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Economic outcomes in adulthood and their associations with antisocial conduct, attention deficit and anxiety problems in childhood

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Short title: Adult economic outcomes

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Background: Conduct disorder (antisocial conduct), attention deficit problems and anxiety in childhood have negative effects on individuals during their childhood, on their families, and often into adulthood.

Aims of the study: To quantify the connections between childhood antisocial conduct, attention deficit and anxiety, and some adulthood economic consequences.

Methods: Data from a British birth cohort study were examined for links between behavioural and emotional problems in childhood, and occupational status and earnings in adulthood, after adjusting for individual and family covariates.

Results: The effects of antisocial conduct on adult labour market outcomes were complex. Results for males with antisocial conduct at age 10 showed a higher probability of being unemployed at age 30 (after adjustment for other factors). However, males with antisocial conduct at age 10 had *higher* earnings than those without such behaviour, again after adjusting for other factors. There were no such differences for females with antisocial conduct. Attention deficit problems at age 10 were associated with lower employment rates, worse jobs, lower earnings if employed, and lower expected earnings overall – for both males and females. Anxiety problems were associated with lower earnings. Other childhood factors associated with worse adulthood economic outcomes included cognitive attainment, living in a disadvantaged neighbourhood, mother's educational qualifications, family income and being looked after by a local authority.

Discussion: Links between antisocial conduct and attention deficit in childhood and high adulthood personal and societal costs support arguments for effective interventions to prevent and treat behavioural problems in childhood. However, the cost-effectiveness of such interventions still needs to be considered carefully.

Implications for policy: Childhood mental health problems are strongly linked to adverse adulthood experiences across a number of domains. Early detection and intervention might head off many of these negative outcomes for children, their

families and wider society. The positive impact of antisocial conduct on earnings needs further examination: it is not necessarily counter-intuitive, but it raises interesting policy questions.

Implications for further research: The long-term outcomes of childhood problems and interventions need further study, as do the pathways connecting childhood morbidity, adulthood outcomes and other potential intervening factors.

INTRODUCTION

Conduct disorder is characterised by persistent and frequently aggressive destructive and disruptive behaviour in the home and at school.[1] It is the most common psychiatric disorder in childhood: the Office of National Statistics estimated its prevalence to be 4.6% among 5 to 15 year olds in Britain.[2]

Persistent antisocial behaviour is associated with high costs in childhood, both for the state and for families,[3] and has been shown to generate service use costs in early adulthood that are ten times higher than the costs of children without such behaviour.[4] As well as these higher rates of service use, adulthood consequences include substance misuse, criminality, suicidal ideation, homelessness, relationship difficulties, domestic violence and poor parenting.[5]

We examined the links between antisocial conduct in childhood (which is closely associated with conduct disorder and some other externalising mental health problems in childhood) and adult employment-related outcomes.

METHODS

Source of data

The 1970 British Cohort Study (BCS70) identified all children born in England, Scotland, Wales and Northern Ireland over a 1-week period during April 1970 and collected data from 17,196 of them. It broadened over time into a general study of health, educational and social development, with data collection sweeps at ages 5, 10, 16, 26, 30 and 34. Because this is a nationally representative birth cohort, with follow-up data over three decades, it offers a good platform for examining the long-term links between childhood characteristics and adulthood achievements and experiences.

Measures

The childhood variables for this study were identified from interviews with parents and teachers and from medical examinations completed at age 10. Teachers completed an educational questionnaire which contained 53 separate items relating to the behavioural and psychological development of each child. The majority of the items used in the BCS70 instruments at age 10 were drawn from existing well-established measures, including the Connors Teacher Rating Scale[6] and the Rutter Teaching Scale.[7] We chose to examine the cohort at this age because we had the benefit of both teacher and parent ratings (the former were not sought at age 5, and were missing for many young people at age 16 because of industrial action by teachers at that time), and we were more confident that behavioural problems would have shown themselves by that age.

Principle components analysis (PCA)[8] was used to reduce the variables that make up the teacher ratings by identifying latent variables. PCA generated standardised indices (each with zero mean and unitary standard deviation) of the severity of problems associated with a series of latent components that account for the majority of the variance in teacher ratings across children. The index scores are essentially a weighted linear combination of each relevant item rating, with the weights chosen such that the variance in the index score is maximised across subjects, based on their component questions. The four components identified were labelled as *antisocial conduct*, *attention deficit problems*, *anxiety* and *coordination problems*.

For each latent component, the individual items from the teacher ratings found to be most highly correlated were as follows:

- *Antisocial conduct* – bullying, teasing of others, temper outbursts, property damage, impulsiveness, quarrelling with other children, ease of frustration, sulky/sullenness, complaining about things, interfering with others, restlessness;

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- *Attention deficit problems* – day dreaming, poor concentration on tasks, confused/hesitant, squirmy/fidgety, inattentiveness, fails to finish tasks, listless/lethargic, forgetful about complex tasks;
- *Anxiety* – obsessed with unimportant tasks, afraid of new situations, cries for little cause, behaves nervously, fussy/over-particular, worried/anxious, relations with others tearful/unhappy;
- *Coordination problems* - trips and bumps into things, clumsy at games, difficulty picking up small objects, drops things, accident-prone, fearful in movement.

