Article

Mechanisms underlying social gradients in child and adolescent antisocial behaviour

Patrycja J. Piotrowska[a,*], Christopher B. Stride[b], Barbara Maughan[c], Richard Rowe[a]

[a] Department of Psychology, University of Sheffield, United Kingdom
[b] Management School, University of Sheffield, United Kingdom
[c] Medical Research Council (MRC) Social, Genetic and Developmental Psychiatry Centre, Institute of Psychiatry, Psychology & Neuroscience, King's College London, United Kingdom

ABSTRACT

Objective: A number of studies demonstrate a social gradient in behavioural problems, with children from low-socioeconomic backgrounds experiencing more behavioural difficulties than those from high-socioeconomic families. Antisocial behaviour is a heterogeneous concept which includes diverse behaviours such as physical fighting, vandalism, lying, disobedience and irritability. It remains unclear whether the mechanisms underlying social inequalities are similar across these different subtypes of antisocial behaviour. This study aimed to simultaneously test a range of individual, family and neighbourhood factors as mediators of the relationship between income and subtypes of antisocial behaviour.

Method: Data on a UK representative sample of 7977 children and adolescents, aged 5–16, was analysed in a series of nested structural equation models. A range of antisocial outcomes, including irritability, aggression, and callous-unemotional traits, were measured. Income quintiles were used to indicate family socioeconomic status. A range of potentially mediating or confounding variables, such as family functioning and parental mental health, were also measured.

Results: Analyses revealed that unhealthy family functioning, neighbourhood disadvantage, stressful life events and children's literacy difficulties were mediating variables contributing to the indirect effect of income on a range of antisocial behaviours.

Conclusion: As expected family functioning accounted for a substantial proportion of the association between SES and antisocial behaviour, we also found evidence that child cognitive functioning might perform an important role. Our findings emphasise the importance of addressing the mechanisms underlying the association between SES and behavioural problems.

1. Introduction

A body of work shows that socioeconomic status (SES) is negatively related to child and adolescent behavioural problems Piotrowska, Stride, Croft, and Rowe (2015). Differences exist not only between rich and poor families but across the entire socioeconomic spectrum (Dodge, Pettit, & Bates, 1994; Emerson, Graham, & Hatton, 2006), and similar gradients have been found across heterogeneous forms of antisocial behaviour Piotrowska, Stride, Maughan, Goodman, and Rowe (2015). Importantly, these gradients are likely to be non-linear, with previous research reporting quadratic (Åslund et al., 2013) or cubic relationships Johnston, Propper, Pudney, and Shields (2014). Such non-linearity implies that the strength of the effect of SES on behavioural outcomes differs across the range of income. For example, there may be a stronger

relationship between SES and child behavioural problems in the low-middle to high-middle income families than in extremely low- and extremely high-income families Piotrowska et al. (2015).

Two reviews of quasi-experimental studies conclude that a causal effect of family SES on offspring antisocial behaviour contributes to the observed correlation (Jaffee, Strait, & Odgers, 2012; Maughan, Rowe, & Murray, 2017). Jaffee and colleagues (Jaffee et al., 2012) published a comprehensive review of the methodological challenges in identifying causal effects on child antisocial behaviour from the many family and social risk factors that have been identified in observational studies. The authors focussed on data from causally informative studies such as the Minnesota Family Investment Partnership Study where families where randomised to receive differing levels of welfare benefit Gennetian and Miller (2002). In this study lower levels of child

externalising behaviours were observed in families who received enhanced payments. Other reviewed studies used a range of methodologies including within-family comparisons (for example, between siblings and cousins) and natural experiments Costello, Erkanli, Copeland, and Angold (2010). The results converged on the conclusion that socioeconomic disadvantage does indeed have a causal effect on children's antisocial behaviour Jaffee et al. (2012). Maughan, Rowe and Murray (Maughan et al., 2017) reviewed an additional three studies published since 2012. One Swedish total population study (N > 526,000) found the association between family income and officially recorded violent crime in adolescents and young adults was non-significant once unobserved familial risk was taken into account by sibling comparison Sariaslan, Larsson, D'Onofrio, Långström, and Lichtenstein (2014). Two other studies using within-family change designs in well-designed studies (the Pittsburgh Youth Study (Rekker et al., 2015) and the Norwegian Mother and Child Cohort Study (Zachrisson & Dearing, 2015)) found evidence of a causal influence of status on antisocial behaviour. Therefore Maughan et al. (2017) concluded that the weight of evidence was still supportive of a causal role for family income in its relationship with antisocial behaviour.

