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A longitudinal study of the association between inattention, hyperactivity and impulsivity and children's academic attainment at age 11

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ABSTRACT

Background: The link between inattention and hyperactivity/impulsivity and poor academic outcomes is well established. Children with mild difficulties can go unnoticed yet may be at risk of poor academic outcomes.
Aims: To investigate the link between a continuum of inattention, hyperactivity and impulsivity at age five and academic attainment at age 11.
Sample: The sample comprised 46,369 children from 1812 English primary schools.
Methods: Reading and mathematics when starting school. Teachers rated behaviour at age five. English and mathematics were assessed at age 11.
Results: A substantive negative direct relationship was found between the severity of inattentive behaviour at age 5 and attainment at age 11. Hyperactivity was not significant but impulsivity was weakly but positively associated with attainment. These relationships applied across the whole range of behaviour scores.
Conclusions: Investigation of the continuum of symptoms has important implications for the teachers; particularly for those children with mild inattention whose difficulties may go unnoticed.

1. Introduction

The association between academic attainment and inattentive, hyperactive and impulsive behaviour, which is characterized by Attention Deficit Hyperactivity Disorder (ADHD), has been documented in previously published studies (Brooke et al., 2009; Shaw et al., 2012). These studies have focused on clinical populations. Other large-scale longitudinal school-based studies have investigated the impact of severe ADHD-type behaviour on the academic attainment of children who do not necessarily have a formal diagnosis of the disorder (Polderman, Boomsma, Bartels, Verhulst, & Huizink, 2010; Washbrook, Propper, & Sayal, 2013; Sayal, Washbrook, & Propper, 2015). The findings from the school-based studies highlight the level of risk of underachievement for children with undiagnosed severe behavioural problems and have important implications for educational policy and practice. However, inattentive, hyperactive and impulsive behaviours present themselves on a continuum and large-scale longitudinal studies to date have not investigated the level of risk of negative academic outcomes for children across the continuum throughout primary education. Children with less severe ADHD symptoms, which would not qualify them for a formal diagnosis of ADHD and which may not cause significant issues for teachers in the classroom may, nevertheless, be at risk of academic problems, and this needs to be further investigated. Thus the objective of this longitudinal study of a large school-based sample of children in England was to investigate the question: What is the strength of association between different severities of inattentive, hyperactive and impulsive behaviour in young children and their academic attainment at the end of primary school at age 11 years after taking baseline factors into account?

ADHD is characterized by inattentive, hyperactive and impulsive behaviours, and for a diagnosis to be made, a number of criteria must be met. The fourth version of the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) (American Psychiatric Association, 1994) identified three sub-types of ADHD; 'Combined' where an individual displays symptoms of inattention, hyperactivity and impulsivity, 'Predominantly Inattentive' and 'Predominantly Hyperactive/Impulsive'. The DSM-IV listed eighteen criteria which characterized ADHD. To qualify for a diagnosis of ADHD, a number of these criteria should be met at a persistent and severe level by an individual in a range of environments, with onset before the age of seven. This has been superseded by the fifth edition of the DSM (American Psychiatric Association, 2013) but the list of diagnostic criteria for ADHD is unchanged and the two domains of inattention and hyperactivity/impulsivity remain.

The prevalence of individuals diagnosed with ADHD varies, depending on factors such as age, the reliability of the diagnostic criteria and

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diagnostic practices. In the UK, the prevalence rate has been estimated to be 2.2% (Ford, Goodman, & Meltzer, 2003). Polanczyk, de Lima, Horta, Biederman, and Rohde (2007) conducted a systematic literature review which analysed 102 studies that had investigated the prevalence rate of ADHD in community or school-based samples of individuals who were 18 years or younger using either the diagnostic criteria for ADHD in the DSM versions III, III-R or IV (American Psychiatric Association, 1980, 1987 and 1994 respectively) or the diagnostic criteria for hyperkinetic disorder in the International Classification of Diseases (ICD, World Health Organization, 1993). The number of participants in these studies totalled 171,756. Their findings estimated a world-wide pooled prevalence rate of ADHD/Hyperkinetic Disorder of 5.3% although there is international variation, for example higher prevalence rates have been reported in the United States (Rowland et al., 2002).

Children who are diagnosed with ADHD have frequently been found to fall behind their peers, academically (for example, Barkley, Fischer, Edelbrock, et al., 1990) and school-based studies have shown that this trend extends beyond clinical samples to children with severe ADHD-type behaviour but without necessarily a formal diagnosis of the disorder. From their systematic review of sixteen studies, Polderman et al. (2010) concluded that children with attentional and hyperactivity problems are at risk of lower academic outcomes. Of the sixteen studies which they reviewed, ten were small-scale clinical samples and six were community population samples. A range of different measures of attentional difficulties and outcomes were used across the studies but no distinction was made between the ADHD sub-types in five of the studies. Washbrook et al. (2013) analysed data from a large cohort of children ($n = 11,640$) collected in the Avon Longitudinal Study of Parents and Children (ALSPAC). The authors linked parents' ratings of their children's level of hyperactivity/inattention at the age of 3 to the GCSE examination results at the end of compulsory education in England at age 16. They found that after adjusting for a broad range of confounder variables, including IQ at age 8, children with severe hyperactivity/inattention problems at age 3 attained significantly lower examination results at age 16 than their peers. For example, boys with high levels of hyperactivity/inattention at age 3 were 33% more likely to not achieve a Grade C (the lowest grade considered to be accepted by higher education and employers as passing the examination) in age 16 examinations. However, the authors recognized that one limitation of the study was the composition of the behaviour rating scale, Goodman's Strengths and Difficulties Questionnaire (SDQ), which did not allow for the association between academic attainment and the separate domains of inattention and hyperactivity to be investigated.