In our statistical analyses we included interaction terms for co-morbidities; that between antisocial conduct and attention deficit was of particular interest.

Each index was scored such that higher scores reflected increased severity of problems. We did not attempt to segment these components in order to identify children with and without specific disorders because the survey instrumentation did not include a diagnostic tool as such. Rather, our approach is to use these constructed measures as indices of childhood characteristics and problems. Our primary interest in this paper is the index of antisocial behaviour. As formal diagnostic instruments were not used to assess behaviour, we were not able to confirm the presence of conduct disorder but instead used the latent component that indicated antisocial conduct as a proxy for suspected conduct disorder.

In addition to the other component scores, the additional child characteristics included in the analysis were:
- c*ognitive skills attainment*: derived by combining verbal and non-verbal test scores of cognitive attainment derived from the British Ability Scales[9] administered at age 10 - a higher score indicating a greater level of cognitive attainment;
- *motivation*: measured using the LAWSEQ scale of self-esteem,[10] with higher scores indicating higher self-esteem; and the CARALOC measure of 'locus of

control' - the tendency to attribute success and failures either to internal factors such as effort or to external factors such as chance;[11]

- *health problems*: a dichotomous variable identifying whether, at age 10, the child had experienced any significant illness, handicap or developmental problem;

- *home-life situation*: lived with same parents (a dichotomous measure based on parental response to a question asking whether the child, at age 10, had lived with the same two parents since birth), ever taken into the child protection system (based on parental report);

- n*umber of children living in household;*

- *attended independent sector (privately paid for) school,* although the proportion of the sample in such schools was small;

- *staff-pupil ratio at school*: number of children in attendance divided by number of teachers in attendance;

- *residence in relatively disadvantaged neighbourhood*: a dichotomous measure based on the mother's description of the area in which the family lived when the child was age 10. A *disadvantaged area* is defined here as either residence in an inner-city neighbourhood or a locality dominated by public-sector housing.

In addition, the following *parental characteristics* were included in the analysis:

- parental education, parental hours of work, parental health, family income.

Occupational and earnings data at age 30 were obtained via interviews of cohort members conducted in 1999/2000. Occupational status and weekly earnings were derived from self-report employment information supplied by those study participants in full-time and part-time employment at age 30. The earnings data allow for the calculation of gross weekly income from employment. These data were not inflated.

Analyses

In the analyses, we first modelled the variable indicating whether or not an individual is economically active. (*Economically active* is defined as employed, in full-time education, enrolled on a government training scheme; *economically inactive* is defined as unemployed, temporarily sick/disabled, permanently sick/disabled, looking after home/family, retired.) We then examined *occupational status* for those in employment. There were five categories based on skill and educational requirements and pay, ranging from unskilled occupations (category 5) through to managerial and professional jobs (category 1). Next we examined *earnings* for those in employment. Finally, we combined the results from the first and third analyses to calculate *expected earnings*.

A probit regression model was used to assess the significance of the age-10 factors on whether or not the individual was economically active at age 30 (defined as working full- or part-time, participating in an educational programme or government work training programme). Separate estimations are reported for males and females because early analyses revealed quite marked differences in the patterns of association between the genders. Economically inactive included unemployed, temporarily or permanently sick/disabled, looking after home/family, retired. We did not have sufficient data to separate all the possible reasons for being economically inactive.

Occupational status was modelled using an ordered probit with robust standard errors. Again, separate models were estimated for males and females.

Earnings were modelled using ordinary least squares (OLS) with log-transformed weekly earnings of those in employment as the dependent variable. Robust standard errors are reported where the variance of the error terms suggested the presence of heteroskedasticity. As in the two previous models, separate estimations were carried out for males and females. The coefficients are estimates of the marginal proportional change in earnings associated with a change in each regressor.

In all analyses, statistical significance is reported at the 0.01, 0.05 and 0.10 levels.

The final task was to combine the results from the first two analyses. By combining the results from the probit regression model on whether or not an individual was economically active at age 30 with the results from the OLS earnings analysis,[12] we could calculate the effect of antisocial conduct and other characteristics on what we can call *expected earnings*. Average expected earnings were calculated for certain points on the observed antisocial conduct range (at the 25th, 90th and 95th percentiles), with all other explanatory variables set at their mean values, and comparisons made between them. The distribution of expected earnings was estimated using a bootstrap algorithm with 1000 repetitions.