The effect of SES on antisocial behaviour is likely to be indirect, potentially passing through a number of mediating variables. For example, low SES may lead to sub-optimal parenting approaches which may in turn cause antisocial behaviour, as posited by the family stress model Conger and Donnellan (2007). The possibility that the effect of SES on antisocial behaviour might be partially explained by a range of intermediate variables may be contrasted with a model where SES has a direct effect on antisocial outcomes with no role for intermediate factors to mediate the effect. A body of work indicates that SES is associated with parental emotional problems, lack of warmth, harsh discipline, and quality of home environment, and that these factors in turn lead to behavioural problems (Dodge et al., 1994; Elder, Van Nguyen, & Caspi, 1985; Conger et al., 1992; Votruba-Drzal, 2006). Specifically, the Family Stress Model (FSM) framework suggests that economic hardships exacerbate children's problems primarily through parents' psychological distress and disrupted parenting with a range of risk and protective factors (e.g., social support) also playing a role Masarik and Conger (2017). Other potentially intervening variables include language ability and neighbourhood deprivation, which are both associated with SES (Vernon-Feagans, Garrett-Peters, Willoughby, & Mills-Koonce, 2012) and also predict problem behaviour development Petersen, Bates, and D'Onofrio (2013). Finally, neighbourhood disadvantage has been often associated with increased levels of behavioural problems (Schneiders et al., 2003; McCulloch, 2006) and may potentially act as a mediator of the SES-antisocial behaviour relationship.

Antisocial behaviour is heterogeneous (Moffitt, Arseneault, & Jaffee, 2008) and these potential indirect relationships have not been explicitly tested across subtypes of antisocial behaviour. Child and adolescent antisocial behaviour is often described in reference to the two clinical diagnoses (American Psychiatric Association, 2013): oppositional defiant disorder (ODD) and conduct disorder (CD). These diagnoses, however, encompass a range of behaviours/dimensions that may have different aetiology, correlates, and prognosis. For example, Stringaris and Goodman (Stringaris and Goodman, 2009) reported that the three dimensions of oppositionality (irritability, headstrongness, and hurtfulness) uniquely predict different disorders. A more recent study (Whelan, Stringaris, Maughan, & Barker, 2013) confirmed that these dimensions are developmentally distinct from middle childhood to adolescence, and associate differently with outcomes later in life. Specifically, irritability predicts depression, and headstrongness is associated with delinquency and callous attitude.

Within the diagnosis of conduct disorder, symptoms may be meaningfully classified as involving physical aggression or not. A meta-analysis of twin and adoption studies (Burt, 2009) supported this distinction by showing that aggressive and non-aggressive/rule-breaking

behaviours may have different aetiology with varying magnitude of genetic and environmental effects. More recently, callous-unemotional (CU) traits have been recognised as a subtype of conduct disorder that is associated with both cognitive and emotional empathy deficits as well as a lack of concern for negative consequences Pardini, Lochman, and Frick (2003). Previous studies concluded that this group of antisocial individuals acquire unique emotional, cognitive, and personality characteristics (Frick & White, 2008; Frick, Ray, Thornton, & Kahn, 2014), and may also show substantial heritability Viding, Blair, Moffitt, and Plomin (2005). This may indicate distinct social information and emotional processing among individuals with CU traits.

This study simultaneously tests a range of individual, family and neighbourhood factors that are previously hypothesised mediators of the relationship between income and antisocial behaviour. We explore whether the same processes act on different behavioural subtypes and whether the same indirect effects are present across the range of income.

2. Method

2.1. Sample and data collection

The data were taken from the B-CAMHS 2004 survey; full study details are described elsewhere Green, McGinnity, Meltzer, Ford, and Goodman (2005). In summary, a sample of 10486 eligible addresses, drawn from the Child Benefit Records (a centralised register of families receiving the state benefit for each child in the family, which was universally available in 2004 and therefore covered almost all of the population) were chosen for interview. Of these, 7977 families (response rate = 76%) responded with sufficient information for diagnostic classification, and the remaining families either declined or could not be traced. Parents and young people aged 11 and older were interviewed alone. For the younger children, only parent report was available. A teacher questionnaire was also sent out where parents provided consent; teacher data were collected for 6236 (78%) of the 7977 participants. B-CAMHS obtained informed consent from parents and children and the study procedures received ethical approval from the appropriate multicentre ethics committee in Great Britain.

2.2. Measures

2.2.1. Antisocial behaviour

The well-validated Development and Well-Being Assessment (DAWBA) (Goodman, Ford, Richards, Gatward, & Meltzer, 2000; Foreman, Morton, & Ford, 2009) was administered to parents (and children aged 11 and older). A shorter version was administered to teachers. Skip rules in place for parents and young people meant that not all of them were asked all DAWBA questions, preventing measure construction for those informants. The DAWBA includes forced choice items complemented by open-ended questions. Behavioural difficulty symptoms were assessed on a 3-point Likert scale: not true (0), partly true (1) and certainly true (2). We used the teacher version of the DAWBA to measure 5 antisocial behaviour subtypes. ODD symptom questions formed irritability (e.g., temper tantrums, being angry and resentful), headstrongness (e.g., disobedience, arguing with adults) and hurtful (e.g., being spiteful) latent factors. CD symptoms items were grouped to form aggressive and nonaggressive dimensions.

