as the most consistent method to assess PA levels of individuals with ID (Hinckson and Curtis, 2013). Through examination of habitual PA levels, ST and PA patterns a better understanding of how, when and where these children and adolescents are most and least active can be established. This information is important to examine whether children are at risk of ill-health due to inactivity, and therefore accurate measurement is fundamental to build these associations, and to ensure appropriateness of the PA interventions implemented.

A number of determinants influence PA behaviours which are outlined in the introduction of this thesis. Welk (1999) suggests that there are clear differences between adults and youth with regards to what influences them to take part in active pursuits regularly. The Youth Physical Activity Promotion Model (YPAPM) (Welk, 1999) referred to within Chapter 1 of this thesis, was applied and contributed throughout this mode of study. The use of the YPAPM enabled the Study Chapters to explore both behavioural and environmental factors whilst also drawing on influencing factors and barriers for children and adolescents with ID (Welk, 1999). Within Study 3, for example, the YPAPM was used to develop the semi-structured focus group guide used to explore teachers' perceptions of barriers and facilitators to PA engagement for youth with ID. Key findings from Study 3 demonstrated that for children and adolescents with ID enjoyment and unstructured activities are key facilitators. Also, both family and school based networks were important reinforcement factors who can positively contribute to PA engagement by youth with ID. Such explorative detail allowed the PhD candidate and additional team members to use the studies key findings, such as those described above, to develop and successfully implement a school-based PA intervention which was suitable for children with severe ID increasing daily MVPA levels. Further research is needed to highlight what methods are most suitable for this population with regards to exploring the participant's perceptions. Empowering youth with SEN to 'speak up' and voice their personal opinions, was highlighted in earlier research by Coates and Vickerman (2010) as a key process to ensure quality learning experiences for those with SEN and to ensure individual needs are met.

7.2.1 Habitual PA levels and ST in children and adolescent with ID

The CMO recommends that children and young people (aged 5 – 18 years) engage in a minimum of 60 min and up to several hours of MVPA every day (Department of Health, 2011). No specific recommendations are made for individuals with disabilities, however, it is suggested that the general recommendations can be adapted based on individual needs and abilities. In the UK, no evidence has been published that has investigated PA levels in ID populations with specific focus on children and adolescents. Study 1 presented PA data on the largest cohort of children and adolescents with moderate and severe ID (n = 38) to date in the UK, and revealed that the majority (~76%) of participants did not engage in enough MVPA to meet governmental recommendations. Furthermore, participants spent the majority of their waking hours engaging in sedentary behaviours (410.8 min•day^{-1}). Based on previous literature regarding habitual ST and PA levels in children and adolescents with ID findings from Study 1 were unsurprising. Study 1 reported no differences between week and weekend days. In contrast, children without ID are consistently reported to engage in greater amounts of PA on school days in comparison to weekend days. The low PA levels and high ST provides the initial rationale to attempt to increase PA levels amongst this population. It should be noted that methodological differences (e.g. accelerometer data reduction and processing) between studies in the current evidence base were outlined as a weakness in the research area (Hinckson and Curtis, 2013). These differences make comparisons of accelerometer assessed PA studies difficult, and standardised approaches are needed.

7.2.2 PA patterns in children and adolescent with ID

Study 1 described PA patterns amongst children and adolescents with ID to be similar to those exhibited by children without ID. Findings presented for this under researched population regarding their nature of PA patterns were novel, and provide an in depth explanation into how children engage in PA. The number and duration of bouts reduced as the intensity of PA increased. The majority of bouts engaged in by both boys and girls were of a low intensity (~2200 bouts/week lasting <5s) with less variation in the number of bouts accrued between MPA (~320 bouts/week lasting <5s) and VPA (~200 bouts/week lasting <5s). Furthermore, no participants in Study 1 engaged in any continuous bouts of PA at light, moderate or vigorous intensity which lasted at least 300s (<5min) or 600s (<10min). Although minimal, in comparison, Baquet et al. (2007) reported that boys and girls without ID engaged in some LPA bouts lasting 1200s and more (>20min). Moreover, differences in the number of bouts accrued between LPA, MPA and VPA intensities did not vary as much in children without ID. Whereas in Study 1 participants demonstrated large variation in the number of continuous bouts engaged in between LPA and MPA, with higher amounts observed in LPA. These findings suggest that children and adolescents with ID's PA engagement was more intermittent than their non-ID peers especially when engaging in LPA.

7.2.3 The school environment and PA for children and adolescents with ID

Findings from Study 1 provided the rationale to explore specific aspects of the school day in greater detail. Study 2 examined playtime and PE lessons within the SEN school setting using two direct observation (DO) techniques (SOCARP and SOFIT). The use of DO worked well amongst this group of children and adolescents

as it involved minimal interference with the participants. Also, most participants were unaware that the measurement was being conducted. As a result participant adherence was not an issue. However, these methods only captured ten minute periods of recess and PE lessons using momentary time sampling, therefore how representative this was of the whole playtime or PE lesson is unclear. Nevertheless playtime observation results were consistent with previous findings (Bingham et al., In Press, Boddy et al., In Press), and demonstrated that participants were observed spending around 50% of the observation time engaging in MVPA. Though findings in relation to PA levels are consistent, the use of the SOCARP tool in this population raised some concerns. The SOCARP tool did not capture key aspects of playtime, such as interactions with teachers and the use of equipment (fixed and unfixed). Furthermore, due to the high teacher: pupil ratio in SEN schools and the additional personal support needed for children and adolescents with ID, interactions with teachers may be a key influence for PA levels during playtime. These concerns provided the rationale to adapt the existing SOCARP version in to a more detailed version (SOCARP-SEN) for use in SEN schools and specifically those with ID, which was then used to assess playtime PA levels and associated behaviours in Study 4.

