

## Predictors of antisocial personality

### Continuities from childhood to adult life

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**Background** Antisocial behaviour in adult life has its roots in childhood.

**Aims** To explore the independent and joint effects of childhood characteristics on the persistence of antisocial behaviour into adult life.

**Method** A clinical sample of twins who were systematically ascertained in childhood was followed up 10–25 years later. A total of 225 twins were interviewed regarding childhood and adult psychiatric disorder, psychosocial functioning, and psychosocial and cognitive risk factors.

**Results** In univariate analyses, childhood hyperactivity and conduct disorder showed equally strong prediction of antisocial personality disorder (ASPD) and criminality in early and mid-adult life. Lower IQ and reading problems were most prominent in their relationships with childhood and adolescent antisocial behaviour. In multivariate modelling childhood conduct disorder and hyperactivity predicted adult ASPD even when intervening risk factors were accounted for. The number of hyperactive and conduct symptoms also predicted adult outcome.

**Conclusions** Childhood disruptive behaviour has powerful long-term effects on adult antisocial outcomes, which continue into middle adulthood. The importance of number of symptoms, the presence of disruptive disorder, and intermediate experiences highlight three areas where interventions might be targeted.

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Conduct disorder is the most common child psychiatric disorder. About a third of those affected have antisocial personality disorder in adult life (Robins, 1978) and a further third experience other personality, psychiatric and psychosocial problems (Zoccolillo *et al*, 1992). Childhood predictors of persisting antisocial behaviour include high levels of aggression (Olweus, 1979), hyperactivity (Farrington *et al*, 1990), early age at onset (Tremblay *et al*, 1994) and aloofness or the absence of friendships (Kerr *et al*, 1997). Other factors have been postulated as mediators or ‘stepping stones’ between child and adult antisocial behaviour, including delinquent peer groups (Fergusson & Horwood, 1995; Fergusson, 1996) and early transitions into adult life such as premature termination of education (Caspi *et al*, 1990). Although these childhood risk factors are established for late adolescent and early adult antisocial behaviour, it is not known whether they continue to exert an effect in later life. This study explores these childhood factors to determine whether they remain risk factors for antisocial behaviour in mid-adult life. We further examine whether such risk factors remain predictive when intervening (late adolescent and early adult) behaviour and experiences are accounted for.

## METHOD

### Sample

A twin sample was used because one of the aims of the study was to examine genetic and environmental influences on the persistence of antisocial behaviour. Twins were selected from all new cases registered in the children’s department of the Maudsley Hospital between 1948 and 1982 and ascertained using multiple methods. The twin register of the Maudsley Hospital was used to identify children under 16 years old who were registered during the study

period. Item sheets from the children’s department, which include twin status, were completed and computerised for all patients seen from 1968 onwards. Finally, an exhaustive review of all children’s case notes during the study period was conducted, as it appeared that there had been occasional failures to include opposite-gender twin pairs in the other two sources of information. Individuals were excluded if the case notes revealed that at least one of the following criteria was present: primary diagnosis other than emotional or behavioural problems; a record of IQ less than 70; and co-twin dead at the time of child psychiatric registration. From the potential participants, 148 probands were identified. Of these, 15 were co-twins, providing a total of 133 twin pairs or 266 individuals for inclusion.

Participants were traced primarily through the National Health Service Register, which indicated the health authority of the general practitioner with whom the person was registered. Individual general practitioners were then contacted to request the person’s address. Where this was unsuccessful, traced co-twins and other family members were asked for the individual’s current address. A total of 244 individuals were successfully traced, 92% of the target sample. Of those traced, 225 participated to some degree, with 2 continuing to defer interview until after the study closed and 17 refusing to participate. Of the 225 participants, 202 completed the entire protocol, 8 completed the protocol only in part, 12 did not directly participate but allowed researchers to interview an informant (usually a co-twin but occasionally a parent or partner) and 3 agreed to let researchers review their adult case notes. Information was available for 107 twin pairs. There were 138 men in the study, of whom 79 were probands, and 87 women, of whom 42 were probands.

### Instruments

The Maudsley version of the Schedule for Affective Disorders and Schizophrenia (Maudsley SADS–L; Harrington, 1988) was used to assess psychiatric disorder in participants from age 22 years to the present. This instrument provided comparability with other local studies undertaken at this time point. To assess personality and psychosocial functioning in adult life, the Adult Personality Functioning Assessment (APFA; Hill *et al*, 1989) was used.

This measure was selected because of its emphasis on psychosocial functioning, which is frequently impaired in adults with a history of conduct disorder. The APFA records level and type of functioning in six domains: work, intimate relationships, friendships, non-specific relationships, negotiations and coping. It focuses on functioning in two age periods: 22–30 years (early period) and the past 5 years (current period). For this reason these two periods were used to define early and middle adult life.

Childhood psychopathology and experiences were assessed using the Retrospective Child and Adolescent Psychopathology (RECAP) assessment (Holmshaw & Simonoff, 1996). This provided standardised information on psychopathological symptoms, family life, school and other experiences up to age 21 years. The psychopathology section is based on the Child and Adolescent Psychiatric Assessment (CAPA; Angold *et al.*, 1995) but requires less detail, with more emphasis on associated impairment for endorsement of individual symptoms, because of its retrospective nature. Recall of symptoms on the RECAP assessment has been validated using both a clinical and a general population sample, as described previously (Holmshaw & Simonoff, 1996).

Each participant was interviewed by a single researcher on all measures. Each member of a twin pair was assessed by a different researcher without knowledge of the co-twin's status. Although researchers were not told in advance who were probands, this information sometimes came out during the course of the assessment. All interviewers were trained to criterion on each of the assessments. Codings were regularly reviewed through research team joint codings of clinical vignettes and meetings of several research teams using the APFA to ensure similar calibration.

### Variable definition

Childhood DSM-III-R symptoms obtained in the RECAP interview were used to generate diagnoses of attention-deficit hyperactivity and conduct disorders (American Psychiatric Association, 1987). This procedure standardised the childhood information, because case notes were available for probands only and were completed at different times during childhood and with variable degrees of detail. As RECAP asks for examples of behaviour for

symptom endorsement, and as retrospective recall may reduce the number of behaviours remembered, lenient thresholds were used for the total number of symptoms required for each diagnosis, consistent with the retrospective use of Research Diagnostic Criteria (RDC; Harrington *et al.*, 1990). For conduct disorder, two or more symptoms were required rather than the usual three. For attention-deficit hyperactivity disorder five symptoms were sufficient, along with an age at onset of 7 years or less.

