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Experiences of physical activity at age 10 in the 1970 British Cohort Study

Will Parry

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August 2013

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Abstract

Interest in school sport and physical education has increased dramatically in the UK since the build-up to the London Olympics of 2012. Politicians are keen to promote competitive sport in schools, with the intention of making children more active and building a legacy of lifelong participation in sport. In an attempt to maximise impact, there has been a gradual increase in policy focus toward primary schooling, with proposals being made for more physical education, specialist PE teachers, coaching, competitions and links with sports clubs.

The academic literature suggests that parental and family influences are the main drivers of children's participation in physical activity. Active children are socialised into active lifestyles by encouraging, supportive parents. They acquire skills and abilities that enable them to do well at and enjoy school sport and physical education.

The analysis presented in this research uses data from the 1970 British Cohort Study (BCS70) to compare statistical models based on policy assertions with models based on socialisation and motivation theories. By doing so, it identifies whether school sport and physical education policy is likely to act as an effective intervention, or whether it mostly benefits children who have already been socialised into active lifestyles by their parents.

It was found that girls and boys had different experiences of physical activity at age 10, indicative of prevailing gender stereotypes. There was little evidence that school sport and physical education acted as an effective intervention. In contrast, there was strong evidence that children who were socialised into sport outside school had better experiences inside school. It is possible that current government policy, which focuses on traditional sports, competition and performance, could have negative impacts on children who are already less active outside school.

Non-technical summary

In 1980, those children who were already more active outside of school were more likely to have positive experiences of primary school sport and physical education. The amount of curricular time devoted to sport and physical education was unrelated to enjoyment or self-perceptions of ability inside school, or participation in sport outside school.

Interest in school sport and physical education has increased dramatically in the UK since the build-up to the London Olympics of 2012. Politicians are keen to promote competitive sport in schools, with the intention of making children more active and building a legacy of lifelong participation in sport.

In an attempt to maximise impact, there has been a gradual increase in policy focus toward primary schooling, with proposals being made for more physical education, specialist PE teachers, coaching, competitions and links with sports clubs.

Academic researchers have frequently criticised this emphasis on competition, however, as it may put children off sport if it leads to negative self-perceptions of ability. On entering school, some children are already more active than others due to parental and family influences, and it is thought that these children are more likely to have positive experiences of the competitive environment in school because of this advantage.

The analysis presented in this research used observational data from the British Cohort Study 1970; an ongoing multi-national cohort study following the lives of children born in one week in April 1970. Although the vast majority of the cohort members enjoyed primary school sport in 1980, girls and boys had different experiences that were indicative of gender stereotyping, both inside and outside school. There was little evidence that school sport and physical education was associated with positive experiences of physical activity or participation in sports outside school.

In contrast, there was strong evidence that children who were already active outside school had better experiences inside school. Conversely, those children who were least likely to be active outside school were most likely to have negative experiences of school sport and physical education.

This research suggests that the competitive sporting environment in primary school was already beginning to have an impact on enjoyment by emphasising performance and encouraging peer comparisons of ability. Overweight and obese children may have been particularly susceptible to these effects, not only through the school environment, but also due to their lower levels of participation outside school. From a policy perspective, one can see that school provision may not have served to reduce inequalities in physical activity, but may have exacerbated differences in participation that already existed outside of school by subtly emphasising performance over participation and failing to encourage those who were already less likely to be active.

Ongoing research will build on the analysis presented in this paper by investigating experiences of physical activity at age 16 in the BCS70 and linking them to those at age 10. The impact of these childhood experiences of physical activity on adult exercise behaviour will then be identified by extending the analysis to the waves of the BCS70 in adulthood.

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1 Introduction

This working paper presents a cross-sectional analysis of experiences of physical activity for boys and girls in the 1970 British Cohort Study (BCS70) during their time at primary school. Recently, a spotlight has been shone on education policy relating to school provision of sport and physical education in the UK, with new policies being published (Department for Culture Media and Sport, 2012), funding announcements made (Department for Education, 2013) and consultations undertaken (House of Commons Education Select Committee, 2013). This policy development is driven by the desire to ensure a lasting legacy for the London 2012 Olympics and ongoing concerns that children are increasingly inactive and overweight.

The short term aims of these policies are to increase participation and develop physical literacy (Whitehead, 2010). Long term, the main goal is to encourage lifelong participation in healthy levels of physical activity in the population as a whole. Policies have consistently argued that 'high quality' school sport and physical education provides a way in which to do this. In an attempt to maximise impact, there has been a gradual increase in policy focus toward primary schooling, with arguments being made for more physical education, specialist PE teachers, coaching, and links with sports clubs (Department for Culture Media and Sport, 2000; Department for Culture Media and Sport & Strategy Unit, 2002; Department for Children Schools and Families, 2008; Sport England et al., 2009).

The academic literature suggests that family influences are the main drivers to early participation in and enjoyment of physical activity. Those children who are encouraged and supported to be physically active outside school develop fundamental motor skills earlier, and are more able and thus more likely to do well at and enjoy formalised sport and physical education in school (Van Der Horst et al., 2007; Kay, 2004; Kirk, 2005). Qualitative evidence suggests that the competitive environment commonly promoted in schools can discourage less able children (Penney & Evans, 1997; Green, 2004; Allender et al., 2006), leading to negative self-perceptions of competence and adverse effects on enjoyment and motivation. Interviews with adults suggest that negative childhood experiences in school have lasting impacts on future participation in sport and exercise (Coakley & White, 1992; Thompson et al., 2003; Allender et al., 2006; Strean, 2009), which could have serious implications for health (Bauman, 2004).

The analysis presented in this research uses data from the BCS70 to identify whether primary school sport and physical education was achieving the aims now commonly asserted in government policy, or whether a better explanation of cohort members' experiences of physical activity is offered by models developed from academic theory. The wave of the BCS70 conducted in 1980, when the cohort members were aged 10 and more than half way through their primary schooling, is particularly useful for this analysis because of the breadth of information that was collected. Variables measuring cohort members' subjective experiences, participation at home and in school, and other correlates of physical activity are available. This analysis also provides an early foundation for ongoing research I am conducting into the impact of childhood experiences of school sport and physical education on adult exercise behaviour.

Document structure

The following sections are included in this paper:

- **Background** – describes the policy context in the UK and characterises school provision in terms of the activities which form the core of provision during primary schooling
- **Academic literature** – provides a brief review of the empirical and theoretical academic literature on childhood participation in physical activity
- **Research questions** – states the research questions the analysis seeks to answer
- **Data** – describes the BCS70 dataset and the measures used in the analyses
- **Methods** – describes the statistical methods used to answer the research questions
- **Preliminary analysis** – presents cross-tabulation, histograms and pairwise correlations to provide a preliminary understanding of the data
- **Path analysis** – presents several path analytic models used to test whether particular relationships are supported by the BCS70 data
- **Discussion** – summarises and discusses the implications of the results of the analyses
- **Appendices** – contains supplementary analysis not presented in the main paper

2 Background

In recent decades, government interest in school sport and physical education has grown as the prevalence of overweight and obesity has risen in the general population (National Obesity Observatory, 2010), the situation being described as an “obesity epidemic” (NICE, 2006). Successive UK governments have aimed at tackling the obesity crisis by developing policies related to both diet and physical activity. These attempts have faced a consistent obstacle in the limited scope available for intervention in the adult population. Generally, it has only been practical to influence adults through public information campaigns, such as the “5-a-day” campaign for improving diets (Department of Health, 2003) and the publication of guidelines for physical activity (Department of Health, 2004; Department of Health, Physical Activity, Health Improvement and Protection, 2011). Government commissioned research projects have found that many of these efforts tend to impact most on those people who already maintain more active lifestyles (e.g. PricewaterhouseCoopers LLP, 2010).

An alternative avenue for intervention is via educational policy and the school system. The school setting is a particularly popular environment for intervention by government policy makers (Bassey, 2003). This popularity is due to education being long-term, compulsory and formative: compulsory schooling lasts for 11 years (from ages 5 to 16) and spans the main developmental period of physical development, learning and character emergence that occurs as children mature. Children are therefore seen as particularly amenable to behaviour change through educational processes and systems. Thus, ever since Balfour’s Education Act of 1902 (Parliament, 1902), government has sought to improve the health and fitness of children, and consequently the population, by including physical education, sport and exercise in compulsory school provision. In recent decades, as the obesity crisis has grown, so has the frequency with which new policies have been released.

The general approach taken in these policies has involved increasing children’s participation in physical activity inside school, and attempting to maintain this participation as they grow into young adults; the implicit assumption being that active children will become adults who lead active lifestyles. Historically, school sport and physical education provision has mostly comprised educational forms of basic gymnastics and traditional team games (Donovan et al., 2006). A survey of primary schools undertaken by Her Majesty’s Inspectors of Schools in 1978 (Department of Education and Science, 1978) found that team games were “played in almost all the classes [surveyed]”. Traditional educational gymnastics “with the emphasis on sensitivity and the ability to invent sustained sequences of movement” and a type of gymnastics “influenced by the British Amateur Gymnastic Association’s award scheme” were also commonly taught. Gymnastics was included in “well over four fifths” of curricula, and equipment was available in “nine out of ten classes”. Swimming was also commonly provided, with provision increasing with the age of the children: at age 9, two thirds of children had swimming classes and at age 11 this rose to ~90%.

More recently, this emphasis on traditional, competitive sports has strengthened and is currently enshrined in government policy. In 1995, John Major’s Conservative Government released ‘Sport: Raising the Game’ (Department of National Heritage, 1995), which promoted traditional, competitive sports at an early age on the basis that they helped to develop the qualities of sportsmanship, taught “healthy sporting habits” (Department of

National Heritage, 1995, pp.6) and would enable young people to "[adopt] a healthy and active lifestyle in future years" (Department of National Heritage, 1995, pp.6). 'A Sporting Future For All' was published 5 years later by the Department for Culture, Media and Sport (Department for Culture Media and Sport, 2000) under Tony Blair's New Labour Government. This strategy document stated that physical education and school sport "enables all young people to develop physical skills, helps personal and social development" (Department for Culture Media and Sport, 2000, pp.29) and "help[s] to make sport and healthy exercise a lifelong habit" (Department for Culture Media and Sport, 2000, pp.29). The PE & Sport Strategy for Young People (Department for Children Schools and Families, 2008; Sport England et al., 2009) aimed to involve 5 to 16 year olds in "at least two hours high quality PE and sport at school each week" (Department for Children Schools and Families, 2008, pp.3). The most recent policy of the current, coalition government, has re-asserted the primacy of competitive sport, with its emphasis on the legacy of the London Olympics, a national 'School Games' and a strong focus on participation in intra and inter-school competition in traditional sports (Department for Culture Media and Sport, 2012). Clearly, the pressure exerted on schools through government policy has served only to increase the focus on competition and traditional sports since the 1980s. Research into PE teachers' views of their subject (Green, 2002) suggests that these policies have only served to entrench teachers' pre-existing sporting ideologies.

School sport and physical education policy is now built on the assertion that increasing children's participation in competitive, traditional sport is the best way to develop their physical proficiency, enjoyment and ongoing participation in physical activity. Logically, if it serves as an effective intervention, it then follows that children attending schools where more curriculum time is devoted to school sport and physical education should be more physically able, more likely to enjoy participating in sport and, as a consequence, participate more frequently outside of school. The analysis presented in this paper seeks to test these hypotheses.

3 Academic literature

Whereas government policy inevitably focuses on the benefits of 'high quality' physical education and school sport for children's participation in physical activity, the academic literature encompasses a multitude of influences. Parental and family influences are known to play an important role (Van Der Horst et al., 2007). Parents can act to normalise activity in the family, effectively habituating children into being active (Moore et al., 1991; Weiss, 2003; Haycock & Smith, 2012). The most commonly cited theory supporting this process is Social Learning Theory (Bandura & Walters, 1963), whereby children observe, imitate and are reinforced by influential role models. Apart from this behavioural influence, parents can also provide practical and emotional support, investing their time and interest in supporting their children's participation in sport and exercise (Kay, 2004). Children who are provided financial support and transportation by encouraging parents are more likely to have access to and engage in a wide variety of physical activities than those who do not (Health Education Authority, 1997; Rees et al., 2001). For young children, who are almost entirely dependent on their parents, this is particularly important in enabling access to highly organised activities such as team sports (Welk et al., 2003; Allender et al., 2006; Brockman et al., 2009; Trost & Loprinzi, 2011).

It is widely thought that parental and family influences are crucial to early childhood development of physical skills and abilities. By having varied and extensive early experiences of physical activity, children develop a basic physical literacy made up of fundamental motor skills (Whitehead, 2001, 2010). On entering school, these skills allow the child to engage with school provision. Early experiences of successful participation can have a lasting impact on self-perceptions of ability and subsequent enjoyment of physical activity, especially as children come to realise between the ages of 8 and 12 that ability is not solely due to the effort invested (Kirk, 2005).

Perceived ability in physical activity is an aspect of 'physical self-concept' (Marsh, 1996b,a). It has consistently been found to influence intrinsic motivation to participate in physical activity (Ryan & Deci, 2000; Cairney et al., 2012; Carroll & Loumidis, 2001), and can mediate the relationship between participation and intrinsic motivation – people enjoy, and are motivated to participate more in, activities they feel competent at, and conversely, feelings of incompetence tend to impede enjoyment and discourage further participation. Self-Determination Theory has been widely used to explain why people are motivated to participate in physical activity (Ryan & Deci, 2000). It posits two main forms of motivation: intrinsic and extrinsic. Intrinsically motivated activity is that which satisfies basic psychological needs for feelings of competence, autonomy and relatedness (Ryan & Deci, 2000, pp.57-58). It is typified by enjoyment, personal choice, interest and investment, and is associated with long-term participation in physical activity (Teixeira et al., 2012). Qualitative evidence has shown that young children participate in physical activity primarily for reasons associated with intrinsic motivation: it is fun and they get to socialise with friends (Allender et al., 2006; Kirk, 2004).

In contrast, extrinsic forms of motivation involve 'separable outcomes' and can vary considerably in their relative autonomy (Ryan & Deci, 2000, pp60-61). At one extreme, a child might participate in PE because they value fitness and health and see it as a way to

achieve these goals. At the other extreme, a child may have to participate as part of compulsory schooling, but would otherwise choose not to. One can see how a child that is experiencing feelings of incompetence may end up 'amotivated' by compulsory, competitive school provision, and could be put off from future participation. Indeed, traditional competitive sports have been found to have limited appeal to many children (Penney & Evans, 1997), and yet schools are generally keen to promote a strong sporting ethos. Consequently, a major concern of research today is how experiences at school influence the tendency to pursue an active lifestyle. Retrospective, qualitative investigations have suggested that negative experiences have a lasting impact on participation in physical activity (Coakley & White, 1992; Thompson et al., 2003; Allender et al., 2006; Strean, 2009), but this question has yet to be adequately addressed by quantitative research.