In Study 2 participants spent a low proportion of the observed period engaged in sport based activities during playtime and PE contexts. This finding, particularly related to PE was explained in Study 3, whereby teachers described how PA was a vehicle for developing fundamental movement and social skills rather than individual 'sporting' skills. This was linked to the development of independence and interactions amongst the pupils which is needed for the uptake of PA outside school

time and across the lifespan. This finding therefore suggests that in SEN schools, teachers do not necessarily actively promote sports per se, but instead appreciate the benefits of PA for other aspects of life and development. Previous research in youth with DS has described difficulties in understanding the rules of certain sports, such as football which prevented them from participating (Downs et al., 2013). Mounting evidence, including results presented in Study 3, suggests that children and adolescents with ID prefer to engage in enjoyable, unstructured PA with fun and social aspects being key facilitators. However, literature in mainstream populations demonstrates associations between sport and higher intensity PA (Ridgers et al., 2012b), similar correlations were also observed in Study 2 between MVPA and sports based activities at playtime. Our evidence suggests that sports based activities may not be suitable for children and adolescents with ID in SEN settings, due to a preference for less structured, sociable activities and difficulties in understanding rules. However, the positive associations between sport participation and increased PA levels are well established. Therefore perhaps adapting sports and promoting informal and unstructured aspects with minimal rules are more appropriate, and should be investigated for use within this population. Furthermore, the reduced levels of sporting engagement exhibited by children and adolescents with ID may explain the reduced levels of PA engagement in the whole ID population. If sports or adapted sports strategies are not promoted then additional efforts should be encouraged to ensure opportunities for regular engagement in MPA and VPA are offered in and out of school as an alternative.

7.2.4 ID severity

In studies 1, 2 and 3 cohorts of participants included a combination of those with moderate ID or severe ID (MLD and SLD). Clear differences between the two groups in PA levels, ST, play behaviours and lesson contexts were noted throughout the current thesis. In Study 1, when comparing PA levels and patterns between age groups, including participants with MLD in the same analysis model as those with SLD was highlighted as a potential issue. Findings from Study 1 involving age related differences were in conflict with previous findings reported within this population. These conflicting findings may have been due to the varying levels of ID severity, rather than age *per se*. It was therefore suggested that future analysis could include school type (MLD or SLD), examine differences by ID severity, or include ID severity as a covariate to examine or control for these factors. Thus, Study 2 examined PA levels, play behaviours and lesson context comparing MLD and SLD participant subgroups. However issues were still apparent as the majority of participants with SLD were primary school aged children, while the majority of participants with MLD were secondary school aged adolescents. The between-group age differences may therefore have had an impact on findings. Results in Study 2 demonstrated large differences with regards to group sizes observed during playtime. Participants with MLD engaged in significantly less alone play (27% vs 66%) and spent significantly more time in small group play (72% vs 29%) compared to their peers with SLD. However, similar levels of MVPA engagement were observed between MLD and SLD participants during playtime and PE (averaging at ~56%). Considering the age differences in the two groups, this finding is surprising. Evidence based on mainstream populations consistently reports that PA declines with age, however, evidence suggests that PA levels not only reduce with age but,

for this population, also with ID severity (Phillips and Holland, 2011). Therefore there is potential to assume that the two factors may have balanced each other out. It is suggested for children and adolescents with ID that comparisons between age groups should only be made if participants are of the same level of ID severity. Moreover, comparisons of ID severity should only be made if participants are of similar ages. As a result of these complexities regarding the grouping of ID severity and school age, the decision was made to direct the school-based PA intervention at primary schools who enrolled children with SLD only.

7.2.5 School-based PA intervention

The school-based PA intervention, which was delivered in two SEN primary schools in the North West of England, was the first of its kind specifically designed for use within SEN context, aimed at children with severe ID. Study 4 was presented as Parts A and B, and evaluated the effectiveness of the intervention using quantitative and qualitative methods. Firstly, Part A, demonstrated changes in PA levels, ST and play behaviours using objective methods. Secondly, Part B, retrospectively explored the self-efficacy of teachers on implementing the intervention using semi-structured interviews.

Results presented in Study 4 were promising. The main outcome measure was accelerometer assessed PA levels; which demonstrated increases in MVPA at post intervention (5 min) and follow up (17 min) time points. However, due to low statistical power significant intervention effects were not apparent. As a result of the low sample size in Study 4 MCID analysis was conducted. MCID results suggested that the changes in MVPA observed between baseline and follow up were likely to

be beneficial to heath. Moreover, though changes did not reach the primary intervention aim, which was to increase MVPA levels by 20 min•day^{-1}, changes approached this target and more participants met the PA guidelines at both post intervention (58%) and at follow up (75%) compared to baseline (25%). Previous intervention literature implies that studies that have set specific PA targets or goals have reaped greater success in relation to increased PA levels and amounts of PA delivery (Naylor et al., 2006, Fairclough et al., 2013). Therefore the intervention goal to increase MVPA by 20 min•day-1 may have contributed positively to the changes observed.

