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Emotional and Behavioural Resilience to Multiple Risk Exposure in Early Life: The Role of Parenting

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Emotional and behavioural resilience to multiple risk exposure in early life: The role of parenting

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Short title: Environmental risk, parenting, resilience

Emotional and Behavioural Resilience to Multiple Risk Exposure in Early Life: The Role of Parenting

Abstract

Ecological and transactional theories link child outcomes to neighbourhood disadvantage, family poverty, and adverse life events. Traditionally, these three types of risk factors have been examined independently of one another or combined into one cumulative risk index. The first approach results in poor prediction of child outcomes, and the second is not well rooted in ecological theory as it does not consider that distal risk factors (such as poverty) may indirectly impact children through proximal risk factors (such as adverse life events). In this study, we modelled simultaneously the longitudinal effects of these three risk factors on children's internalising and externalising problems, exploring the role of parenting in moderating these effects. Our sample followed 16,916 children (at ages 3, 5, and 7 years; N = 16,916; 49% girls) from the UK Millennium Cohort Study. Parenting was characterised by quality of parent-child relationship, parental involvement in learning, and parental discipline. Neighbourhood disadvantage, family poverty and adverse events were all simultaneously related to the trajectories of both outcomes. As expected, parenting moderated risk effects. Positive parent-child relationship, rather than greater involvement or authoritative discipline, most consistently 'buffered' risk effects. These findings suggest that a good parent-child relationship may promote young children's emotional and behavioural resilience to different types of environmental risk.

Keywords: cumulative risk; emotional and behavioural problems; Millennium Cohort Study; parenting; resilience

Early exposure to family poverty or neighbourhood disadvantage can constitute risks for children's emotional and behavioural adjustment [1-5]. The effects of these environmental factors appear to be robust, but seem to operate distally, via stressful life events [6] or parental depression [7]. Parental depression, in turn, appears to cause emotional/behavioural problems through less positive parenting behaviours including less parental warmth, more physical punishment, or fewer rules and routines [8]. Studies modelling environmental risk effects on child adjustment often generate indices of risk which include factors proximal to the child's behavioural development (such as family poverty or parenting) along with distal ecological factors, such as neighbourhood poverty [9]. A problem with including distal and proximal risk influences in the same index is that the opportunity to examine proximal factors as mediators or moderators of relations between distal risk and child outcomes is lost. In other words, with this approach it is not clear if proximal factors explain or modify the relationship between distal risk and child outcomes. In this study, we attempted to solve this problem by partitioning environmental risk into three types: neighbourhood disadvantage, family poverty and adverse life events. We modelled simultaneously the effects of these risk factors on children's emotional (internalising) and behavioural (externalising) problems. We allowed risk effects to be mediated (explained) and moderated (modified) by parenting (measured as quality of parent-child relationship, parental involvement in learning, and parental discipline). We also investigated whether the association between family poverty and adverse life events with child adjustment may be different at different levels of family poverty and at different numbers of adverse life events. Put differently, we examined if the effects of family poverty and adverse life events may be moderated by level of these risk factors and by parenting.

The moderation of risk by level of risk

Although most studies find that the relationship between exposure to environmental risk and child adjustment is linear [10], there is also some evidence for nonlinear (e.g., threshold) effects [11]. A threshold pattern suggests that after a certain number of risk factors are experienced, behaviour changes. Researchers that find threshold effects usually fit quadratic trends showing that, as their number increases, risk factors potentiate each other such that their combined effect on child adjustment is far worse than a mere summation of their separate effects [12]. However, some studies show a threshold beyond which children's adjustment plateaus rather than accelerates [13].

Some nonlinearity between cumulative risk and specific child outcomes is clearly in line with theory. For example, the threshold pattern of the effect of adverse life events on children's depressive symptoms [14] is in line with the stress sensitization hypothesis of depression. The stress sensitization model is consistent with the pioneering diathesis-stress perspectives, which suggest that individuals with a pre-existing vulnerability to psychopathology might require lower levels of stress to trigger the onset of symptoms than those without [15]. However, there may also be methodological reasons for the mixed picture about the linearity or otherwise of cumulative risk effects on child outcomes [6]. For example, because ceiling effects may result in artifactual nonlinearity, studies using high-risk samples may be more likely to find nonlinear relationships because of ceiling effects alone. An accelerating function could also mask more severe reactions to a particularly toxic risk factor. Studies using cumulative risk indices of factors widely different in impact (i.e., usually non-collinear) may tend to find nonlinear effects.

The moderation of risk by parenting

Not all young children have the same reactions to neighbourhood disadvantage, family poverty or adverse life events. Some continue on a typical life trajectory [16]. Positive or warm child-parent relationship is one factor

associated with such resilience. There is mounting evidence that aspects of nurturant parenting, particularly warmth and sensitivity, can favourably mold the stress-response tendencies of vulnerable children [17]. Parental nurturing may also help mitigate the wear and tear that low socio-economic status (SES) places on children's physiology [18-19], a well-established path to child behaviour and health. Positive parent-child relationship does not moderate only the effects of SES or neighbourhood disadvantage, family poverty and adverse life events on young children's emotional/behavioural functioning [20-24]. It also moderates the effects of other types of environmental risk [25-26, 19] as well as genetic risk [27] on a range of children's outcomes, from cognitive and social skills to substance abuse and allostatic load. At the same time, positive parent-child relationship has been found to mediate, at least partially, the effect of both neighbourhood disadvantage and family poverty on children's emotional/behavioural functioning [20, 28-30]. This finding is usually taken to support the social causation view that socio-economic disadvantage affects families and the development of children through both family stress processes and family investments in children [31]. By contrast, positive parent-child relationship seems to moderate rather than mediate the direct effect of adverse life events on children's emotional/behavioural problems [32].