Diagnoses of antisocial personality disorder were generated from the APFA for the early and current periods. For the early period, a more lenient criterion of two or more symptoms was used, as the variables of non-maintenance of a monogamous relationship and unsatisfactory parenting in these younger individuals often could not be assessed. For the current period, the DSM-III-R requirement of four symptoms was implemented. Because the study aims to examine continuities over time, childhood conduct disorder was not included as a prerequisite for the diagnosis of antisocial personality disorder in either period. However, three-quarters (48 of 65) of those reaching the diagnostic threshold for antisocial personality disorder in the early adult period and 14 of 16 reaching the threshold in mid-adult life (current period) also met the threshold for conduct disorder.

Data on criminal convictions were obtained from the Criminal Records Office (CRO) as described by Elander *et al.* (2000). Convictions were included only if they were for offences normally recorded at the CRO; thus, traffic offences were excluded. A series of offences dealt with at a single prosecution were coded as one offence and was described in nature by the most serious offence. Violent offences were categorised separately and included robbery, riot and affray, assault, grievous bodily harm, actual bodily harm, wounding and sexual offences (Hough & Mayhew, 1983). Data were grouped according to whether convictions occurred during the age periods under 17 years, 17–21 years, 22–30 years, and 31 years or older. Official data were supplemented with self-reports from the RECAP and APFA. For the APFA, which covered offences during both early and current periods, this included both convictions and undetected crime (i.e. self-reports of criminal activity not detected by the authorities). For those aged under 17 years, reports of crime detected by the police and leading to a conviction were included.

There were no self-report data for the 17–21 years age period. For the current analyses, criminality was dichotomised according to whether no crime or any crime had been committed during each period, and was divided into 'any crime' and 'violent crime' only.

Peer group delinquency during secondary school was ascertained from the RECAP and was scored as positive whether or not the person interviewed was involved in the group's delinquent activities. The absence of a best friend during the secondary school period was coded positively. Aloofness was coded positively in the absence of both a best friend during secondary school and also a regular peer group during the same period.

To estimate intellectual ability, the Quick Test was used (Ammons & Ammons, 1962). This vocabulary test requires the participant to point to one of four pictures, choosing the one that best depicts the word that has been read aloud. The Quick Test has been validated in our sample against childhood IQ measures in the subgroup where these were available, showing a correlation of 0.48 with childhood IQ. This is only slightly lower than the correlations reported for more standard measures of IQ over the period from childhood to adult life (Anastasi, 1990). IQ was used as a continuous measure. Reading and/or spelling problems in childhood were recorded as a binary variable using retrospective recollection of problems and/or help with these problems in primary or secondary school. This measure was independently validated in a subgroup of 59 persons for whom relevant psychometric test data for specific reading retardation were available from childhood, and showed a sensitivity of 66.7%, specificity of 93.1% and correct classification of 86.4%. Age of leaving school was extracted from the RECAP.

### Statistics

Data reduction was performed in SAS (SAS, 1988). Data from both members of twin pairs were used. To correct for the non-independence of these observations, Huber's formula for calculating robust standard errors (Huber, 1967) was implemented in Stata (StataCorp, 1997). Linear regression was used for continuous dependent variables and logistic regression for categorical outcomes. To account for variation in the age of participants at

follow-up, a covariate reflecting age was used. For analyses using dependent variables where participants were 30 years old or less, to account for the length of recall required, a dummy variable generated from age at interview minus 21 years (the beginning of the early adult period) was used. For dependent measures in the period over age 30 years, variation in the length of the period was accounted for by using a dummy variable of current age minus 30 years, with values missing for those aged 30 years or less at follow-up interview. Categorical age classification into early age at follow-up (under age 35 years coded as 0) and those with current information (age 35 years or above coded as 1) was made to provide a direct comparison of these two groups.

## RESULTS

At the time of follow-up the mean age of the sample was 38.2 years (range 28–59) with no significant gender difference. One 18-year-old died at that age and an informant interview with the co-twin was conducted. Of the sample, 65% ( $n=147$ ) were 35 years of age or more at the time of interview. This allowed a division of the sample into younger (under 35 years at time of follow-up interview) and older (35 years or more at

follow-up) cohorts. Only in the older cohort do 'current' ratings apply.

The rates for the childhood disruptive diagnoses and other risk factors are presented in Table 1, along with the effects on prevalence of gender, proband status and age at follow-up. Over half the men had a diagnosis of conduct disorder, compared with only a fifth of women. Proband status was more likely to have conduct disorder than non-proband status. Younger people were more likely to report the presence of conduct disorder. With respect to hyperactivity disorder, the higher rate in men was not significant, nor did it vary significantly according to proband status, although both trends were in the expected direction. The prevalence did not change according to age group at follow-up. Hyperactivity was significantly related to conduct disorder ( $OR=5.3$ , 95% CI 2.3–11.9;  $P<0.001$ ).

The supplementation of official juvenile crime records (which are usually expunged if there is no record of adult crime) with self-reports from the RECAP increased the number of those convicted at age 16 years or younger from 45 to 62. This rate of more than a quarter of the sample (35% of men, 14% of women) who were convicted does not include those receiving either official or unofficial cautions, or those prosecuted but found not guilty. The prevalence of 'transitional' offences occurring from ages

17 years to 21 years was slightly lower, at 21%, but may be an underestimate because there were no self-report data for this period. In both periods, male participants and probands were more likely to have committed any crime. Only 'any crime' during the transitional period showed a significant effect of age classification. The rates of violent offences were low; although men had more frequently committed violent offences, significant differences could not be determined either because of low power (in the transitional period) or empty cells (no affected women in the juvenile period). There was an association between having a juvenile offence and both conduct disorder ( $OR=11.52$ , 95% CI 5.13–25.89;  $P<0.001$ ) and hyperactivity ( $OR=3.13$ , 95% CI 1.57–6.24;  $P<0.001$ ): see Table 3. Similar relationships were observed between both total transitional offences and conduct disorder ( $OR=3.36$ , 95% CI 1.53–7.34;  $P<0.001$ ) and hyperactivity ( $OR=2.32$ , 95% CI 1.44–4.69;  $P=0.02$ ), although the latter became insignificant once conduct disorder was accounted for (adjusted  $OR=1.80$ , 95% CI 0.85–3.78;  $P=0.12$ ).

