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Psychopathology trajectories of children with autism spectrum disorder: The role of family poverty and parenting

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Abstract:	Objective Children with autism spectrum disorder (ASD) are reported to have high rates of co-occurring psychopathology. Little is known about risk factors that might contribute to this psychopathology. This study modelled the effect of family poverty on psychopathology trajectories in young children with ASD, and examined whether home organisation and maternal warmth and involvement can buffer the effect of poverty on children's psychopathology. Method The sample comprised 209 children with ASD who participated in the UK's Millennium Cohort Study, a population birth cohort study. Individual trajectories of psychopathology at ages 3, 5 and 7 years were analysed using growth curve models. Psychopathology was assessed with the Strengths and Difficulties Questionnaire. Results Children with ASD exhibited increasingly high rates of psychopathology over time. Family poverty was associated with broad and specific (emotional and conduct problems) psychopathology, but not with changes in psychopathology over time. Warmth, involvement and home organisation did not buffer the association of family poverty with psychopathology. However, low warmth explained the relationship between poverty and broad psychopathology, and predicted annual changes in broad psychopathology. Warmth was associated with fewer conduct problems and less hyperactivity, and with an annual decrease in peer and conduct problems. Household chaos was a risk factor for conduct problems as was maternal involvement for peer problems. Conclusions Family poverty, low maternal warmth and household chaos are risk factors for externalising problems in children with ASD. Maternal warmth may be a key

	target for intervention, particularly in poorer families of children with ASD.

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Psychopathology trajectories of children with autism spectrum disorder: The role of family poverty and parenting

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Objective Children with autism spectrum disorder (ASD) are reported to have high rates of co-occurring psychopathology. Little is known about risk factors that might contribute to this psychopathology. This study modelled the effect of family poverty on psychopathology trajectories in young children with ASD, and examined whether home organisation and maternal warmth and involvement can buffer the effect of poverty on children's psychopathology. **Method** The sample comprised 209 children with ASD who participated in the UK's Millennium Cohort Study, a population birth cohort study. Individual trajectories of psychopathology at ages 3, 5 and 7 years were analysed using growth curve models. Psychopathology was assessed with the Strengths and Difficulties Questionnaire. **Results** Children with ASD exhibited increasingly high rates of psychopathology over time. Family poverty was associated with broad and specific (emotional and conduct problems) psychopathology, but not with changes in psychopathology over time. Warmth, involvement and home organisation did not buffer the association of family poverty with psychopathology. However, low warmth explained the relationship between poverty and broad psychopathology, and predicted annual changes in broad psychopathology. Warmth was associated with fewer conduct problems and less hyperactivity, and with an annual decrease in peer and conduct problems. Household chaos was a risk factor for conduct problems as was maternal involvement for peer problems. **Conclusions** Family poverty, low maternal warmth and household chaos are risk factors for externalising problems in children with ASD. Maternal warmth may be a key target for intervention, particularly in poorer families of children with ASD.

Introduction

Autism spectrum disorder (ASD) describes a group of pervasive developmental disorders, including autism and Asperger's syndrome.[1] Children with ASD exhibit a range of problems, including communication difficulties, impairments in reciprocal social interaction, limited imagination, and repetitive and restricted patterns of behaviours. Currently, ASD affects roughly 1% of the child population.[2] Recent research has demonstrated that children and adolescents with ASD can exhibit additional psychiatric symptoms and disorders, such as anxiety disorders, oppositional defiant disorder and ADHD, that do not form part of the diagnostic criteria for ASD.[3-5] This co-occurring psychopathology[a] may severely impact on children with ASD and their families.