There are many other influences on childhood participation in physical activity, apart from family socialisation, enjoyment and the development of physical ability. Sex and gender are known to have a great impact on levels of participation; girls are generally less active than boys (Biddle et al., 2011). This disparity increases with age and is not extant in very early childhood (<6 years, see Hinkley et al., 2008). By adolescence, however, it becomes a consistent phenomenon across studies (Sallis et al., 2000). For girls in particular, the physiological changes they go through during puberty seem to impede engagement in physical activity. Qualitative research suggests that girls become much more self-conscious on entering puberty (Coakley & White, 1992) and are also influenced by prevailing gender stereotypes. It is common for girls to perceive being physically active or 'sporty' as unfeminine (Allender et al., 2006; Rees et al., 2001). More generally, the provision of opportunities to be physically active is gendered in society. Certain activities are generally regarded as feminine (such as hockey, dance, netball, etc.) and others as masculine (football, rugby, cricket, etc.) (Fox & Rickards, 2004; Department for Culture Media and Sport, 2010). This stereotyping also occurs in schools, which frequently provide gender-specific sport and activity options. Despite recent efforts to counter this phenomenon, it has remained pervasive and PE teachers are frequently complicit in the promotion of gendered activity options (Smith et al., 2009). Traditional sports, in particular, have been criticised for being dominated by a masculine perspective, involving a discourse of competition and elitism that is inherently excluding of stereotypically feminine qualities (Stevenson, 2002; Kirk, 2004, 2005). The gendered construction of sport and exercise pervades our culture. It is ingrained in school provision, the print media and television coverage of elite sport.

Disability and weight status also affect participation. Opportunities to participate tend to be more limited and less varied for the disabled, and they may need special assistance and facilities to participate effectively (Finch, 2001). The evidence linking physical activity to weight status in children is inconclusive but strongly suggests that the amount of physical activity is not a primary determinant of weight status (Biddle et al., 2011) or weight gain over time (Wilks et al., 2011). However, overweight children are more likely to be bullied in primary school (Griffiths et al., 2006) and can develop negative body image (Reulbach et al., 2013), and this can have a detrimental effect on their enjoyment of physical activity.

According to the academic literature, we might expect that primary school experiences of sport and physical education are strongly determined by exposure to physical activity outside of school. Parents who support and encourage their children to be active from an early age promote the development of fundamental motor skills and socialise the child into an active

lifestyle. Physical skill and ability allows these children to experience feelings of competence when participating in school sports and physical education, which in turn promotes enjoyment and future participation. Conversely, those children who lack these skills may suffer from negative self-perceptions that are exacerbated by the compulsory, competitive nature of school provision, a strong performance-orientated sporting ethos, and the exposure of their inability to peers in the class environment. Physiological differences in children's rate of maturation, body type, natural ability, disability and weight status will also influence experiences at school. Even at such an early age, the heavily gendered stereotypes that pervade culture in relation to sport may also have begun to affect preferences. The analysis presented in this paper seeks to identify whether there is evidence of these influences in the experiences of the BCS70 cohort members at age 10.

4 Research questions

This paper seeks to answer the following research questions using data from the BCS70 when the cohort members were aged 10:

1. Are differences between the sexes in experiences of physical activity already apparent by age 10? Are these differences indicative of gender stereotyping?

2. In what way are experiences of physical activity inside school associated with those outside school at this age?

    (a) Is more participation in school sport and physical education associated with the positive outcomes commonly asserted by government policy?
    (b) Are children who are socialised into physical activity outside school more likely to have positive experiences inside school?

3. Does perceived ability mediate enjoyment of school sport and physical education at age 10?

4. Are these associations robust to the inclusion of other correlates of physical activity?

5 Data

The BCS70 is a multi-national, large-scale, prospective, multi-purpose study consisting of a cohort of people born in Great Britain after the 24th week of gestation between 00:01am on Sunday 5th April and 24:00pm Saturday 11th April 1970. The original study was called the British Birth Survey. It focused on the circumstances and outcomes of birth. The study broadened considerably in subsequent waves, looking at health, education and social development in childhood and adolescence, and then the transition into adulthood, entry to the labour market, the formation of partnerships, and parenthood. Children were traced for the 10-year survey of the Child Health and Education Study using information collected during previous waves and with the assistance of Local Education Authorities (LEAs) in England and Wales and Regional Councils in Scotland (Butler et al., 1980).

This wave of the study contained 10 main data collection forms split into an educational pack and a health pack. In the educational pack, six of the forms were completed by the child and were administered by the class teacher. A self-completion form asked the child questions about their educational experiences. There was also a form answered by the class and head teachers relating to the cohort member. The health pack contained three forms: a maternal self-completion form, a parental interview form and a medical examination form (completed by a community medical officer or school nurse). Data collection took place between March 1980 and October 1981.

The estimated target sample size at age 10 was 16,152 children, of which 14,350 were surveyed (a response rate of 88.8%). Response for individual survey instruments and question items inevitably varies, however (see Ketende et al. (2010) for more information). A certain degree of pragmatism was necessary in identifying measures for particular concepts, and so some act as proxies and must be treated with a degree of caution. The main variables of interest to the analysis included:

Enjoyment – measured using a categorical variable asking the cohort member whether they like team games. This was the only measure of enjoyment available at age 10. Almost all children would have played team games inside school (Department of Education and Science, 1978). Enjoyment is an indicator of intrinsic motivation (Ryan & Deci, 2000; McAuley et al., 1989; Teixeira et al., 2012).

Perceived ability – measured using two binary variables asking the cohort member if they do well in (a) games and (b) gymnastics. Almost all schools at the time included educational gymnastics in their physical education provision (Department of Education and Science, 1978) alongside team games. Perceived ability is an indicator of physical self-concept (Marsh, 1996b,a) and a determinant of intrinsic motivation (Ryan & Deci, 2000).

Participation outside school – measured using three ordinal variables asking the mother of the cohort member how often their child (a) plays sports (b) rides a bike or (c) swims in their spare time.

Participation inside school – measured using an interval variable asking the class teacher how many hours a week the cohort member is engaged in PE/movement/games during school periods.

Additional variables were included in order to control for physiological, socioeconomic and school environment factors. Measures used to control for cohort member physiology included:

Weight status – binary indicators of underweight, overweight and obesity were derived. Measures of height and weight recorded as part of the medical examination form were used to calculate BMI. The binary indicators were derived using an approach similar to that used by the WHO in their 2007 growth reference (Dinsdale et al., 2011). BMI>1 standard deviation below the mean was classed as underweight, BMI>1 standard deviation above the mean was classed as overweight, and BMI>2 standard deviations above the mean was classed as obese. Unlike the WHO growth reference, the derivations were not calculated separately by sex. Practically all children were taught in mixed sex classes at this age, and so relative weight status compared to all peers is more applicable as a physiological control than that compared only to same-sex peers.

Maturation – measured using a binary variable and recorded as part of the medical examination form, this indicated whether the medic had noticed signs that the child had begun to go through puberty.

Disability – measured using a binary variable indicating whether the child has a physical or mental disability which interferes with everyday life and might be a problem at school, answered by a parent (usually the mother) during the parental interview.

Motor coordination – used as a proxy measure for innate (inherited) physical ability, motor coordination was measured using four binary indicators of ability to balance on one leg, recorded over two tests administered during the medical examination. The child was asked to stand on the right leg with the left foot against the knee of the right leg and hands on hips. The child was then told to try to hold the position for 30 seconds (test 1). The medic recorded whether the hands or feet moved out of position within the 30 seconds. The test was then repeated with the child standing on the left leg (test 2).Evidence suggests that relative differences in coordination between children remain stable over time, despite generally improving with age (Vandorpe et al., 2012), and so these measures should serve as a reasonable proxy for innate motor coordination.

Measures used to control for socioeconomic factors included:

Parental income – measured using an ordinal variable with six categories representing ranges of gross weekly parental income (including all earned and unearned income of both the mother and father before deductions for national insurance and tax, excluding income from other household members and child benefit), answered by a parent (usually the mother) during the parental interview.

Social class – measured using a variable with six categories representing the father's occupation, based on the Registrar General's classification (Rose & Pevalin, 2001), answered by a parent (usually the mother) during the parental interview.

Parental education – measured using two variables, each with five categories, representing the level of the highest educational qualifications attained by the mother and father, answered by a parent (usually the mother) during the parental interview.

Measures used to control for the school environment included:

Class size – measured by the number of pupils in the cohort member's class, answered by the class teacher as part of the educational pack.

School social mix – measured using an estimate of the percentage of pupils' fathers whose occupations were 'professional/managerial' (social class I) or 'clerical and other 'white collar' workers (social class II) in the cohort member's school, answered by the headmaster as part of the educational pack.

6 Methods

The analytical strategy for this paper comprised two main stages:

1. Preliminary analysis

a) all variables were analysed by sex using cross-tabulation, bar charts and histograms in order to determine any interesting features in the data and identify disparities between the sexes
b) the variables measuring enjoyment, perceived ability and participation in physical activity were used to estimate a pairwise correlation matrix to give a preliminary indication as to whether they were associated with one another, as might be expected according to the assertions of policy and the theories put forward in the academic literature.

2. Path analysis

Several models were constructed in order to test whether:

a) participation in school sport and physical education was significantly associated with the positive outcomes commonly asserted by government policy
b) participation in physical activity outside school was significantly associated with better experiences inside school, as suggested by socialisation theory
c) perceived competence mediated the relationship between participation and enjoyment, as suggested by self-determination theory
d) controlling for physiological, socioeconomic and school environmental influences moderated the associations between the variables of interest.

All of the variables used to estimate pairwise correlations in the preliminary analysis were binary, except for the measure of participation inside school (hours of PE/movement/games). It was therefore necessary to use appropriate analytical techniques suited to these types of measure. Tetrachoric correlations were estimated where the variables were binary, because these items represented approximations of underlying/latent continuous variables. Biserial correlations were estimated where binary items were correlated with interval items. Cohen's effect size conventions for the social sciences (Cohen, 1992) were employed as a useful yardstick against which to compare correlations. These state that a correlation of 0.5 is large, 0.3 is medium sized, and 0.1 is low. These are useful as simplistic guidelines but must be used intelligently – for policy makers, even small causal effects can be worthy of policy intervention (Coe, 2002).

The models presented in the path analysis were estimated using Mplus version 6.12. Path analysis is a form of regression analysis where complex relationships between variables, including direct and indirect effects on outcomes, can be modelled simultaneously. It enables a variety of models to be specified and tested against sample data to identify whether there is evidence that the processes defined in the model provide a good explanation for the associations observed amongst the sample data. Along with Z-tests of statistical significance for individual model parameters, various measures of overall fit are available. In this paper, I

report the χ^2 statistic and test, the root mean square error of approximation (RMSEA), the comparative fit index (CFI) and the Tucker-Lewis fit index (TLI). The reason for using several measures of fit is that each one is somewhat imperfect, but taken together they provide a good indication of whether the model fits the sample data well.

The χ^2 test is a measure of absolute fit to the sample data and is somewhat sensitive to sample size, the number of parameters in the model (and resulting degrees of freedom, df) and the strength of associations. Sample sizes over N=400 generally result in a significant test, indicating poor fit (Byrne, 2011, pp.67-69). The sample sizes in this paper are all much larger than this, and so this measure is reported alongside the RMSEA, CFI and TLI. The RMSEA is another measure of absolute fit. It is based on the non-centrality parameter $\chi^2 -$ df and penalises model complexity using the ratio χ^2/df, thus preferring a parsimonious model. The advantage of the RMSEA is that it gives an indication of how well the model would fit the population from which the observed data has been sampled. An RMSEA value of <0.05 is commonly thought to indicate good fit (Browne & Cudeck, 1992). The CFI is a measure of incremental fit that compares the specified model with a null model where the variables are assumed to be uncorrelated. It is also based on the non-centrality parameter χ^2 − df and uses the number of parameters added to the model to penalise model complexity. A CFI value of >0.95 is commonly thought to indicate good fit (Hu & Bentler, 1999). The TLI is another measure of incremental fit that compares the specified model with the null model. It is based on the ratio χ^2/df and penalises inclusion of additional parameters more than the CFI. A TLI value of >0.95 is commonly thought to indicate good fit (Hu & Bentler, 1999).

The Mplus default option of using full information maximum likelihood (FIML) imputation to impute missing items was used as there was little difference between these estimates and those from a complete case analysis. As a result, the analysis is conducted under the assumption of missing data being conditionally missing at random (i.e. MAR according to Rubin's (1976) terminology. Ongoing research I am conducting into experiences of physical activity in the BCS70 includes a thorough investigation into any biases resulting from missing data using a multiple-imputation approach). Because the modelled outcomes represented approximations of underlying/latent continuous variables, probit models were estimated. For clarity, error/residual terms are not represented in path diagrams. All estimates are shown in unstandardised probits. Estimates were not standardised for two reasons. Firstly, many of the explanatory/control variables were categorical, and so X-standardisation would have been inappropriate. Secondly, the models were estimated using the weighted least squares estimator (WLSMV) in Mplus. This uses a diagonal weight matrix with standard errors and a mean-and variance-adjusted chi-square test statistic that uses a full weight matrix, for which standardised estimates are not available when the model contains covariates (Muth´en & Muth´en, 2010, pp533, 643). This method provides a rapid way to estimate models and has been found to produce stable and reliable estimates where sample sizes are relatively large (N>1000) (Asparouhov & Muth´en, 2010; Nussbeck et al., 2006). Due to the measurement level of the variables, the only alternative to this estimator for the more complex models presented would have been numerical integration, which was found to be prohibitively slow.

7 Preliminary analysis

7.1 Experiences of physical activity at age 10

Research has consistently found that there are disparities in levels of physical activity between the sexes (Biddle et al., 2011; Bauman et al., 2002), with males generally being more active and participating in more sport and exercise than females. This disparity increases with age and is not extant in very early childhood (<6 years, see Hinkley et al., 2008). By adolescence, however, it becomes a consistent phenomenon across studies (Sallis et al., 2000). In order to identify whether this disparity had already become apparent amongst the cohort members at age 10, the variables measuring enjoyment, perceived ability and participation were cross-tabulated by sex (Table 1).