Minimal changes were observed in PA levels, play behaviours, teacher interactions and equipment usage during playtime as assessed using direct observation. The significant increase in physical social peer interactions that was observed between baseline to post intervention was not observed between baseline and follow up. It was suggested that the lack of changes to variables during the playtime context was because no specific aims were set targeting playtime periods *per se*. Instead the intervention design allowed school staff the flexibility to choose when they integrated the additional MVPA into the school day. However, this is the first time the adapted version of the SOCARP tool (SOCARP-SEN) was used, and the baseline data offered some interesting results which are worthy of further investigation.

Accelerometer assessment alone did not allow for researchers to observe the types of PA that were engaged in, moreover, the small sample size meant that it was not possible to examine PA levels at specific segments of the school day. The retrospective interviews which were carried out with teachers strengthened this

aspect of Study 4. In addition to gaining an insight into the teachers' self-efficacy when delivering the intervention, the interviews also demonstrated the success of the intervention with regards to the intervention impact and reach. Furthermore, results from Study 4 Part B outlined the success of implementing the Wake up! Shake up! session, which was one PA promotion idea put forward in the intervention information packs. Results described how the Wake up! Shake up! concept was implemented well in both schools with one participant citing how it had impacted on the whole school: '*It's now gone across the school because it has worked so well'* (P6, p. 183). The flexibility of the intervention design also meant that the Wake up! Shake up! sessions were delivered in a range of environments (i.e., school hall and class rooms) and at different times of the day, which was dependant on the pupils' preferences. They also offered a cost effective and time efficient method to integrate regular PA opportunities during school time, and therefore warrant further investigation in relation to potential beneficial effects for children with ID on a larger scale.

The rigorous planning process, strong researcher-school link and mixed method approach to assess PA outcomes and intervention effectiveness, all contributed to the success of the implementation and evaluation of the PA intervention. Moreover, teachers identified that implementing specific targets and goals for PA outcomes, and providing school staff with ideas and suggestions to promote PA were key influences and benefits for teachers and therefore intervention outcomes.

7.3 Conclusions

A major intention of this thesis was to increase the understanding and knowledge base around children and adolescents with ID's levels of PA and how they engage in PA. This was achieved via a mixed method approach in Studies 1, 2 and 3, which additionally outlined some of the difficulties experienced when working with this population. Children and adolescents with ID do not engage in enough MVPA to meet current PA recommendations. Interestingly, Study 1 reported that participants' patterns of PA engagement were similar to children without ID. However, the PA levels observed did not differ by day (weekday vs weekend day), whereas children without ID typically engage in greater amounts of PA on weekdays than on weekend days. Further examination into the school day (Study 2) demonstrated that children and adolescents with ID engage in similar amounts of MVPA during playtime and PE lessons. Minimal amounts of sport based activities were engaged in during these contexts, and during playtime, participants tended to engage in alone or small group play. Results from Studies 1 and 2 also revealed that children and adolescents with MLD and SLD may engage in PA in different ways and warrants further investigation.

Qualitative methods allowed for a greater explorative detail related to the understanding of PA engagement by children and adolescents with ID. In the current thesis, this was particularly useful, in addition to objective methods, not only to inform the PA intervention but also to evaluate the impact, reach and teacher self-efficacy of the school-based PA intervention.

The current PA guidelines offer no specific recommendations for children and adolescents with ID. Though more supportive evidence is needed before final conclusions can be made; Study 4 of this thesis suggests that children with severe ID can, if provided with appropriate opportunities, meet the minimum recommendation of 60min MVPA every day. Qualitative results in Study 4 further outlined that teachers and school staff benefited when given ideas to use when promoting PA, and support provided from the research team was a key motivation to actively promote PA. Finally findings highlighted that the SEN school environment can and should be used to help combat the particularly low levels of PA observed in this population.

7.4 Recommendations for future research

Based on the findings and difficulties encountered during completion of the research studies highlighted within this thesis, a number of recommendations for future research have been proposed.

7.4.1 Measurement

- Future researchers are recommended to use a mixed method approach to ensure PA and the determinants of this behaviour are captured sufficiently.
- Future research investigating the validity and reliability of the SOCARP-SEN tool is warranted as this tool provides opportunities to explore behaviours and interactions that may be related to PA engagement during playtime within the SEN environment.

7.4.2 ID severity

- Future research investigating children and adolescents with ID should ensure that:
    - The level of ID severity is defined (i.e., mild, moderate and severe).
    - Participants with MLD and SLD are matched by age when comparisons are being made.
    - Participants with MLD and SLD are investigated as two separate groups or ID severity is included in the analysis as a covariate to control for differences.

7.4.3 Recruitment

- Future research should investigate different recruitment methods through discussion with Local Authorities and participating schools to increase study sample sizes and examine compliance strategies.
- Future research should consider collaborations with fellow research institutes to increase participant sample sizes and replicate Studies 1 and 2 to see if findings are consistent and are therefore representative of the ID population.

7.4.4 Intervention design

- Future researchers should replicate the school-based PA intervention in a larger cohort of SEN schools, and include intervention and control conditions to allow for a more rigorous evaluation of the intervention effectiveness.
- Future research should consider conducting a pilot school-based PA intervention study in secondary SEN schools to evaluate the effectiveness on PA levels in an older cohort of pupils.

- Future researchers should evaluate the effectiveness of a Wake up! Shake UP! school-based PA intervention to explore if this daily activity session in isolation demonstrates positive MVPA intervention effects in primary and secondary SEN schools.