Negative outcomes extend beyond academic domains and although this study focuses on academic attainment, other outcomes are no less important. A systematic review of 351 longitudinal studies compared the long-term (which was defined as more than two years) outcomes of individuals with ADHD receiving treatment with those not receiving treatment. They found negative associations between ADHD and drug use/addictive behaviour, social functioning, self-esteem, occupation, driving and obesity (Shaw et al., 2012). Moyá et al. (2014) conducted a twenty-year follow-up study of a community-based sample of boys in London, England. From an initial sample of 3215 boys, 40 who were identified at age 6–7 years as having pervasive hyperactivity and 25 with no identified behavioural difficulties were followed up at age 27. Not all of those identified as having pervasive hyperactivity at age 6–7 were diagnosed with ADHD as adults but those who were ($n = 9$) reported difficulties with social relationships and negotiation skills. Those with milder hyperactivity did not report experiencing the same level of negative outcomes at follow-up.

Recent studies have identified differences in the strength of the link between inattention, hyperactivity and impulsivity, and academic attainment. Merrell and Tymms (2005) followed a cohort of children from age 4 to 7 years and found that inattention has been most strongly linked with negative academic outcomes with hyperactivity being more weakly so. Other studies have found a similar negative association between inattention and academic achievement, including the systematic review by Polderman et al. (2010) described earlier, a study by Pingault et al. (2011), which followed the progress of a sample of 2000 students between the ages of 6 and 12, then followed them up to graduation, and a study by Duncan et al. (2007) who conducted a meta-analysis of the outcomes of a sample of 34,000 participants from six population-based large-scale longitudinal studies. The sample size of the six studies analysed by Duncan et al. was not as large as the present study and the outcome measures were different between studies. Probing the association between behaviour and academic outcomes, Sayal et al. (2015) analysed a population-based sample of 11,640 students whose behaviour was assessed by parents and teachers at the age of 7 using the Developmental and Wellbeing Assessment (DAWBA) and followed them up to the end of compulsory secondary education in England. The DAWBA provided scores for inattention and hyperactivity/impulsivity on a continuum which allowed the authors to investigate academic outcome for the full range of behaviours from no symptoms through to severe. They found a linear association between each one point increase in inattention symptoms and lower GCSE scores after adjusting for confounder variables. Inattention was a stronger predictor of later academic outcomes than hyperactivity/impulsivity. Most studies have considered hyperactivity and impulsivity as a single factor, however Tymms and Merrell (2011) analysed them separately and found that impulsivity was advantageous to academic outcomes after controlling for inattention, in particular verbal impulsivity (e.g. children blurting out answers to questions before the teacher has finished asking them).

The current study adds to previous research by investigating a large sample of 46,369 children over their first seven years of school using a measure of behaviour which provides separate scores for inattention, hyperactivity and impulsivity. It exceeds the sample size of studies reported to date and an advantage of this large sample size is that it includes sufficiently large numbers of children across the full range of scores on the behaviour rating scale to enable a detailed investigation of the association between academic progress over the first seven years of primary school in relation to the number of ADHD criteria met. Information about academic progress across the continuum of behavioural difficulties can be expected to have important messages for educational provision.

2. Method

Quantitative assessment data of children's early reading and mathematics development were collected at the start of school in England, when the children were aged four. Teachers' ratings of the children's behaviour were collected at the end of their first year of school (children aged 4–5 years). These data were matched to the statutory assessments taken by all children at the end of primary school in England at age 11.

2.1. Measures

2.1.1. Academic attainment at the start of school

Children's early reading and mathematics were assessed at the start of school using the PIPS On-Entry baseline assessment. The content of the assessment is based on skills and areas of knowledge that research has shown to be the best predictors of later success or difficulty at school (Tymms, 1999). It includes sections which assess vocabulary acquisition, concepts about print, phonological awareness, letter and word recognition, reading comprehension, understanding of mathematical concepts, counting, arithmetic and problem solving, shape identification and digit identification. It is computer-delivered and teachers assess one child at a time. The software presents questions verbally using recorded sound files. The content is arranged in series of sub-tests. Each sub-test is terminated after three wrong answers are given in a row or four in total. The pupils respond by either saying the answer or pointing to the answer on-screen and are not under time pressure.