Although the aetiology of ASD is unclear, genetic risk factors are known to contribute to its development. Twin studies consistently reveal a high concordance rate amongst monozygotic compared to dizygotic twins with autism. However, rates are not 100%,[7] highlighting the potential importance of environmental factors. One line of investigation into environmental influences addresses the role of family and contextual factors for psychopathology in children with ASD.[4] These factors play little role in ASD symptomatology itself. Bettelheim's[8] proposition that autism may result from poor parenting behaviours has been discredited. However, environmental factors including aspects of parenting and parent-child interaction may contribute to the co-occurrence of psychopathology and ASD.[9-12]

Family socio-economic disadvantage (SED) is widely acknowledged as a risk factor of psychopathology in the general population of children.[13] However, research elucidating its role in psychopathology of children with ASD is generally limited and has produced mixed results.[14-15] In a cross-sectional study using a population-representative sample of 10- to 14-year olds with ASD, family material deprivation was not associated with children's psychiatric disorders.[4] However, in a follow up study, deprivation predicted less improvement in emotional symptoms over time[16]. Using a more detailed measure of family SED and a large longitudinal population sample, we aimed to explore the role of family poverty in the development of psychopathology in children with ASD from preschool age to middle childhood. Longitudinal data allowed us to get closer to estimating causal relations than would cross-sectional data. We also explored the role in this association of three factors related to resilient outcomes in typically

[a] Contrary to the DSM-IV-TR hierarchical rules, DSM-5 allows a diagnosis of ADHD alongside an ASD diagnosis.[6]

developing children: maternal warmth, maternal involvement, and home organisation. Examining the role of the above factors in the development of psychopathology in the early years in children with ASD may help professionals identify at-risk ASD children early. Interventions for these children may be most useful during early development.[17]

Maternal warmth, maternal involvement, and home organisation

There is much evidence for the role of home organisation and maternal warmth and involvement in mental health outcomes in typically developing children.[18-22] However, there is little research on their role in psychopathology in atypical populations. With regard to warmth, there is evidence that its effect on behaviour problems in autistic children may be non-linear, with behavioural difficulties being linked both with parenting that is highly intrusive and lacking in warmth and responsiveness, and with emotional over-involvement.[23-24] However, warm, sensitive, facilitative parenting has been associated with optimal behavioural development in adolescents and adults with ASD.[10] Regarding involvement, although Osborne et al.[25] found no relationship between parental involvement and behaviour problems in autistic children, more recently, Osborne and Reed[9] found strong evidence of involvement interacting bi-directionally with parenting stress, a powerful risk factor of adjustment problems in children with developmental disabilities.[26] Finally, household chaos, a home environment characterised by high levels of noise and disorganisation and low levels of regularity and routine, [27] strongly predicts behavioural problems in typically developing[27] and autistic[28] children. To date, no study has investigated its role in the development of behaviour problems in ASD children. . Previous research with typically developing children has also suggested that warm and involved parenting and home organisation may not only predict adjustment but also promote resilience; that is, better than expected outcomes in children exposed to contextual risk factors [21,29] . It is possible that similar effects may be evident in the ASD population. To date, no study has tested this.

The present study

It is difficult to isolate the causal impact of SED, as many factors might jointly determine SED and child psychopathology. To avoid attributing to SED what should be attributed to correlated determinants of both SED and psychopathology, we adjusted for maternal qualifications as a proxy for family socio-economic status and an indicator of human capital in the family. We also adjusted for children's verbal cognitive ability and low birthweight status. Verbal cognitive ability is a strong predictor of emotional and

behavioural adjustment among children in the general population[30] and among those with ASD.[16] It is also related to childhood family poverty.[31] Low birthweight children are at increased risk of developing psychiatric problems by middle childhood[32].

We hypothesised that, both concurrently and over time, SED and household chaos would contribute to heightened levels of psychopathology, whereas higher parental warmth and involvement would be associated with less psychopathology. Also, given their association with resilience among children in the general population, we hypothesised that parental involvement, parental warmth, and home organisation would moderate (i.e., 'buffer') the effect of SED on children's psychopathology.