A 7-item parent-report questionnaire (Moran, Ford, Butler, & Goodman, 2008) measuring callous-unemotional (CU) traits was completed for all participants. Each item was scored on a 3-point Likert scale coded as not true (0), partly true (1) or certainly true (2). The questions included perceiving a child as cold-blooded or callous, and not being genuinely sorry if s/he hurt someone. This measure correlated at 0.81 with the CU component of the Antisocial Process Screening Device Moran, Rowe, and Flach (2009). The six dimensions of antisocial behaviour (irritability, headstrongness, hurtfulness, aggressive

behaviours, nonaggressive behaviours, and callous-unemotional traits) were represented in the analyses as latent factors: the corresponding 6-factor measurement model had previously been tested using confirmatory factor analysis (Piotrowska et al., 2015), giving a satisfactory fit (CFI = 0.992, RMSEA = 0.023) under the fit index criteria suggested by Hu and Bentler (Hu & Bentler, 1998), and a significantly better fit than alternative factor solutions. The subsets of antisocial behaviour symptom items loading on to each factor showed good reliability in the current dataset.

2.2.2. Income

Caregivers were asked to indicate their annual household gross income on a 22 point ordinal scale; the values ranged from 'no source of income' (0) to '£40,000 or more' (21). These were then grouped to form income quintiles as follows: 1st quintile - £0 to £11,999; 2nd - £12,000 to £19,999; 3rd - £20,000 to £29,999; 4th - £30,000 to £39,999; 5th - £40,000 or more.

2.2.3. Parental mental health

Parents completed the 12 item General Health Questionnaire (GHQ-12) (Goldberg & Williams, 1988) screen for non-psychotic psychiatric disorders. This questionnaire assesses recent problems in everyday functioning such as feeling strained, concentration and sleep problems. A total problem score was calculated from each item scored as present (1) or absent (0). The GHQ-12 has been shown to demonstrate good sensitivity and specificity in identifying clinical cases Goldberg, Gater, and Sartorius (1997).

2.2.4. Family functioning

Parents completed the 12 item General Functioning Scale of the McMaster Family Assessment Device (FAD) Epstein, Baldwin, and Bishop (1983). Coverage includes misunderstandings, available support and openly discussing sadness and fears. Each item was rated as 'strongly agree' (1), 'agree' (2), 'disagree' (3) or 'strongly disagree' (4). Scores were averaged with higher scores indicating less healthy family functioning. This scale historically demonstrates good internal consistency reliability and criterion validity in distinguishing between healthy functioning families and those attending a psychiatric service (Kabacoff, Miller, Bishop, Epstein, & Keitner, 1990; Miller, Epstein, Bishop, & Keitner, 1985).

2.2.5. Stressful life events

Parents completed a 10-item scale addressing events such as serious illness of a parent and death of a friend: each event was scored 1 if it had been experienced and 0 if it had not Green et al. (2005). One question addressing parent police contact was omitted from scale construction as it involved a direct risk factor for children's antisocial behaviour and could represent the intergenerational transmission of antisocial behaviour (Maughan, Pickles, Rowe, Costello, & Angold, 2000; Meyer, Rutter, & Silberg, 2000; Besemer, Ahmad, Hinshaw, & Farrington, 2017). A total score was then created for each respondent by summing responses to the remaining nine questions.

2.2.6. Physical health and literacy

Parents answered the question'How is your child's health in general?' on a scale from very good (1) to very bad (5). Teachers assessed children's reading and spelling compared with peers. The 4-point response scale was coded 'above average' (1), 'average' (2), 'some difficulty' (3) or 'marked difficulty' (4).

2.2.7. Neighbourhood and peer characteristics

Neighbourhood characteristics were measured using the ACORN (CACI Information Services, 2014) classification scheme which is based on geographical characteristics and population behaviour (e.g., money spending or hobbies). Neighbourhoods were coded as 'wealthy achievers' (1), 'urban prosperity' (2), 'comfortably off' (3), 'moderate means'

(4) or 'hard pressed' (5). Parents reported whether a child's friends get into trouble, coded using an ad-hoc scale 'not at all' (0), 'a few are like that' (1), 'many are like that' (2) or 'all are like that' (3).