Table 1: Cross-tabulation of measures relating to enjoyment, perceived ability and participation in physical activity

Concept	Variable	Value	Female (%)	Male (%)
Enjoyment	Do you like team games? (self-report)	Yes	90.9	94.3
		No	6.4	4.0
		Don't know	2.7	1.7
Perceived ability	Do you do well or not so well in games? (self-report)	Well	84.5	92.0
		Not so well	15.5	8.0
	Do you do well or not so well in gymnastics? (self-report)	Well	49.2	41.9
		Not so well	50.8	58.1
Participation outside school	Plays sports in spare time (mother report)	Often	41.7	67.0
		Sometimes	47.6	28.1
		Never or hardly ever	10.7	4.9
	Rides a bike in spare time (mother report)	Often	50.9	69.0
		Sometimes	38.4	24.6
		Never or hardly ever	10.7	6.4
	Swims in spare time (mother report)	Often	54.9	56.3
		Sometimes	37.2	34.7
		Never or hardly ever	7.9	8.9
			Female	Male
Participation inside school	Hours curricular PE/games/ movement per week (teacher report)	Mean (hours)	1.91	1.93
		Std. dev. (hours)	0.68	0.72

Note: sample sizes on which figures are based vary between 5,559 and 6,502 per sex; the respondent is shown in brackets in the *Variable* column

Almost all of the cohort members enjoyed games at this age; with 90.9% of girls and 94.3% of boys reporting that they like team games. The measure of perceived ability in games presented a similar picture to the variable measuring enjoyment, with the vast majority of girls (84.5%) and boys (92.0%) reporting a high perceived ability in games. Nevertheless, almost twice as many girls did not have a high perceived ability in games (15.5%) compared to the boys (8.0%). These results suggest that gender disparities in experiences of physical

activity in school were already becoming evident at age 10, with boys being more likely to have positive experiences of participating in games.

Perceived ability in gymnastics was far lower for both sexes: only 49.2% of girls and 41.9% of boys reported high perceived ability. This suggests there was something particular to gymnastics that caused perceived ability to be lower. The way in which gymnastics was commonly taught in schools at the time could have been responsible for this dramatic difference in perceived ability. Games comprised team sports with little or no formal assessment of performance, and no obvious or precise way for children to compare ability. In contrast, gymnastics required children to perform in front of their classmates. A national curriculum specification from 1989 supports this notion, stating that "children should have had experiences which enable them to: [...] perform sequences [...] copy sequences devised by others [...and...] reproduce some specific movement patterns, for example, in named skills such as handstands" by the age of 11 (Department of Education and Science, 1989). By emphasising individual performance and attainment, educational gymnastics exposed the cohort members to explicit comparisons of their abilities against those of their peers – a relative assessment that would generally result in half of the children assessing themselves as worse than average and half as better than average.

In 1980, British culture exposed children to traditionally polarised gender stereotypes (e.g. see Collins & Kay, 2003, pp.102-107). These would have encouraged boys' engagement and sporting identities whilst discouraging girls. At 10 years of age, the children in the BCS70 may have reached a point in their lives where they became increasingly sensitive to these cultural norms. The measures of enjoyment and perceived ability seem to support this notion. In gymnastics, which is traditionally perceived as feminine, girls reported higher perceived ability than boys. Girls also performed better on motor coordination tests, which would have offered an advantage in gymnastics. For team games, more commonly regarded as masculine activities, boys reported higher perceived ability and enjoyment. Unfortunately, there was no question on enjoyment related to gymnastics.

Participation in physical activity outside school was measured by asking cohort members' mothers what activities their children did in their spare time. Mothers were more likely to answer that boys 'often' play sports (67.0%) than girls (41.7%), with girls more than twice as likely to 'never or hardly ever' play sports (10.7%) than boys (4.9%). The proportions relating to the question on riding a bicycle were very similar to playing sports for boys, but for girls, more were reported to ride a bicycle often (50.9%) than play sports (41.7%). Girls were still less likely than boys (69.0%) to ride a bicycle often, however. The proportions who swam were approximately equal across the two sexes, thus being the most frequent activity of the three for girls, and the least frequent for boys. The mothers' answers suggested that sports participation outside school was highly gendered and, to a lesser degree, so was riding a bicycle. In contrast, there was no gender disparity for swimming. This may have been due to the perceived importance of swimming as a life skill for all. Local Education Authorities of the time were very active in promoting swimming (Department of Education and Science, 1978).

The categories of the variables measuring participation outside school were somewhat vague, with 'sometimes' and 'often' not being defined explicitly. In an attempt to reduce error in the measures and increase the clarity of interpretation, simpler binary versions were derived indicating whether the cohort members participated in the activities 'often' or not.

These binary variables were then used to identify whether cohort members frequently took part in combinations of these activities (Table 2). This analysis demonstrated further differences between the sexes. The most common combination of responses for girls described participation in none of the activities often (19.3%); for boys, only 7.6% had this combination of responses. The second most common combination for girls described participation in all of the activities often (17.8%); this was the most common combination for boys (32.3%). This difference suggested that boys participated in these activities more frequently in general. For both sexes, there was a large minority that were reported as participating often in only a single activity (around 25% of boys and 30% of girls). A count of how many of these activities each cohort member frequently participated in was derived (Table 3). It clearly demonstrated greater participation by boys. Because of the obvious limitations of these indicators, it is not possible to be certain that boys were more active than girls, but the data strongly indicate they were.

Table 2: Cross-tabulation of activities the cohort member does 'often' in spare time by sex

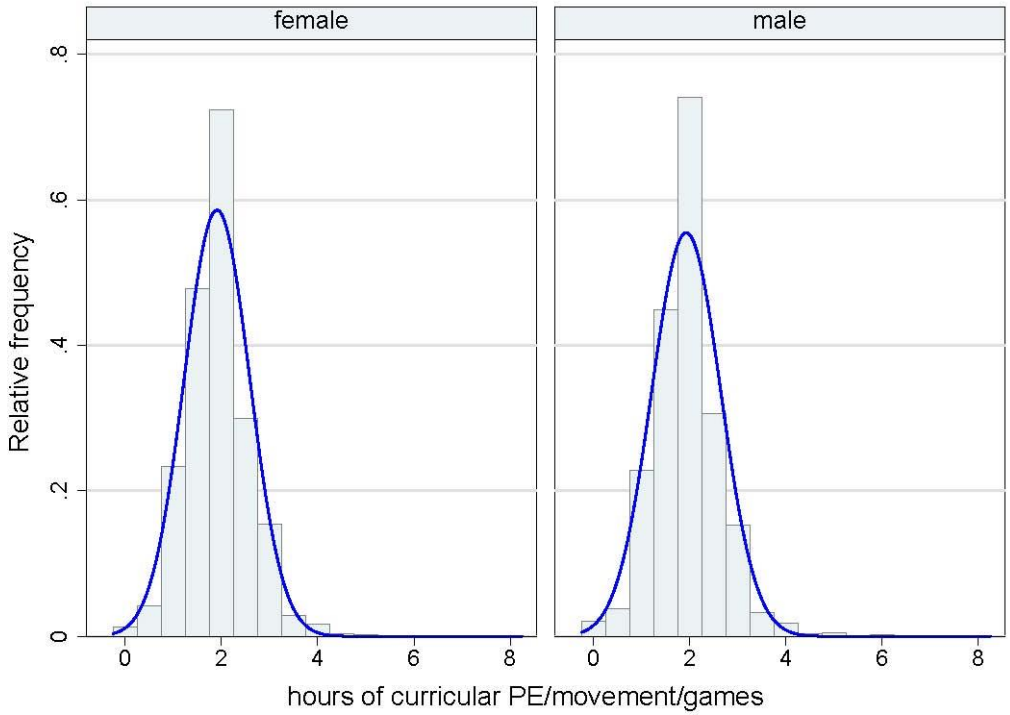
Females			Males		
Activities	N	%	Activities	N	%
none	1,172	19.3	none	489	7.6
sports only	379	6.2	sports only	600	9.3
swim only	798	13.2	swim only	295	4.6
bicycle only	743	12.3	bicycle only	703	10.9
sports & swim	623	10.3	sports & swim	618	9.6
sports & bicycle	439	7.2	sports & bicycle	1,025	15.9
bicycle & swim	831	13.7	bicycle & swim	640	9.9
all	1,080	17.8	all	2,089	32.3
Total	6,065	100.0	Total	6,459	100.0

Table 3: Cross-tabulation of the count of activities the cohort member does 'often' in spare time by sex

Count of activities	Females (%)	Female bar chart	Males (%)	Male bar chart
0	19.3	|||||||||	7.6	||||
1	31.7	|||||||||||||||	24.7	|||||||||||
2	31.2	|||||||||||||||	35.3	|||||||||||||||||
3	17.8	|||||||||	32.3	|||||||||||||||
Total	100.0		100.0	

Note: Females N=6,065, Males N=6,459

Figure 1: Histograms of how many hours of curricular 'PE/movement/games' the cohort member is engaged in per week during school periods



Teachers' estimates of how many hours of curricular 'PE/movement/games' the cohort members were engaged in per week were used to measure participation in physical activity inside school. The mean curricular provision was just under two hours per week (1.92 hours), but there was quite a lot of variation, the standard deviation being 0.70 hours. The measured range of hours provision was zero to eight per week. Histograms were plotted (Figure 1) and showed that the distribution did not appear to differ by sex and was approximately normal, apart from being limited at zero and having some positive skew. The vast majority of cohort members (93.5%) experienced between 1 and 3 hours of PE/movement/games per week. Primary schools at the time generally taught children in mixed sex classes (97.4% of cohort members in the BCS70 at age 10 were in schools that were mixed), and this was also true of school sport and physical education (Department of Education and Science, 1978) – girls and boys would have participated with and against one another (however informally) in team games and gymnastics.

It is striking that the average curricular provision of school sport and physical education was around 2 hours per week in 1980, according to the BCS70 data. About 40% of estimates were below 2 hours, and only about 15% were below 1.5 hours per week. Compare this with the policy aims documented in Game Plan (Department for Culture Media and Sport & Strategy Unit, 2002) during the Blair era over 20 years later: "ensuring that 75% of 5-16 year olds [are] spending at least 2 hours of high quality physical education and sport per week in and beyond the school curriculum by 2006" (Department for Culture Media and Sport & Strategy Unit, 2002, pp.57) (i.e. in curricular and extra-curricular time) – provision must have dropped markedly at some point in the intervening years. Detailed statistics of school provision are not available before the introduction of the first Young People and Sport study

in 1994 (Sport England, 2003), but historical analyses of the policy landscape during the 1990s suggest that physical education suffered from "decreases in curriculum time allocation, impoverished facilities and equipment, perceived lower esteem and status, [and] inadequate teacher preparation, especially for primary school physical education" (Donovan et al., 2006).[1]

7.2 Correlates of physical activity at age 10

Several of the commonly identified correlates of physical activity were available in the BCS70 data at age 10. Because differences in experiences between the sexes could have been caused by variation in these correlates, it was important to investigate them alongside the variables of interest. Table 4 shows the cross-tabulation of these variables by sex.

There were some notable differences between the sexes for the physiological factors. Slightly more girls than boys were underweight, overweight or obese. To some extent, this is due to the differing ages of maturation for boys and girls. The question on maturation showed that only a small minority of boys (4.7%) were showing signs of puberty, whereas over one quarter of girls (26.5%) were, and so, rather than being overweight or obese, some of these girls may have started their growth spurt and sexual development. Slightly more boys (8.8%) were also reported to suffer a disability than girls (6.7%). The girls were more likely to perform well in the motor coordination tests, with around 8% to 10% more boys having to move their hands or feet in each test in order to retain their balance. In contrast, the statistics for socioeconomic factors were very similar for both sexes, as were those for the school environment factors.

7.3 Pairwise correlations of variables measuring experiences of physical activity at age 10

For the last 20 years, a central aim of school sport and physical education policy has been to increase the amount of time that children participate in physical activity at school (Department of National Heritage, 1995; Department for Culture Media and Sport, 2000; Department for Culture Media and Sport & Strategy Unit, 2002; Department for Children Schools and Families, 2008; Sport England et al., 2009; Department for Culture Media and Sport, 2012). The rationale for this policy is that children will be more active and develop physical literacy; they will not only be more active inside school, but will also choose to be more active outside school; and they will learn to use their bodies and become proficient in physical skills and abilities which enable them to enjoy being active, increasing the chances of them remaining active throughout their lives. School sport and physical education can thus be viewed as an intervention intended to produce multiple and wide-ranging beneficial outcomes. In contrast, the academic literature suggests that the dominant process is one of socialisation into sport (Bandura & Walters, 1963; Moore et al., 1991; Weiss, 2003; Haycock & Smith, 2012): children who are supported and encouraged to participate outside school by family and friends at an early age become socialised into a physically active lifestyle, develop physical skills and abilities and transfer these skills into the school environment.

[1] The Blair targets for school provision were scrapped by Michael Gove (Gove, 2010)

A preliminary step in identifying whether enjoyment, perceived ability and participation inside and outside school were associated with one another in the BCS70 was to estimate simple pairwise correlations between the variables. As gender disparities had already been identified in the cross-tabulations of experiences of physical activity presented in Tables 1, 2 and 3, correlations were estimated separately by sex (Table 5). Where categorical variables had more than one category, derived binary versions were used. For the measure of enjoyment, this was a binary indicator for liking games. For the variables identifying participation outside school, these were the previously derived binary indicators of participating 'often' in spare time. Where the correlated measures were binary, tetrachoric correlations were estimated; where measures were correlated with the measure of participation inside school (hours of PE/movement/games per week), biserial correlations were estimated.