The roles of parental discipline and parental involvement in learning as possible moderators of the association between environmental risk and child emotional/behavioural functioning are less well-examined. To the best of our knowledge, neither has been investigated as a moderator of the effects of the risk factors examined in this study, although parental involvement has been tested as a moderator of the effect of SES [33], which is related to both neighbourhood disadvantage and family poverty. We expected that both low involvement and negative discipline would exacerbate the effect of environmental risk on child emotional/behavioural functioning. Imposition of inappropriate costs for misbehaviour (negative parental discipline) and inadequate constraints on behaviour (low parental involvement) may leave children more vulnerable to other risks, more likely to be found in disadvantaged environments. We also expected that, like parent-child relationship, involvement and discipline would explain the effects of neighbourhood disadvantage and family poverty on children's emotional/behavioural problems. Negative parental discipline is related to parental depression [1, 30], which is associated with both family poverty and neighbourhood disadvantage. Negative parental discipline is also directly associated with family poverty, although not consistently [34, 30] or across ethnic groups [35]. Differences in parental involvement, on the other hand, are socio-economically patterned, but at the level of family [35] rather than neighbourhood [4].

The present study

Using a UK sample of families with young children followed longitudinally from age 9 months to 7 years, this study tested the nature of the longitudinal effects of neighbourhood disadvantage, family poverty and adverse life events on children's internalising and externalising problems, and explored the role of parenting in moderating these effects. Our first hypothesis was that the effect of both family poverty and adverse life events would be linear. To ensure that any nonlinear effects found would not be artifactual, we used a large normative sample and cumulative risk indices of both family poverty and adverse life events that did not differ in the degree of impact of their component risk factors. Our second hypothesis was that parenting would moderate the association between risk and child outcomes. We expected that parenting would also mediate the association between socio-economic risk (i.e., neighbourhood disadvantage and family poverty) and child outcomes.

To avoid attributing to environmental risk that which is due to correlated determinants of both risk and child outcomes, our models adjusted for mother's education as a proxy for parental human capital. Maternal psychological

distress [36] and family structure [37] were two additional potential confounders. Our child-level covariates were sex and ethnicity. Girls, in general, are at lower risk of behavioural problems than boys [38]. The main ethnic minority groups in the UK have similar or better mental health than white British children for common disorders, and higher rates for some less common conditions [39].

Method

Participants and procedure

The Millennium Cohort Study (MCS) (www.cls.ioe.ac.uk/mcs) is a longitudinal survey drawing its sample from all births in the UK over a year, from 1 September 2000. The sample is disproportionately stratified to ensure adequate numbers in the four UK countries and electoral wards with disadvantaged or ethnic minority populations [40]. Ethical approval for the MCS was gained from NHS Multi-Centre Ethics Committees, and parents gave informed consent before interviews took place. Sweep 1-4 took place when the children were around 9 months, and 3, 5 and 7 years. Externalising and internalising problems were measured in Sweeps 2-4. We used records for only one child per family (the first-born where there were twins or triplets). Our analytic sample comprised children with a score for externalising or internalising problems in at least one of Sweeps 2-4 (n = 16,916). Complete externalising and internalising data were not necessary as growth curve modelling, that we adopted, is able to handle unbalanced data.

Measures

Emotional (internalising) and behavioural (externalising) problems were measured at ages 3, 5 and 7 with the parent-reported Strengths and Difficulties Questionnaire (SDQ) [41]. Each SDQ item is a statement about a particular behaviour, scored 0 if the response is 'not true', 1 for 'somewhat true', and 2 for 'certainly true'. Each of the four problem subscales (emotional symptoms, peer problems, conduct problems, and hyperactivity/inattention) has 5 items. Internalising is the sum of emotional symptoms and peer problems, and externalising that of conduct problems and hyperactivity. In our sample, internal consistency was at acceptable levels, and in line with other SDQ research [42]. Across the three sweeps, it ranged from .61 to .72 for internalising, and from .78 to .80 for externalising problems.

Family poverty, henceforth socio-economic disadvantage *(SED)*, was measured as the sum of four binary indicators [23] of the family's level of economic deprivation at ages 3, 5 and 7. This four-item SED score captures poverty and its associated material conditions more broadly than relying on measured income alone, and emphasises the interrelationships between family-level socio-economic risk factors. The four items were overcrowding (>1.5 people per room excluding bathroom and kitchen), not owning the home, receipt of means-tested income support, and income poverty (below the poverty line for equivalised net family income at 60% of the UK national median household income). For each sweep, we created a summary score of the four SED items.

Adverse life events (ALE) at ages 3, 5 and 7 were measured as the number (out of eleven) of potentially stressful life events experienced by the family between two consecutive sweeps. The events, derived from available MCS data and based on Tiet et al.'s [43] Adverse Life Events Scale, were: family member died, negative change in financial situation, new stepparent, sibling left home, child got seriously sick or injured, divorce or separation, family moved, parent lost job, new natural sibling, new stepsibling, and maternal depression (currently being treated for depression or having been diagnosed with depression). At each sweep, the number of events occurring since the previous sweep was summed to form a total ALE score.