2.2.8. Covariates

The B-CAMHS study measured a selection of demographic variables that might confound the relationship between income and antisocial behaviour, and were therefore used as covariates in all analyses. Specifically these were: the number of children in a household; family type [coded 'married' (1), 'cohabiting' (2) or 'lone parent' (3)]; the family's employment status ['both parents working' (1), 'one parent working' (2), 'neither parent working' (3)]; caregiver's educational status ['No qualifications' (0), 'GCSE (D-F)' (1), 'GCSE (A-C)' (2), 'A-level' (3), 'Teaching/Nursing qualification' (4), 'Degree level' (5)]; child's age (in years), and child's gender ['female' (0), 'male' (1)].

2.3. Data analysis

This study built on previous work (Piotrowska et al., 2015) using these data in which cubic-shaped income gradient models adequately represented the relationships between income and six antisocial behaviour outcomes (aggressive, non-aggressive, headstrongness, hurtfulness, irritability, and callous-unemotional traits). A series of models tested whether the hypothesised mediating variables explain a nontrivial component of the relationship between income and antisocial behaviour. The schematic diagram of the mediation model for prediction of antisocial behaviour from income via potentially mediating variables is presented in Fig. 1. Models were tested separately for each outcome. SES, measured by income quintiles and hence an ordinal categorical variable, was dummy coded using backward difference contrasts, so that each quintile other than the lowest was represented by a dummy variable providing a test of the difference in the outcome between that quintile against the preceding quintile. Indirect effects from each income dummy variable to the specific antisocial behaviour outcome via each observed mediator variable were calculated and tested simultaneously. For each mediator, the product of the income dummy-to-mediator and mediator-to-outcome regression coefficients represents the relative indirect effect of that income dummy variable on the outcome factor via that mediator, that is, the indirect effect relative to that of the preceding category of income Hayes and Preacher (2013).

For each outcome the modelling comprised three stages. First, an overall 'partially' mediated model that included the direct effect of income on the antisocial outcome factor (naturally logistic shape modelled adequately by fixing the coefficients for the dummy variables representing quintile 4 vs 3 and quintile 3 vs 2 equal to emulate the cubic shape of the relationship) as well as the set of relative indirect effects via the eight hypothesised mediators (models 1.1–1.6). These relative effects of the income dummy variables on each mediator (and
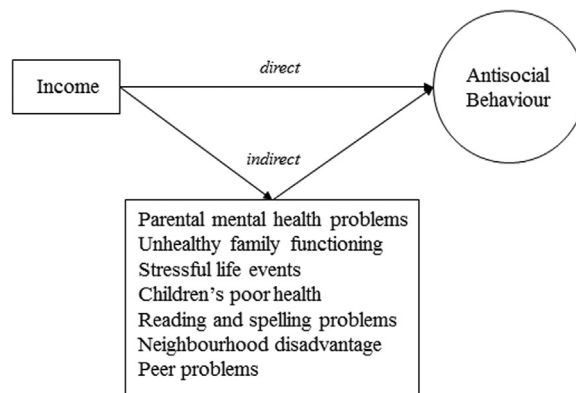

Fig. 1. The path diagram of the mediation model for prediction of antisocial behaviour from income via potentially mediating variables.

hence, collectively, the shape of the indirect effect via each mediator) were initially freely estimated (i.e. a logistic shape was not imposed). Second, the effect of income on each mediator was also modelled as a logistic shape by imposing the same fixings on the dummy variable coefficients as for the direct effect (models 2.1–2.6). Having ascertained the best fitting model (i.e., model 2 versus 1), the final set of models (model 3) removed the direct effects of income to test whether the mediators alone adequately explained the relationship between income and the antisocial outcomes. For each outcome, the three competing models were compared using the Satorra-Bentler scaled chi-square difference test Satorra and Bentler (1999). Relative indirect effects with 95% bias-corrected bootstrap confidence intervals are reported, which quantify the effect of being in one income quintile in contrast to the preceding one Hayes and Preacher (2013). In each analysis, mediator variables were allowed to correlate, and the effect of income was assessed with both mediators and outcomes regressed upon potentially confounding demographic variables, namely child's age and gender, and parents' marital and employment status, and education.

Models were fitted in Mplus 7.2 with a weighted least square estimator with standard errors (WLSM) and mean-adjusted chi-square test statistic applied Muthén and Muthén (1998–2012). Due to incomplete data on key study measures, the sample sizes used in these analyses differed very slightly between outcomes (4940–5031 cases). Where directional hypotheses were tested, p-values from one-tailed tests are reported. Additionally, given the large sample size, when testing both parameters and competing models, the significance of the results was reported at three levels, namely $p < .001$, $p < .01$ and $p < .05$. Further, to avoid preferring more complex models simply due to the high power of the chi-square difference tests, changes in model fit indices were also noted. The rule-of-thumb that a change in the CFI value (CFI – comparative fit index) less than or equal to 0.01 (i.e., reduced CFI indicating worse model fit) being considered trivial was used Cheung and Rensvold (2002).