Boys, probands and younger participants more commonly had a delinquent peer group. Reading and spelling problems were also more frequent in males but there was no difference according to proband

**Table 1** Rates of childhood disorders and risk factors

|                                       | Overall<br><i>n</i> (%) | Male<br><i>n</i> (%) | Female<br><i>n</i> (%) | OR or <i>t</i> <sup>1</sup> |          |                            |
|---------------------------------------|-------------------------|----------------------|------------------------|-----------------------------|----------|----------------------------|
|                                       |                         |                      |                        | M > F                       | Pr > NPr | Young > older <sup>2</sup> |
| <b>Diagnosis</b>                      |                         |                      |                        |                             |          |                            |
| Conduct disorder                      | 101 (46.5)              | 79 (59.4)            | 22 (21.2)              | 4.1***                      | 1.6***   | 2.6**                      |
| Hyperactivity                         | 38 (17.4)               | 27 (20.5)            | 11 (12.6)              | 1.7                         | 1.3      | 1.2                        |
| <b>Risk factor</b>                    |                         |                      |                        |                             |          |                            |
| Delinquent peer group                 | 71 (31.6)               | 54 (39.1)            | 17 (19.5)              | 3.0**                       | 1.3*     | 1.9*                       |
| IQ <sup>3</sup>                       | 195 (98)                | 120 (97.2)           | 75 (99.3)              | 1.16                        | 0.44     | 4.74***                    |
| Reading/spelling problems             | 66 (29.6)               | 47 (34.6)            | 19 (21.8)              | 1.9*                        | 0.9      | 1.3                        |
| Age at leaving school <sup>3</sup>    | 220 (15.8)              | 134 (15.7)           | 86 (15.9)              | 0.84                        | 2.04*    | –1.93*                     |
| Absence of best friend                | 91 (41.9)               | 27 (31.4)            | 64 (48.9)              | 2.1*                        | 3.0***   | 1.1                        |
| Aloofness                             | 12 (5.5)                | 8 (4.7)              | 4 (5.5)                | 1.3                         | 1.3      | 1.4                        |
| Any offences (at age < 17 years)      | 62 (27.6)               | 50 (36.2)            | 12 (13.8)              | 3.8***                      | 1.7***   | 1.1                        |
| Violent offences (at age < 17 years)  | 6 (2.7)                 | 6 (4.3)              | 0 (0)                  | n.c. <sup>4</sup>           | 1.5      | 3.9                        |
| Any offences (at age 17–21 years)     | 48 (21.3)               | 40 (29)              | 8 (0.2)                | 4.0**                       | 1.3      | 2.5*                       |
| Violent offences (at age 17–21 years) | 12 (5.3)                | 10 (7.3)             | 2 (2.3)                | 3.3                         | 1.1      | 1.4                        |

M, male; F, female; NPr, non-proband; Pr, proband.

1. Odds ratios (except for IQ and school leaving age): \* $P<0.05$ ; \*\* $P<0.01$ ; \*\*\* $P<0.001$ .

2. Young, 34 years old or less at interview; older, 35 years old or greater.

3. Mean differences examined by *t*-test, value given is *t*.

4. Not calculable, no female offenders.

**Table 2** Rates of adult antisocial outcomes

| Diagnosis                              | Overall<br>n (%) | Male<br>n (%) | Female<br>n (%) | OR <sup>1</sup> |          |                              |
|--|------------------|---------------|-----------------|-----------------|----------|------------------------------|
|  |                  |               |                 | M > F           | Pr > NPr | Younger > older <sup>2</sup> |
| <b>Antisocial personality disorder</b> |                  |               |                 |                 |          |                              |
| At 22–30 years of age                  | 67 (31.2)        | 51 (39.2)     | 16 (18.8)       | 2.8**           | 1.1      | 3.4***                       |
| Current                                | 16 (11.1)        | 12 (13.9)     | 4 (7)           | 2.2             | 1.0      | NA <sup>3</sup>              |
| <b>Any offence</b>                     |                  |               |                 |                 |          |                              |
| At 22–30 years of age                  | 68 (30.4)        | 57 (41.6)     | 11 (12.6)       | 4.9***          | 1.1      | 1.8                          |
| At > 30 years of age                   | 29 (18.2)        | 25 (26.3)     | 4 (6.3)         | 5.4**           | 1.3      | NA <sup>3</sup>              |
| <b>Violent offence</b>                 |                  |               |                 |                 |          |                              |
| At 22–30 years of age                  | 27 (12.1)        | 25 (18.3)     | 2 (2.3)         | 9.4**           | 1.2      | 2.3                          |
| At > 30 years of age                   | 12 (6.9)         | 10 (10.5)     | 1 (1.6)         | 7.4             | 2.9      | NA <sup>3</sup>              |

M, male; F, female; NPr, non-proband; Pr, proband

1. Odds ratios; \**P* < 0.05; \*\**P* < 0.01; \*\*\**P* < 0.001.

2. Younger, 34 years old or less at interview; older, 35 years old or greater. Comparisons not available for the current period.

3. Not applicable, because only measured on older cohort.

status or age group classification. There was no gender or proband difference in mean IQ but younger participants performed significantly better. Over the entire sample, the mean age of leaving school was 15.8 years, being younger in probands but showing no gender difference. The older cohort left school earlier (mean age 15.7 years) than the younger cohort (mean age 16.0 years). The effect is in line with the change in statutory school leaving age from 15 years to 16 years in 1974, although the age cohort classification is not identical with this shift.

Men were twice as commonly affected with antisocial personality disorder than women (Table 2) although the difference was only significant in the early adult period. Neither early nor current-period rates varied according to proband status. The effect of age cohort could only be tested for variables in the early period, as the younger cohort did not have data for the current period. Early antisocial personality disorder was significantly increased in the younger cohort. Rates in the early period were also considerably higher than those in the current period. To determine the reasons for this difference, we first compared the rates of the disorder using the same, less stringent criteria of two or more symptoms in both periods, for the subgroup of people in whom diagnoses of antisocial personality disorder were available for both age periods. This revealed rates of 21.8% and 21.3% for the early and current periods, which were not significantly different (McNemar's *S* = 0.0, *d.f.* = 1, *P* > 0.8). A

comparison of the stricter and more lenient criteria for the disorder in the current period revealed rates of 11.1% *v.* 21.5% (McNemar's *S* = 15.0, *d.f.* = 1, *P* < 0.001), indicating that the symptom threshold significantly altered the rate of diagnosis. This suggests that the difference in the rates across the early and current age periods was due both to the varying stringency of criteria and also to a secular change in the sample; the latter has been reported in other samples (Robins & Price, 1991). However, the absence of change in rates over the two time periods using the less stringent threshold for both periods suggests that neither differential recall nor reduction in antisocial personality disorder with increasing age was operating.