Table 4: Cross-tabulation of correlates of physical activity by sex

Variable	Value	Female (%)	Male (%)
weight status (medic report)	underweight	13.2	11.5
	normal weight	68.9	77.4
	overweight	11.7	7.5
	obese	6.2	3.6
maturation (medic report)	yes	26.5	4.7
disabled (mother report)	yes	6.7	8.8
motor coordination (medic report)	test 1 moved foot	31.1	41.5
	test 1 moved hands	22.5	30.5
	test 2 moved foot	33.9	42.3
	test 2 moved hands	24.0	32.6
parental income (mother report)	under £50/week	7.0	7.1
	£50 to £99 per week	30.4	29.5
	£100 to £149 per week	34.2	35.0
	£150 to £199 per week	16.0	16.9
	£200 to £249 per week	6.8	5.7
	£250+ per week	5.7	5.9
social class (mother report)	I	6.0	6.2
	II	24.3	23.7
	III non-manual	9.0	9.1
	III manual	44.4	44.8
	IV	12.5	12.1
	V	3.8	4.1
mother's education (mother report)	no qualifications	55.1	54.3
	trade apprentice	16.3	16.1
	O-levels	20.3	21.2
	A-levels	5.6	5.6
	degree	2.8	2.9
father's education (mother report)	no qualifications	39.7	39.1
	trade apprentice	20.2	21.1
	O-levels	17.4	16.9
	A-levels	10.0	10.3
	degree	12.7	12.7
		Female	Male
class size (teacher report)	mean (number of pupils)	29.4	29.0
	standard deviation (number of pupils)	4.9	5.3
school social mix (headmaster report)	mean (% of school)	35.7	35.2
	standard deviation (% of school)	25.3	25.3

Table 5: Pairwise correlation matrix of experiences of physical activity at age 10 – correlations for females are in the upper right triangle, correlations for males are in the lower left triangle

	1	2	3	4	5	6	7
1 enjoyment of games	1	0.53	0.21	0.22	0.09	0.12	-0.03
2 perceived ability in games	0.59	1	0.43	0.31	0.11	0.13	-0.03
3 perceived ability in gymnastics	0.15	0.34	1	0.29	0.05	0.12	0.00
4 plays sports outside school	0.45	0.47	0.10	1	0.24	0.32	0.05
5 rides a bicycle outside school	-0.02	0.09	0.06	0.14	1	0.22	-0.03
6 swims outside school	0.07	0.12	0.05	0.26	0.22	1	0.08
7 participation inside school	0.01	0.02	-0.04	0.03	0.03	0.10	1

Note: table contains tetrachoric and biserial correlation coefficients, depending on the measurement level of the variables used to calculate the correlation

For girls, enjoyment and perceived ability correlated reasonably strongly. In comparison to Cohen's effect size conventions for the social sciences (Cohen, 1992), enjoyment of games was strongly correlated with perceived ability in games (0.53), supporting the relationship proposed in self-determination theory between intrinsic motivation and competence (Ryan & Deci, 2000). Perceived ability in games was also strongly correlated with perceived ability in gymnastics (0.43), suggesting that girls' ability and perceptions of ability were not specific to each activity type inside school, i.e. girls who were good at games were also likely to be good at gymnastics. In terms of associations of experiences in school with participation outside school, there were small to medium sized correlations of enjoyment and perceived ability with playing sports (0.22 to 0.31) and small correlations of enjoyment and perceived ability with swimming (0.12 to 0.13) and riding a bicycle outside school (0.05 to 0.11). Considering that provision in schools tends to comprise mostly of competitive sports, as opposed to recreational or artistic physical activities, this makes sense. The correlations amongst the various activities outside school (0.22 to 0.32) suggested that they were not entirely independent behaviours, i.e. more active children were more likely to participate in each of the activities measured. Most notably, there seemed to be near-zero correlations (-0.03 to 0.08) between hours of participation inside school and all other measures, suggesting that the amount of curricular 'PE/movement/games' was not an important determinant of experiences of physical activity at age 10, contrary to government policy assertions.

For boys, as with girls, enjoyment and perceived ability were correlated. Perceived ability in games was more strongly correlated with enjoyment for boys (0.59) than for girls (0.53). The correlation between perceived ability in games and gymnastics was slightly weaker for boys (0.34) than for girls (0.43). There were higher correlations of enjoyment and perceived ability in games with playing sports outside school for boys (0.45 and 0.47) compared to girls (0.22 and 0.31), but only a low correlation with perceived ability in gymnastics (0.11), which was much higher for girls (0.29). As with girls, there were low correlations with swimming (0.05 to 0.12) and riding a bicycle outside school (-0.02 to 0.09). Also, as with girls, there were medium sized correlations amongst the activities outside school (0.14 to 0.26), suggesting that they were not entirely independent behaviours, and near-zero correlations (-0.04 to 0.10) between participation inside school and all other measures.

For both boys and girls, the strong associations between enjoyment and perceived ability in games supported the relationship between intrinsic motivation and competence proposed in self-determination theory (Ryan & Deci, 2000). Playing sports outside school was associated with perceived ability and enjoyment inside school, providing some preliminary support for the socialisation theory (Weiss, 2003).

The small correlations of riding a bicycle and swimming with perceived ability and enjoyment suggested that simply being active was not strongly associated with positive experiences inside school, whereas experience in sports was. For girls, it seemed that perceived ability in gymnastics was a stronger correlate than for boys overall. This added to the accumulated evidence for gender disparities in experiences of physical activity. For both boys and girls, participation inside school did not seem to be a strong correlate of any of the other measures, suggesting that school sport and physical education may not be a particularly effective intervention with regard to these outcomes, in contradiction to government policy.

Summary

1. At age 10, the vast majority of girls and boys enjoyed games in school and reported a high perceived ability. Nevertheless, girls were more likely than boys to report that they did not enjoy games or had low perceived ability. This could have been due to the way in which traditional games activities were perceived as masculine pursuits, or differences in physiology between the sexes.

2. Perceived ability in gymnastics was far worse than for games, with more than half of the cohort members (and more boys than girls) reporting low perceived ability. A possible explanation for this is that gymnastics classes were structured in a more formal manner than games, with individual performance being a core part of participation. Girls higher perceived ability could have been related to gymnastics being perceived as feminine or due to better motor coordination.

3. Participation in activities outside school varied greatly by sex. There were large gender differences in playing sports, riding a bicycle and the combinations of activities participated in. Overall, boys seemed more active than girls with a larger proportion participating in the measured activities often. The only exception to this was swimming, where participation rates were practically identical. This may have been because swimming escaped gender stereotyping, being seen as an important life skill.

4. On average, the hours per week of participation inside school were identical for boys and girls. This is because the vast majority of schools and classes were mixed at age 10. This implies that girls and boys would have participated with and against each other, however informally.

5. On average, there was very little difference between the sexes in the socioeconomic and school environment correlates of physical activity. There were some notable differences for the physiological factors, where many more girls showed signs of maturation than boys; more girls were underweight, overweight or obese than boys; and girls tended to have better motor coordination when balancing on one leg.

6. Pairwise correlations demonstrated that perceived ability and enjoyment of games were strongly correlated, supporting self-determination theory. Playing sports outside school was correlated with perceived ability and enjoyment, highly for boys and moderately for girls, supporting the socialisation theory. An exception to this was perceived ability in gymnastics for boys, which demonstrated only a low correlation with playing sports outside school, providing further evidence for gender based disparities in experiences of physical activity.

7. All of the correlations with hours of participation inside school were near zero, except for swimming, which was low. This suggested that the amount of school provision was unlikely to have a substantial impact on enjoyment, perceived ability and participation outside school.

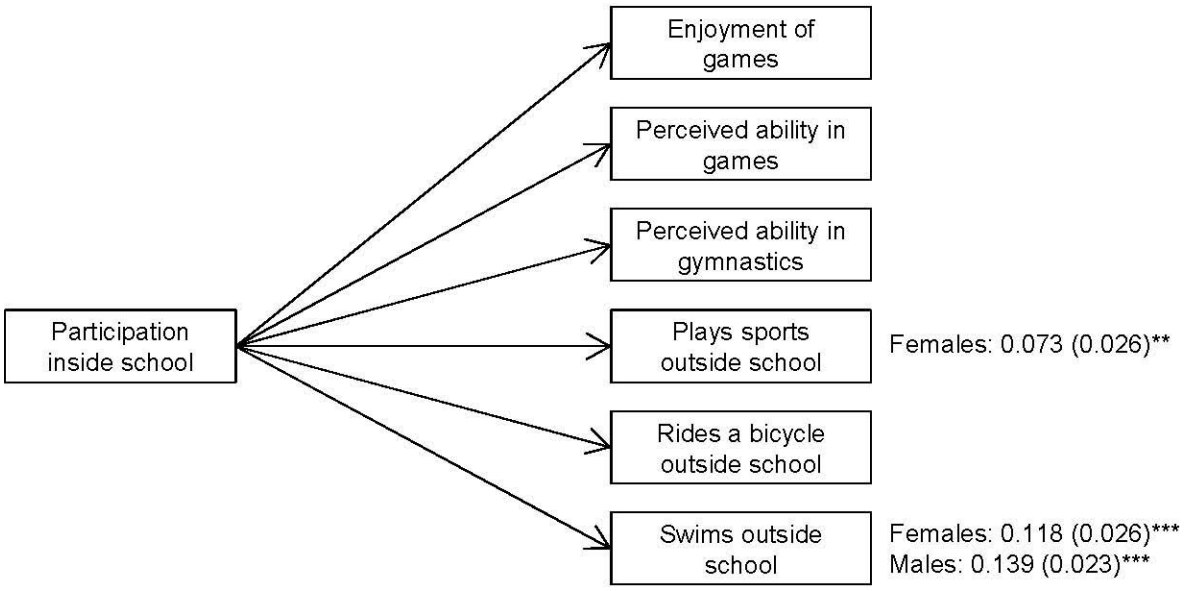
8 Path analysis

8.1 Is primary school sport and physical education an effective policy intervention?

Although the pairwise correlations suggested that participation inside school was only very weakly associated with the other measures, some of these associations may have been statistically significant and of interest to policy makers. A simple path model was created using hours of participation inside school as a cause of enjoyment and perceived ability inside school, and participation outside school, in order to identify whether any of the associations were significant.

It is important to note that policy generally aims to develop physical literacy by improving the physical 'skills and ability' of children, implicitly meaning objective ability rather than perceived ability. At age 10 in the BCS70, there is no direct measure of objective ability. Instead, the measures of perceived ability were included in the analysis. The analysis was conducted separately by sex. A diagram of the model with significant estimates shown (at α=5%) is presented in Figure 2.

Figure 2: Path model used to identify whether participation inside school is significantly associated with enjoyment and perceived ability inside school, and participation outside school, with significant estimates shown



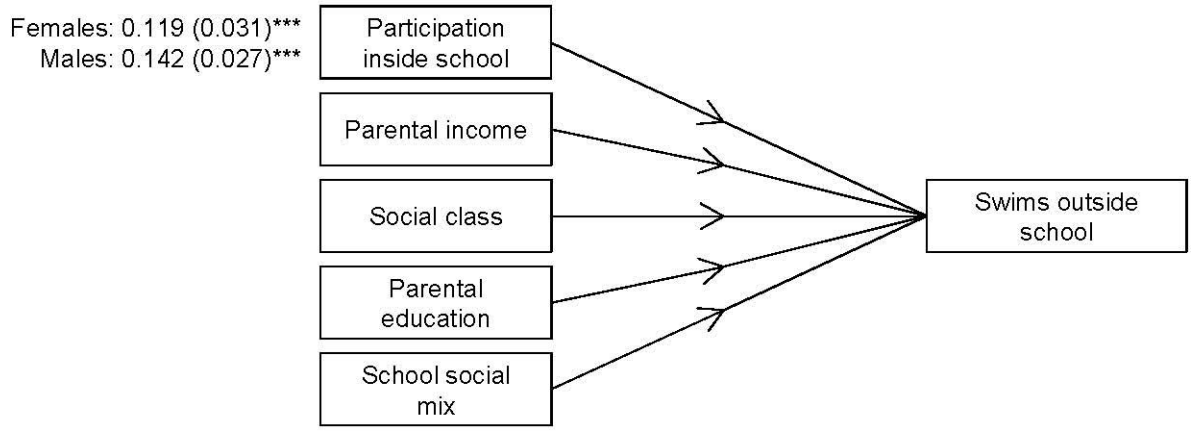
Note: probit estimates are followed by standard errors in parentheses and asterisks indicating significance of p-value * α=5%, ** α=1%, *** α=0.1%

Participation inside school was significantly associated with swimming for both girls (0.118, p=0.000) and boys (0.139, p=0.000). For girls, participation inside school was also significantly associated with playing sports outside school (0.073, p=0.005). No significant associations were found between participation inside school and enjoyment of games, perceived ability in games or gymnastics, riding a bicycle and, for boys, playing sports

outside school. Predicted probabilities of swimming and (for girls) playing sports outside school were calculated, comparing 1 hour of participation per week inside school with 3 hours per week. For boys, the model predicted that 1 hour per week would be associated with 51.5% swimming 'often' outside school, whereas 3 hours would result in 62.4% swimming often. For girls, the model predicted that 1 hour per week would result in 50.9% swimming often, whereas 3 hours would result in 60.2% swimming often. Despite the effects being small, the resulting difference is large enough to be of interest to policy makers and suggests that school provision of sport and physical education could have had an impact on how many cohort members swam outside school. At this age, a large proportion of children in the sample would have been receiving swimming lessons, as teaching children to swim was a common objective of Local Education Authorities at the time. Thus, schools reporting more hours of PE/movement/games per week may have been more likely to provide swimming lessons. The HMIS survey of schools in 1978 (Department of Education and Science, 1978) suggested that swimming provision increased with age, with two thirds of children at age 9 having swimming lessons in primary school, growing to 90% at age 11. For girls, the model made a more modest prediction for the change in probability of playing sports often, with 1 hour of PE/movement/games per week being associated with 37.7% playing often and 3 hours per week associated with 43.4% playing often, a difference of 5.7%.

The association of participation inside school with swimming outside school could have been spurious, reflecting socioeconomic differences in school provision and family swimming. Cohort members from high socioeconomic status families could have had greater access to schools that provided more school sport and physical education, which may have increased the likelihood of swimming in spare time. Alternatively, cohort members that attended schools with more physical activity provision may have come from high socioeconomic status families that may have been more likely to take their children swimming regardless of school provision. Additional models were estimated that included controls for family socioeconomic status and school social mix in an attempt to isolate these factors from the association of interest. Figure 3 shows a diagram of the model with significant estimates relating to participation inside school shown. The addition of the control variables made no difference to these estimates, providing support for a causal explanation of the association of school provision with participation in swimming outside school by cohort members. (A table containing all estimates from the models is available in the appendix in section 10).