Neighbourhood disadvantage was measured with the Indices of Multiple Deprivation (IMDs) [44] at ages 3, 5 and 7 for each of the four UK countries. IMDs are weighted aggregations of certain domains of deprivation. One source of difficulty in making comparisons across UK countries is that these domains are not identical in the four countries. A second source is that the geographical unit on which levels of deprivation are assessed is smaller in Scotland than elsewhere (Data Zone vs. Lower layer Super Output Area). The index scores are based on the ranking on the individual domain scores. These rankings are exponentially transformed in order to avoid a cancelling-out effect when different domains are combined in the overall index. The domain scores are then combined and weighted to produce each country's overall index of deprivation. Compared to the smaller UK countries, England has a wider variation in underlying deprivation across neighbourhoods. This leads to a third source of incomparability. That is, a deprivation unit in England spans a larger range in absolute terms than the same unit in the other UK countries. We therefore expected differences in England to be more robust given that England has a wider variation in underlying deprivation across neighbourhoods. In Northern Ireland, on the other hand, more areas are considered poor or deprived. Scotland and Wales are situated in between these two countries.

Area stratum was adjusted in all conditional models to reflect the stratified sampling design of MCS.

Key covariates were the child-level variables of sex and ethnicity, and the family-level variables of family structure, maternal education, and maternal psychological distress. Maternal education was measured as the highest academic qualification achieved by Sweep 4, coded as University degree or not. Family structure (two parents or not) and maternal psychological distress (assessed with the 6-item Kessler scale [45]; α = .82-.84 across sweeps) were measured at ages 3, 5 and 7.

Parenting was measured at age 3 as *parent-child relationship*, *parental involvement*, and *negative parental discipline*, and was parent-reported. *Parent-child relationship* was assessed with the short form of the Child-Parent Relationship Scale [46], a 15-item 5-point measure of closeness and conflict. Conflict items were reverse scored so that higher scores indicated more positive parent-child relationship (α = .77). *Parental involvement* was assessed using five items measuring how frequently the parent engages in the following activities with the child: reading, helping to learn the alphabet, teaching counting, teaching songs/poems/rhymes, and painting/drawing. All items were measured on 6-point scales. A higher score indicated greater involvement (α = .60). *Negative parental discipline* was measured in MCS with seven items, from the Straus Conflict Scale [47], of how often the parent does the following when the child misbehaves: ignores, smacks, shouts, sends to naughty chair, takes away treats, tells off, and bribes with sweets. A total score was generated by summing the responses (on 5-point scales). A higher score indicated more frequent use of these tactics (α = .66).

Analytic strategy

First, we investigated whether those families in our analytic sample (n = 16,916) were different (at $p < .05$) from those families not in the analytic sample (n = 2,601) on our study variables. Next, we explored the shape of the children's average trajectories of externalising and internalising problems, which, as discussed below, was curvilinear. Following this, we inspected the correlations between our main (risk, moderator and outcome) variables, and between the items of the risk indices. We then explored levels and patterns of missingness in our covariates to decide on our approach to dealing with missing data. Finally, we fitted three-level growth curve models which enabled us to avoid the underestimation of standard errors due to the hierarchical nature of our data by having repeated measures (at ages 3, 5 and 7) of externalising and internalising problems (Level 1) nested in children (Level 2) nested in areas (Level 3). We

accounted for area clustering at the level of ward on which the MCS survey design was built. In all our conditional models (i.e., Models 2-5), we adjusted for stratum (a Level 3 variable) to reflect the stratified sample design of MCS. Growth curve models allowed us to estimate the average level of problems at a particular time-point and the average growth rate in problems over time. By specifying a random slope on the child's age to allow for changes in problems across time to vary between children, we could also model individual trajectories of problems from age 3 to 7. We fitted both fixed and random linear slopes, and we included a fixed quadratic term to account for the curved shape of children's average trajectories.

The full sequence of models estimated is outlined in Table 1. Model 1 (the unconditional model) investigated the average levels and growth of externalising and internalising problems by regressing them on age in years (grand mean centred at age 5.2 years) and its square. Grand mean centring age at the 'midpoint' minimises the correlation between age and age-squared thus stabilising the estimation. Model 2 added the three risk factors along with dummy variables for UK country of residence as a main effect, as we interacted country with our country-specific IMD measures. We specified the risk factors to be related to the intercept and slopes (linear and quadratic) of externalising and internalising problems. This enabled us to examine whether levels of problems at around age 5 and rate of change in problems over time shifted with SED, IMD and ALE. Model 3 included squared terms for SED and ALE, and, to examine nonlinear effects of risk on trajectories, also interacted them with age and age-squared. Model 4 added the child and family covariates and introduced the moderators, allowing them to predict the intercept and slopes of externalising and internalising problems. Model 5 investigated the interaction between each risk factor and each moderator at central age.

(Table 1)

Results

Descriptives

On average, emotional and behavioural difficulties decreased from age 3 to 5, and then increased slightly from age 5 to 7, although children's slopes varied. The moderators appeared to be correlated with adjustment except for parental involvement, which was very weakly or nonsignificantly associated with the outcomes. As expected, of the three parenting variables examined, parent-child relationship was more strongly related to child adjustment. In line with previous findings, child adjustment was significantly correlated to environmental risk (particularly IMD and SED). The association between risk and parenting was, in general, small. Correlations with risk were largest for parent-child relationship, and nonsignificant for involvement. The association between negative discipline and SED in the three sweeps was very small (.03 to .12) but its direction was opposite to that expected. An increase in both family and neighbourhood deprivation was related to *less* use of negative discipline. As expected, all associations between the items of the ALE scale were very small. Those between the SED items differed somewhat in size; although overcrowding correlated very weakly (up to .19) with the other SED items, all other inter-item correlations were at around .50.