There were substantial gender differences in criminality rates for any offence in both adult age periods, but no effect of proband status, nor an effect of age cohort on early adult crime. Although more male than female participants had committed violent offences, the rates were high enough to achieve statistical significance only for the 22–30 year age period. There was no effect of proband status for violent offending in either of the time periods. There were non-significant trends for the younger cohort and for probands to have committed more violent crime. In the 22–30 year age period, any offence was strongly related to contemporaneous antisocial personality disorder (OR = 18.1, 95% CI 8.8–37.1; *P* < 0.001) and the same was the case for violent offences (OR = 10.8, 95% CI 4.0–28.7; *P* < 0.001). The relationship between

antisocial personality disorder in the current period and criminality is not strictly contemporaneous: whereas ratings for antisocial personality disorder cover the past 5 years only, criminality includes all offences committed after the age of 30 years. Nevertheless, the associations remain strong. Those with a current diagnosis of antisocial personality disorder were 22.6 times more likely to have committed any offence at age 31 years or above (95% CI 6.2–81.8; *P* < 0.001) and 18.6 times more likely to have committed a violent crime in that period (95% CI 4.5–76.9; *P* < 0.001).

**Longitudinal relationships**

The odds ratios adjusted for age between childhood risk factors and adult outcome were initially explored through univariate analyses (Table 3). Of the 135 relationships tested where an odds ratio could be calculated (5 relationships were excluded where the odds ratio was not available because of empty cells), 73 (54%) were significantly associated in the predicted direction at *P* < 0.05 or lower. All of the 5 odds ratios that could not be calculated involved violent crimes, the least prevalent outcomes. Furthermore, only one of the non-significant relationships showed an odds ratio in the direction opposite to prediction; in other cases the strength of the relationship fell short of significance. Particularly striking are the predictions from early childhood variables to antisocial personality disorder in the current period, where 46% of the sample were being rated at age 40–44 years or older. These associations were as large for the latter period as for the earlier adult period, demonstrating that the impact of childhood problems does not attenuate during adult life.

It is interesting to note that neither aloofness nor the absence of a best friend was associated with any of the antisocial outcomes. It is also intriguing that the impact of leaving school early becomes more important with age, both in terms of magnitude of the odds ratio and statistical significance. Although the significance of the relationship between reading problems and antisocial outcomes varied, and was only significant for total crime in the transitional and early adult periods, it is interesting to note that the magnitude of the odds ratios increases with outcomes in older age periods.

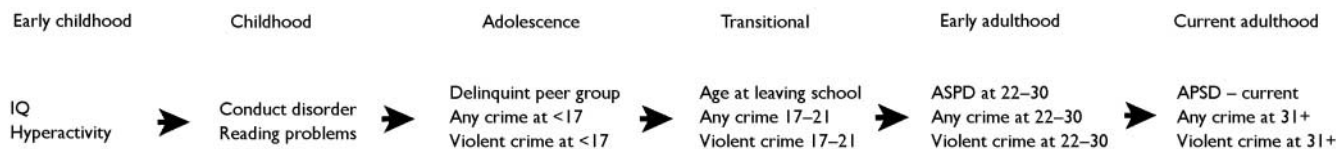
To examine the mechanisms of continuity from childhood to adult life, we