Figure 3: Path model used to identify whether participation inside school is significantly associated with swimming outside school, controlling for socioeconomic factors, with estimates for participation inside school shown

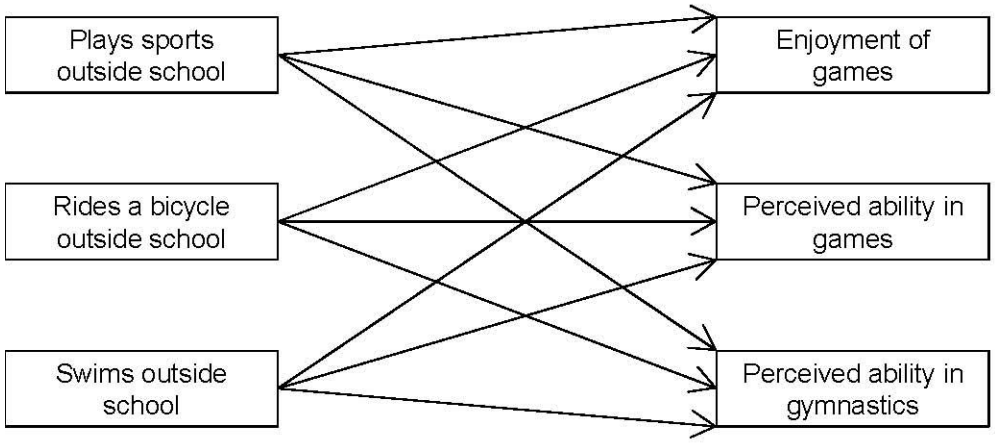


Note: probit estimates are followed by standard errors in parentheses and asterisks indicating significance of p-value * α=5%, ** α=1%, *** α=0.1%

8.2 Does socialisation into sport at home increase enjoyment and perceived ability inside school?

In the previous section, participation inside school was not associated with enjoyment or perceived ability, suggesting it was unlikely to be a causal factor in determining whether experiences of physical activity inside school were positive. An alternative model, based on the socialisation theory, was specified. This model posited that participation outside school may be related to positive experiences inside school, due to socialisation into sport by the parents and home environment, i.e. children who are active outside school develop physical skills and abilities which enable them to do well at and enjoy competitive school sports and physical education. A path diagram for this model is shown in Figure 4.

Figure 4: Path model used to identify whether playing sports, riding a bicycle and swimming outside school are significantly associated with perceived ability and enjoyment inside school



Models were estimated separately by sex. The three binary indicators for the activities participated in outside school (playing sports, riding a bicycle and swimming) were included in the path model simultaneously, i.e. each of the estimated coefficients control for participation in the other activities. For the sake of simplicity, interactions between the activities were not included in the model.

The resulting estimates are shown in Table 6. For girls, there were small significant associations of swimming outside school on enjoyment and perceived ability (0.100 to 0.133), and riding a bike on perceived ability in games (0.092). By far the strongest associations were for playing sports outside school on enjoyment and perceived ability (0.323 to 0.491). For boys, apart from a borderline significant association of riding a bike with perceived ability in gymnastics (0.077, p=0.045), the only significant associations were for playing sports. These associations were very large for enjoyment (0.791, p=0.000) and perceived ability in games (0.793, p=0.000). For perceived ability in gymnastics, however, the association was quite small (0.154, p=0.000). In each case, the coefficients for playing sports were much larger than those for swimming and riding a bicycle. Considering that the majority of school provision was sport based, it makes sense that those children who participate outside school would transfer the benefits of this additional practice, in terms of skills development, into the school environment. The estimates provided additional support for the gender discrepancies previously identified. Considering the size of the effects of playing sports outside school on enjoyment and perceived ability in games for boys, the effect on perceived ability in gymnastics was very low (0.154), and far lower than for girls (0.465). The largest effects for girls (0.465, 0.491) were also far smaller than those for boys (0.791, 0.793).

Table 6: Estimates for path model used to identify whether playing sports, riding a bicycle and swimming outside school are significantly associated with perceived ability and enjoyment inside school

		Estimate	S.E.	P-Value	
Females					
enjoyment of games	← rides a bicycle outside school	0.073	0.051	0.153	
	← swims outside school	0.133	0.050	0.008	**
	← plays sports outside school	0.323	0.054	0.000	***
perceived ability in games	← rides a bicycle outside school	0.092	0.044	0.037	*
	← swims outside school	0.100	0.044	0.024	*
	← plays sports outside school	0.491	0.048	0.000	***
perceived ability in gymnastics	← rides a bicycle outside school	0.006	0.036	0.861	
	← swims outside school	0.107	0.037	0.004	**
	← plays sports outside school	0.465	0.037	0.000	***
Males					
enjoyment of games	← rides a bicycle outside school	-0.106	0.066	0.112	
	← swims outside school	-0.028	0.063	0.660	
	← plays sports outside school	0.791	0.063	0.000	***
perceived ability in games	← rides a bicycle outside school	0.083	0.056	0.137	
	← swims outside school	0.048	0.053	0.365	
	← plays sports outside school	0.793	0.053	0.000	***
perceived ability in gymnastics	← rides a bicycle outside school	0.077	0.038	0.045	*
	← swims outside school	0.042	0.036	0.245	
	← plays sports outside school	0.154	0.038	0.000	***

Note: asterisks indicate significance of p-value, * α=5%, ** α=1%, *** α=0.1%

Table 7 shows predicted probabilities of perceived ability and enjoyment for cohort members who played sports outside school, compared to those who did not, holding the dummy variables for the other activities at zero (not riding a bicycle and not swimming). The predicted probability of having high perceived ability in gymnastics for girls was 18.4% greater for those who played sports compared to those who did not, and the predicted probability of high perceived ability in games was 12.0% greater. For boys, those that played sports had a 14.1% greater predicted probability of high perceived ability in games and an 8.5% greater predicted probability of enjoying games. Playing sports outside school seemed to have a smaller effect on enjoyment of games for girls (5.7%) and perceived ability in gymnastics for boys (5.9%). There was a very big gender disparity in the predicted probabilities of high perceived ability in gymnastics. Boys who played sports often were not much more likely to have high perceived ability in gymnastics than those who did not. For girls, playing sports was associated with a much greater probability of reporting high perceived ability. Overall, this analysis provided considerable support for the socialisation theory.

Table 7: Predicted probabilities of high perceived ability and enjoyment inside school associated with playing sports outside school

	Females (%)		response	*Males* (%)		response
	sport	no sport	effect	sport	no sport	effect
enjoyment of games	92.4	86.7	5.7	98.0	89.5	8.5
perceived ability in games	89.1	77.1	12.0	95.4	81.3	14.1
perceived ability in gymnastics	57.6	39.2	18.4	40.8	34.9	5.9

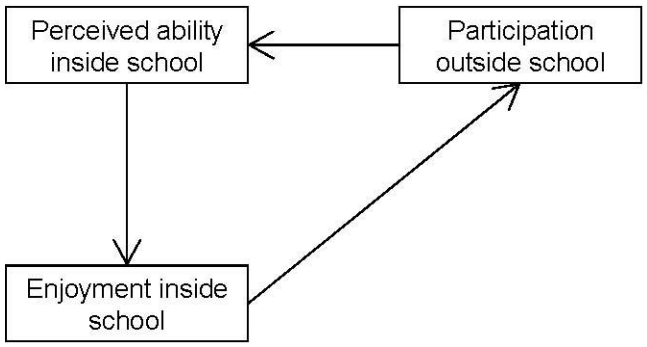
Note: 'response effect' column shows the absolute difference between the predicted probabilities associated with frequently playing sport outside school ('sport') or not ('no sport')

An important caveat to this model regards the imposition of a direction of causality to the estimated effects. It is quite possible that a child might have positive experiences of physical activity inside school and, as a result, increase their participation outside school. However, several arguments can be made for a preference for the direction of causality shown in the model:

1. The amount of time spent engaging in school sport and physical education (approximately 2 hours per week on average) is likely to be lower than the amount of time spent playing sports outside school for those children described by their mothers as playing 'often' (though, admittedly, lunch and break times would undoubtedly have been periods of informal physical activity for children at this age)
2. Access to opportunities to play sports outside school may require transport and financial support by parents, acting as a potential barrier to participation regardless of perceived ability and enjoyment inside school
3. Perceived ability is unlikely to cause increased participation in sport outside school without the mediation of enjoyment; children of this age are unlikely to seek out opportunities to engage in activities they do not enjoy.

Together, these considerations would suggest that the most plausible path model would involve a circular relationship as shown in Figure 5, with enjoyment inside school potentially increasing participation outside school.

Figure 5: Path model of the circular association of participation outside school, perceived ability and enjoyment inside school



The theory of socialisation into sport was strongly supported by the model. The cohort members' experiences of playing sports outside of school seemed to be important in determining whether they had positive experiences inside school. Considering the amount of curricular time given to school sport and physical education (1-3 hours per week), this is perhaps not very surprising. It seems unlikely that this little school sport and physical education would have much of an impact over and above participation by physically active children outside school and in school breaks. Conversely, for inactive children, it is unlikely to have provided them with sufficient opportunity to catch up with their active peers, especially considering they would be participating together in a competitive environment. Worryingly, there is a distinct possibility that school provision may have (and continue to) entrench negative self-perceptions in those with low ability on entry to primary school. This could have long-term ramifications for enjoyment of and motivation to participate in physical activity throughout the lifecourse.

Summary

1. A path analysis of the effect of hours of participation inside school on the other measures found very few significant associations. The only association that was present for both sexes was with swimming. The predicted probability of swimming often in spare time increased by ~10% when comparing 1 to 3 hours of PE/movement/games per week. Once additional variables had been added to the analysis to control for socioeconomic factors, the estimates did not change, increasing support for a causal explanation: more school provision was responsible for more swimming outside school by cohort members. It is possible that the difference between those schools with high and low amounts of provision may have been due to extra time being dedicated to swimming lessons, something that Local Education Authorities were keen to promote at the time. This effect is certainly large enough to be of interest to policy makers. For girls, there was also a small but significant effect of hours of participation inside school on playing sports outside school. The predicted probability of playing sports increased by 5.7% when comparing 1 to 3 hours of PE/movement/games per week.

2. In contrast with the previous analysis, a path analysis of the effects of playing sports, riding a bicycle and swimming outside school on perceived ability and enjoyment inside school identified many significant associations. Playing sports was consistently and strongly associated with perceived ability and enjoyment inside school, as might be expected considering that school provision is traditionally focused on competitive sport. The predicted probability of high perceived ability in games increased by 12.0% for girls and 14.1% for boys when comparing those who played sports often to those who did not. For girls, the largest effect of playing sports was on perceived ability in gymnastics; the predicted probability was 18.4% higher for those who played sports often. The effect for boys was far smaller, giving an increase in predicted probability of only 5.9%.

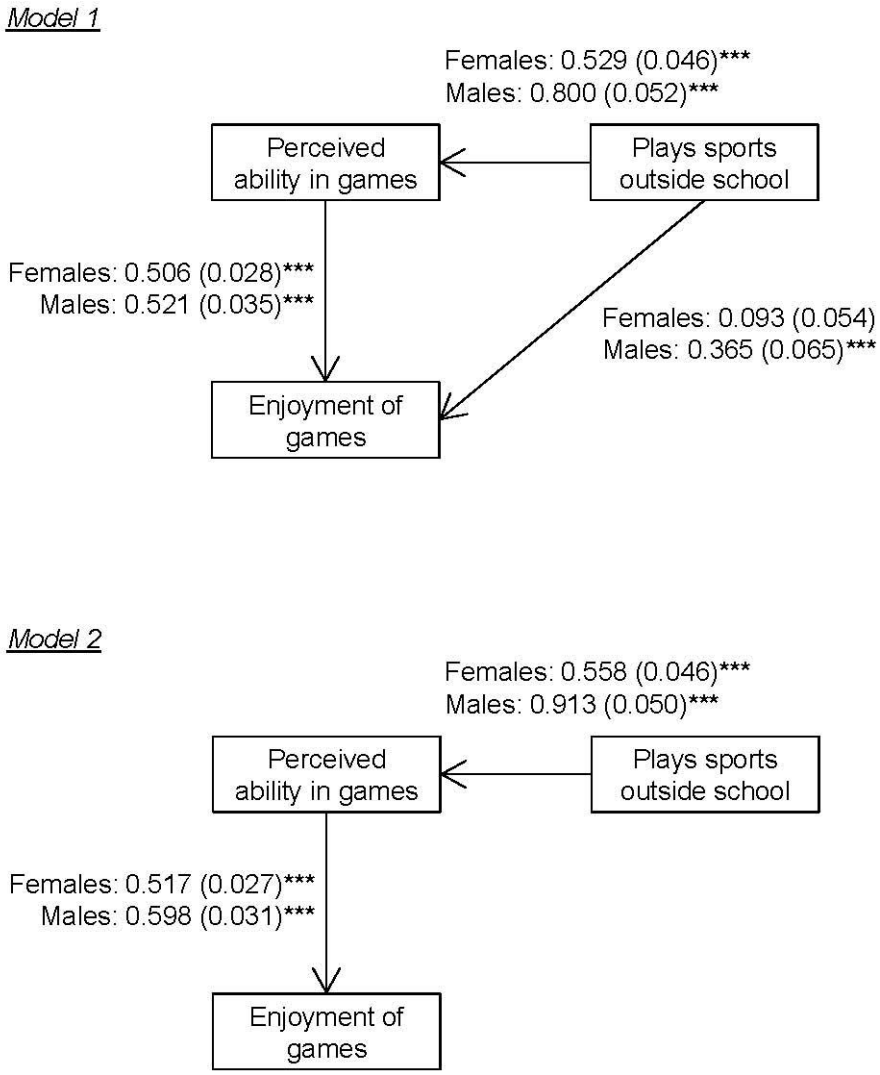
3. The analysis provided strong support for the theory of socialisation into sport. It seems overambitious to assert that a few hours of school sport and physical education per week can have the wide-ranging impacts commonly elaborated upon in government policy. School provision may even serve to entrench differences in

ability already present on entry to primary school and cause negative self-perceptions to develop.

8.3 Is perceived competence an important mediator of enjoyment inside school at age 10?

Self-determination theory suggests that perceived ability is an important mediator of the relationship between participation and enjoyment, i.e. people enjoy activities they feel competent at, and conversely, feelings of incompetence can reduce enjoyment (Ryan & Deci, 2000). The pairwise correlation matrix estimated in section 7.3 had identified a strong correlation between perceived ability and enjoyment of games inside school. Playing sports outside school had been found to have a strong effect on perceived ability in games inside school in section 8.2. Thus, perceived ability may have been acting as a mediator between playing sports outside school and enjoyment of games inside school. Path models were estimated to identify whether this mediation model was supported. Two models were compared to test whether perceived ability completely or only partially mediated the relationship between playing sports outside school and enjoyment inside school. The models were estimated separately by sex. Diagrams of the models, along with resulting parameter estimates, are shown in Figure 6. Complete mediation would mean that the association of playing sports outside school with enjoyment inside school was entirely due to associated changes in perceived ability, i.e. perceived ability is crucial to enjoyment and, without high perceived ability, playing sports outside school does not result in enjoyment inside school.