In our analysis of these relationships, we tested the role of parenting in 'mediating' and 'moderating'[33] the effect of SED. A mediator is a variable that accounts for the relation between the 'independent' and 'dependent' variables, establishing 'how' or 'why' the relationship exists. We first examined whether the association between SED (independent) and psychopathology (dependent) could be explained by less maternal warmth, less involvement and less home chaos. In this case, warmth, involvement and home organisation were tested as mediators. . A moderator is a variable that affects the strength and/or direction of the relation between an independent and a dependent variable, establishing 'when' or 'for whom' a relationship exists. We tested whether the effect of SED on psychopathology differed depending on the level of maternal involvement, warmth and household organisation (the 'moderators'). For example, we hypothesized that greater maternal involvement would weaken the relationship between SED and psychopathology such that children with more involved mothers would have fewer problems than their counterparts with less warm mothers. Moderation was examined by specifying interaction terms of SED and the 'moderators'.

METHOD

Sample

Data were obtained from the first four sweeps (at ages 9 months, and 3, 5 and 7 years) of the Millennium Cohort Study (MCS), a population-based cohort study of children born in the UK in 2000-2002. MCS was designed to over-represent families living in areas of high child poverty, areas with high proportions of ethnic minority populations across England, and the three smaller UK countries.[34] Parent-reported data were collected through interviews and self-completion questionnaires.

At Sweep 1, 18522 families participated, and the numbers of productive families at Sweeps 2, 3, and 4 were 15590, 15246, and 13857, respectively. For families with twins and triplets, we used information only about the first-born twin or triplet. At Sweep 4, the main caregiver was asked, "Has a doctor or health professional ever told you that [Cohort child's name] had Autism or Asperger's Syndrome?" The 'ASD' sample (n=209, 174 boys) included children whose main caregiver indicated 'yes' to this question. The 'non-ASD' sample of children whose main caregiver answered 'no' (n=13737, 6888 boys) was used for descriptive comparative analyses. Recent research provides strong evidence for the reliability of parent-reported community diagnosis of ASD.[35]

Measures

Child psychopathology. Psychopathology was assessed at Sweeps 2- 4 using the main caregiver's report of the Strengths and Difficulties Questionnaire (SDQ),[36] a valid and reliable measure of child psychopathology[37] and a useful clinical screening tool for children with autism.[38] Total scores were calculated for each 5-item (on a 3-point scale) subscale of emotional symptoms, conduct problems, hyperactivity/inattention, and peer relationship problems (specific psychopathologies). A total difficulties score (broad psychopathology) was calculated by summing the subscale scores. In our ASD sample, Cronbach's alpha for total difficulties ranged from .64-.74 across sweeps, indicating adequate internal consistency. At Sweep 4, subscales had acceptable coefficients (ranging from .73 to .79); in earlier sweeps, some appeared unreliable (e.g., peer problems (α=.48) at Sweep 2)).

Family socio-economic disadvantage. Family socio-economic disadvantage (SED) was measured at Sweeps 2- 4 with a 4-item summative index of family poverty.[39] The four dichotomous items were overcrowding (>1.5 people per room excluding bathroom and kitchen), lack of home ownership, receipt of income support, and income poverty (below the poverty line). One official poverty line for equivalised net family income is set at 60% of the UK national median household income. *Parenting.* The parenting variables hypothesized to buffer poverty effects were reported by the main caregiver at Sweep 2. *Parental warmth* was assessed with the short form of the Child-Parent Relationship Scale.[40] The scale has 15 items rated on a 5-point Likert scale measuring closeness and conflict (reverse coded). All items were summed to form a total score (α=.77). *Parental involvement* was assessed using five items (on a 5-point frequency scale) measuring how often the parent engages with the child in reading, helping to learn the alphabet, teaching counting, teaching songs/poems/rhymes, and painting/drawing. The level of involvement was

computed by summing item scores (α=.60). A higher score indicated more involvement. *Household chaos* was measured with three items (on 5-point Likert scales) from the Confusion, Hubbub, and Order Scale (CHAOS) [41]: "the atmosphere in my home is calm"; "I can't hear myself think in my home" and "it is really disorganised in our home". A total score was generated by summing the items. A higher score indicated a more chaotic household (α=.66).