Missing data analysis and imputation

Differences between the analytic and the non-analytic samples were small (Tables A1-A2). In the former, there was a slight over-representation of white children and involved mothers, and households with less material deprivation. By contrast, there was some under-representation of families in Wales, Scotland and Northern Ireland, and from areas

in England with high ethnic minority density. Because of some missingness on our study variables in the analytic sample (8.2-9.4% of values were missing across sweeps), we multiply imputed missing data. We generated five imputed datasets in SPSS20 using the Markov Chain Monte Carlo procedure. In the imputation model we included all covariates as predictor and predicted variables. We fitted our models in Stata12 using the MI estimate command which performs individual analyses for each of the imputed datasets, collects estimates of coefficients and their Variance-Covariance estimates, and reports the pooled results.

Model results

The unconditional model (Model 1, Table 2) revealed that children in the analytic sample decreased by -0.04 and -0.48 points on the SDQ scale per annum in their internalising and externalising difficulties, respectively. According to the quadratic term for age, the downward slopes were steeper before age 5, particularly for externalising problems. After age 3, internalising problems fell by about one third of a point on the SDQ scale, and externalising by about 1.3. Both internalising and externalising trajectories stopped falling after age 5 (at 5.5 and 6.0 years, respectively), turning slightly upward before age 7. The within-child, between-child and between-ward variance was larger in externalising than in internalising problems, suggesting that, compared to internalising, externalising problems varied more over time, and differed more between both families and areas.

(Table 2)

In Model 2, SED and ALE were significantly associated with both internalising and externalising problems at central age. ALE was associated with change in internalising problems, and SED with change in externalising problems. IMD in England and Wales was associated with both problem types at central age, and IMD in Scotland was related to age 5 externalising problems only. IMD in England was associated with rates of change in both problem types. Model 3 revealed that on both outcomes, the effect of ALE and SED was non-quadratic. Model 4 showed that most of those significant associations with risk were not fully attenuated (i.e., they did not lose statistical significance), despite the introduction of variables such as maternal psychological distress (which had the largest effect of all regressors on both problems) and parenting. There was one exception. The effect of ALE on annual linear change in internalising problems became nonsignificant. (Further analysis showed that this attenuation was due to the covariates entered in this model - that is, family structure, maternal psychological distress and maternal education - not parenting.) The accumulation of the three environmental risks widened the vertical gap in the predicted trajectories of both problems. Children exposed to high levels of all three risk factors maintained more problems over time compared with those not exposed (Figures 1-2). As for externalising problems (Figure 2), children exposed to high levels of all three risk factors had a level of problems nearing a score of 9 (out of 20) at age 3, a cutoff for identifying borderline abnormality based on recommended practice (Goodman, 1997). For internalising problems, children exposed to all three risks at a high level did not near the cutoff of 7 for borderline abnormality.

(Figures 1-2)

Model 6 showed that, at central age, positive parent-child relationship moderated the effect of ALE ($t = -2.12$) and of IMD for children in Northern Ireland ($t = 2.71$) on internalising problems, and the effect of IMD for English ($t = 3.16$) and Scottish ($t = 2.39$) children on externalising problems. Parental involvement moderated the effect of SED ($t = 2.09$) on externalising problems. In all models and on both outcomes, the effect of disadvantaged stratum, particularly in England, remained significant, highlighting the long-term effect of area-level child poverty on child outcomes. Figures 3-4 plot two of these interaction effects. As can be seen, the association of family adversity with children's emotional

adjustment was stronger in less close families. Similarly, compared to children of less close families in deprived areas, children of close families in deprived areas seemed to have fewer externalising problems across the entire trajectory. (Figures 3-4)

Discussion

We explored the association between environmental risk (measured with indices of adverse life events, family poverty and neighbourhood disadvantage) and children's emotional and behavioural development from age 3 to 7, and the role of parenting in this association. As expected, parenting, particularly parent-child relationship, moderated the effect of adverse life events and neighbourhood disadvantage on children's internalising and externalising problems, suggesting that positive parent-child relationship was not compromised by exposure to these environmental risks. Also, parenting did not fully explain the effects of these risk factors or that of family poverty on children's internalising and externalising problems. Rather, it was associated with children's emotional and behavioural resilience to risk, but also children's adjustment, whether or not these risks were present. These findings are in line with mounting evidence that aspects of nurturant parenting, particularly warmth and sensitivity, can 'buffer' children from the effects of neighbourhood disadvantage [21] and family adversity [24]. Also as expected, the role of family environmental risk in child outcomes did not differ by level of risk. There was, therefore, no evidence that children, at least at this age, were sensitised to cumulating effects of early adversity. In terms of main risk effects, we confirmed our hypothesis that neighbourhood 'effects' in England would be more robust. We also supported previous findings about the role of socio-economic risk (at both family and neighbourhood) in externalising problems [1] and that of adverse life events in internalising problems [32].