Figure 6: Models for testing to what extent the association of participation outside school with enjoyment inside school is mediated by perceived ability inside school



Note: probit estimates are followed by standard errors in parentheses and asterisks indicating significance of p-value * α=5%, ** α=1%, *** α=0.1%

For girls, estimates from Model 1 showed that the direct path from playing sports outside school to enjoyment of games was not significant, and this was confirmed with a likelihood ratio test of the nested models ($\chi^2(1)=2.913$, p=0.0879). This provided support for a model of complete mediation for girls, indicating that enjoyment was only associated with playing sports outside school through its association with perceived ability in games (as shown in Model 2). For boys, this was not the case, with the direct effect of playing sports on enjoyment being highly significant (0.365, p=0.000), indicating that there was an association of playing sports with enjoyment even controlling for perceived ability. A chi-square test of nested models confirmed this ($\chi^2(1)=31.473$, p=0.000). In both cases, the indirect effect of playing sports on enjoyment was fairly large and highly significant, supporting the mediation theory (0.288, p=0.000 for girls, and 0.417, p=0.000 for boys). The female model fitted the data well, with a $\chi^2(1)=2.913$ (p=0.0879), an RMSEA of 0.019 (90% CI: 0.000 to 0.046), a

CFI of 0.996 and a TLI of 0.989. It was not possible to produce fit statistics for the preferred male model when freely estimated, due to there being no remaining degrees of freedom when the direct path from playing sports to enjoyment was included. A constraint was added to the model by fixing the path from playing sports to perceived ability to 0.8, thereby freeing a degree of freedom to test model fit. This model fitted the data perfectly, with a $\chi^2(1)=0.000$ (p=0.9899), an RMSEA of 0.000 (90% CI: 0.000 to 0.000), a CFI of 1.000 and a TLI of 1.005.

These models suggested that playing sports outside school did not have an effect on enjoyment inside school for girls, except through its effect on perceived ability. In contrast, boys who played sports outside school were more likely to enjoy games inside school regardless of their perceived ability. This may have been due to the general appeal of sports for boys due to cultural norms and gender stereotypes. The effect of playing sports on perceived ability was much higher for boys (0.800) than girls (0.558), implying that experience of playing sports outside school was more likely to transfer into high perceived ability inside school for boys. In both cases, perceived ability was found to be a crucial mediator of the relationship between participation outside school and enjoyment inside school.

8.4 Are these associations robust to the inclusion of other correlates of physical activity at age 10?

The mediation models estimated above were simplistic in the sense that they did not control for any of the correlates of physical activity commonly identified in the academic literature (see section 3). This could have inflated the associations between the variables of interest. Also, playing sports outside school was treated as an exogenous variable, and so was assumed to be measured without error. In order to determine whether the correlates of physical activity were associated with the variables of interest, and to allow for measurement error in sports participation outside school, additional control variables were included and tested in blocks according to how they were expected to influence experiences of physical activity. Three blocks were tested (see section 5 for more detail):

Physiological factors – weight status, maturation, disability and motor coordination were hypothesised to be associated with whether the cohort member plays sports in spare time, does well in games and likes games.

Socioeconomic factors – Parental income, social class and parental education were hypothesised to be associated with the opportunities cohort members had for playing sports outside school.

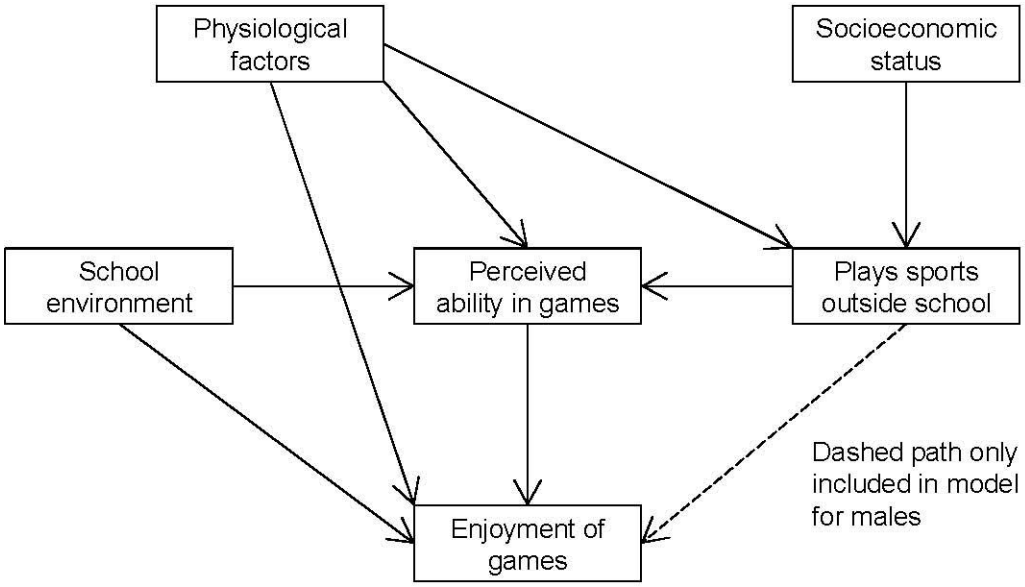
School environment factors – class size and school social mix were hypothesised to be associated with perceived ability and enjoyment of games inside school.

Although four binary indicators of motor coordination were available (see section 5), only a single indicator (for moving the foot during test 1) was used as the measure of motor coordination in subsequent analyses. Tetrachoric correlations between the indicators showed that they were highly correlated. In order to extract a single measure of motor coordination, a latent trait measurement model was constructed. The same model fit the

data for both sexes and demonstrated strong measurement equivalence. As the final model indicated an almost perfect loading of the latent trait onto the first indicator (for moving the foot during test 1), it was decided to use this indicator as the measure of motor coordination in all subsequent analyses. For further details of the latent trait analysis, see the appendix in section 11.

Figure 7 shows a diagram of the associations that were tested in the path analysis. Models were estimated separately by sex. The dashed path between playing sports outside school and enjoyment of games inside school was only included in the model for boys. For girls, complete mediation of this relationship by perceived ability had been supported (see section 8.3). Paths from the physiological factors to playing sports outside school, perceived ability in games and enjoyment of games inside school were estimated in blocks. For girls, significant associations were identified with playing sports, but not with perceived ability or enjoyment. A chi-square test of all the paths to perceived ability and enjoyment was not significant ($\chi^2(12)=11.864$, p=0.4567). Backward selection of the remaining physiological variables resulted in the removal of the association between maturation and playing sports ($\chi^2(1)=1.191$, p=0.2752). Tests of the socioeconomic factors found that the associations of parental income ($\chi^2(5)=3.882$, p=0.5665), social class ($\chi^2(5)=7.123$, p=0.2117), and parental education (mother's: $\chi^2(4)=6.832$, p=0.1450; father's: $\chi^2(4)=6.825$, p=0.1454) with playing sports were not significant, and so were dropped. For the school environment factors, the associations of class size with perceived ability and enjoyment were not significant ($\chi^2(2)=4.457$, p=0.1077) and were dropped. The measure of participation inside school (hours of PE/movement/games per week) was reintroduced to this more complex model to determine if it was now significantly associated with experiences of physical activity. For enjoyment, the association was not significant ($\chi^2(1)=1.013$, p=0.3143), but for playing sports (0.086, p=0.002) and perceived ability (-0.077, p=0.043) it was. The estimates for the final model are shown in Table 8. The model fitted the data well, with a $\chi^2(13)=15.610$ (p=0.2708), RMSEA of 0.007 (90% CI: 0.000 to 0.017), a CFI of 0.996 and a TLI of 0.992.

Figure 7: Mediation model controlling for physiological, socioeconomic and school environment factors



The model suggested that the physiological factors (weight status, disability and motor coordination) were important correlates of playing sports outside school for girls. The effect of being obese (-0.261) was comparable to that of disability (-0.239). It is possible that overweight and obesity caused girls to be less active outside school and made physical activity less appealing, but lower levels of activity may also have increased the risk of weight gain. Additionally, low activity and high weight could both have been a result of unhealthy parental and family influences, consisting of low levels of support for physical activity and poor eating habits. Disability will have acted as a barrier to participation outside school; recent research has found that access is still an issue for disabled people (London Assembly, 2012; Beresford & Clarke, 2009). Motor coordination was associated with playing sports outside school (0.164), suggesting that those with an innate physical ability may have been more likely to participate, though this effect was smaller than that of weight status or disability. Interestingly, physiological factors were not associated with perceived ability and enjoyment inside school, controlling for playing sports outside school. This suggests that any effect of these factors on enjoyment and perceived ability was through their association with playing sports outside school. School social mix was associated with perceived ability and enjoyment, with higher social class mixes being associated with lower perceived ability (-0.263) and more enjoyment (0.349). The opposite directions of these effects may have been a reflection of school social mix acting as a proxy for two correlated aspects of the school environment: quality of facilities and sporting ethos. It is possible that better facilities would provide more enjoyable and varied opportunities to participate, but a strong sporting ethos could have a detrimental effect on perceived ability. Small opposing effects were estimated for participation inside school, with more hours of PE/movement/games being associated with lower perceived ability (-0.077) and more participation in sports outside school (0.086). Again, more provision inside school could have reflected a stronger sporting ethos, detrimentally affecting perceived ability but also exposing children to a wider variety of sporting activities which could promote participation outside of school, but these effects were relatively small. Compared to the mediation model without controls, the association of

playing sports with perceived ability was lower (0.364 compared to 0.558), suggesting that school environment had an important impact on perceived ability. The association of perceived ability with enjoyment was higher (0.652 compared to 0.517), emphasising its importance as a crucial mediator of enjoyment. Parental income, social class and parental education were not associated with playing sports for girls, suggesting that access to opportunities to play sports outside school was not associated with parents' financial support or social background at this age. Of course, this does not negate the possibility that other forms of parental support (such as interest, encouragement and investment of time) were important to girls' participation.

Table 8: Estimates for mediation model for females controlling for physiological and school environment factors

		Estimate	S.E.	P-Value	
plays sports outside school	← underweight	-0.131	0.058	0.025	*
	← overweight	-0.186	0.062	0.003	**
	← obese	-0.261	0.084	0.002	**
	← disability	-0.239	0.087	0.006	**
	← motor coordination	0.164	0.042	0.000	***
	← participation inside school	0.086	0.028	0.002	**
perceived ability in games	← plays sports outside school	0.364	0.033	0.000	***
	← school social mix	-0.263	0.098	0.007	**
	← participation inside school	-0.077	0.038	0.043	*
enjoyment of games	← perceived ability in games	0.652	0.048	0.000	***
	← school social mix	0.349	0.130	0.007	**

Note: estimates are in probits; asterisks indicate significance of p-value * α=5%, ** α=1%, *** α=0.1%; $\chi^2(13)$=15.610 (p=0.2708), RMSEA=0.007 (90% CI: 0.000 to 0.017), CFI=0.996, TLI=0.992; reference category for weight status is normal weight

For boys, as with girls, enjoyment was not associated with the physiological factors, a chi-square test of the paths not being significant ($\chi^2(6)$=4.520, p=0.6067). Backward selection of the remaining physiological variables resulted in the removal of the associations of motor coordination with perceived ability and playing sports ($\chi^2(2)$=3.522, p=0.1718), disability with perceived ability ($\chi^2(1)$=2.580, p=0.1082), and maturation with playing sports ($\chi^2(1)$=2.645, p=0.1039). For the socioeconomic factors, the association of income with playing sports was not significant ($\chi^2(5)$=8.635, p=0.1245), the association of father's education was not significant ($\chi^2(4)$=3.144, p=0.5341), and when it was replaced with mother's education, this was also not significant ($\chi^2(4)$=6.790, p=0.1474). The association of social class with playing sports was significant ($\chi^2(5)$=23.991, p=0.0002). For the school environment factors, the association of class size with enjoyment was not significant ($\chi^2(1)$=1.691, p=0.1934). The individual associations of school social mix with perceived ability (-0.260, p=0.087) and enjoyment (-0.306, p=0.062) were not significant when included in the model simultaneously, but were retained as a chi-square test showed that they did significantly improve the overall fit of the model ($\chi^2(2)$=9.697, p=0.0078). The measure of participation inside school (hours of PE/movement/games per week) was reintroduced to this more complex model to determine if it was now significantly associated with experiences of physical activity. A likelihood ratio test showed that it was still not significant ($\chi^2(3)$=4.272, p=0.2336). The estimates for the

final model are shown in Table 9. The model fitted the data well, with a $\chi^2(20)=31.707$ (p=0.0465), RMSEA of 0.012 (90% CI: 0.002 to 0.019), a CFI of 0.980 and a TLI of 0.962.

The model demonstrated that physiological factors were associated with both perceived ability and playing sports in the expected direction for boys. Weight status and disability had an effect on playing sports, with the effect of being obese (-0.475) again being comparable to the effect of disability (-0.453). Unlike for girls, weight status also had an effect on perceived ability. The masculine perception of games may have made competition between boys more pronounced than for girls, causing weight status to have a more noticeable impact on ability and perceived ability. An alternative interpretation is that weight related bullying may have been more likely between boys than girls. Also, whereas motor coordination was associated with playing sports for girls, this association was not present for boys, perhaps because playing sports was more common in general, being perceived as a masculine pursuit.