7.4.5 Health implications

- Future research should investigate low and high active children with ID to examine what implications differences may have on health and identify any predisposing, enabling and potential barriers to activity within the two groups.
- Future researchers are recommended to evaluate the broader health and behavioural effects (e.g. cardiovascular risk, challenging behaviours) of a school-based PA intervention for children with ID.

Chapter 8

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Chapter 9

Appendices

Appendix A: Study 3 - Teacher focus group guide

My name is... and I would firstly like to thank you for taking time to take part in this focus group. We, as a research group, are interested in your personal opinions and experiences with the children in your school in relation to physical activity. There will be several sections of the focus group where we will discuss different issues to physical activity. If you don't understand a question at any point or you would like to ask a question then please feel free to do so. Please be aware that you may all have different opinions regarding your responses to the questions and we would like to emphasise there is no right or wrong answer with any of the questions we will ask. First can each member of this group please introduce themselves so we're all familiar with each other's names and job roles if you don't already know so…			
Demographics		Can you introduce yourself and tell us about your role within the school? Duration worked there	
Thank you that's great. The first set of questions relate to your personal views related to what enables the children to take part in physical activity. As you will not be aware of all physical activity the children do out of school, we ask if you could focus your answers primarily to during playtime and lesson time.			
Enabling factors	Fitness	What types of activity do the children participate in during playtime and lesson time? *This can include active and non active activities...* How often? Which are preferred?	Can you give examples?
	Skills	What skills related to PA are taught or fostered during school time? When do they do this?	Give examples of skills e.g. throwing, catching, skipping
	Access	What PA opportunities are available at the school for the children? Does the school have any after school or lunchtime clubs?	Please can you

		What is the attendance rate like at the clubs? What arrangements are made as regards to the children getting home after the after school clubs	describe these...?
	Environment	What facilities are available to the children at the school to be physically active? i.e. Indoor/outdoor Supervised/ curriculum When can/can't they use these facilities, why is this? So you mentioned above that the school have X facilities, how does the equipment and facilities encourage children to be physically active, and if so how?	Please can you describe some of the facilities...? Please explain
Thank you those responses were great. Any information that you give us allows us to have a real insight into the PA experiences the children have during school time, and so far all your responses have been detailed and specific which is great. Now I would like you to have a think about how certain individuals influence the children's PA engagement, and how this might reinforce PA. Please focus your thoughts and responses towards you as a teacher/coach and how you feel the children influence each other.			
Reinforcing factors	Family influence	How are the children's families involved with their children's activity at school? Do they come and watch? How they get involved?	Can you explain how
	Peer influence	How do the children interact together during school PE	

		lessons and playtime? How do you feel the children's peers influence their PA engagement? Positively/ negatively	Examples
"Thank you, your responses are great and are really helping us to have an insight into what influences the children at different times. We are interested to know what you, as teachers and staff, observe when you watch the children with regards to their social behaviours. Social behaviours are any type of social behaviour that is directed towards another person. This doesn't have to just be through speech, it can be through any form of interaction such as dancing, reading, playing etc."			
		Are there any typical social behaviours that **you** observe regularly at playtime? Can you describe these?	
		How do **you** encourage physical activity within the school? How do you feel the children interact with their coaches/teachers during a PE class? How do children react to positive/negative feedback, why do you think this is? Who do you feel has the biggest influence on children's participation in PA?	Enjoy, Listen, Like Other peers,

			family, parents, friends …Why do you think this is?
Thank you. We really appreciate your adherence and openness towards all the questions we have asked you and now I would like to ask you one final section of questions. Please now focus your thoughts towards how physical activity influences the children and what you believe the children's attitudes as well as your own attitudes to physical activity are.			
Predisposing factors	Am I able	Do the children take part in all activities offered to them, if not why? How does the children's disability influence their PA engagement? How do you think this can be avoided, what additional adaptations are made?	Examples Can you expand?
	Is it worth it?	Why do the children engage in PA, and what influences their choice of activity? What's the most popular type of activity? i.e. games, gymnastics, sports, fitness What do they like to do during play time?	Enjoyment? Told to? Why? Socialise? General play? Skills?
		How do you feel PA benefits the children? How do you as teachers help	Please give an example

		to promote healthy lifestyles?	Positive/ negative. Food Exercise
		What do you think the children's attitude towards PA is? Positive/ negative	Why do you think this is?
We have asked all the questions we would like to, are there any other points that anyone would like to add or points mentioned early that you would like to discuss further? OK thank you for responding and discussing all the questions today. We hope that you have found it as informative as we have, in particularly sharing different opinions and experiences amongst the group. We really appreciate you taking out the time to have done this.			

General Prompts

- Can you explain this further
- Have you experienced this before?
- Can you give an example of this?
- Does everyone agree with this?
- What do you think about this?
- Does anyone have any other thoughts regarding this?

Appendix B: Study 4 - Intervention information sheet, learning objectives and fact sheet for school

Physical Activity Intervention

Your school has agreed to take part within our research project; from previous research conducted last year we know that physical activity levels of children with special needs were below recommended physical activity guidelines. Some of the students at your school have had their physical activity levels measured. As a school we would like to increase physical activity levels of all the students through a school-based physical activity intervention. The intervention will last 12 weeks. After the 12 weeks, physical activity levels of some students will be measured again. This will allow us to see what effect the intervention has had on the student's physical activity levels.