Some of our findings, however, were unexpected. Firstly, negative parental discipline correlated negatively (albeit weakly) with family poverty, a finding also reported by others using the Millennium Cohort Study [48]. We think that this correlation may be due to the fact that this discipline scale includes a combination of discipline tactics (e.g., smacking, bribing, sending to naughty chair) that may be differentially related to parental background characteristics. For example, Kiernan and Huerta [30], also using the Millennium Cohort Study, showed that the two harsher disciplinary tactics of the scale (smacking and shouting) were positively (albeit nonsignificantly) associated with family's economic deprivation. Secondly, negative parental discipline did not moderate risk effects, and the evidence for a moderating role of parental involvement was very weak. It seems that of the three parenting dimensions, the one that most closely indexes warmth, i.e., parent-child relationship, was most consistently associated with resilience to risk in our study. This finding has policy implications, as it suggests that, among parenting interventions, promoting maternal warmth could help protect children from the effects of neighbourhood disadvantage and family stress. Of course, this recommendation is predicated on the assumption that there are no passive gene-environment correlations and that shared environmental effects exist. Although a number of studies have shown that these assumptions are likely true [25-26], we still cannot rule out the possibility that parental behaviour was affected by child behaviour in our study. A number of studies have shown that maternal warmth can be child-specific within families [49].

There are some additional limitations. The study is correlational, and the reliance on parental reports to measure both children's emotional and behavioural problems and parenting means that correlations between these measures are likely inflated by the idiosyncrasies of the person reporting. Also, some of our measures of parenting demonstrated only adequate reliability and may have demand characteristics. Finally, although we included household

moves in our adverse life events index, we did not account for change in the characteristics of neighbourhoods over the course of the study period, making, instead, an assumption that area characteristics were fixed over time. There is little research on the extent of area change in the UK due to the limited availability of longitudinal data on areas and the lack of comparability of area boundaries and data over time [50]. However, areas could change over time in resident composition, employment opportunities, cultures of poverty, social capital, collective action, or local policies.

Despite these limitations, our study suggests that parenting, particularly a close parent-child relationship, is beneficial for the emotional and behavioural development of young children growing up in deprived neighbourhoods and in families experiencing adversity. We acknowledge that the magnitude of the estimated effects was quite modest. Future data sweeps of MCS will enable us to determine if this modest average difference in early childhood is the beginning of a significant divergence in paths later in life, or masks more extreme individual differences in response to risk.

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Table 1
Model Summary

Model	Variables
1 (unconditional)	Age (grand mean centred) in years and age^2
2	Model 1 + area stratum + SED + SED*age + SED*age^2 + ALE + ALE*age + ALE*age^2 + W + S + NI + IMDUK[a] + IMDUK*age + IMDUK*age^2
3	Model 2 + SED*SED + SED*SED*age + SED*SED*age^2 + ALE*ALE + ALE*ALE*age + ALE*ALE*age^2
4	Model 3 **+** child factors[b] + parent factors[c] + relationship + relationship*age + relationship*age^2 **+** discipline + discipline*age + discipline*age^2 **+** involvement + involvement*age + involvement*age^2
5	Model 4 + SED*relationship + ALE*relationship + IMDUK*relationship + SED*discipline + ALE*discipline + IMDUK*discipline + SED*involvement + ALE*involvement + IMDUK*involvement

Note: SED = Socio-economic disadvantage; ALE = Adverse life events; W = Wales; S = Scotland; NI = Northern Ireland; IMD = Index of Multiple Deprivation; [a] a vector of 4 variables (UK country (time-varying) interacted with own deprivation); IMD is fixed for a given locality over the time observed but can vary between surveys if the family moves; [b]sex and ethnicity; [c]mother's psychological distress (time-varying), two-parent family (time-varying) and mother's education.

Table 2
Fixed Effects Estimates and Variance Covariance Estimates of Trajectories of Internalising and Externalising Problems in the Analytic Sample

	Model 1 (unconditional)						**Model 5**					
	Internalising			**Externalising**			**Internalising**			**Externalising**		
	Coeff.	SE	95% CI	Coeff.	SE	95% CI	Coeff.	SE	95% CI	Coeff.	SE	95% CI
						Fixed effects						
Constant	2.504***	0.033	[-2.44,-2.57]	4.840***	0.046	[4.75,4.93]	7.032***	0.261	[6.52,7.54]	12.770***	0.358	[12.06,13.48]
Age	-0.040***	0.006	[-0.05,-0.03]	-0.477***	0.008	[-0.49,-0.46]	-0.335***	0.092	[-0.52,-0.15]	-1.778***	0.112	[-2.00,-1.55]
Age^2	0.064***	0.004	[0.06,0.07]	0.203***	0.005	[0.19,0.21]	0.182**	0.062	[0.06,0.31]	0.641***	0.066	[0.51,0.77]