Table 9: Estimates for mediation model for males, controlling for physiological, socioeconomic and school environment factors

		Estimate	S.E.	P-Value	
plays sports outside school	← underweight	-0.064	0.063	0.312	
	← overweight	-0.219	0.078	0.005	**
	← obese	-0.475	0.107	0.000	***
	← disability	-0.453	0.074	0.000	***
	← social class II	0.100	0.092	0.273	
	← social class III non-manual	0.244	0.106	0.021	*
	← social class III manual	0.234	0.089	0.009	**
	← social class IV	0.198	0.104	0.057	
	← social class V	0.107	0.136	0.429	
perceived ability in games	← plays sports outside school	0.541	0.046	0.000	***
	← underweight	-0.110	0.104	0.288	
	← overweight	-0.197	0.119	0.098	
	← obese	-0.348	0.155	0.024	*
	← maturation	-0.302	0.152	0.047	*
	← class size	-0.019	0.008	0.011	*
	← school social mix	-0.260	0.152	0.087	
enjoyment of games	← plays sports outside school	0.304	0.057	0.000	***
	← perceived ability in games	0.517	0.059	0.000	***
	← school social mix	-0.306	0.164	0.062	

Note: estimates are in probits; asterisks indicate significance of p-value * α=5%, ** α=1%, *** α=0.1%; $\chi^2(20)=31.707$ (p=0.0465), RMSEA=0.012 (90% CI: 0.002 to 0.019), CFI=0.980, TLI=0.962; reference categories are normal weight and social class I

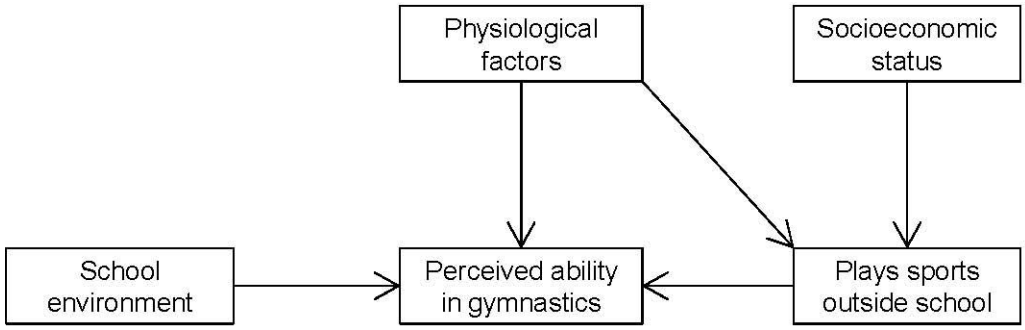
Social class was found to be associated with playing sports, with social class III non-manual (0.244) and manual (0.234) occupations being associated with an increased likelihood of playing sports outside school as compared to the reference category of social class I (professional occupations). This pattern of association was unexpected – participation in physical activity is generally expected to be more common in high social classes. Again, school social mix was associated with both perceived ability (-0.260) and enjoyment (-0.306) but unlike the model for girls, both associations were negative. It is possible that boys were

more competitive than girls, and that this effect was more pronounced in schools with a high social class mix, impacting negatively on enjoyment for boys, but this difference between the two sexes is not easily explained. Class size was found to be associated with perceived ability (-0.019), with larger class size associated with lower perceived ability. Frame of reference effects, commonly identified in the self-concept literature (Chanal et al., 2005; Seaton et al., 2009, 2010), offer a possible explanation for this – as class size increases, perception of ability may be negatively influenced by the size of a class reference group (in this case, the group of physically able or 'sporty' children), i.e. the number of children who are more able than the cohort member tends to increase with class size. Research in the self-concept literature on class size effects in physical education is sparse but a study on academic self-concept has found similar effects (Thijs et al., 2010), and a lack of objective measures of ability in sport may compound this effect. Compared to the mediation model without controls, the association of playing sports with perceived ability was lower (0.541 compared to 0.800) and with enjoyment was slightly, but not significantly, lower (0.304 compared to 0.365). The association of perceived ability with enjoyment was practically unchanged (0.517 compared to 0.521). Parental income and education were not associated with playing sports outside school, suggesting financial support was not particularly important in providing opportunities for boys to play sports outside school at age 10. Hours of participation in school sport and physical education was not associated with any of the variables measuring experiences of physical activity.

8.5 Modelling girls' perceived ability in gymnastics at age 10

In section 8.2, it was found that there was a strong association of playing sports outside school with perceived ability in gymnastics inside school for girls, supporting the socialisation theory. The predicted probability of high perceived ability in gymnastics for those who played sports often outside school was 18.4% higher than for those who did not (see Table 7). This analysis suggested that gymnastics might be more salient to girls than games, due to gymnastics being a stereotypically feminine activity. In order to investigate how this association was affected by inclusion of the correlates of physical activity, a similar modelling process was undertaken as above using the model shown in Figure 8. Unfortunately, as no gymnastics-related measure of enjoyment was available in the BCS70 data, enjoyment was not included in the model.

Figure 8: Model focusing on perceived ability in gymnastics for females, controlling for physiological, socioeconomic and school environment factors



Paths from the physiological factors to playing sports and perceived ability in gymnastics were estimated in blocks. Backward selection of the physiological variables resulted in the removal of the associations of disability ($\chi^2(1)=1.342$, p=0.2467) and motor coordination ($\chi^2(1)=2.081$, p=0.1492) with perceived ability, and maturation with playing sports ($\chi^2(1)=2.244$, p=0.1341). For the socioeconomic factors, the associations of parental income ($\chi^2(5)=4.641$, p=0.4612) and social class ($\chi^2(5)=4.579$, p=0.4693) with playing sports were not significant. The association with parental education, as measured by mother's education level, was significant ($\chi^2(4)=12.345$, p=0.0150). For the school environment factors, the association of school social mix with perceived ability was not significant ($\chi^2(1)=2.835$, p=0.0922). Hours participation inside school was reintroduced to the model to determine if it was now associated with playing sports or perceived ability for this more complex model. The association with perceived ability was not significant ($\chi^2(1)=0.002$, p=0.9607), whereas the association with playing sports was. The estimates for the final model are shown in Table 10. The model fitted the data well, with a $\chi^2(9)=6.956$ (p=0.6417), RMSEA of 0.000 (90% CI: 0.000 to 0.014), a CFI of 1.000 and a TLI of 1.022.

This model demonstrated that physiological factors were associated with both perceived ability in gymnastics and playing sports outside school for girls. Interestingly, the variables retained in the model were quite similar to the previously estimated model focusing on boys' perceived ability in games. Weight status was associated with both playing sports and perceived ability. In the previous model for girls, negative significant effects had been estimated for being any weight other than in the normal range. For gymnastics, this was no longer the case, with underweight being positively associated with high perceived ability (0.114, p=0.060), although the effect was of borderline significance compared to the reference category of normal weight. This effect is striking in that gymnastics is a sport that favours slender, flexible individuals. Maturation was negatively associated with perceived ability (-0.184), suggesting that those girls who had entered puberty may have been more self-conscious or less able to perform gymnastic activities. The association of disability with playing sports outside school was negative (-0.259), and the association for motor coordination was positive (0.196), as before. With the exception of mothers for which a trade apprenticeship was the highest qualification held (0.155), mother's education was not associated with playing sports. As with social class in the model for boys, this effect is difficult to explain. Class size was negatively associated with perceived ability (-0.012), and hours participation inside school was positively associated with playing sports outside school

(0.091), though the effect was quite small. The association of playing sports with perceived ability in gymnastics was lower than that estimated in section 8.2 (0.309 compared to 0.465), due to the inclusion of the physiological controls. Parental income and social class were not associated with playing sports outside school, again suggesting that financial support was not crucial at this age. Interestingly, in contrast with the previous models, the association of school social mix with perceived ability was not significant. Potential explanations for the absence of this effect include the possibility that educational gymnastics was less dependent on equipment and facilities than team sports provision, and its format may have precluded school sporting ethos from having an effect.

Table 10: Estimates for path model focusing on perceived ability in gymnastics for females, controlling for physiological, socioeconomic and school environment factors

		Estimate	S.E.	P-Value	
plays sports outside school	← underweight	-0.080	0.060	0.181	
	← overweight	-0.143	0.064	0.025	*
	← obese	-0.206	0.090	0.022	*
	← disability	-0.259	0.090	0.004	**
	← motor coordination	0.196	0.044	0.000	***
	← mother's educ. - trade appr.	0.155	0.056	0.006	**
	← mother's educ. - o-levels	0.059	0.052	0.259	
	← mother's educ. - a-levels	0.046	0.087	0.601	
	← mother's educ. - degree	-0.033	0.128	0.797	
	← hours participation in school	0.091	0.030	0.002	**
perceived ability in gymnastics	← plays sports outside school	0.309	0.027	0.000	***
	← underweight	0.114	0.061	0.060	
	← overweight	-0.246	0.067	0.000	***
	← obese	-0.415	0.093	0.000	***
	← maturation	-0.184	0.049	0.000	***
	← class size	-0.012	0.004	0.006	**

Note: estimates are in probits; asterisks indicate significance of p-value * α=5%, ** α=1%, *** α=0.1%; $\chi^2(9)$=6.956 (p=0.6417), RMSEA=0.000 (90% CI: 0.000 to 0.014), CFI=1.000, TLI=1.022; reference categories are normal weight and mother's education - no qualifications

Summary

1. Perceived ability was found to be an important mediator of the association of participation outside school with enjoyment inside school for both boys and girls. For girls, a model of complete mediation was supported. The models supported both the socialisation theory – that experience of sport outside school (driven by parental and family influences) leads to better experiences inside school, and self-determination theory – that perceived ability is an important determinant of enjoyment.
2. Although the preferred models specified paths from participation outside school to enjoyment inside school, it is quite possible that enjoyment inside school could lead to increased participation outside school (as in Figure 5). Unfortunately, this model could not be tested as no instrumental variables were available.

3. In general, weight status, disability, school social mix and class size were important correlates of experiences of physical activity at age 10 for both boys and girls. Being overweight and obese had large negative associations with participation in sports outside school, the size of the effect for obesity being similar to that of being disabled. Interestingly, being disabled was not associated with perceived ability or enjoyment inside school, suggesting that schools were inclusive of disabled children in their provision. For girls, motor coordination was associated with playing sports outside school. Being especially able may have allowed or encouraged these girls to participate in a male dominated sporting environment, whereas the cultural norms of sports participation may have precluded its importance for boys.
4. For girls, school social mix was associated with perceived ability and enjoyment of games inside school. For boys, perceived ability was also associated with class size and weight status. This may have suggested that participation in games in school was more competitive or appealing for boys than girls. Heavier children may have found it more difficult to compete against their normal weight peers and bullying of overweight children is a distinct possibility.
5. For girls, the effect of school social mix was positive for enjoyment but negative for perceived ability in games. Both of the effects were negative for boys. If school social mix acted as a good proxy for a strong school sporting ethos, it may be the case that this association reflects a tougher, more competitive sporting environment, along with improved facilities. If girls were inherently less competitive or interested in games, the benefits to enjoyment of improved facilities may have overridden the detrimental effect on perceived ability. Supporting this is the negative effect of class size on perceived ability for boys. However, even controlling for perceived ability, school social mix was negatively associated with enjoyment for boys.
6. Outside school, both disability and weight status were negatively associated with playing sports. Disability would have been a significant barrier to access and participation at the time, and much more so than today. Inside school, disability was not associated with perceived ability or enjoyment, suggesting that school provision was relatively inclusive. Being overweight or obese may have made physical activity less appealing, but lower levels of activity may also have increased the risk of weight gain, and so the direction of causality is not clear. Likewise, both may have been a result of parental and family norms of low activity and poor diet, reflecting socialisation into unhealthy behaviours.
7. For girls, participation inside school was associated with slightly more participation in sports outside school, but also slightly worse perceived ability in games. For boys, there were no significant associations of school provision with experiences of physical activity. Socioeconomic factors did not seem to be important correlates at age 10. For boys, social class was associated with playing sports outside school; for girls, mother's education was associated with playing sports outside school in the model focusing on perceived ability in gymnastics, but an obvious interpretation of these effects was not apparent.
8. The gymnastics model did not include a measure of enjoyment, but included similar effects to the boys' model focusing on perceived ability in games. The gymnastics model retained associations of weight status and maturation with perceived ability, suggesting that this activity may have been more difficult, or involved bullying or promoted self-consciousness for overweight or obese girls. Interestingly, underweight girls seemed to have higher perceived ability in gymnastics – an activity that favours

slender, flexible individuals. Also, as with the boys model for games, class size was negatively associated with perceived ability, suggesting frame of reference effects.

9. Perceived ability seemed to be a very important mediator of the effect of participation outside school on enjoyment inside school. The difference between the games and gymnastics models for girls, and the similarity of the latter with the games model for boys, suggested that there was a gender disparity in the activities that were most salient to boys' and girls' experiences at age 10: games for boys and gymnastics for girls. This salience may have inflicted a cost in terms of perceived ability and enjoyment. With importance comes an increased sensitivity to perceived ability and performance, and possibly a greater detrimental impact on enjoyment when perceived ability is low.

9 Discussion

The analyses presented in this paper have demonstrated that there were gender disparities in experiences and correlates of physical activity in 1980 when the BCS70 cohort members were aged 10. Boys seemed to be more active than girls outside of school, with a particularly strong disparity in sports participation and a lesser disparity in riding a bicycle. This reflects a gender bias in British culture, stronger then than it is now, which would have viewed sports and exercise as predominantly masculine activities. An exception to this was swimming, where participation rates were almost identical for both sexes. It is likely that swimming was seen as an essential life skill by parents, and Local Education Authorities were promoting it extensively. Inside school, differences in experiences were not as great. Mixed classes meant that boys and girls were exposed to the same provision, on the whole, and levels of enjoyment and perceived ability were roughly similar. Some evidence for the gender bias was present in school, with girls reporting better perceived ability in gymnastics and boys reporting more enjoyment and perceived ability in games, but the differences were small or moderate. Interestingly, perceived ability in gymnastics was far worse than for games for both sexes. The likely focus on individual performance and assessment provides a reasonable explanation for why perceived ability was so low in this case. The only notable differences identified in the correlates of physical activity were in weight status, maturation and motor coordination, with more girls being categorised as underweight, overweight and obese than boys; far more girls showing signs of maturation than boys; and more girls performing well on each of the motor coordination tests than boys.

Pairwise associations between the variables demonstrated that some experiences of physical activity inside and outside school were associated with one another. The associations between enjoyment and perceived ability were strong, supporting the notion that perceived ability (or feelings of competence) is causally related to enjoyment (or intrinsic motivation), as proposed in self-determination theory. The associations between perceived ability in games and gymnastics suggested that physical skills and abilities are somewhat transferable between activities. The most striking results from this analysis were the near zero associations of hours of participation inside school with all the other variables. The only notable positive effect was on swimming, which was robust to the addition of controls for socioeconomic factors. An increase in weekly hours of provision inside school from 1 to 3 was associated with a 10% increase in swimming often outside school for both boys and girls. It is possible that the difference between schools with high and low hours of provision may have been due to dedicated swimming lessons; something that Local Education Authorities were keen to promote at the time. Nevertheless, there was generally little evidence that more participation in school sport and physical education was beneficial for cohort members' experiences of physical activity, calling into question whether the frequently reiterated aims of government policy are realistic.

In contrast to the associations with participation inside school, playing sports outside school was significantly associated with perceived ability and enjoyment inside school for both boys and girls. This provided support for the theory of socialisation into sport, whereby the parents, family and home environment are the main drivers of positive experiences of physical activity in early childhood. It seems logical that cohort members frequently engaged in sports outside school would be more able and experienced at the types of activities

commonly found in school provision – traditional, competitive sports. The association of playing sports with perceived ability provided further evidence of gender disparities. The associated difference in predicted probability of reporting high perceived ability in gymnastics was very large for girls (18%) and far smaller for boys (6%), but was similar between the two sexes in the case of perceived ability in games (12% and 14%, respectively).

Although socialisation theory proposes that experiences outside school causally affect those inside school, it is possible that enjoyment of school sport and physical education could cause children to seek out further opportunities to participate in sports outside school. Thus, a circular relationship between participation outside school, perceived ability inside school, enjoyment inside school and further participation outside school was proposed. In this model, as proposed in self-determination theory, perceived ability was a crucial mediator of the relationship between participation outside school and enjoyment inside school.