Key covariates. The covariates were gender, low birthweight (<2.5 kilos), verbal cognitive ability, and maternal education. Verbal cognitive ability was measured at Sweep 2 with the British Ability Scales II Naming Vocabulary subtest.[42] The mother's highest educational qualification as at Sweep 4 was measured using the National Vocational Qualification (NVQ) levels.

Statistical Analysis

To predict children's psychopathology over time due to SED and parenting (adjusting for covariates), we modelled individual trajectories of emotional and behavioural problems using hierarchical growth curve models[43]. This approach allowed us to estimate mean trajectories (i.e., growth) of children's psychopathology from age 3 to 7 by specifying an independent variable for time (in this study, our time variable is age in years centred at the grand mean across sweeps (5.28 years)). Importantly, as children with ASD may differ from each other in the level of psychopathology at different ages, this approach also captures these individual differences in (both linear and non-linear) patterns over time (i.e., growth curves) and therefore deviations from mean trajectories. At the same time, these models capture 'clustering' of repeated measures of children's psychopathology as an individual child's problems will be correlated across measurement occasions. In this type of model, occasions are considered to be at 'Level 1' and children are at 'Level 2' as occasions are nested within the child. These models specify both fixed and random growth parameters. The fixed parameters are the intercept (mean psychopathology scores at the average age) and the slope (mean change in scores per annum). The random parameters simultaneously capture the variation in scores between occasions for each child ('between-occasion variance'), between children at the average age ('between-child intercept variance') and the variation in their annual growth ('between-child slope variance'). The covariance of the variances at the average age and over time tells us whether there is a relationship between children's scores at around age 5 and their growth between ages 3 and 7.

The individual trajectories plot of broad psychopathology indicated an overall linear pattern with a steady increase in problems over time and non-parallel trajectories, suggesting that total difficulties varied with age and between children with ASD. Therefore, a two-level linear growth model was deemed appropriate to capture the inter-individual differences in intra-individual change. Because age was centred at the grand mean across sweeps, all main effects predicted psychopathology at the second measurement occasion (around age 5).

Models (Table 1) were carried out for broad and specific psychopathology. Data were analysed using SPSS18 and MLwiN 2.25, a statistical package for multilevel modelling. In descriptive analyses, survey weights were used to account for the MCS survey design and non-response. In multilevel analyses, the stratified sampling design of MCS was recognized by modelling the design variables that accounted for the oversampling of children from particular area types.

(Table 1)

RESULTS

Children with ASD displayed significantly higher rates of broad and specific psychopathology than children without ASD at all ages. Figure 1 and Table S1, available online, show the weighted mean broad and specific psychopathology scores for the ASD and non-ASD groups. The ASD group showed an average increase in broad psychopathology across time and the non-ASD group demonstrated an average decrease. Table 2 shows the descriptive statistics for the key parenting predictors in the two groups. The ASD group had lower levels of maternal warmth and higher levels of household chaos and SED. Scores for maternal involvement did not differ significantly between groups.

(Figure 1 and Table 2)

Linear Growth Curve Regression Models

Broad psychopathology

The main effect of SED on broad psychopathology of ASD children was statistically significant (Model 1, Table 3), with an increase in one element of disadvantage being associated with an increase in roughly one parent-reported difficulty. Its effect on average annual change in difficulties was not statistically significant. Notably, there was a fairly large effect of mother's education. The significant random

parameters indicated variation between occasions as well as between children in both average difficulties and in the average linear change over time. Markedly, there was greater between-occasion than between-child variation reflecting the instability of other developmental outcomes (e.g., cognitive) in children with ASD. [44] Furthermore, the significant positive covariance of the between-child intercept and slope variances suggested that children with more problems at age 5 increased in their problems at a faster rate over time compared with children with fewer problems at age 5.