The intervention:

- The school, teaching staff and teaching assistants will deliver the intervention
- A primary aim and 7 learning objectives have been set that school staff should follow and promote over the 12 week period
- If you would like some additional help, advice or ideas of how to meet the set aims please get in touch. See contact details below
- As you know your students individual strengths and abilities well, how you choose to meet the aims and learning objectives is up to you, we appreciate that one specific intervention would not suit all the students. Therefore this is where your practical experience and expertise come in.
- Please share your ideas and methods to increase physical activity with other staff members, and work together to increase physical activity levels of all the students.
- As the intervention takes place we would like to conduct short informal interviews with some staff members, this will allow us to explore how the intervention has fit into your school day whilst discussing any issues or barriers that have been a problem. We would also like to talk about your feelings towards the intervention, including self-efficacy and confidence with the delivery of the intervention and how/if this has developed over time.

Primary aim:

- **Increase moderate to vigorous physical activity (MVPA) levels of all students by at least 20minutes per day during school time**

Ways to increase physical activity levels during school time include:

- Active breaks during class time
- Introduce 'Wake Up and Shake Up' sessions every day for 10mins (in class or hall), for more information visit http://www.wakeupshakeup.com/index.php
- Promote active play during playtime – use of equipment, get involved with the kids playing games that get the children running around
- Decrease sitting time – encourage children that are usually inactive at playtime to get up and walk/run around
- Be an **active** role model for your students

Learning objectives:

1. What is physical activity (PA)?
    - Increase understanding of what physical activity is
    - Identify examples of engaging in physical activity
    - Define physical activity

2. Keep Moving! – map different ways to be active
    - Increase awareness of PA opportunities available in school
    - Interactive ideas session – mapping with pictures

3. Go for Goal – setting realistic goals
    - Tailored individual goals
    - Identify personal aims
    - What can they do and how can this be achieved
    - Rewards system – targets for each day – gold stars

4. Physical activity and health
    - Identify how physical activity benefits health

5. Be active outside school
    - Discussing opportunities to be active outside of school
    - Identify and list these opportunities

6. Muscle Mysteries – learn about different muscle groups
    - Health and fitness
    - Increase awareness
    - See CHANGE! information for session ideas

7. Power down screen time
    - Reduces the amount of TV watched and computer games played
    - Decrease sedentary (inactive) time, increase awareness
    - Promote having active breaks during sedentary activities

Research team's contact details:

Sam Downs – S.J.Downs@2012.ljmu.ac.uk

Please get in touch with either Sam or Lynne if you have any questions or queries and we will respond ASAP.

PHYSICAL ACTIVITY FACT SHEET

What is physical activity?

Physical activity is defined as: "Any bodily movement produced by skeletal muscles that requires energy expenditure" (World Health Organisation, 2011)

Examples of being physically active include:

- Walking, jogging, running
- Swimming
- Cycling
- Playing sports – football, basketball, Boucher, trampolining
- Games – parachute, ball games, catch, what time is it Mr wolf
- House hold jobs – hovering, gardening
- And many more…

What are the recommended physical activity guidelines?

The Chief Medical Officer (2011) states that physical activity guidelines for children and young people (5 – 18 years) are that children should participate in a minimum of 60 minutes and up to several hours of moderate to vigorous intensity physical activity every day.

What is moderate to vigorous physical activity?

Moderate intensity physical activity can be described as; when you're working hard enough to raise your heart rate and break into a sweat also, if you're able to talk but unable to sing the words to a song. Vigorous intensity physical activity can be described as; when you're breathing hard and fast and your heart rate has increased significantly. If you're working at this level, you won't be able to say more than a few words without pausing for a breath. Moderate to vigorous physical activity is a combination of the two.

How does physical activity benefit health?

Physical activity benefits health in many ways. Including the reduction in risk of many diseases (i.e. cardiovascular diseases, cancer, respiratory diseases and diabetes), helps to achieve and maintain a healthy weight and improves mental wellbeing.

Physical activity and concentration levels.

It has been suggested my various research studies that regular engagement in physical activity improves concentration levels of children. The 'Wake Up and Shake Up' activity session is described to improve concentration and application to tasks immediately after the brief exercise session.

Research team's contact details:

Sam Downs – S.J.Downs@2012.ljmu.ac.uk

Please get in touch with either Sam or Lynne if you have any questions or queries and we will respond ASAP.

Appendix C: Study 4 - SOCARP-SEN 1 & 2 instructions and observation recording forms and

SOCARP-SEN 1 – Teacher interactions instructions

Activity Level

Activity levels of the child in focus will be measured at the end of every 10s interval.

Activity level will be coded for using numbers 1-5 as done in SOCARP.

1. Lying
2. Sitting
3. Standing
4. Walking
5. Very active

Code 1-4 unless the child is expending more energy than an ordinary walk

Code 5 for any activity that requires the child to expend more energy than he/she would for an ordinary walk e.g., running, jogging, hopping, wrestling with a peer and fast movements on the spot

When the child is in transition, code the higher category.

Group Size

The social group size reflects the number of people that the child is playing/interacting with. Code the group size (A, S, M, L) using momentary time sampling at the **record** prompt. Include the target child, other children and adults participating in the group (e.g. organising, refereeing) in the count.

Alone (A)	Target child is alone, and not interacting with any other person.
Small (S)	Target child is in a group of 2 to 4 people.
Medium (M)	Target child is in a group of 5 to 9 people.
Large (L)	Target child is in a group of 10 or more people.