Table 3 Univariate relationships between juvenile risk and adult outcome

| Predictor variable     | Outcome variable: odds ratios (95% CI) |                      |                       |                         |                        |                           |                          |                         |                          |                          |                           |      |
|------------------------|--|----------------------|-----------------------|-------------------------|------------------------|---------------------------|--------------------------|-------------------------|--------------------------|--------------------------|---------------------------|------|
|                        | At < 17 years                          |                      |                       | At 17–21 years          |                        |                           | At 22–30 years           |                         |                          | Current (31+ years)      |                           |      |
|                        | Any crime                              | Violent crime        | ASPD                  | Any crime               | Violent crime          | ASPD                      | Any crime                | Violent crime           | ASPD                     | Any crime                | Violent crime             | ASPD |
| Gender                 | 3.52<br>(1.78–6.97)***                 | NA <sup>1</sup>      | NA <sup>1</sup>       | 4.01<br>(1.50–10.73)**  | 3.30<br>(0.69–15.76)   | 2.89<br>(1.36–6.15)**     | 4.93<br>(2.31–10.52)***  | 9.42<br>(2.24–39.68)**  | 2.19<br>(0.63–7.69)      | 5.36<br>(1.74–16.44)**   | 7.42<br>(0.92–59.95)      |      |
| Proband                | 1.76<br>(1.33–2.33)***                 | 1.38<br>(0.53–3.58)  | 1.18<br>(0.65–1.90)   | 1.38<br>(1.03–1.84)*    | 1.11<br>(0.65–1.90)    | 1.18<br>(0.80–1.60)       | 1.19<br>(0.90–1.57)      | 1.29<br>(0.86–1.94)     | 1.08<br>(0.68–1.71)      | 1.32<br>(0.92–1.88)      | 1.98<br>(0.90–4.36)       |      |
| Conduct disorder       | 11.52<br>(5.13–25.89)***               | NA <sup>1</sup>      | 6.55<br>(1.29–33.20)* | 3.36<br>(1.53–7.34)**   | 6.55<br>(1.29–33.20)*  | 4.95<br>(2.41–10.14)***   | 4.45<br>(2.30–8.61)***   | 3.91<br>(1.57–9.76)***  | 14.25<br>(2.93–69.46)*** | 5.45<br>(2.16–13.72)***  | 4.69<br>(1.17–18.87)*     |      |
| Hyperactivity disorder | 3.13<br>(1.57–6.24)***                 | 3.83<br>(0.71–20.03) | 1.28<br>(0.34–4.78)   | 2.32<br>(1.44–4.69)*    | 1.28<br>(0.34–4.78)    | 3.78<br>(1.94–7.38)***    | 2.93<br>(1.52–5.63)***   | 2.63<br>(1.05–6.58)*    | 3.71<br>(1.01–13.55)*    | 2.72<br>(1.06–7.03)*     | 3.38<br>(0.83–13.75)      |      |
| IQ                     | 0.97<br>(0.87–1.00)                    | 0.87<br>(0.64–0.99)* | 0.94<br>(0.84–1.05)   | 0.92<br>(0.86–0.96)*    | 0.94<br>(0.84–1.05)    | 0.96<br>(0.92–1.06)       | 0.95<br>(0.87–1.05)      | 0.92<br>(0.85–1.00)     | 0.99<br>(0.87–1.11)      | 0.92<br>(0.84–1.02)      | 0.89<br>(0.78–1.01)       |      |
| School leaving age     | 2.52<br>(1.06–6.00)*                   | 1.14<br>(0.11–12.07) | 3.08<br>(0.57–16.54)  | 2.2<br>(0.82–5.96)      | 3.08<br>(0.57–16.54)   | 2.29<br>(0.76–6.94)       | 4.36<br>(1.70–11.19)**   | 1.39<br>(0.36–5.35)     | 2.03<br>(0.18–22.95)     | 12.73<br>(2.83–57.42)*** | 25.20<br>(5.13–123.81)*** |      |
| Reading problem        | 1.44<br>(0.75–2.77)                    | 1.12<br>(0.20–6.26)  | 2.50<br>(0.70–8.95)   | 3.17<br>(1.61–6.25)***  | 2.50<br>(0.70–8.95)    | 1.85<br>(0.97–3.52)       | 1.90<br>(1.02–3.54)*     | 2.01<br>(0.77–5.28)     | 1.35<br>(0.40–4.57)      | 2.16<br>(0.86–5.41)      | 2.29<br>(0.69–7.59)       |      |
| Delinquent peer group  | 5.04<br>(2.67–9.51)***                 | 3.62<br>(0.60–21.76) | 3.26<br>(1.01–10.56)* | 5.02<br>(2.34–9.91)***  | 3.26<br>(1.01–10.56)*  | 3.17<br>(1.64–6.14)***    | 5.44<br>(2.78–10.68)***  | 2.75<br>(1.19–0.35)*    | 9.60<br>(2.81–32.84)***  | 6.67<br>(2.71–16.43)***  | 6.27<br>(1.58–24.83)**    |      |
| No best friend         | 1.69<br>(0.89–3.19)                    | 3.24<br>(0.53–19.73) | 2.99<br>(0.80–11.24)  | 1.85<br>(0.98–3.52)     | 2.99<br>(0.80–11.24)   | 1.42<br>(0.77–2.65)       | 1.58<br>(0.84–2.95)      | 1.92<br>(6.79–4.68)     | 1.53<br>(0.53–4.42)      | 2.12<br>(0.90–5.01)      | 1.59<br>(0.47–5.27)       |      |
| Alloofness             | 1.24<br>(0.34–4.53)                    | NA <sup>2</sup>      | 3.82<br>(0.64–22.74)  | 1.56<br>(0.43–5.67)     | 3.82<br>(0.64–22.74)   | 0.77<br>(0.23–2.63)       | 1.24<br>(0.30–5.06)      | 2.77<br>(0.58–13.15)    | 1.00<br>(0.14–7.10)      | 3.56<br>(0.77–16.47)     | 1.08<br>(0.98–1.20)       |      |
| At < 17 years          |  |                      |                       |                         |                        |                           |                          |                         |                          |                          |                           |      |
| Any crime              |  |                      |                       | 8.82<br>(4.53–17.19)*** | 5.85<br>(1.53–22.33)** | 2.50<br>(1.31–4.81)**     | 4.75<br>(2.56–8.87)***   | 5.90<br>(2.26–15.42)*** | 5.71<br>(1.87–17.45)**   | 1.31<br>(32.8–16.32)*    | 4.09<br>(1.21–13.82)*     |      |
| Violent crime          |  |                      |                       | 19.72<br>(1.51–185.35)* | NA <sup>2</sup>        | 7.82<br>(1.25–40.82)*     | 10.46<br>(1.10–99.53)*   | 2.36<br>(0.52–14.73)    | 10.37<br>(1.12–96.41)*   | NA <sup>1</sup>          | NA <sup>2</sup>           |      |
| At 17–21 years         |  |                      |                       |                         |                        |                           |                          |                         |                          |                          |                           |      |
| Any crime              |  |                      |                       |                         |                        | 6.14<br>(2.91–12.96)***   | 15.08<br>(6.71–33.88)*** | 8.03<br>(3.26–19.82)*** | 12.24<br>(4.00–37.45)*** | 15.96<br>(5.11–49.85)*** | 6.18<br>(1.89–20.15)**    |      |
| Violent crime          |  |                      |                       |                         |                        | 30.53<br>(4.22–220.83)*** | 13.51<br>(2.51–72.58)**  | 9.51<br>(2.05–44.00)**  | 12.09<br>(2.64–55.34)*** | 16.86<br>(3.05–93.27)*** | 5.94<br>(0.99–35.66)      |      |
| At 22–30 years         |  |                      |                       |                         |                        |                           |                          |                         |                          |                          |                           |      |
| ASPD                   |  |                      |                       |                         |                        |                           |                          |                         |                          |                          |                           |      |
| Any crime              |  |                      |                       |                         |                        |                           |                          |                         |                          |                          |                           |      |
| Violent crime          |  |                      |                       |                         |                        |                           |                          |                         |                          |                          |                           |      |
| At 31+ years           |  |                      |                       |                         |                        |                           |                          |                         |                          |                          |                           |      |
| ASPD                   |  |                      |                       |                         |                        |                           |                          |                         |                          |                          |                           |      |
| Any crime              |  |                      |                       |                         |                        |                           |                          |                         |                          |                          |                           |      |
| Violent crime          |  |                      |                       |                         |                        |                           |                          |                         |                          |                          |                           |      |

1. High risk independent measure predicts all cases of positive (antisocial) outcome.  
 2. High risk independent variable predicts none of positive (antisocial) outcomes.  
 ASPD, antisocial personality disorder; NA, odds ratio not applicable.