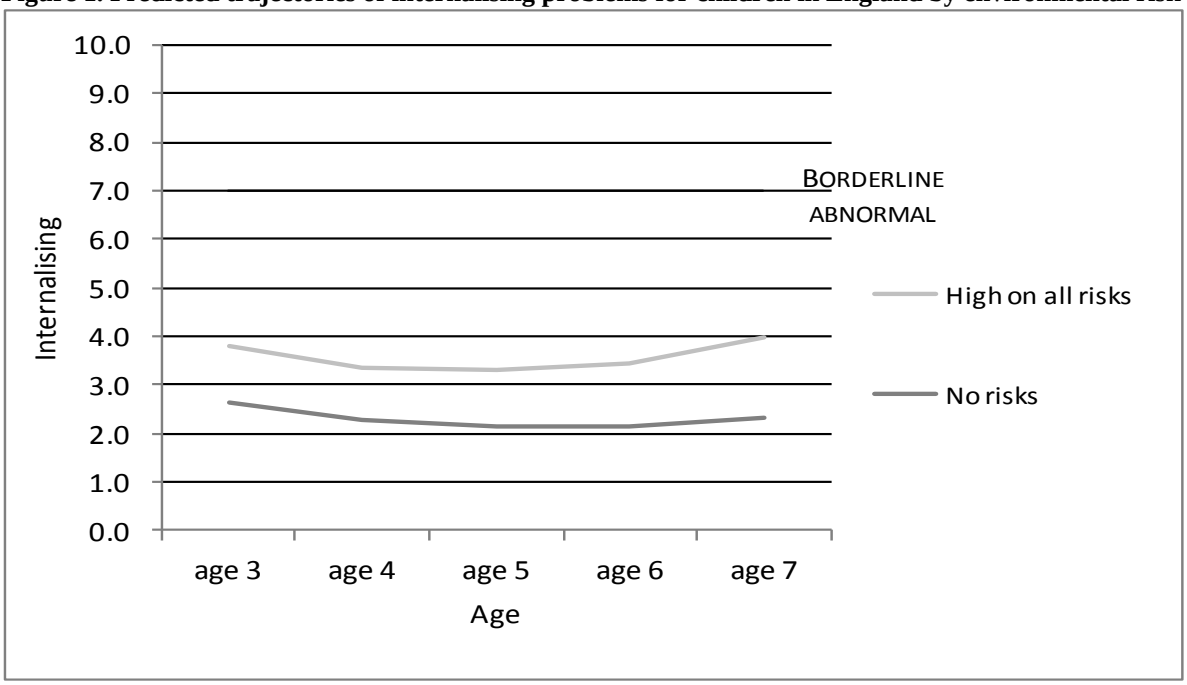
Girl	-0.098**	0.030	[-0.16,-0.04]	-0.729***	0.042	[-0.81,-0.65]
Child's ethnicity (Ref: White)						
Mixed	0.076	0.092	[0.10,0.26]	0.040	0.128	[-0.21,0.29]
Indian	0.585***	0.109	[0.37,0.80]	-0.132	0.149	[-0.16,0.42]
Pakistani/Bangladeshi	1.072***	0.090	[0.90,1.25]	0.064	0.127	[-0.19,-0.43]
Black/Black British	-0.001	0.096	[-0.19,0.19]	-0.692***	0.134	[-0.95,0.43]
Other	0.848***	0.146	[0.56,1.14]	-0.270	0.216	[-0.70,0.16]
Mother is University-educated	-0.313**'	0.047	[-0.41,-0.22]	-0.916***	0.065	[-1.04,-0.79]
Mother's psychological distress	0.130***	0.005	[0.12,0.14]	0.118***	0.006	[0.11,0.13]
Two-parent family	-0.087*	0.037	[-0.16,-0.05]	-0.396***	0.047	[-0.49,-0.30]
SED	0.117*	0.056	[0.01,0.23]	0.314***	0.068	[0.18,0.49]
SED*age	0.053**	0.019	[0.02,0.09]	0.017	0.024	[-0.03,0.06]
SED*age^2	0.035*	0.014	[0.01,0.06]	-0.002	0.017	[-0.03,0.03]
ALE	0.093*	0.040	[-0.00,0.06]	0.094*	0.048	[0.00,0.19]
ALE*age	0.029	0.016	[-0.00,0.06]	0.016	0.020	[-0.02,0.06]
ALE*age^2	0.008	0.012	[-0.02,0.03]	0.016	0.014	[-0.01,0.04]
IMD*E	0.007***	0.002	[0.00,0.01]	0.007**	0.002	[0.00,0.01]
IMD*W	0.008*	0.003	[0.00,0.02]	0.013**	0.004	[0.00,0.02]
IMD*S	0.003	0.003	[-0.00,0.01]	0.014**	0.004	[0.01,0.02]
IMD*NI	-0.001	0.005	[-0.01,0.01]	0.007	0.006	[-0.00,0.02]
IMD*E*age	-0.002**	0.001	[-0.00,0.00]	-0.002*	0.001	[-0.00,-0.00]