3. Results

First the relationships between income, potential mediators and antisocial outcomes were explored. Clear income gradients were found across all mediators (Table 1) so that lower income was associated with higher levels of risk. Similarly, significant associations were found between the mediators and all antisocial outcomes (Table 2). Correlations between mediators (Table 3) were trivial ($< .1$) in most cases. Medium sized positive relationships were found between parental mental health problems and both of unhealthy family functioning ($r = .23$) and stressful life events ($r = .20$).

Table 4 shows comparisons between models for each outcome. The first models estimated logistic direct paths and unconstrained indirect paths from income separately for each outcome (models 1.1–1.6, Table 4). These were formally tested against respective models 2.1–2.6, which constrained the indirect pathways from income to mediators to have a logistic shape. Although the χ^2 difference tests were significant for four out of the six outcomes (i.e., irritability, headstrongness, aggressive, and nonaggressive), the model fit indices did not show substantial changes in model fit. Therefore, models 2.1–2.6 were accepted

for their respective outcomes as being more parsimonious. This shows that the indirect effect of income on a range of antisocial constructs can be modelled as having a logistic shape.

In models 3.1–3.6, only the indirect pathways from income to antisocial outcomes via the eight mediators were estimated (model 3). This set of models was not significantly worse than the models including the direct path from income to antisocial outcomes (models 2.1–2.6). Furthermore, CFIs remained similar and RMSEAs decreased between the respective pairs of models 2.1–6 and 3.1–6, indicating the last set of model models 3.1–3.6 as best-fitting for their respective antisocial outcomes. Likewise, considered against the suggested benchmark model fits (Goldberg & Williams, 1988), these indices indicated that models 3.1–3.6 were adequate. Removing the direct effect of income did not worsen model fit, hence the effect of income on antisocial behaviour is adequately modelled by its transmission via this set of mediators.

In order to test whether the mediators were of equal importance in accounting for the link between income and different forms of antisocial behaviour, the magnitude of the relative indirect effects estimated in models 3.1 to 3.6 were inspected (Online Supplement A). As income is measured by four dummy variables, there are four relative indirect effects for each mediator-outcome combination. To aid interpretation of the relative contributions of all mediators, the proportions of the total indirect effect on a particular outcome that can be attributed to a particular mediator are graphically presented in Fig. 2. Given the shape of the relationship with the largest effects in the middle, the fixed values for the two middle contrasts were chosen for illustration purpose. Unhealthy family functioning, reading and spelling difficulties, stressful life events and neighbourhood disadvantage contributed most strongly to explaining the association between income and the range of antisocial behaviours. Conversely, parental mental health, peer problems and children's poor health did not play an important independent role in mediating the effect of income on antisocial behaviour; their estimated effects were trivial and all of the 95% confidence intervals for their indirect effects included zero. Detailed results of the covariates estimation are provided in the Online Supplement B.

The relative importance of unhealthy family functioning, reading and spelling difficulties, stressful life events and neighbourhood disadvantage as mediators, conceptualised by considering their contribution to the total indirect effect, was similar across our outcomes of irritability, headstrongness, hurtfulness, aggressive and nonaggressive behaviours. Children from higher income quintiles were more likely to have better reading and spelling skills, fewer stressful life events and were more likely to live in more prosperous neighbourhoods. This, in turn, was associated with lower levels of antisocial behaviour. The pattern of effects was somewhat different for CU traits; paths via unhealthy family functioning and neighbourhood disadvantage yielded the strongest indirect effects, and the effects of stressful life events and reading and spelling difficulties were less pronounced.

4. Discussion

These results indicate that the effect of income on a range of antisocial behaviours is primarily transmitted via unhealthy family functioning, stressful life events, reading and spelling difficulties, and neighbourhood disadvantage. One of the principal mediators in this study was unhealthy family functioning, a collective measure of the level of support, trust, misunderstanding, and conflict within a family Epstein et al. (1983). Previous research found that family interactions and conflict mediated the relationship between SES and children's behavioural problems (Conger, Ge, Elder, Lorenz, & Simons, 1994; Harnish, Dodge, & Valente, 1995), with lower levels of SES having a detrimental effect on the quality of family interactions and support available, which in turn may lead to increased risk for behavioural problems. Conger and colleagues (Conger et al., 1994) suggested that family conflict and low quality interactions may create coercive

Table 1
Means of mediators by income quintiles.