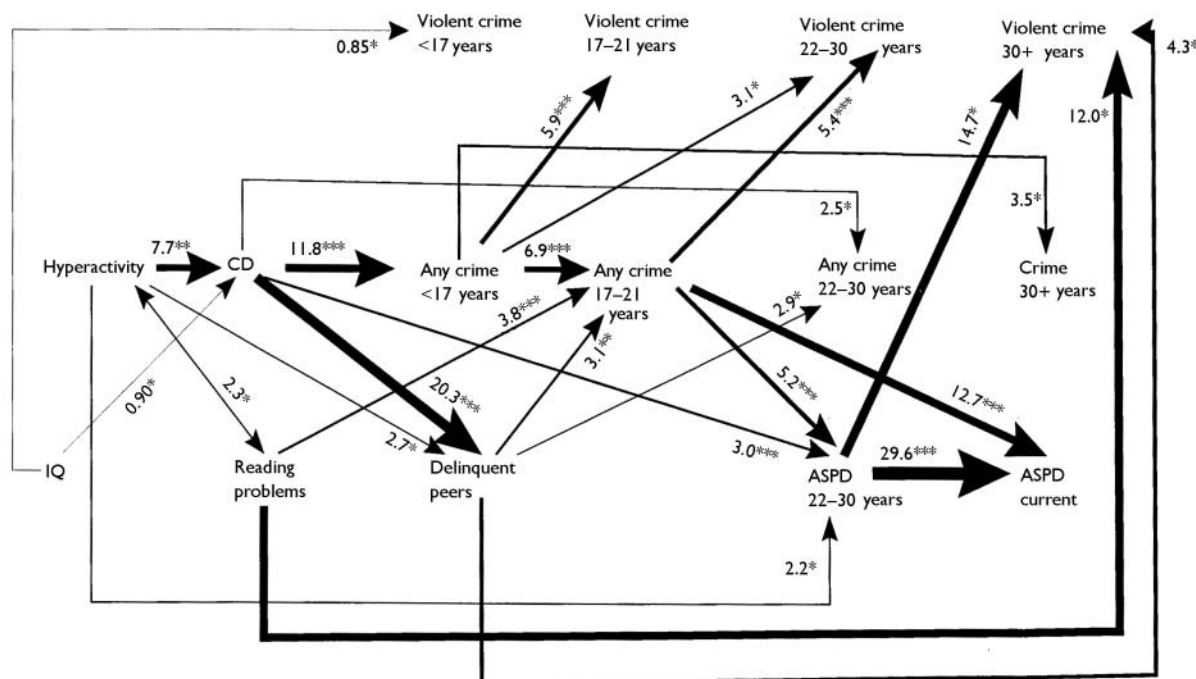
**Fig. 1** Temporal associations between variables assumed for multivariate longitudinal model-fitting. Variables were entered in blocks according to the age period to which they were assigned. ASPD, antisocial personality disorder.

built up a longitudinal model based on temporal sequence (Fig. 1). Reading problems and IQ were selected as antecedent variables based on longitudinal studies where these appear to be precursors of later behavioural problems. Hyperactivity disorder had a requirement of onset before age 7 years and was therefore likely to precede conduct disorder reaching diagnostic threshold. Absence of a best friend and aloofness were not included, as they did not predict outcome in the univariate analyses. A model was built up, allowing all temporally antecedent variables to be possible predictors. Non-significant variables were sequentially removed, starting with the least significant, and re-running the model each time. Only those predictor variables significant at  $P < 0.05$  were retained in the final model.

The significant relationships are shown in Fig. 2, with the adjusted odds ratios. Both IQ and reading problems were entered

as predictors of hyperactivity. Although reading problems and IQ were themselves highly associated (OR=0.82 per IQ point, 95% CI 0.77–0.94;  $P < 0.001$ ), their patterns of prediction were different from those of early disruptive behaviours. Whereas IQ was associated with conduct disorder but not with hyperactivity, not even in bivariate analyses, reading problems were associated with hyperactivity but not with conduct disorder – again not even in bivariate analyses. Having an adolescent delinquent peer group was predicted by both conduct disorder and hyperactivity. Any juvenile crime was predicted by conduct disorder alone. Juvenile violent crime was predicted by low IQ; an odds ratio for the effect of conduct disorder could not be calculated in the multivariate context because in all cases in which violent crime had been committed the person had conduct disorder.

Any transitional crime was most strongly predicted by any juvenile crime, although a delinquent peer group and reading problems also contributed. Although conduct disorder and hyperactivity were significant predictors in bivariate analysis, they had no independent effect when more temporally proximate variables were included. Violent crime during the transitional period was independently predicted only by any juvenile crime. As with any transitional crime, while both conduct disorder and delinquent peer group predicted transitional violent crime in univariate analyses, neither association was significant in multivariate analysis. Although the number of violent crimes in both juvenile and transitional periods was small, it is of interest that none of the 6 persons who committed violent crimes in the juvenile period were among the 12 committing them in the transitional period.



**Fig. 2** Final model from multivariate analysis, retaining only significant associations. Adjusted odds ratios are given, along with significance levels: \* $P < 0.05$ ; \*\* $P < 0.01$ ; \*\*\* $P < 0.001$ . ASPD, antisocial personality disorder; CD, conduct disorder.

The finding of antisocial personality disorder in early adult life was predicted by three variables: conduct disorder, hyperactivity and any transitional crime. That crime in the preceding age period predicted early antisocial personality disorder is not surprising, but the further impact of childhood variables, having accounted for the intermediate effects, is notable. On its own, conduct disorder correctly classified early antisocial personality disorder in 69.5% of the sample. Of those with conduct disorder, half (48 of 95; 51%) went on to have antisocial personality disorder in the early period, whereas only 17 of the 115 (15%) not reaching the conduct disorder threshold had subsequent antisocial personality disorder. Nine of these 17 had one DSM-III-R symptom, leaving only 8 of the 65 with early antisocial personality disorder without any DSM-III-R conduct symptoms by retrospective report. About the same proportion of those with hyperactivity (23 out of 42; 55%) developed early antisocial personality disorder, although its impact in multivariate analyses was smaller than that of conduct disorder. The combination of childhood conduct disorder and hyperactivity, along with any crime in the preceding period, correctly classified more than three-quarters (78%) of the sample with respect to early antisocial personality disorder.

Any early adult crime was predicted by any offences in the preceding period, a delinquent peer group and conduct disorder, with crime in the preceding period the strongest predictor. Violent crime in early adulthood was predicted by any crime in both of the two preceding periods. Although violent crime in the transitional period was a significant predictor in

bivariate analyses, it failed to reach significance in multivariate analysis.