In cases where information was not collected for specific questions at age 10, multiple imputation was performed. Multiple imputation involves using the observed data to estimate the missing data a multiple of times, creating equally plausible versions of the complete dataset. Each dataset is then analysed, and the results combined, using Rubin's[13] rules for scalar estimands, to produce one set of estimates and standard errors. The advantage of this method is that it preserves the variance structure of the data and incorporates uncertainty around the imputed values. The NORM multiple imputation software was used to generate the multiple imputed data sets.[14] This software bases imputation on the assumption of joint normality in the variables imputed. Binary and ordinal variables were imputed to preserve their distributional shape. The impact of imputing non-normal variables under normality assumptions has been shown to produce acceptable results.[15]

RESULTS

Of the initial birth cohort, 14,875 (86.5%) members were traced and included in the age-10 sample. At age 30, attrition resulted in 11,261 individuals (65.5% of the original birth sample) being interviewed. Data on whether or not an individual was economically active were available for 11,182 respondents (99.3% of the age-30

sample). In total, 9,342 individuals reported being in employment at age 30. A greater number of respondents answered the question regarding their type of employment than reported their income. Of those in employment, occupational status and earnings were available for 9,071 (97.1%) and 8,323 (89.1%) respectively.

Descriptive statistics for the dependent and explanatory variables are presented in **Tables 1 and 2** respectively. The majority of both male and female respondents were in the three highest occupational status categories. The mean weekly income values exceed the median values, reflecting a right-skewed distribution.

Economic inactivity

Among men, there was a significant relationship between antisocial conduct and being economically inactive at age 30 (**Table 3**). Attention deficit problems at age 10 were significantly associated with being economically inactive for both men and women. Neither anxiety nor coordination problems, measured at age 10, were associated with employment activity, nor were interaction terms for co-morbidity. Being economically inactive was associated with the following age-10 characteristics for both males and females: lower family income, higher number of children in household, living in a disadvantaged neighbourhood, low staff-pupil ratio at school and low cognitive attainment. Among males, health problems up to age 10 and having been taken into care also predicted economic inactivity at age 30.

Occupational status

The ordered probit analyses of occupational status produced positive signs on the attention deficit variable in both the male and female equations (**Table 4**). This implies that workers who had more severe problems of this nature at age 10 were more likely to be in less-skilled, lower-paid jobs. The same direction of effect was also observed for antisocial conduct at age 10, although the effect is not statistically significant. Neither of the other age-10 psychosocial indicators (anxiety and coordination problems) was associated with age-30 occupational status. A higher

locus of control score at age 10 was strongly associated with higher occupational status, as were higher age-10 cognitive attainment scores. Both males and females who had more educated parents and who lived in a higher-income household at age 10 were found to have higher-status jobs, other things being equal. Workers who attended an independent sector primary school were also predicted to have a higher occupational status at age 30, while those who lived in a relatively disadvantaged neighbourhood were less likely to be employed in jobs of higher status at age 30.

Earnings from employment

Earnings were modelled for those in employment using OLS with log-transformed weekly earnings as the dependent variable: a test suggested by Manning and Mullahy - based on the Park test - supported the use of OLS as a log-transformed dependent variable.[16, 17] Robust standard errors are reported where there was evidence of heteroskedastic error variances (**Table 5**).

For males, increasing severity of *antisocial conduct* at age 10 was associated with *higher* weekly earnings at age 30. The estimated effect is statistically significant at the 1% level. The same direction of association for the antisocial conduct variable was observed for females, but the effect is comparatively weak and not statistically significant at the levels set for this study.

The coefficients reported in Table 5 are estimates of the marginal proportional change in earnings associated with a unit change in each regressor, holding other influences on earnings constant. These marginal effects can therefore be used to compare the percentage earnings differential between individuals positioned at different points within the childhood score distributions. For example, a male located at the 90th percentile of the *antisocial conduct* index at age 10 is estimated to earn almost 9% more than a male employee positioned at the 25th percentile. The differential increases to 11% when comparing someone at the 95th percentile with someone at the 25th percentile.

The effects of other mental health needs at age 10 are in the opposite direction: the greater the index of severity at age 10, the lower were earnings at age 30. *Attention deficit problems* at age 10 were strongly and significantly associated with lower earnings at age 30 for both male and female workers. A male worker who was at the 90th percentile on the attention deficit index at age 10 is estimated to earn around 7% less than a male positioned at the 25th percentile, and a male worker at the 95th percentile is estimated to earn 9% less than a male worker who was located at the 25th percentile at age 10. The corresponding deficits are considerably larger for females: a woman who was positioned at the 90th percentile on the attention deficit index is estimated to earn 17% less than a similar worker who was at the 25th percentile age-10 score for girls (and around 20% less when comparing those at the 95th percentile to those at the 25th percentile).

The age-10 *anxiety* variable was significant only at the 10% level within the male earnings equations, and the point estimate suggests a much smaller proportional impact on earnings when comparing workers who were located at different points across the age-10 anxiety score distribution.