	1st (low)	2nd	3rd	4th	5th (high)
Parental mental health problems	2.22	1.90	1.49	1.38	1.17
Unhealthy family functioning	1.79	1.74	1.69	1.66	1.59
Stressful life events	1.45	1.15	0.88	0.69	0.65
Children's poor health	1.48	1.45	1.32	1.30	1.25
Reading and spelling difficulties	2.32	2.19	1.97	1.83	1.68
Neighbourhood disadvantage	3.92	3.63	3.11	2.63	1.98
Peer problems	0.44	0.40	0.34	0.32	0.27

Table 2

Correlations between the mediators and antisocial outcomes[1].

	CU	Irritability	Headstrong	Hurtful	Aggressive	Non-aggressive
Parental mental health problems	0.19	0.09	0.09	0.07	0.07	0.07
Unhealthy family functioning	0.30	0.10	0.12	0.07	0.08	0.07
Stressful life events	0.15	0.13	0.13	0.10	0.11	0.09
Children's poor health	0.16	0.09	0.09	0.06	0.07	0.08
Reading and spelling difficulties	0.19	0.22	0.24	0.18	0.17	0.21
Neighbourhood disadvantage	0.17	0.13	0.12	0.12	0.12	0.11
Peer problems	0.25	0.20	0.23	0.18	0.16	0.17

[1] All correlations significant (p < 0.001, 2-tailed)

mechanisms and lead to hostility towards children and as such affect their externalising problems. In the present study the role of unhealthy family functioning was particularly pronounced regarding callous-unemotional traits. Individuals scoring high on CU traits are characterised by unique emotional, cognitive, and personality characteristics (Frick & White, 2008) such as callous lack of empathy, shallow or deficient affect American Psychiatric Association (2013). It might be that these characteristics represent children's response to family conflict and hostility, with children isolating themselves from the environment that lacks support, and as such being perceived by their parents as unemotional. It is also possible that the relationship between unhealthy family functioning and children's CU traits is bidirectional; children's callousness and unemotionality may disrupt family functioning and parent-child interactions which in turn, further exacerbate children's behaviour. Alternatively, CU traits are highly heritable (Viding et al., 2005) and shared genetic influences may contribute to the relationship between unhealthy family communication and children's callousness and unemotionality. Such alternative explanations will need to be explored in future studies.

Another important mediator was neighbourhood disadvantage, which substantially contributed to the total indirect effect of income on all antisocial outcomes studied. Previous research has often reported relationships between neighbourhood deprivation, collective efficacy and other structural or social neighbourhood variables with behavioural problems (Schneiders et al., 2003; Odgers, Moffitt, & Tach, 2009; Fabio, Tu, Loeber, & Cohen, 2011; Ingoldsby et al., 2006). However, it remains difficult to disentangle the effects of neighbourhood- and family-level disadvantage on behavioural problems. Both have been shown to have independent effects on antisocial behaviour, however, no studies have empirically tested potential indirect effects from family SES via neighbourhood disadvantage. It is possible that families self-select themselves into specific contexts, environments or neighbourhoods based on their financial resources. The causal role of neighbourhood deprivation is supported by evidence from a randomised housing voucher experiment which showed that moving to lower-poverty areas reduced the level of crime among young people Kling, Ludwig, and Katz (2005). It remains important to consider both family- and neighbourhood-level factors in order to fully delineate the relationship between SES and children's behavioural problems. It should also be noted that neighbourhood disadvantage can interact with biological risk to increase antisocial behavior. Lei and colleagues

(Lei, Simons, Edmond, Simons, & Cutrona, 2014) reported that the effects of neighborhood disadvantage on antisocial behavior were moderated by genetic polymorphisms showing that genetic variations account, at least in part, for dissimilarities in the way that people respond to their neighborhoods. This should be further considered in future studies that explore the importance of community-level factors as well as individual characteristics.

Stressful life events made a smaller but non-trivial independent contribution to explaining the indirect effect of income on all antisocial outcomes studied. Previous research has largely focussed on financial stresses Conger et al. (1993). One study, however, showed that SES is negatively correlated with family life stressors such as serious illness or death of significant other(s) which then predicted both teacher- and peer-reported behavioural problems Dodge et al. (1994). The current study supports this idea, indicating that stressful events in children's lives may mediate the effect of family income on children's behavioural problems, as has been previously shown for emotional problems Langton, Collishaw, Goodman, Pickles, and Maughan (2011). It could be argued, however, that it is antisocial behaviour that shapes future experiences and life events Rutter, Giller, and Hagell (1998). This alternative pathway, however, is more likely regarding 'dependent life-events' (i.e., events that result from the child's behaviour). In the current study, the stressful life events scale focussed on independent events such as serious mental or physical illness of a parent, or death of a child's close friend, which are unlikely to have resulted from the child's behaviour. Hence the idea of antisocial behaviour causing the stressful life events measured in this study seems less plausible.