Current antisocial personality disorder was most strongly predicted by its presence in the preceding period. Any crime in the transitional period added to the prediction. Because any crime in the transitional period and any crime in the early adult period were so strongly associated they did not predict independently, but there was little difference in the model fit according to which crime variable was entered. In the presence of early antisocial personality disorder, none of the earlier childhood variables contributed in multivariate analyses, because the association between early and current antisocial personality disorder was so strong. When early antisocial personality disorder was removed as a predictor of its current presence but all other preceding variables were entered into the model, the two significant independent predictors were conduct disorder (OR=8.2, 95% CI 1.7–39.4;  $P < 0.01$ ) and early adult crime (OR=11.8, 95% CI 3.2–43.3;  $P < 0.001$ ). Early antisocial personality disorder and transitional crime correctly classified 92.3% of the group with respect to current antisocial personality disorder; a similar multivariate model including conduct disorder and early adult crime correctly classified 91.6% of the group.

In the current period, any crime was independently predicted by any crime in both the early adult and juvenile periods. Current violent crime was independently predicted by early adult antisocial personality disorder and also by reading problems. All 11 participants with current violent crime had a history of any crime in the early adult period, indicating a strong

relationship, although an odds ratio could not be calculated.

### Characteristics of childhood disruptive symptoms

The role of age at onset of DSM-III-R conduct disorder symptoms was examined by determining the age at first onset of any symptom and then dichotomising according to onset before age 10 years or at 10 years or later, as specified in DSM-IV (American Psychiatric Association, 1994). Of the 167 participants with any conduct disorder symptom, 104 reported onset of at least one symptom before age 10 years. In bivariate logistic regression, age at onset was not significantly associated with IQ or reading problems and fell short of a significant association with hyperactivity (OR=2.1, 95% CI 0.9–5.0;  $P = 0.10$ ). Early age at onset also did not predict any of the adult outcomes. The findings were similar when the analysis of symptom onset was limited to those with a conduct disorder diagnosis.

The predictive role of levels of conduct and hyperactivity symptoms was tested by creating three groups: those not meeting threshold for either conduct disorder or early antisocial personality disorder ( $n = 98$ ); those with conduct disorder but not early antisocial personality disorder ( $n = 47$ ); and those with both conduct disorder and early antisocial personality disorder ( $n = 48$ ). The three groups were compared with respect to the mean number of hyperactivity and conduct disorder symptoms using analysis of variance (ANOVA; Table 4). There was a significant main effect for both symptom counts, with a *post hoc* Tukey test indicating significant group differences between all three groups for conduct symptoms. For hyperactivity, group differences were significant between no antisocial behaviour and persistent antisocial behaviour and also between child antisocial behaviour only and persistent antisocial behaviour.

A similar strategy was used to examine the specific impact of aggressive and non-aggressive childhood antisocial behaviours on persistence. The aggressive conduct disorder symptoms included fighting, assault on others, stealing with confrontation of the victim, threatening others, extortion and cruelty to animals, and were scored by a symptom count of 0–6. All other conduct symptoms were included in the non-aggressive count, and scored from 0

**Table 4** Mean symptom levels according to stability of antisocial behaviour

| Symptom area           | Group means          |                                  |                                | $F_{(2,190)}^1$ | Group differences <sup>2</sup> |
|------------------------|----------------------|----------------------------------|--------------------------------|-----------------|--------------------------------|
|                        | Never antisocial (1) | Antisocial in childhood only (2) | Antisocial in both periods (3) |                 |                                |
| Total conduct          | 0.25                 | 3.91                             | 5.56                           | 248.84***       | 1 < 2, 1 < 3, 2 < 3            |
| Total hyperactivity    | 0.52                 | 1.33                             | 3.70                           | 16.60***        | 1 < 3, 2 < 3                   |
| Aggressive conduct     | 0.03                 | 0.83                             | 1.77                           | 82.62***        | 1 < 2, 1 < 3, 2 < 3            |
| Non-aggressive conduct | 0.23                 | 3.09                             | 3.75                           | 290.42***       | 1 < 2, 1 < 3, 2 < 3            |

1. Analysis of variance;  $P < 0.05$ ; \*\* $P < 0.01$ ; \*\*\* $P < 0.001$ .

2. Tukey *post hoc* test, all tested at  $P < 0.05$ .

to 7. For both cases there was a highly significant main effect (Table 4) and Tukey *post hoc* tests indicated that all three groups were significantly different from each other.

## DISCUSSION

### Conduct disorder and hyperactivity as predictors of adult antisocial personality disorder

Our findings extend the results from other longitudinal studies by demonstrating the long-term impact of childhood characteristics on antisocial behaviour in mid-adult life. Bivariate analyses show that both childhood hyperactivity and conduct disorder are as strongly related to later as to early adult antisocial personality disorder. The multivariate findings further support the role of childhood behaviour problems in demonstrating the independent associations of conduct disorder and hyperactivity on antisocial personality disorder in the early adult period. Within this sample, only 14 of the 104 (13%) participants below the threshold for both hyperactivity and conduct disorder had early adult antisocial personality disorder, compared with 20 of 31 (65%) of those in whom both disorders were present. The observation that childhood conduct disorder and hyperactivity did not predict antisocial personality disorder in the current period in the multivariate analyses reflects the strong relationship between antisocial personality disorder in the two periods. Of the 14 participants with both conduct disorder and current antisocial personality disorder, only one did not also have early antisocial personality disorder; this person's interview data recorded only one symptom of the disorder in the 22–30 year age period but a violent offence was committed by him during that time. Of participants with neither hyperactivity nor conduct disorder, only 2 of 81 (2.5%) with current period data had current antisocial personality disorder, compared with 7 of 20 (35%) where both childhood disorders were present.

### Mediating influences between childhood conduct and hyperactivity disorders and adult outcome

Our findings highlight the role of mediators in the longitudinal course of antisocial behaviour. Having a delinquent peer group in adolescence independently predicted any

crime in both the transitional and the early adult period as well as violent crime in current adulthood. Of those with conduct disorder and early adult antisocial personality disorder, 62% had a delinquent peer group in the intervening time period, compared with only 39% of those with conduct disorder but no adult antisocial personality disorder and 9% of those with neither. Similarly, in multivariate analyses any juvenile crime was a predictor of crime in all three of the subsequent periods. These mediators are themselves predicted by childhood conduct disorder. A notable exception was violent crime, which could be considered the most extreme of the antisocial behaviours but predicted very little subsequent antisocial behaviour. The bivariate analyses of violent offences as predictors demonstrated odds ratios that were well above 1, but often with wide confidence intervals, because of the small number of participants who had committed violent offences. It is therefore likely that the failure of violent offences to predict is mainly a problem of power.