Workers whose mothers were better educated are estimated to earn more, although the effect on this variable is only statistically significant in the male earnings regression. Males and females who lived in higher-income families at age 10 are also estimated to earn significantly more than workers from poorer backgrounds. Those who lived in a relatively disadvantaged neighbourhood when they were aged 10 were estimated to earn significantly less than workers who grew up in other types of locality: this effect appears to operate independently of parental education and family income. Male and female workers who scored more highly on tests of cognitive attainment at age 10 and who had a higher level of self-esteem and 'locus of control' were also estimated to earn more than their peers. Male employees who had experienced being taken into care are estimated to be particularly disadvantaged with respect to earnings, other things being equal, although the same significance of effect is not observed for females.

Expected earnings

We combined the probability of being in employment with predicted earnings of employees, which we call *expected earnings*. A bootstrapping algorithm was used to compare the expected earnings between the 25th, 90th and 95th percentiles on each of the mental health measures (see **Table 6**).

For the *antisocial conduct* measure, a male at the 25th percentile at age 10 would be expected to have weekly earnings at age 30 of £499, compared to £524 at the 90th percentile and £530 at the 95th percentile. The 95% confidence interval for the difference between the 25th and 90th percentiles in average expected earnings for males (£2 to £49) indicated that antisocial conduct had a significant positive effect on expected earnings. For females, the 95% confidence interval for the difference (-£3 to £30) indicated that antisocial conduct did not have a significant effect on expected earnings. Comparing the 25th and 95th percentiles, the confidence intervals showed the same pattern (3 to 60 for males; -5 to 38 for females).

For the *attention deficit* measure, the differences between the 25th and 90th percentiles in average expected earnings were -£36 for males (95% confidence interval -60 to -12) and -£61 for females (-81 to -42), indicating that attention deficit problems were associated with lower expected earnings. The differences between the 25th and 95th percentiles are also significant.

For *anxiety problems*, the differences between the 25th and 90th percentiles in average expected earnings were -£25 for males (95% confidence interval -47 to -3) and -£29 for females (-46 to -11), indicating an association with lower expected earnings. The differences between the 25th and 95th percentiles are also significant.

DISCUSSION

Summary

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A British national cohort study offered data on a large, representative sample. We used data collected from and on these individuals at ages 10 and 30 to explore and quantify the links between mental health needs in childhood – with a particular focus on antisocial conduct – and adverse economic consequences in adulthood. We examined four measures in adulthood: whether an individual was economically active (employed, in full-time education or training), occupational status (type of job) for those in employment, earnings for those in employment, and expected earnings (probability of being economically active multiplied by the earnings from employment).

Our findings indicate associations between antisocial conduct, attention deficit, anxiety and coordination problems at age 10, and some or all of these poor economic outcomes at age 30. We summarise the findings in **Table 7**. Generally, the presence of symptoms of mental health problems in childhood is associated with worse employment-related outcomes at age 30. These detrimental effects are particularly marked for 10-year olds with *attention deficit* problems, with lower employment rates, worse jobs, lower earnings if employed, and lower expected earnings overall. For children with *anxiety*, the only significant effects are seen in relation to earnings. Children with *coordination problems* appeared to experience no adulthood economic consequences except that expected earnings could be lower for males. It is the 10-year olds with *antisocial conduct* who have the most interesting patterns of economic outcomes 20 years later: males with antisocial conduct are less likely than males without such a characteristic to be economically active, but are likely to have higher earnings if in a job, as well as higher expected earnings (taking into account the level of inactivity). There are no differences at age 30 between females with and without antisocial conduct at age 10.

Limitations

Before discussing these results we should note some limitations. We should also emphasise that this is a study of associations over time, and the significant links revealed by our analyses do not necessarily imply causality.

One limitation is our reliance on teacher ratings for some of the characteristics. There are often differences between teacher, parent and self ratings, but we were constrained in these analyses by availability (partly because of the design of the cohort study, partly because of non-response patterns). However, we do not anticipate that the core findings at age 30 would have been markedly different had we used a different configuration of data at age 10. Another limitation is our focus on data at age 10, and it would have been interesting, although considerably more demanding, to examine data at a range of ages in both childhood and adulthood. For example, looking at age 5 would have allowed us to look at earlier behavioural disorders in childhood as well as continuities over time, but age-5 data were only available from parents. Some behavioural problems evident at age 10 would not have been observed at age 5. These further analyses will have to await another study, in so far as data allow.

Some women will have chosen not to be in the employment, and the model of weekly earnings of those women in employment does not take account of this in estimating the impact of age-10 characteristics on earnings. One approach to dealing with this would be to run a Heckman model which would account for sample selection.[18, 19] This would require there being variables that strongly affect the choice of women to enter the labour market (e.g. number of children at age 30). Without adequate variables for observing this affect, the Heckman model results may not be robust.[20]

Aetiology

There is currently no established view of the causes of conduct disorder: inadequate or inappropriate stimulation in the early stages of life may make children more susceptible to behavioural or emotional problems as they develop. Measures of restlessness and impulsive behaviour among children prior to age 5 have been shown to predict conduct problems later in childhood.[21] Other suggested risk factors include: social disadvantage, dysfunctional family environments, poor parenting,

family history of antisocial behaviour, community, school and peer factors and biological and individual factors.[5, 22, 23, 24] But there are also definitional problems: Maughan and Rutter[21] questioned whether conduct disorder should be diagnosed on the basis of a discrete set of categories or on the observation of a combination of problem behaviours; they also questioned the persistence of certain dimensions of antisocial behaviour across individuals.