IMD*W*age	-0.001	0.001	[-0.00,0.00]	-0.001	0.001	[-0.00,0.00]
IMD*S*age	0.002*	0.001	[-0.00,0.00]	-0.000	0.001	[-0.00,0.00]
IMD*NI*age	0.001	0.001	[-0.00,0.00]	-0.001	0.002	[-0.00,0.00]
IMD*E*age^2	-0.000	-0.00(	[-0.00,0.00]	0.001*	0.000	[0.00,0.00]
IMD*W*age^2	0.000	0.001	[-0.00,0.00]	0.001	0.001	[-0.00,0.00]
IMD*S*age^2	-0.000	0.001	[-0.00,0.00]	0.001	0.001	[-0.00,0.00]
IMD*NI*age^2	-0.000	0.001	[-0.00,0.00]	0.001	0.001	[-0.00,0.00]
SED*SED	0.009	0.018	[-0.03,0.05]	-0.025	0.021	[-0.07,0.02]
SED*SED*age	-0.012	0.006	[-0.03,0.00]	-0.009	0.008	[-0.02,0.01]
SED*SED*age^2	-0.010*	0.005	[-0.02,0.00]	0.000	0.005	[-0.01,0.01]
ALE*ALE	-0.005	0.010	[-0.03,0.02]	-0.003	0.012	[-0.03,0.02]
ALE*ALE*age	0.003	0.004	[0.01,0.01]	0.001	0.005	[-0.01,0.01]
ALE*ALE*age^2	-0.000	0.003	[-0.01,0.01]	-0.001	0.004	[-0.01,0.01]
Parent-child relationship	-0.075***	0.003	[-0.08,-0.07]	-0.135***	0.005	[-.014,-0.13]
Parental involvement	-0.002	0.004	[-0.01,0.01]	-0.018**	0.006	[-0.03,-0.01]
Negative parental discipline	-0.015***	0.004	[-0.02,-0.01]	0.056***	0.005	[0.05,0.07]
Parent-child relationship*age	0.003*	0.001	[0.00,0.01]	0.023***	0.001	[0.02,0.03]
Parental involvement*age	0.003**	0.001	[0.00,0.01]	0.001	0.002	[-0.00,0.01]
Negative parental discipline*age	0.001	0.002	[-0.00,0.00]	-0.011***	0.002	[-0.02,-0.01]
Parent-child relationship*age^2	-0.002**	0.001	[-0.04,-0.00]	-0.009***	0.001	[-0.01,-0.01]
Parental involvement*age^2	-0.001	0.001	[-0.00,0.00]	0.001	0.001	[-0.00,0.00]

Negative parental discipline*age^2							0.001	0.001	[-0.00,0.00]	0.006***	0.001	[0.00,0.01]
Area stratum (Ref: England-advantaged)												
England-disadvantaged							0.206***	0.052	[0.10,0.31]	0.281***	0.076	[0.13, 0.43]
England-ethnic							0.151	0.083	[-0.01,0.31]	0.069	0.123	[-0.17,0.31]
Scotland-advantaged							-0.122	0.199	[-0.51,0.27]	-0.134	0.263	[-0.65,0.38]
Scotland-disadvantaged							-0.024	0.206	[-0.43,0.38]	0.055	0.276	[-0.49,0.60]
Northern Ireland-advantaged							-0.082	0.339	[-0.75,0.58]	-0.619	0.442	[-1.48,0.24]
Northern Ireland-disadvantaged							0.149	0.337	[-0.51,0.81]	-0.400	0.440	[-1.26,0.46]
Wales-advantaged							-0.177	0.183	[-0.54,0.18]	-0.246	0.243	[-0.23,0.72]
Wales-disadvantaged							-0.062	0.174	[-0.40,0.28]	0.492*	0.230	[0.04,0.94]
Random effects												
Level 3 (ward)												
Intercept	0.252***	0.026	[0.21,0.31]	0.489***	0.056	[0.39,0.61]	0.013***	0.007	[0.01,0.04]	0.054***	0.015	[0.03,0.09]
Level 2 (child)												
Intercept	3.469***	0.054	[3.36,3.58]	8.116***	0.111	[7.90,8.34]	2.579***	0.045	[2.49,2.67]	5.039***	0.081	[4.88,5.20]
Slope	0.161***	0.008	[0.15,0.18]	0.313***	0.012	[0.29,0.34]	0.155***	0.008	[-0.14,0.17]	0.274***	0.011	[0.25,0.30]
Intercept/slope covariance	0.206 **	0.013		-0.064**	0.023		0.095**	0.012		0.037**	0.019	
Level 1 (occasion)												
Slope	2.812***	0.036	[2.74,2.88]	3.784***	0.049	[3.69,3.88]	2.811***	0.036	[2.74,2.88]	3.740***	0.048	[3.65,3.84]

Note: *$p < .05$, **$p < .01$, ***$p < .001$. The effect of UK country at interview (nonsignificant) was adjusted but is not shown. Ns = 16,877 (externalising), 16,884 (internalising). N is not 16,916 because we did not impute missing values on the outcomes (externalising and internalising)

Figure 1. Predicted trajectories of internalising problems for children in England by environmental risk