Finally, reading and spelling difficulties as assessed by teachers mediated the effect of income on antisocial behaviour, with a pronounced contribution to the relationship between income and irritability, headstrongness, hurtfulness and nonaggressive behaviours. Previous research indicates that SES predicts children's language development (Vernon-Feagans et al., 2012), and language ability is associated with behavioural problems (Petersen et al., 2013; Brownlie, Beitchman, & Escobar, 2004). It is possible that the covariance between language skills and behavioural problems may be due to common genetic factors Beaver, Boutwell, Barnes, Schwartz, and Connolly (2014). Alternatively, language impairment may increase the risk for behavioural problems by affecting communication ability, social competence and moral development. Similarly, Ketelaars and colleagues (Ketelaars, Cuperus, Jansonius, & Verhoeven, 2010) found a significant

Table 3

Correlations between the mediators[1] (N = 5031).

	1	2	3	4	5	6	7
1. Parental mental health problems	–						
2. Unhealthy family functioning	0.23***	–					
3. Stressful life events	0.20***	0.05***	–				
4. Children's poor health	0.10***	0.11***	0.13***	–			
5. Reading and spelling difficulties	0.02	0.04**	0.06***	0.10***	–		
6. Neighbourhood disadvantage	0.03*	-0.02	0.04**	0.03*	0.04**	–	
7. Peer problems	0.09***	0.09***	0.09***	0.05***	0.08***	0.04**	–

[1] Significant 2-tailed correlations presented at ***p < 0.001 **p < 0.01 *p < 0.05 levels.

Table 4
Mediation model fits across outcomes.

Model	Fit Indices	Callous-unemotional	Irritability	Headstrongness	Hurtfulness	Aggressive	Nonaggressive
1	χ^2(df)	739.846(153)	106.674(42)	338.681(72)	67.733(23)	210.349(125)	227.153(72)
	RMSEA	0.028	0.017	0.027	0.02	0.012	0.021
	CFI	0.974	0.998	0.994	0.998	0.997	0.991
	R^2	0.285	0.171	0.204	0.139	0.201	0.216
2	χ^2(df)	755.269(160)	120.532(49)	347.174(79)	78.953(30)	224.940(132)	310.167(79)
	RMSEA	0.027	0.017	0.026	0.018	0.012	0.024
	CFI	0.974	0.998	0.994	0.998	0.996	0.988
	R^2	0.285	0.171	0.204	0.139	0.202	0.216
3	χ^2(df)	750.498(163)	116.892(52)	312.020(82)	80.050(33)	234.436(135)	274.000(82)
	RMSEA	0.027	0.016	0.024	0.017	0.012	0.022
	CFI	0.974	0.998	0.995	0.998	0.996	0.989
	R^2	0.282	0.167	0.204	0.137	0.198	0.215
Difference test							
2 vs 1		12.806(7)	14.642(7)*	15.437(7)*	13.551(7)	15.213(7)*	18.186(7)*
3 vs 2		5.886(3)	4.453(3)	3.104(3)	5.544(3)	6.776(3)	3.646(3)

  * significant at $p < 0.05$ level; Model 1 includes the direct effect of income on the antisocial outcome factor (modelled as a logistic shape) and the set of free indirect effects via the eight mediators; Model 2 includes the direct and indirect effects of income modelled as a logistic shape; Model 3 removed the direct effect of income on antisocial outcomes

negative relationship between pragmatic competence (i.e., communicative problems, understanding and conveying intentions) and conduct problems. This has been supported by a meta-analysis of prospective cohort studies which found that children with impaired language were more than twice as likely to experience externalising problems Yew and O'Kearney (2013). The study described here is the first to show that children's reading and spelling difficulties, operationalised as a proxy for children's language and communication abilities, may mediate the relationship between income and a range of behavioural problems.

Parental mental health problems, peer problems and children's general poor health did not independently contribute to the total indirect effect of income on any of the outcomes studied.

It is possible that parental mental health problems may serve as a more distal risk factor than some of the other mediators identified here, including unhealthy family functioning, as suggested in the Family Stress Model Conger and Donnellan (2007). The potential relationships between mediators will need to be explicitly addressed and the potential for serial mediation models explored. Nonetheless, current findings suggests that unhealthy family functioning, neighbourhood

disadvantage, stressful life events as well as children's reading and spelling problems may transmit the effect of income on children's antisocial behaviour.