What is not disputed is that the externalising behaviours associated with persistent antisocial conduct problems are distressing and often damaging for the child, their siblings and parents, and have longer-term deleterious impacts that can extend into adolescence and adulthood.[1, 25] For example, it has been suggested that antisocial behaviour peaks between the ages of 13 and 16, but nonetheless approximately 40% of antisocial children go on to exhibit antisocial behaviour in adulthood.[21, 26, 27] Indeed, the overwhelming majority of adults who are antisocial have previously displayed such behaviour in childhood.[21, 26, 28]

Maughan and Kim-Cohen,[29] using developmental and genetic studies, set out two developmental taxonomies of antisocial behaviour: the first involves childhood onset of antisocial behaviour which persists to adulthood, while the second involves the commencement of antisocial behaviour only in adolescence which does not tend to persist into adulthood. Disruptive behaviour at an early age, they argue, may stem from a combination of neurocognitive deficits and adverse parenting that result in problems in interacting with others, and then evoke reinforcing responses. Adverse parenting may take the form of parental emotional disorder, family discord, or negative expressed emotion towards the child. Antisocial behaviour which begins in adolescence, on the other hand, is likely to result from peer-group influences.

Links to adulthood outcomes

During childhood, disruptive behaviour is associated with poor educational performance and depressed mood.[30] It is also associated with problems in peer relationships and poor social adjustment at age 17.[21] Both of these studies also

linked such behaviour in childhood to poor outcomes in adulthood. A 25-year longitudinal study in New Zealand found that children assessed with conduct problems at ages 7 to 9 went on to commit more crimes, were more likely to suffer substance dependency and mental health problems, and had poorer sexual/partner relationships.[31] Moreover, an earlier, large multi-centre study[32] found a link between childhood conduct problems and adult phobia, major depressive episodes, obsessive-compulsive disorder, schizophrenia, panic disorder, manic episodes and somatisation. Indeed, Kim-Cohen et al[33] estimated that effective treatment of childhood conduct disorder and/or oppositional defiance disorder might prevent 26% of adult anxiety disorder, 23% of adult depression, 25% of adult schizophrenia-type disorders, 32% of adult mania, 46% of adult eating disorders and 41% of adult antisocial personality disorder.

On another dimension, Caspi et al[34] established a link between antisocial behaviour in childhood and adolescence and higher rates of unemployment between the ages of 15 and 21, while Healey et al,[35] following individuals from the age of 8 to 32, observed poorer adult labour market outcomes (lower employment rates and lower earnings). Furthermore, Scott et al[4] showed that children in a London (UK) sample with conduct disorders at age 10 had generated costs to public services amounting to approximately £70,000 by age 28, as opposed to costs of approximately £7,000 for children who had no conduct problems.[36]

Other research has produced similar results to some of our findings presented here. For example, the link between antisocial behaviour in adolescence and unemployment in adulthood has been observed elsewhere.[37, 38, 39, 40] The literature also suggests a link between antisocial behaviour and contact with the criminal justice system, receipt of state benefits and homelessness.[39, 40, 41, 42] One US study[43] estimated that a single high-risk adolescent could cost society between US$1.7 million and US$2.3 million (in 1997) as a result of criminal offending as a young person and as an adult. Another found that failing to provide early childhood care and education for at least two years to children born into poverty would incur costs of approximately $100,000 per child.[44] A further study looked at public expenditures,

including spending on mental health, general health, education and juvenile justice of young people with conduct disorder in the US, and found public costs exceeded $70,000 over a 7-year period.[45]

However, our finding that anti-social conduct at age 10 is associated with higher earnings at age 30 is perhaps unexpected, even though the finding was robust to a range of other exploratory analyses. We have not found previous research evidence to support such a positive association, or to shed light on its meaning. It may be that antisocial youths develop a degree of resilience to overcome their situation, developing strategies valuable to them in early adulthood. It may be that there are characteristics of antisocial individuals that lend themselves to certain occupations that are quite well remunerated in early adulthood, such as jobs that involve physical activity (such as construction site work) or risk-taking (such as investment banking or stock-broking) or where more aggressive behaviour is rewarded (such as in some forms of management). Even though antisocial 10-year olds have a lower probability of being in paid employment by age 30, the wage differential for those who are in employment is sufficient to make the expected earnings higher for this group of young people.