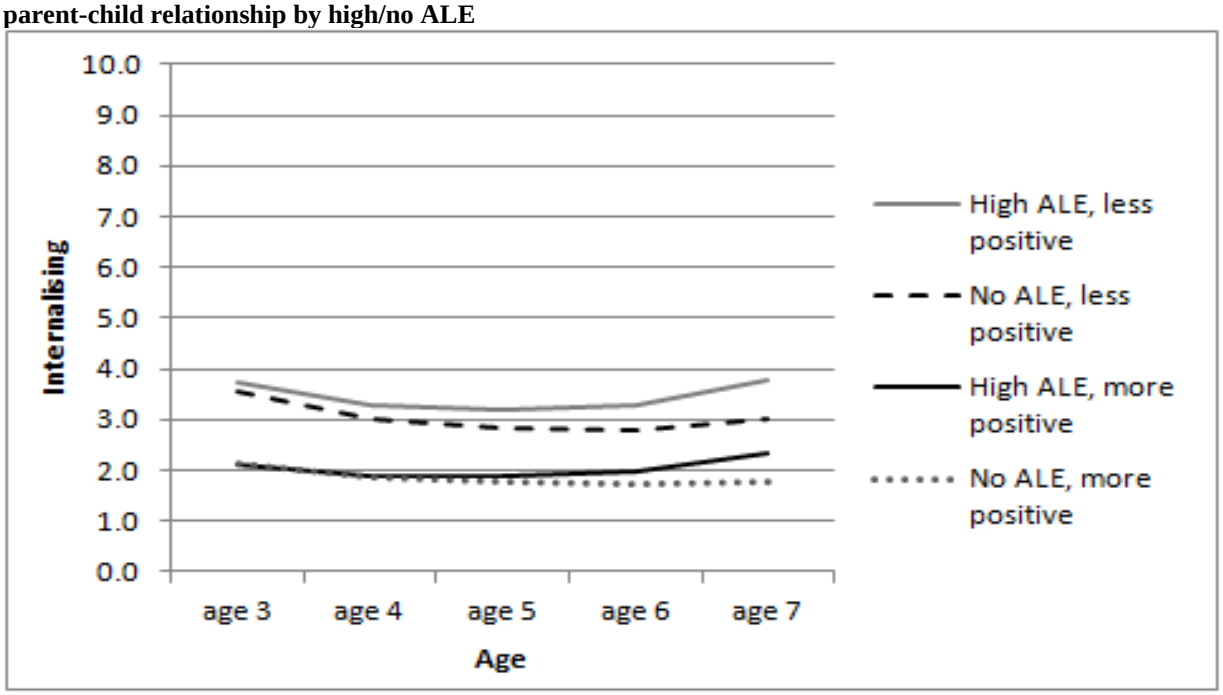


Note: 'High on all risks' was having all three environmental risks (IMD, SED, ALE) at the 90th percentile values, and living in an disadvantaged ward at Sweep 1 (age 9 months). 'No risks' was having each of these risks at the 10% percentile values (and living in an advantaged ward at age 9 months). Predictions are plotted for a continuous two-parent family and otherwise the reference group for each categorical variable, and at the mean of each continuous variable. An internalising problems score of 7 is the cutoff for identifying borderline abnormality.

Figure 2. Predicted trajectories of externalising problems for children in England by environmental risk

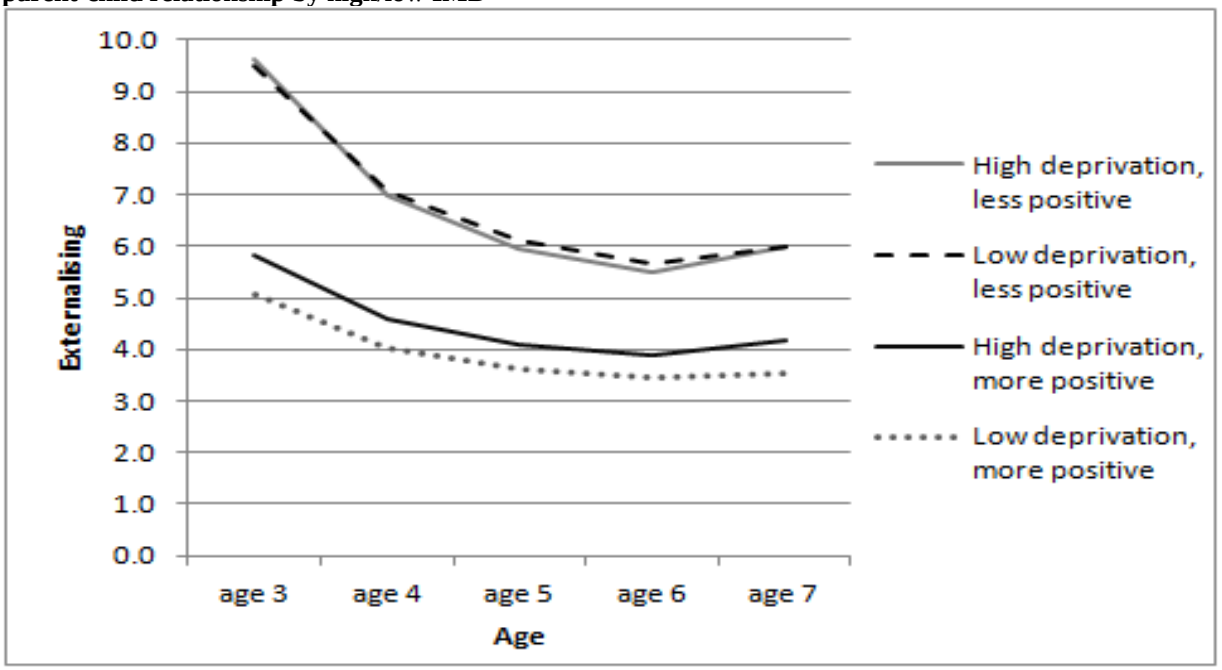
Note: See note to Figure 1. An externalising problems score of 9 is the cutoff for identifying borderline abnormality.

Figure 3. Predicted internalising problem trajectories for children in England with more vs. less positive parent-child relationship by high/no ALE



Note: 'High ALE' was having experienced three adverse life events (ALE; the 90th percentile value) at each sweep. 'No ALE' was no ALE in any sweep (10% percentile). More and less positive parent-child relationship was set at 90th and 10th percentile values. Predictions are plotted for a continuous two-parent family and otherwise the reference group for each categorical variable, and at the mean of each continuous variable.

Figure 4. Predicted externalising problem trajectories for children in England with more vs. less positive parent-child relationship by high/low IMD



Note: High/low neighbourhood deprivation was set at 90th and 10th percentile values of IMD (Index of Multiple Deprivation), respectively, at each sweep, and living in a disadvantaged/advantaged ward, respectively, in England at Sweep 1 (age 9 months). For other assumptions, see note to Figure 3.

Supplementary Material

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