Despite the strengths of the current study including simultaneous modelling of multiple mediators and their unique effects on heterogeneous forms of antisocial behaviour as well as controlling for a range of covariates such as household size or parent education and employment status, this study had some limitations. Firstly, we were limited in the choice of potentially mediating variables by the measures included in the B-CAMHS which may in some cases reflect compromises between comprehensive construct measurement and the brevity required to fit into a large-scale wide-ranging study of this sort. For example, while the GHQ is a well-validated screening tool for mental health problems, the construct measured may not fully represent all aspects of parental mental wellbeing that are relevant to the association of SES and antisocial behaviour. Moreover, other factors that have been previously shown to explain the relationship between SES and behavioural problems such as cognitively stimulating home environment or parenting behaviours (Linver, Brooks-Gunn, & Kohen, 2002; Eamon, 2000) could not be investigated here. However, we did find that the indirect effects
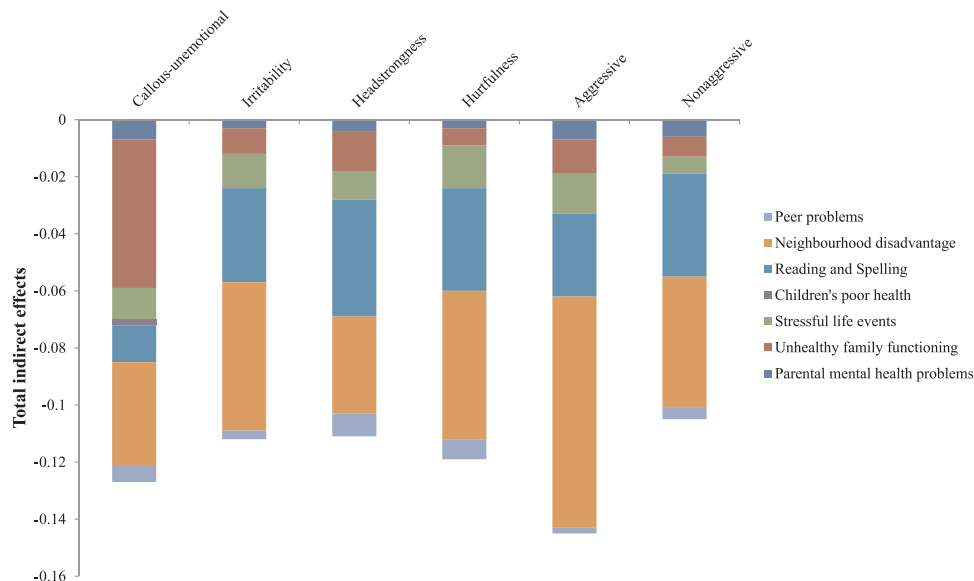

Fig. 2. Bar chart representing each mediator's middle contrasts contributions to the total indirect effect.

via the mediators included were substantial enough to render the direct effect of income on the antisocial behaviour measures as trivial. Another important factor to be considered in relation to child and adolescent antisocial behaviour is the age of onset. These data were not consistently available in the B-CAMHS dataset for all relevant outcomes. Instead, all analyses included child's age as a covariate. Previous research suggests that early- and late-onset groups are associated with similar risk factors and present similar characteristics (e. g., emotion processing deficits, changes in brain structure, atypical personality traits) Fairchild, Goozen, Calder, and Goodyer (2013). However, there is a large body of evidence identifying differences between antisocial behaviour disorders with early- and late-onset (Moffitt, Arseneault, & Jaffee, 2008) it is possible that social gradients or the mechanisms involving family variables differ between these groups. For example, Moore and colleagues (Moore, Silberg, Roberson-Nay, & Mezuk, 2017) found that early-onset life course persistent conduct disorder is more strongly influenced by childhood environment than late-onset antisocial behaviours. This will need to be further addressed in future research. Finally, mediation analyses assume causal processes but do not provide definitive causal evidence. Hence, alternative causal models cannot be ruled out particularly in the cross-sectional analyses presented here. Consistent with coverage in the previous literature (Yoshikawa, Aber, & Beardslee, 2012), the mediation models in the current study assume that SES causes variation in the mediators and the mediators lead to variation in antisocial behaviour. Although the direction of the effect from SES to antisocial behaviour has been supported by randomised controlled trials and natural experiments (Milligan & Stabile, 2011; Costello, Compton, Keeler, & Angold, 2003), potentially intermediate variables may show bidirectional relationships with antisocial outcomes, or in fact be directly affected by antisocial behaviour. Replication and extension of work in longitudinal studies is of high priority, particularly with regards to modelling potential links between mediators. Our findings provide a strong basis for causal hypotheses which should be examined in causally informative designs. These studies can then provide intervention targets in order to minimise social inequalities in and the absolute level of behavioural problems in childhood.

Declarations of interest

None.

Ethics response

The data were taken from the Mental Health of Children and Young People in Great Britain (B-CAMHS) 2004 survey conducted by the Office for National Statistics. Principal investigators obtained informed consent from parents and children and the study procedures received ethical approval from the appropriate multicentre ethics committee in Great Britain.

Appendix A. Supplementary material

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.ssmph.2019.100353.

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