When the child is in transition between groups of different sizes on the record prompt, circle the code for the group the child has just left. For example, code L (large) if the child is just leaving a group of 10 children and walking away on his/her own.

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Teacher interactions

N – No interaction (The child in focus has no interaction with teachers)

PS- Physical social (The child in focus interacts with a teacher in a positive physical way)

VS – Verbal social (The child in focus interacts with a teacher in a positive verbal way, or an interaction which is nonverbal including gestures such as thumbs up or waving to get another pupils attention, or sign language)

PC- Physical conflict (The child in focus interacts with a teacher in a negative physical way)

VC- Verbal conflict (The child in focus interacts with a teacher in a negative verbal way, also includes negative interaction in sign language and negative gestures SUCH AS)

I- Ignore (The child ignores a teacher who is trying to interact with them).

Additional teacher interactions

S- Supervision (Teacher only). During the shot of the child is a member of staff just supervising.

P- Promoting (Teacher only). During the shot of the child if the teacher interacts do they promote PA.

R – Restricting. Restricting/controlling active play in certain areas of the playground. For example, not allowing a child to use trikes and bikes in certain areas or asking children to stop running etc.

Teacher proximity

Whilst looking at the child in focus if there is any interaction with a teacher we will look at the proximity of the child to the teacher.

D- Distant (2+ metres)

N- Near (up to 2metres away)

SOCARP-SEN 2 – equipment use and peer interactions

Activity Level

Activity levels will be measured at the end of every 10s interval.

Activity level will be coded for using numbers 1-5 as done in SOCARP.

1. Lying
2. Sitting
3. Standing
4. Walking
5. Very active

Code 1-4 unless the child is expending more energy than an ordinary walk

Code 5 for any activity that requires the child to expend more energy than he/she would for an ordinary walk e.g., running, jogging, hopping, wrestling with a peer and fast movements on the spot

When the child is in transition, code the higher category. For example if the child makes the transition from sitting to standing, it should be coded for standing as this is the higher category.

Use of Equipment

The use of equipment will be coded using the following procedure:

F- Fixed. This will describe the child playing with any equipment that is fixed/ is part of the playground. This equipment cannot be moved or taken to be played with elsewhere. Examples of fixed equipment; swings, markings on the floor, slide, benches, see saw, climbing frames.

H – Hand non-fixed. This includes any hand equipment that is not fixed. Examples include balls, bats, Frisbees, hula hoops etc.

S – Self-propelled non-fixed. This includes any self-propelled equipment that is not fixed. Examples include bikes, scooters, trikes etc.

A- Absent. This will be code for when the child is not playing with any equipment at all, for example interacting with another child or just playing alone, for example running or skipping.

Peer interaction

N – No interaction (The child in focus has no interaction with peers)

PS- Physical social (The child in focus interacts with a peer in a positive physical way, for example holding hands or playing with same piece of equipment)

VS – Verbal social (The child in focus interacts with a peer in a positive verbal way, or an interaction which is nonverbal including gestures such as thumbs up or waving to get another pupils attention, or sign language)

PC- Physical conflict (The child in focus interacts with a peer in a negative physical way, for example hitting or pushing)

VC- Verbal conflict (The child in focus interacts with a peer in a negative verbal way, also includes negative interaction in sign language and negative gestures)

I- Ignore (The child ignores a peer who is trying to interact with them).

SOCARP–SEN 1 observation recording form – teacher interactions

Date: Observer: Target child gender: Reliability: Yes / No

Interval	Activity Level	Group Size	Teacher Interaction	Teacher Involvement	Teacher Proximity
1	1 2 3 4 5	A S M L	N PS VS PV VC I	S P R	D N
2	1 2 3 4 5	A S M L	N PS VS PV VC I	S P R	D N
3	1 2 3 4 5	A S M L	N PS VS PV VC I	S P R	D N
4	1 2 3 4 5	A S M L	N PS VS PV VC I	S P R	D N
5	1 2 3 4 5	A S M L	N PS VS PV VC I	S P R	D N
6	1 2 3 4 5	A S M L	N PS VS PV VC I	S P R	D N
7	1 2 3 4 5	A S M L	N PS VS PV VC I	S P R	D N
8	1 2 3 4 5	A S M L	N PS VS PV VC I	S P R	D N
9	1 2 3 4 5	A S M L	N PS VS PV VC I	S P R	D N
10	1 2 3 4 5	A S M L	N PS VS PV VC I	S P R	D N
11	1 2 3 4 5	A S M L	N PS VS PV VC I	S P R	D N
12	1 2 3 4 5	A S M L	N PS VS PV VC I	S P R	D N
13	1 2 3 4 5	A S M L	N PS VS PV VC I	S P R	D N
14	1 2 3 4 5	A S M L	N PS VS PV VC I	S P R	D N
15	1 2 3 4 5	A S M L	N PS VS PV VC I	S P R	D N
16	1 2 3 4 5	A S M L	N PS VS PV VC I	S P R	D N
17	1 2 3 4 5	A S M L	N PS VS PV VC I	S P R	D N
18	1 2 3 4 5	A S M L	N PS VS PV VC I	S P R	D N
19	1 2 3 4 5	A S M L	N PS VS PV VC I	S P R	D N
20	1 2 3 4 5	A S M L	N PS VS PV VC I	S P R	D N
21	1 2 3 4 5	A S M L	N PS VS PV VC I	S P R	D N
22	1 2 3 4 5	A S M L	N PS VS PV VC I	S P R	D N
23	1 2 3 4 5	A S M L	N PS VS PV VC I	S P R	D N
24	1 2 3 4 5	A S M L	N PS VS PV VC I	S P R	D N
25	1 2 3 4 5	A S M L	N PS VS PV VC I	S P R	D N
26	1 2 3 4 5	A S M L	N PS VS PV VC I	S P R	D N
27	1 2 3 4 5	A S M L	N PS VS PV VC I	S P R	D N
28	1 2 3 4 5	A S M L	N PS VS PV VC I	S P R	D N
29	1 2 3 4 5	A S M L	N PS VS PV VC I	S P R	D N
30	1 2 3 4 5	A S M L	N PS VS PV VC I	S P R	D N
31	1 2 3 4 5	A S M L	N PS VS PV VC I	S P R	D N
32	1 2 3 4 5	A S M L	N PS VS PV VC I	S P R	D N
33	1 2 3 4 5	A S M L	N PS VS PV VC I	S P R	D N
34	1 2 3 4 5	A S M L	N PS VS PV VC I	S P R	D N
35	1 2 3 4 5	A S M L	N PS VS PV VC I	S P R	D N