Given the evidence from previous research that co-morbid attention deficit hyperactivity disorder (ADHD) in children with conduct disorder increases the risk of persistent antisocial behaviour into adulthood,[46] it is also relevant to point to studies demonstrating links running from childhood ADHD to later adverse economic outcomes,[47, 48] something we found in this study. However, an interaction term of the co-morbidity of antisocial conduct and attention deficit was examined in each of our analyses and not found to be statistically significant.

Richards et al[49] analysed three UK birth cohort datasets (1946, 1958 and 1970), assessing the impact of adolescent conduct and emotional problems on adult emotional problems, education, labour market and social participation outcomes and contact with the criminal justice system. Thus their analyses partly overlap with the work reported in this paper. Our own analyses here build on unpublished

doctoral work by Healey,[50] completed prior to the work by Richards and colleagues. The two studies have some important differences. Using BCS70 data, Richards et al[49] assessed conduct problems at age 16 while we used data from interviews when the child was age 10. This difference could have a bearing on results due to the different taxonomies in the development of conduct disorder suggested by Maughan and Kim-Cohen.[29] Also, while both studies used factor analysis to derive an index of antisocial conduct, the details of the items included in the index used by Richards were not published. It is quite possible that their measure of conduct problems differs in construct from our index of antisocial conduct. Like us, Richards and colleagues observed associations between adolescent conduct problems and adult emotional problems, smoking, divorce, teenage parenthood, being arrested and court convictions. But they did not appear to adjust for some of the variables included in our modelling, some of which we found to be statistically significant. These differences may partly explain why our finding that antisocial conduct at age 10 was associated with *higher* earnings at age 30 among men was not consistent with their results. Despite these differences, however, the two analyses both observe an association between antisocial conduct in childhood or adolescence and poor employment outcomes in adulthood in the form of greater likelihood of economic inactivity and lower occupational status for those in employment.

Prevention and treatment

Despite the finding of higher earnings, antisocial conduct in childhood is generally associated with high personal and certainly societal costs in adulthood, which helps to support the case for effective preventive or treatment interventions in childhood. Aos et al[51] reviewed programmes to reduce adverse adult outcomes of behavioural problems in childhood and adolescence, concluding that interventions directed at juvenile offenders produced savings of between $1,900 and $31,200 per adolescent. They also argued that some forms of home visiting programmes targeting high-risk and/or low-income mothers and children were effective, as were early childhood education for 3- and 4-year olds in low-income families and some youth development programmes. Foster et al[52] point to cost-effectiveness advantages from

stacking multiple interventions in the Incredible Years Program. In England and Wales, Sutton et al[53] agreed that the use of effective early childhood intervention with only one in ten of the 7,500 young people under 18 who are sentenced to custody each year in England and Wales could save more than £100 million a year for public services. Feinstein and Sabates[54] showed the possibility of predicting high adult cost/harm outcomes by examining known childhood risk factors, therefore giving policy makers the possibility of targeting interventions to specific 'at-risk' groups early on. At age 5 years, they argued, it is possible to recognise more than one third of children who may go on to experience problems 25 years later in adulthood. Preventive efforts need to be explored more rigorously.[55]

Interventions to affect conduct disorder vary in their aims and focus. Some target all children, with the aim of preventing the development of persistent disruptive behaviour, whereas others focus specifically on the more disruptive children to prevent the subsequent development of more serious delinquent behaviour.[30, 56] In addition, interventions may be intended to reduce risk factors in a child's environment. It is clear that a successful intervention might potentially have substantial long-term impacts due to the many problems associated with conduct disorder. There have been no long-term evaluative studies of this kind; indeed, economic evaluative evidence in this area remains very sparse.[57, 58] We did not explore longer-term cost-effectiveness arguments in this paper, but the estimates of associations over time might provide a platform for such work.

Further work

Our findings quantify some of the links between childhood antisocial conduct problems and personal and societal costs in adulthood, in the context of other long-term links. Further exploration of the long-term personal and societal costs would be possible using other national and local cohort studies, and could range over a wider set of impacts. Research is particularly needed to explore the economic benefits of evidence-based childhood interventions to prevent or treat conduct disorder, and so

help policy makers to get a better understanding of the types of childhood

interventions that may be effective, cost-effective and equitable.

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Table 1: Labour market status at age 30: descriptive statistics

	MALES		FEMALES	
Economically active (%)	N=5,430		N=5,752	
		92.0		76.0
Occupational status (%)	N=4,830		N=4,240	
1. Professional		8.0		4.4
2. Managerial/technical		34.3		35.7
3. Skilled		45.0		46.4
4. Semi-skilled		10.7		11.4
5. Unskilled		2.1		2.1
Weekly earnings: £,gross (Mean; Std. Dev.)	N=4,466	537;1,753	N=3,856	351;1,161
Weekly earnings: £, gross (Median; IQR)		375; 276-520		253; 143-375