We then examined the effects of the three parenting variables in Models 2a-2d on problem trajectories. Warmth was significantly associated with total difficulties at age 5 (*b*=-.263, SE=.082, Model 2a). A one point increase on the warmth scale at age 3 was associated with an average annual increase of .065 in total difficulties. A trajectories plot demonstrated that ASD children with mothers exhibiting higher levels of warmth had fewer difficulties at age 3 than those with mothers with less warmth. However, at age 5 the difficulties scores of children with less warm mothers appeared to drop. Therefore, the effect of low maternal warmth was stronger in preschool years, weakening thereafter. Moreover, the addition of warmth mediated the relationship between SED and broad psychopathology. Neither the main nor the interaction (by age) effects of involvement (Model 2b) and chaos (Model 2c) were statistically significant. However, the effects of warmth discussed above were robust to adjustment for both involvement and chaos in Model 2d (Table 3). To assess the fit of Model 2d compared with Model 1, we examined the likelihood ratio (LR) test statistic, calculated as two times the difference in the log likelihood values for the two models (LR=2*(2116.27-1348.28)=1535.98). The 5% point of a chi-squared distribution on 6 d.f. (as there are 6 parameters' difference between Models 1 and 2d) is 12.60[b]. Therefore, Model 2d was a statistically significant improvement on Model 1. Finally, we investigated whether warmth, involvement and chaos moderated the effect of SED on total difficulties at age 5 and over time. None of the interactions between parenting factors and age were statistically significant (Model 3d, Table 3). Model 3d (with 6 additional parameters than Model 2d) was not a statistically significant improvement on Model 2d (LR=2*(1348.28-1345.27)=3.01).

(Table 3)

[b] Even when applying a Bonferroni correction, Model 2d was a better fit than Model 1. Based on our corrected alpha of .025, obtained by dividing the alpha of .05 by 2 for the number of model comparisons, the 2.5% point of a chi-square distribution on 6 d.f. is 14.45.

Specific psychopathology

We then fitted these models on the four SDQ difficulties. In Model 1, the main effect of SED was statistically significant only on emotional symptoms (*b*=.131, SE=.228) and conduct problems (*b*=.307, SE=.109). There were no significant interactions between SED and age in any psychopathological domain. However, in Model 2d, the effect of SED on emotional symptoms was attenuated by the addition of warmth, chaos, and involvement. Warmth had a significant main (negative) effect on age 5 conduct problems and hyperactivity, and was positively associated with growth in both conduct (*b*=.020, SE=.009) and peer problems (*b*=.028, SE=.011). Therefore, the effect of warmth on the average trajectory of total difficulties was likely due to the effect of warmth on the average trajectory of conduct and peer problems. In Model 2d there was also a positive main effect of chaos on conduct problems (*b*=.114, SE=.057), and a positive main effect of involvement on peer problems (*b*=.172, SE=.081). Finally, Models 3a-3d showed that warmth, involvement and chaos did not moderate the effect of SED on the four difficulties at age 5 or on their growth over time.

DISCUSSION

Following a large sample of children with ASD from age 3 to 7, we investigated the role of family poverty and parenting (maternal warmth and involvement, and home organisation) in children's psychopathology trajectories. We also examined the moderating role of parenting in the association between poverty and child psychopathology. Compared to children without ASD, children with ASD showed higher levels of psychopathology as early as age 3 which increased over time, extending previous research findings on co-occurring psychiatric problems in ASD children[45-46]. Additionally, poverty was associated with broad and specific (conduct problems and emotional symptoms) psychopathology above and beyond child-level characteristics of intellectual ability and low birthweight. Poor families may face barriers to accessing autism-related services[47]; the relationship between poverty and psychopathology may reflect this. Future research might explore the issue of governmental agencies intervening when poor families have a child with ASD. However, poverty was not associated with change over time in any psychopathology, which may be related to the developmental stage of our sample. Poverty has been related to an increase in psychopathology in ASD populations in studies with adults[15] and adolescents.[16]