Models were estimated to test the extent of mediation. They supported a relationship of complete mediation for girls and partial mediation for boys, both models fitting the data well. Again, the models provided further evidence of gender disparities in experiences at age 10. Perceived ability was very important for girls experiences: girls who had negative perceptions of their ability were less likely to enjoy games compared to those with positive perceptions of ability, regardless of whether they played sports outside school. For boys, although perceived ability was still very important, playing sports outside school was independently associated with enjoyment of games, even if they had negative perceptions of their ability inside school. This may have been due to the popularity and social desirability of sport with boys. An extension of the analysis to include controls for known correlates of physical activity found that physiological factors and the school environment were important influences on experiences. Weight status was a severe impediment to participation in sports outside school for both girls and boys, and also influenced perceived ability (in games for boys and gymnastics for girls) over and above its impact through participation outside school. The effect was large – comparable to the effect of disability on participation outside school. This result suggests that overweight and obese children were already accumulating negative experiences of physical activity inside school at age 10. They were also less likely to participate outside of school. It is easy to see how this could create a self-exacerbating situation, whereby children who are less active and overweight have negative experiences of physical activity at school and become even less likely to be active outside of school, increasing their disadvantage. These associations may have reflected an alternative socialisation process related to unhealthy physical activity and dietary behaviours at home.

Disability was not associated with perceived ability or enjoyment inside school, but was negatively associated with participation outside school, suggesting that school provision was inclusive of those with disabilities, whereas opportunities outside of school were more limited. Motor coordination was associated with playing sports for girls but not boys. This could have been due to the popularity of sports for boys. The effect of the school environment differed for girls and boys. For girls, school social mix was associated with lower perceived ability and more enjoyment, but for boys both effects were negative. This difference may have been related to boys being generally more competitive in games than girls due to a gender bias in the social desirability of sports competition. High social class school mixes may have reflected more competitive, high pressure sporting environments (assuming the measure acted as a reasonable proxy for sporting ethos), negatively

impacting on perceived ability and enjoyment. Socioeconomic factors did not seem to play an important role in the models, suggesting that opportunities to participate in sports outside school were not strongly determined by family social class or financial support at age 10. However, this did not negate the possible influence of parental interest, encouragement and other forms of parental and family support.

Even after controlling for many of the correlates of physical activity, the associations between participation outside school, perceived ability, and enjoyment inside school remained relatively strong. The analysis supported the relationships proposed in socialisation theory: the influence of parents and the home environment on children's early experiences of physical activity are the primary driver of positive experiences of physical activity both outside and inside school. Self-determination theory posits that feelings of competence are a key component of intrinsic motivation. The role of perceived ability as an important mediator of the relationship between participation and enjoyment was tested and confirmed. In contrast to these findings, the assertions of government policy were not supported. More participation in school sport and physical education did not seem to have a beneficial effect on perceived ability, enjoyment or participation outside school. The only exception to this was swimming, where a small effect was identified.

This analysis suggests that even at such an early age, the competitive sporting environment in school was having an impact on enjoyment by emphasising performance and encouraging peer comparisons of ability. Overweight and obese children may have been particularly susceptible to these effects, not only through the school environment but also due to their lower levels of participation outside school. From a policy perspective, one can see that school provision may not have served to reduce inequalities in physical activity but may have exacerbated differences in participation that already existed outside of school by subtly emphasising performance over participation and reducing the enjoyment of those who were already less likely to be active. Ongoing research will build on the analysis presented in this paper by investigating experiences of physical activity at age 16 in the BCS70 and linking them to those at age 10. By doing so, it will identify whether these very early experiences are predictive of participation, physical self-concept and intrinsic motivation related to sport and exercise at age 16. Finally, the impact of these childhood experiences of physical activity on adult exercise behaviour will be identified by extending the analysis to the waves of the BCS70 in adulthood.

10 APPENDIX: Estimates from path model for swimming outside school

Table 11: Estimates for path model of swimming outside school regressed on participation inside school, controlling for socioeconomic factors

		Estimate	S.E.	P-Value	
Females					
hours participation inside school		0.119	0.031	0.000	***
parental income	£50 to £99 per week	0.097	0.126	0.440	
	£100 to £149 per week	0.219	0.126	0.081	
	£150 to £199 per week	0.329	0.132	0.013	*
	£200 to £249 per week	0.276	0.148	0.063	
	£250+ per week	0.221	0.154	0.151	
social class	II	-0.057	0.101	0.572	
	III non-manual	-0.101	0.118	0.390	
	III manual	-0.042	0.104	0.686	
	IV	-0.195	0.116	0.092	
	V	-0.173	0.147	0.239	
mother's education	trade apprentice	0.052	0.061	0.393	
	O-levels	-0.006	0.057	0.910	
	A-levels	-0.054	0.097	0.578	
	degree	-0.122	0.138	0.374	
school social mix		-0.010	0.093	0.914	
Males					
hours participation inside school		0.142	0.027	0.000	***
parental income	£50 to £99 per week	-0.024	0.116	0.837	
	£100 to £149 per week	0.130	0.115	0.256	
	£150 to £199 per week	0.223	0.121	0.066	
	£200 to £249 per week	0.029	0.140	0.837	
	£250+ per week	0.332	0.146	0.023	*
social class	II	0.148	0.101	0.142	
	III non-manual	0.208	0.121	0.086	
	III manual	0.204	0.112	0.069	
	IV	0.257	0.124	0.038	*
	V	0.018	0.150	0.904	
father's education	trade apprentice	0.056	0.055	0.303	
	O-levels	0.005	0.062	0.932	
	A-levels	-0.011	0.075	0.888	
	degree	-0.046	0.091	0.616	
school social mix		-0.018	0.090	0.842	

Note: estimates are in probits; asterisks indicate significance of p-value * α=5%, ** α=1%, *** α=0.1%; reference categories are under £50 per week for parental income, social class I, no qualifications for mother's/father's education

11 APPENDIX: Latent trait analysis of motor coordination

11.1 Introduction

A single binary indicator of motor coordination was used in the main analysis as a proxy for innate physical ability. The findings from a latent trait analysis supported its use in this way. Four binary indicators measured the ability of the cohort member to balance on one leg during the medical examination at age 10. The child was asked to stand on the right leg with the left foot against the knee of the right leg and hands on hips. The child was then told to try to hold the position for 30 seconds (test 1). The medic recorded whether the hands or feet moved out of position within the 30 seconds. The test was then repeated with the child standing on the left leg (test 2). This appendix describes the modelling that was undertaken to estimate a single latent trait for motor coordination, the tests undertaken to determine measurement equivalence across the sexes, and the rationale for resorting to a single indicator once this analysis had been completed.

11.2 Descriptive analysis

A tabulation of the four binary indicators by sex demonstrated that girls performed better on the tests than boys (Table 12), with the percentage of them using their hands and feet to balance during the test being consistently lower by 8% to 10%. A tetrachoric correlation matrix was then estimated to determine to what extent the indicators were correlated (Table 13). All correlations were high, varying between 0.46 and 0.82, suggesting that the indicators may be measures of an underlying motor coordination trait. The highest correlations (0.76 to 0.82) were between the indicators for moving the foot and hands in a single test, as might be expected due to losing balance on a test occasion. The next highest correlations were between indicators for moving the hands on both occasions (0.65 and 0.65) and moving the foot on both occasions (0.60 and 0.61), suggesting a preference for using the hands or feet to aid balance.

Table 12: Descriptive statistics for correlates of physical activity at age 10

Variable	Value	Female (%)	Male (%)
motor coordination (medic report)	test 1 moved foot	31.08	41.50
	test 1 moved hands	22.46	30.45
	test 2 moved foot	33.88	42.30
	test 2 moved hands	23.97	32.55

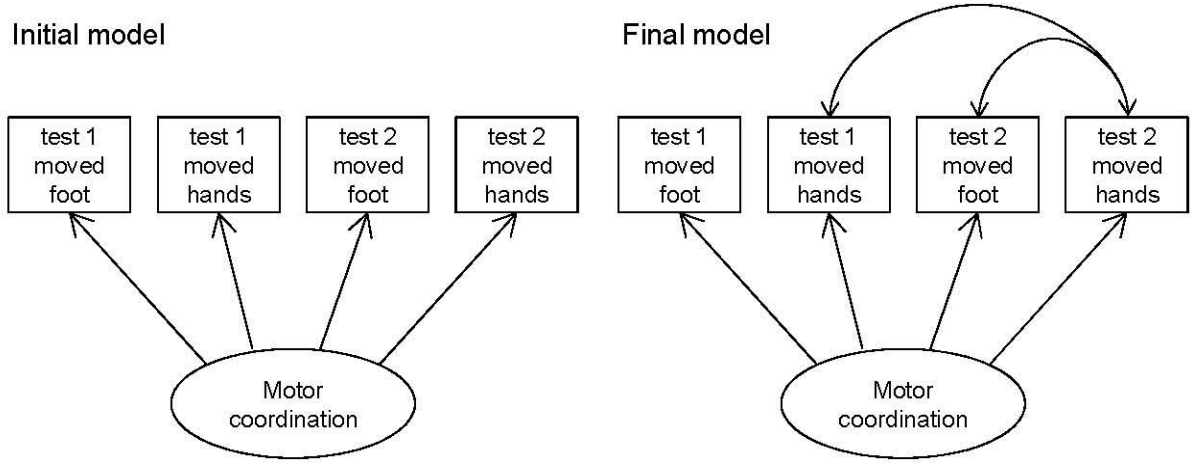
Table 13: Tetrachoric correlation matrix of binary coordination indicators – correlations for females are in the upper right triangle, correlations for males are in the lower left triangle

	t1mf	t1mh	t2mf	t2mh
test 1 moved foot	1	0.79	0.60	0.47
test 1 moved hands	0.76	1	0.50	0.65
test 2 moved foot	0.61	0.46	1	0.82
test 2 moved hands	0.47	0.65	0.81	1

11.3 Specifying the model

A model was specified that attempted to account for the correlations amongst the indicators using a single latent trait. Figure 9 shows a diagram of the initial model and the final model. Model selection was undertaken separately for each sex in order to determine whether the same configuration arose from separate model selection processes. The models were identified by constraining the variance of the latent trait to 1, allowing all loadings onto the indicators to be freely estimated. Parameters were added to the initial model based on a combination of substantive rationale and evidence from modification indices in order to achieve a good fit to the data. In both cases, the initial model did not fit the data well. For girls, the model demonstrated poor fit with a $\chi^2(2)=482.75$ (p=0.0000), RMSEA of 0.202 (90% CI: 0.187 to 0.218), a CFI of 0.958 and a TLI of 0.875. The modification indices suggested that allowing the residuals for the items related to test 2 to be correlated would improve the model fit considerably (MI=414.683, StdYX EPC=1.928). This modification index suggested that variation in ability to balance on the left leg was not explained adequately by the latent trait. Laterality provides a reasonable explanation for this correlation. Children are likely to have more ability on one leg than on another, irrespective of their overall motor coordination ability. The degree to which they are laterally biased would vary, with children generally being strongly left or right biased and some being ambidextrous. The model with this correlation added was a significantly better fit to the data $\chi^2(1)=303.78$ (p=0.0000), with overall fit statistics of $\chi^2(1)=185.41$ (p=0.0000), RMSEA of 0.177 (90% CI: 0.156 to 0.199), a CFI of 0.984 and a TLI of 0.904. Although this was a much improved fit, it was still quite poor. Modification indices for this model suggested that allowing the residuals to correlate between the indicators for moving the hands on both test occasions would improve the fit considerably (MI=185.408, StdYX EPC=1.020). The descriptive statistics showed that moving the hands was less frequent than moving the foot in order to stay balanced. It seems plausible that children would vary in their tendency to use their hands to balance when in the set position, again irrespective of their overall motor coordination ability. Adding this correlation to the model resulted in a just-identified model, with no remaining degrees of freedom to test model fit. However, a difference test of nested models demonstrated that this correlation significantly improved model fit $\chi^2(1)=185.41$ (p=0.0000). In order to test the overall model fit, a constraint was added to the model. The loading of the indicator for moving the foot on the first test was not significantly different from 1 ($\chi^2(1)=2.12$ (p=0.1454)) and so it was constrained to this value. The overall fit of the resulting model was very good, with a $\chi^2(1)=2.120$ (p=0.1454), RMSEA of 0.014 (90% CI: 0.000 to 0.040), a CFI of 1.000 and a TLI of 0.999.

Figure 9: Path diagrams of initial and final latent trait measurement models of the coordination indicators at age 10



An identical approach was taken for boys, resulting in a model with an identical configuration. As with the model for girls, the loading of the indicator for moving the foot on the first test was constrained to 1 to allow testing of model fit. The resulting model was a very good fit to the data, with a $\chi^2(1)=0.043$ ($p=0.8352$), RMSEA of 0.000 (90% CI: 0.000 to 0.020), a CFI of 1.000 and a TLI of 1.000. The next stage of testing involved identifying whether the model was equivalent across the sexes. The model was estimated with increasing constraints placed on the parameters. The resulting model demonstrated very strong measurement equivalence, with only one indicator threshold (for moving the hands in the second test) varying between groups. The results for the models are shown in Table 14. The chi-square difference between this highly constrained model and the model with no constraints across the sexes was not significant $\chi^2(7)=8.173$ ($p=0.3176$) and the fit of the constrained model was very good, with a $\chi^2(8)=8.505$ ($p=0.3857$), RMSEA of 0.003 (90% CI: 0.000 to 0.016), a CFI of 1.000 and a TLI of 1.000. A comparison of the latent trait means for the male and female models demonstrated that boys had poorer motor coordination than girls, the mean being 0.308 standard deviations less than that of the females on the latent scale, reflecting the poorer performance on each indicator that was previously identified in Table 12. The loading for moving the foot in test 1 was very high and estimates of the proportion of variance explained (R-square) for this indicator showed that it was almost perfectly explained by the latent trait. This suggested that using this single indicator in subsequent analyses would be practically equivalent to using the latent trait as a measure of motor coordination. Accordingly, this indicator was included in the path analyses to control for motor coordination, as a proxy for innate ability.

Table 14: Estimates from the model testing for measurement equivalence of the motor coordination latent trait at age 10

	Estimate	S.E.	P-Value
Loadings			
test 1 moved foot	0.984	0.012	0.000
test 1 moved hands	0.786	0.011	0.000
test 2 moved foot	0.611	0.011	0.000
test 2 moved hands	0.468	0.014	0.000
Residual correlations			
test 2 indicators	0.529	0.012	0.000
moved hands indicators	0.285	0.012	0.000
Trait means			
female	0.000		
male	-0.308	0.023	0.000

Note: estimates are in probits; $\chi^2(8)=8.505$ (p=0.3857), RMSEA=0.003 (90% CI: 0.000 to 0.016), CFI=1.000, TLI=1.000; the female trait mean was constrained for the purpose of identification

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