Table 2: Explanatory variables: descriptive statistics

	Males			Females		
	Mean	**Std. Dev**	**N**	**Mean**	**Std. Dev**	**N**
Antisocial conduct (PCA standardised score: teacher ratings)	0.009	1.006	2987	-0.105	0.913	3181
Attention deficit problems (PCA standardised score: teacher ratings)	0.107	1.027	2987	-0.208	0.917	3181
Anxiety (PCA standardised score: teacher ratings)	-0.111	0.997	2987	0.114	0.967	3181
Poor coordination (PCA standardised score: teacher ratings)	-0.041	1.020	2987	0.062	0.943	3181
Antisocial conduct (PCA standardised score: maternal ratings)	0.059	1.021	4269	-0.125	0.849	4597
Restlessness-impulsiveness (PCA standardised score: maternal ratings)	0.124	1.047	4269	-0.172	0.902	4597
Attention deficit problems (PCA standardised score: maternal ratings)	0.080	1.052	4269	-0.106	0.899	4597
Emotional problems (PCA standardised score: maternal ratings)	-0.057	0.987	4269	0.009	0.965	4597
Poor coordination (PCA standardised score: maternal ratings)	-0.024	0.980	4269	0.037	0.995	4597
Cognitive attainment (BAS combined scores)	76.415	13.933	3950	75.199	13.404	4225
Locus of control (CARALOC score)	19.580	4.892	4002	19.458	4.771	4301
Self esteem (LAWSEQ score)	15.996	4.208	4082	14.829	4.513	4343
Health problems up to age 10 (=-no; 1=yes)	0.290	0.451	4592	0.250	0.432	4892
Mother has formal qualifications (0=no; 1=yes)	0.480	0.500	4450	0.467	0.499	4754
Father has formal qualifications (0=no; 1=yes)	0.625	0.484	4341	0.608	0.4883	4549
Hours of work: father	45.301	12.557	4279	45.030	12.452	4501
Hours of work: mother	21.640	15.143	3527	21.803	14.624	3726
Health problems from child's 5th birthday: mother (0=no; 1=yes)	0.128	0.334	4664	0.134	0.341	4966
Health problems from child's 5th birthday: father (0=no; 1=yes)	0.117	0.322	4664	0.126	0.331	4966
Family income (scale 1-7)	4.072	1.257	4360	4.052	1.262	4629
Taken into care (0=no; 1=yes)	0.016	0.126	4673	0.017	0.129	4968
Lived with same parents (0=no; 1=yes)	0.884	0.320	4702	0.867	0.339	5008
Number of children living in household	2.526	1.028	4694	2.526	1.065	5011
Attended independent sector primary school (0=no; 1=yes)	0.030	0.159	4382	0.020	0.153	4640

Staff-pupil ratio at school	20.443	9.260	4181	20.816	9.333	4432
Residence in relatively disadvantaged neighbourhood (0=no; 1=yes)	0.299	0.458	4671	0.315	0.464	4985

Table 3: Probit analyses of economical activity at age 30

	MALES		FEMALES	
	β	z	β	z
Antisocial conduct	-0.089**	-2.68	-0.031	-1.00
Attention deficit problems	-0.118***	-3.33	-0.111***	-3.10
Anxiety	-0.021	-0.71	-0.039	-1.18
Coordination problems	-0.018	-0.52	-0.020	-0.66
Health problems: mother	-0.077	-1.00	0.010	0.17
Health problems: father	-0.049	-0.50	-0.012	-0.19
Formal qualifications: mother	0.003	0.05	0. 080*	1.72
Formal qualifications: father	0.123	1.32	0.017	0.39
Family income	0.071***	2.79	0.053***	2.71
Number of children in household	-0.042*	-1.65	-0.101***	-5.13
Working hours: mother	0.000	0.04	0.000	-0.25
Working hours: father	0.002	1.08	-0.001	-0.69
Lived in disadvantaged neighbourhood	-0.241***	-3.42	-0.126**	-2.55
Independent school	-0.271	-1.36	-0.176	-1.21
Staff-pupil ratio at school	0.006*	1.92	0.006**	2.23
Health problems up to age 10	-0.190**	-2.73	0.029	0.59
Locus of control (CARALOC score)	0.010	1.41	0.013**	2.51
Self esteem (LAWSEQ score)	-0.004	-0.61	-0.002	-0.39
Cognitive attainment (BAS combined score)	0.007**	2.39	0.009***	3.63
Taken into care	-0.397**	-2.13	-0.133	-0.91
Same parents since birth	0.134*	1.70	0.144**	2.26
N	5429		5751	

Notes

1. ***significant at 1% level, **significant at 5% level, *significant at 10% level.