As expected, household chaos was associated with conduct problems. Children with autism require structure and routine in their lives.[1] Families of children with ASD may find it difficult to manage their

children's challenging behaviours and, in turn, have trouble maintaining organisation and routine at home. Families of children with ASD may benefit from support or education that encourages the maintenance of calmness and routine within the home. However, in line with Osborne et al.[25],we did not find a strong association between mothers' involvement and children's psychopathology. Parental involvement may operate differently within the ASD population compared with typically developing children. For example, parental involvement, assessed in this study as degree of active or structured interaction with the child, has also been conceptualised as parental accessibility.[48] Accessibility, not measured in MCS, may be more important to children with ASD, for whom active over-involvement may be disadvantageous. El-Ghoroury and Romancyzk[49] found a negative association between parental play behaviours and children's social characteristics, suggesting that high levels of interaction can prevent the child with autism from initiating interactions. Alternatively, the severity of children's ASD may be confounded with parents' involvement as children with a more severe disorder may have both more involved parents and greater psychiatric problems. Moreover, parental involvement and parental stress could interact to affect children's displayed difficulties.[9]

Our most notable findings were those pertaining to the role of maternal warmth. Warmth was associated with lower scores in broad and specific (conduct problems and hyperactivity) psychopathology at age 5, and with change in conduct and peer problems over time. These results complement findings from studies indicating the importance of warmth for adjustment in young people with ASD[10] and in the general population.[21] Importantly, maternal warmth fully explained the effect of poverty on broad psychopathology. Hence, warmth may contribute to the poverty-psychiatric problems pathway in children with ASD. Together, our findings suggest that parental warmth may have important implications for the development of psychiatric symptoms in young children with ASD, especially those living in poverty.

However, we found no evidence to suggest that warmth, involvement and home organisation buffered the effect of poverty on psychopathology in our ASD sample. Studies within the general population have indicated that these factors can promote resilience among children at this developmental stage.[21,29] As suggested by Simonoff et al.,[16] it is important to consider alternative pathways that may be responsible for psychopathology in children with ASD. For example, children's autistic traits themselves may contribute towards additional psychiatric problems. Furthermore, children with ASD may be predisposed to biological risks that affect their susceptibility to environmental influence.[50] If so, the buffering role of

family factors on psychiatric symptoms may be harder to underpin. Fortunately, there is increasing exploration of interactive effects within the family that can influence development of children with ASD in terms of core autism symptoms and co-occurring psychopathology, and with regard to maternal well-being[11-12]. The development of such an evidence-base can contribute to identifying and supporting potentially vulnerable families to promote better child outcomes.

There are a number of study limitations that should be acknowledged. First, children's medical diagnoses of ASD were based on parent reports, which may have limited validity due to reporter bias. Nonetheless, parental reports can have good reliability.[35] Second, the severity of autism was unknown. Severity can contribute significantly to the degree of psychiatric problems displayed.[51] Third, the SDQ does not identify all areas of additional difficulties in the ASD population, such as sleeping problems and emotion regulation deficits.[52] Fourth, some of our measures, such as parental involvement, did not demonstrate strong internal consistency and have not undergone psychometric validation. Fifth, caution should be taken when generalising this study's findings to all families of children with ASD. Last, our study focused on one risk factor (poverty) ignoring co-occurring adversities such as abuse and parental mental illness[53]. Future research should address the effects of multiple and cumulative risk on psychopathology of children with ASD.