SOCARP-SEN 2 observation recording form – equipment use and peer interactions

Interval	Activity Level	Activity Type	Equipment Usage	Peer Interaction
1	1 2 3 4 5	SP G S L O	F H S A FB	N PS VS PC VC I
2	1 2 3 4 5	SP G S L O	F H S A FB	N PS VS PC VC I
3	1 2 3 4 5	SP G S L O	F H S A FB	N PS VS PC VC I
4	1 2 3 4 5	SP G S L O	F H S A FB	N PS VS PC VC I
5	1 2 3 4 5	SP G S L O	F H S A FB	N PS VS PC VC I
6	1 2 3 4 5	SP G S L O	F H S A FB	N PS VS PC VC I
7	1 2 3 4 5	SP G S L O	F H S A FB	N PS VS PC VC I
8	1 2 3 4 5	SP G S L O	F H S A FB	N PS VS PC VC I
9	1 2 3 4 5	SP G S L O	F H S A FB	N PS VS PC VC I
10	1 2 3 4 5	SP G S L O	F H S A FB	N PS VS PC VC I
11	1 2 3 4 5	SP G S L O	F H S A FB	N PS VS PC VC I
12	1 2 3 4 5	SP G S L O	F H S A FB	N PS VS PC VC I
13	1 2 3 4 5	SP G S L O	F H S A FB	N PS VS PC VC I
14	1 2 3 4 5	SP G S L O	F H S A FB	N PS VS PC VC I
15	1 2 3 4 5	SP G S L O	F H S A FB	N PS VS PC VC I
16	1 2 3 4 5	SP G S L O	F H S A FB	N PS VS PC VC I
17	1 2 3 4 5	SP G S L O	F H S A FB	N PS VS PC VC I
18	1 2 3 4 5	SP G S L O	F H S A FB	N PS VS PC VC I
19	1 2 3 4 5	SP G S L O	F H S A FB	N PS VS PC VC I
20	1 2 3 4 5	SP G S L O	F H S A FB	N PS VS PC VC I
21	1 2 3 4 5	SP G S L O	F H S A FB	N PS VS PC VC I
22	1 2 3 4 5	SP G S L O	F H S A FB	N PS VS PC VC I
23	1 2 3 4 5	SP G S L O	F H S A FB	N PS VS PC VC I
24	1 2 3 4 5	SP G S L O	F H S A FB	N PS VS PC VC I
25	1 2 3 4 5	SP G S L O	F H S A FB	N PS VS PC VC I
26	1 2 3 4 5	SP G S L O	F H S A FB	N PS VS PC VC I
27	1 2 3 4 5	SP G S L O	F H S A FB	N PS VS PC VC I
28	1 2 3 4 5	SP G S L O	F H S A FB	N PS VS PC VC I
29	1 2 3 4 5	SP G S L O	F H S A FB	N PS VS PC VC I
30	1 2 3 4 5	SP G S L O	F H S A FB	N PS VS PC VC I
31	1 2 3 4 5	SP G S L O	F H S A FB	N PS VS PC VC I
32	1 2 3 4 5	SP G S L O	F H S A FB	N PS VS PC VC I
33	1 2 3 4 5	SP G S L O	F H S A FB	N PS VS PC VC I
34	1 2 3 4 5	SP G S L O	F H S A FB	N PS VS PC VC I
35	1 2 3 4 5	SP G S L O	F H S A FB	N PS VS PC VC I

Appendix D: Study 4 – Teacher interview guide and intervention interview aid-memoir

Teacher Interview Schedule

What influence has the intervention programme had on behaviour or general receptiveness of the children since the beginning of the intervention? *Could you provide an example?*

What impact has the intervention had on the children? *Could you provide an example?*

After the first day how confident were you in your ability to lead and deliver the intervention?

If a colleague asks why the intervention was being done what would your reply be?

We're really interested in how the intervention works in practice, so how compliant have you been to the intervention guidelines and completing all aspects?

Are you the only teacher to have delivered sessions to children?

Who have you told about the intervention?

Do you feel that you will continue to implement the intervention after the allocated time?

Physical activity intervention interview: Aid memoir

We will be asking you questions about the intervention since it started last year, please take some time to read through the primary aims and learning objectives of the intervention as well as the questions you will be asked. Write down any notes related to each question in the space provided to help with your answers during the interview. As you do this, and where possible, examples to illustrate your answers are appreciated.