2. Robust standard errors used to calculate z-values (males and females).

Table 4: Ordered probit analyses of occupational status at age 30

	MALES		FEMALES	
	β	z	β	z
Antisocial conduct	0.041	1.52	0.007	0.25
Attention deficit problems	0.126***	5.15	0.134***	5.72
Anxiety	0.115	0.47	0.007	0.24
Coordination problems	0.006	0.29	-0.012	-0.59
Health problems: mother	0.035	0.72	-0.035	-0.66
Health problems: father	0.066	1.12	-0.083	1.52
Formal qualifications: mother	-0.139***	-3.40	-0. 182***	-4.01
Formal qualifications: father	-0.141	-3.29	-0.073	-1.64
Family income	-0.093	5.83	-0.091**	-5.62
Number of children in household	0.003	0.18	0.032	1.60
Working hours: mother	0.000	0.21	0.000	0.72
Working hours: father	0.001	0.42	0.001	0.56
Lived in disadvantaged neighbourhood	0.160***	3.58	0.151	3.16
Independent school	-0.246**	-2.12	0.142	1.48
Staff-pupil ratio at school	0.000	0.18	-0.001	-0.46
Health problems up to age 10	-0.001	-0.02	-0.001	-0.04
Locus of control (CARALOC score)	-0.015***	-3.03	-0.024**	-4.96
Self esteem (LAWSEQ score)	0.006	1.80	-0.001	-0.23
Cognitive attainment (BAS combined score)	-0.018***	-11.87	-0.017**	-8.39
Taken into care	-.0160	1.11	0.071	0.43
Same parents since birth	0.056	1.01	-0.049	-0.83
N	4830		4240	

Notes

1. ***significant at 1% level, **significant at 5% level, *significant at 10% level.

2. Robust standard errors reported.

Table 5: OLS regression analyses of log of weekly earnings at age 30

	MALES		FEMALES	
	β	t-ratio	β	t-ratio
Antisocial conduct	0.046***	3.53	0.022	0.96
Attention deficit problems	-0.035**	-2.53	-0.087***	-3.80
Anxiety	-0.027*	-1.78	-0.376	-1.45
Coordination problems	-0.023	-1.28	-0.005	-0.30
Health problems: mother	-0.016	-0.45	0.036	0.79
Health problems: father	-0.051	-1.39	0.015	0.32
Formal qualifications: mother	0.088***	3.34	0.052	1.40
Formal qualifications: father	0.028	0.99	0.000	0.02
Family income	0.046**	4.27	0.077***	5.76
Number of children in household	-0.002	-0.21	-0.018	-1.12
Working hours: mother	-0.001	-1.19	-0.001	-1.08
Working hours: father	0.000	0.51	-0.001	-0.92
Lived in disadvantaged neighbourhood	-0.055	-1.92	-0.115***	-2.99
Independent school	0.142	1.48	0.126	1.19
Staff-pupil ratio at school	-0.000	-0.46	-0.004	-1.68
Health problems up to age 10	-0.001	-0.04	0.029	0.75
Locus of control (CARALOC score)	0.008***	2.68	0.008	1.83
Self esteem (LAWSEQ score)	0.006*	1.80	0.009**	2.46
Cognitive attainment (BAS combined score)	0.003***	3.37	0.009	6.11
Taken into care	-0.297***	-2.62	0.059	0.44
Same parents since birth	-0.008	-0.21	0.045	0.97
Constant	5.224***	47.12	4.164***	24.04
N	4466		3855	

Notes

1. ***significant at 1% level, **significant at 5% level, *significant at 10% level.

2. Robust standard errors reported.

Table 6: Expected weekly earnings based on 2-part models of labour market participation and income

Factor	Males (n=5,449)			Females (n=5,774)		
	Predicted earnings at 25th percentile (95% CI)	Predicted earnings at 90th percentile (95% CI)	Predicted earnings at 95th percentile (95% CI)	Predicted earnings at 25th percentile (95% CI)	Predicted earnings at 90th percentile (95% CI)	Predicted earnings at 95th percentile (95% CI)
Antisocial conduct	£499 (460 – 538)	£524 (477 – 572)	£530 (479 – 582)	£279 (250 – 308)	£293 (261 – 325)	£296 (261 – 331)
Attention deficit problems	£499 (460 – 538)	£463 (424 – 501)	£455 (414 – 496)	£279 (250 – 308)	£217 (193 – 242)	£208 (183 – 232)
Anxiety	£499 (460 – 538)	£474 (435 – 513)	£469 (429 – 509)	£279 (250 – 308)	£251 (223 – 278)	£245 (217 – 273)
Coordination problems	£499 (460 – 538)	£476 (435 – 518)	£470 (428 – 511)	£279 (250 – 308)	£264 (234 – 295)	£261 (229 – 293)

Notes
1. For each estimate, the remaining behavioural factors are set at the 25th percentile of their distribution.

Table 7: Summary of findings for all economic outcomes and childhood problems

	Antisocial conduct	Attention deficit	Anxiety	Coordination problems
Economically active				
Males	Worse	Worse	-	-
Females	-	Worse	-	-
Occupational status				
Males	-	Worse	-	-
Females	-	Worse	-	-
Earnings				
Males	Better	Worse	Worse	-
Females	-	Worse	-	-
Expected earnings				
Males	Better	Worse	Worse	Worse
Females	-	Worse	Worse	-