Our failure to find a significant association between aloofness and antisocial behaviour may relate to variable definition. Our measure of aloofness is based on the absence of a peer group and does not take account of the motivational components that might differentiate anxious individuals who are interested in having social relationships from those who are truly aloof. Other work has highlighted the need to differentiate anxiety or withdrawal, which do not increase the risk of antisocial behaviour, from aloofness or inhibition (Kerr *et al*, 1996). Our aloofness measure showed a non-significant association with the presence of an anxiety disorder (OR=2.8, 95% CI 0.8–10.1;  $P=0.11$ ), suggesting that it might be contaminated by anxiety. As anxiety may be protective against antisocial behaviour (Kerr *et al*, 1997), this contamination could wash out an effect of aloofness. When those with an associated anxiety disorder were excluded from the aloofness group, the numbers (5 participants) were too small for analysis.

### Predictive role of severity and early onset of conduct disorder

This study supports the view that severity of conduct problems is an important predictor of outcomes (Robins, 1991). A similar effect was found for symptoms of hyperactivity. Our results confirm the

importance of childhood aggression on long-term outcome but highlight that non-aggressive conduct symptoms also predict adult status. The absence of aggression may not indicate a good prognosis when there are multiple other conduct disorder and hyperactivity symptoms.

Other studies have differentiated early-onset from adolescent-limited conduct disorder, suggesting that the latter is associated with a relatively good long-term prognosis (Moffitt, 1993a). Our results fail to substantiate this distinction, detecting no significant difference in outcome according to age at onset of conduct symptoms. One possible explanation for this difference is that retrospective recall might increase inaccuracy in dating symptom onset, obscuring a true relationship in our data. It is also possible that factors associated with clinical referral have influenced the impact of early-onset *v.* late-onset disorder, with those experiencing later onset who were referred for psychiatric assessment being a subgroup at greater risk of ongoing antisocial behaviour than the general population with late-onset conduct disorder. Against this interpretation is the fact that the distinction between early and late onset has been reported in other clinical samples (Lahey *et al*, 1998). A recent follow-up into adult life of the sample in which the early-onset/adolescent-limited distinction was made revealed that the later-onset group were showing more adult antisocial behaviour than controls, suggesting that outcome for this group might be less benign than previously thought (Moffitt *et al*, 2002).

### Cognitive influences on antisocial behaviour

Level of IQ was associated with childhood conduct disorder and also with juvenile delinquency, both 'any' and 'violent' crime under age 17 years, and any crime during the transitional period. There was no significant association, even in bivariate analyses, with adult outcomes, although the relationship with violent crime in early and mid-adulthood fell just short of significance ( $P=0.06$  and  $P=0.08$ , respectively) and the relationships with early and current antisocial personality disorder were of similar magnitude. The effect of reading problems was more long-lasting, with significant bivariate associations with any crime in the transitional, early adult and current periods and with violent crime in



mid-adulthood. The relationship with later violent crime remained in the multivariate analysis. Most of the previous work linking early cognitive problems and subsequent antisocial behaviour has used adult criminality rather than antisocial personality as the outcome (Farrington, 1993), and has suggested that the link might be largely with verbal ability and verbal memory or executive functioning deficits (Moffitt, 1993b). Although the Quick Test correlates slightly more with verbal than with performance IQ tests, it is best considered as a general measure of ability. It is possible that a more specific measure would have shown stronger associations with adult outcomes. Our finding of prediction from reading problems not only to criminality but also to antisocial personality disorder argues against a mechanism of poor literacy affecting detection rather than perpetration of crime and suggests instead that reading problems are a weak but long-term predictor of antisocial behaviour more generally.

The failure to find an association between reading problems and conduct disorder is surprising because of the consistency of this finding in earlier research (Maughan *et al*, 1996). However, work has suggested that the link between reading problems and disruptive behaviour might be mediated through hyperactivity (Fergusson & Horwood, 1995), an association that was present in our data. Although our measure was retrospective, it showed good agreement with the childhood psychometric data that were available. The finding of much weaker links between reading problems and adult antisocial behaviour is consistent with other follow-up studies (Maughan *et al*, 1996). The association in multivariate analysis between reading problems and any crime in early adulthood and violent crime in mid-adult life, but not with antisocial personality disorder, suggests that the link between cognitive problems and antisocial outcomes is strongest in relation to criminality. The question remains open from the studies to date whether this relationship in part reflects the greater likelihood of those with cognitive problems being detected when involved in criminality.

### Implications for intervention

The importance of childhood and adolescent predictors of subsequent antisocial behaviour raises the possibility that

### CLINICAL IMPLICATIONS

- Childhood disruptive behaviour has potent effects on antisocial behaviour and criminality, even into mid-adulthood.
- Intermediate, 'stepping stone' experiences partially mediate between childhood disruptive behaviour and adult outcomes. Reducing subsequent high-risk experiences among those with early disruptive behaviour might alter their life trajectory away from antisocial behaviour.
- Secular trends to increased antisocial behaviour in both childhood and adult life indicate that interventions to reduce child disruptive behaviour should be a high priority for public mental health programmes.

### LIMITATIONS

- Although the models presented assume a longitudinal course, the use of retrospective data make it impossible to be certain of the direction of effects. Recall of childhood status may be influenced by subsequent behaviour and experiences.
- The sample varied in date of presentation to clinical services and age at follow-up in adult life, which may increase the heterogeneity of the group. Caution should be used in extrapolating from a clinical sample to the general population.
- Data were largely obtained by self-report (excluding criminal records) and multiple informants would be expected to give additional information regarding both child and

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intervention to reduce these antecedents might alter adult outcomes. Several intervention programmes, such as On Track in the UK, have reduction of adult antisocial behaviour as an explicit aim of child-based intervention. However, the demonstration of a longitudinal association does not imply particular mechanisms of causality. In particular, if the longitudinal association is due to genes that affect the risk of both child and adult problems, then interventions to reduce the presence of childhood problems will not reduce negative adult outcome. Thus, caution is necessary regarding the implications of the findings for intervention.

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