Primary aim: Increase moderate to vigorous physical activity (MVPA) levels of all students by at least 20minutes per day during school time

Learning objectives:

1. **What is physical activity?** Increasing the children's understanding of what physical activity is using examples and definitions to help.
2. **Keep Moving! – map different ways to be active** Increase awareness of physical activity opportunities available in school.
3. **Go for Goal – setting realistic goals** Tailored individual goals; Identify personal aims; What can they do and how can this be achieved; Rewards system – targets for each day – gold stars
4. **Physical activity and health** Identify how physical activity benefits health
5. **Be active outside school** Identify, discuss and list opportunities to be active outside of school
6. **Muscle Mysteries – learn about different muscle groups** Increase awareness of health and fitness. See CHANGE! information for session ideas
7. **Power down screen time** Reduces the amount of TV watched and computer games played and promote having active breaks during sedentary activities

Since the intervention started on the 18th November, can you describe the specific influence it has had on the behaviour or general receptiveness of the children whilst at school?	
Early intervention – from 18th November to Christmas Break	**Late intervention** – from January term start to end

Describe any broader impacts of the intervention on the children that you have seen as a teacher?	
Early intervention – from 18th November to Christmas Break	**Late intervention** – from January term start to end

Over the course of the intervention how would you describe your confidence in leading and delivering the sessions?	
Early intervention – from 18th November to Christmas Break	**Late intervention** – from January term start to end

If a colleague asks why the intervention was being run how would you reply?	
Early intervention – from 18th November to Christmas Break	**Late intervention** – from January term start to end

How would you assess your compliance to the intervention guidelines and completing all aspects?	
Early intervention – from 18th November to Christmas Break	**Late intervention** – from January term start to end

Are you the only teacher to have delivered the intervention to your class? If not, how did you ensure consistency of the delivery?	
Early intervention – from 18th November to Christmas Break	**Late intervention** – from January term start to end

Have you told anyone about the intervention?	
Early intervention – from 18th November to Christmas Break	**Late intervention** – from January term start to end

Do you feel that you will continue to implement the intervention after the allocated time? **If so, how would this work practically?** **If not, what do you need to support the continuation of the intervention?**	
Early intervention – from 18th November to Christmas Break	**Late intervention** – from January term start to end

Appendix E: Ethical Approvals

Dear Samantha,

Ethical Approval Deferred – Full Ethical Approval: Application for Ethical Approval No.: 12/SPS/033 - An investigation into habitual physical activity and sedentary behaviour, recess play behaviour, and their determinants among children and young people with intellectual disabilities

With reference to your application for Ethical approval.

On behalf of Liverpool John Moores University Research Ethics Committee (REC) the Chair of the Committee has reviewed your response to the request for further information related to the above study. The Committee is now content to give a favourable ethical opinion and recruitment to the study can now commence.

Approval is given on the understanding that:

- any adverse reactions/events which take place during the course of the project will be reported to the Committee immediately;
- any unforeseen ethical issues arising during the course of the project will be reported to the Committee immediately;
- any substantive amendments to the protocol will be reported to the Committee immediately.
- the LJMU logo is used for all documentation relating to participant recruitment and participation eg poster, information sheets, consent forms, questionnaires. The JMU logo can be accessed at http://www.ljmu.ac.uk/corporatecommunications/60486.htm

For details on how to report adverse events or amendments please refer to the information provided at: http://www.ljmu.ac.uk/RGSO/RGSO_Docs/EC8Adverse.pdf

Please note that ethical approval is given for a period of five years from the date granted and therefore the expiry date for this project will be 10th October 2017. An application for extension of approval must be submitted if the project continues after this date.

Yours sincerely

PP:

Dr Sue Spiers

Chair of the LJMU REC

Tel: 0151 904 6463 E-mail: j.m.mckeon@ljmu.ac.uk

Dear Samantha

With reference to your application for Ethical approval:

13/SPS/026 - Increasing physical activity in children and young people with intellectual disabilities: A feasibility study assessing the effectiveness of a school based physical activity intervention

Liverpool John Moores University Research Ethics Committee (REC) has reviewed the above application and following the resolution of certain issues I am happy to inform you that the Committee are content to give a favourable ethical opinion and recruitment to the study can now commence.

Approval is given on the understanding that:

- any adverse reactions/events which take place during the course of the project will be reported to the Committee immediately;
- any unforeseen ethical issues arising during the course of the project will be reported to the Committee immediately;
- any substantive amendments to the protocol will be reported to the Committee immediately.
- the LJMU logo is used for all documentation relating to participant recruitment and participation eg poster, information sheets, consent forms, questionnaires. The JMU logo can be accessed at http://www.ljmu.ac.uk/corporatecommunications/60486.htm

For details on how to report adverse events or amendments please refer to the information provided at http://www.ljmu.ac.uk/RGSO/RGSO_Docs/EC8Adverse.pdf

Please note that ethical approval is given for a period of five years from the date granted and therefore the expiry date for this project will be July 2018. An application for extension of approval must be submitted if the project continues after this date.

LIVERPOOL JOHN MOORES UNIVERSITY

Mandy Williams
Research Support Officer, Research Support Office
Kingsway House, Hatton Garden, Liverpool L3 2AJ
t: 01519046467 e: a.f.williams@ljmu.ac.uk