Despite these limitations, our study has several strengths. It included a large sample of young children with ASD drawn from a population rather than a clinically referred sample. Its prospective longitudinal design allowed for a rigorous examination of family-level predictors of children's early trajectories of psychopathology. Furthermore, the inclusion of a non-ASD group for initial exploratory analyses allowed for group comparisons, and helped set the scene for further multilevel analysis within the ASD sample. Finally, although this study did not find that parenting buffered the effect of poverty on psychopathology, it underscored the importance of family experiences in the early life of children with ASD.

REFERENCES

1. American Psychiatric Association. *Diagnostic and statistical manual of mental disorders.* 4th ed. Text revision. Washington, DC: Author; 2000.
2. Baird G, Simonoff E, Pickles A, et al. Prevalence of disorders of the autism spectrum in a population cohort of children in South Thames: the Special Needs and Autism Project (SNAP). *Lancet.* 2006;368:210-215.
3. Leyfer OT, Folstein SE, Bacalman S et al. Comorbid psychiatric disorders in children with autism: interview development and rates of disorders. *J Autism Dev Disord*. 2006;36:849-861.
4. Simonoff E, Pickles A, Charman T, Chandler S, Loucas T, Baird G. Psychiatric disorders in children with autism spectrum disorders: prevalence, comorbidity, and associated factors in a population-derived sample. *J Am Acad Child Adolesc Psychiatry*. 2008;47:921-929.
5. Totsika V, Hastings RP, Emerson E, Lancaster GA, Berridge DM. A population-based investigation of behavioural and emotional problems and maternal mental health: associations with autism spectrum disorder and intellectual disability. *J Child Psychol Psychiatry*. 2011;52:91-99.
6. Coghill D, Seth S. Do the diagnostic criteria for **A**DHD need to change? Comments on the preliminary proposals of the DSM-5 ADHD and Disruptive Behavior Disorders Committee.*Eur Child Adolesc Psychiatry*. 2011;20(2):75-81.
7. Miles JH. Autism spectrum disorders--a genetics review. *Genet Med*. 2011;13:278-294.
8. Bettelheim B. ed. *The empty fortress: infantile autism and the birth of the self.* New York: The Free Press; 1967.
9. Osborne LA, Reed P. Stress and self-perceived parenting behaviors of parents of children with autistic spectrum conditions. *Res Autism Spectr Disord.* 2010;4:405-414.
10. Smith L, Greenberg JS, Seltzer MM, Hong J. Symptoms and behavior problems of adolescents and adults with autism: Effects of mother-child relationship quality, warmth, and praise. *Am J Ment Retard.* 2008;113:378-393.
11. Meirsschaut M, Warreyn P, Roeyers H. What is the impact of autism on mother-child interactions within families with a child with autism spectrum disorder? *Autism Res.* 2011;4:358-367.
12. Wan MW, Green J, Elsabbagh M, Johnson M, Charman T, Plummer F; BASIS Team. Parent-infant interaction in infant siblings at risk of autism. *Res Dev Disabil*. 2012;33:924-32.

13. Ford T, Goodman R, Meltzer H. The relative importance of child, family, school and neighbourhood correlates of childhood psychiatric disorder. *Soc Psychiatry Psychiatr Epidemiol.* 2004;39:487-496.

14. Gillberg C, Steffenburg S. Outcome and prognostic factors in infantile autism and similar conditions: A population-based study of 46 cases followed through puberty. *J Autism Dev Disord.* 1987;17:273-287.

15. Gray K, Keating C, Taffe J, Brereton A, Einfeld S, Tonge B. Trajectory of Behavior and Emotional Problems in Autism. *Am J Intellect Dev Disabil.* 2012;117:121-133.

16. Simonoff E, Jones CRG, Baird G, Pickles A, Happé F, Charman T. The persistence and stability of psychiatric problems in adolescents with autism spectrum disorders. *J Child Psychol Psychiatry.* 2013; 54:186-189.

17. Charman T. Developing approaches to understanding and treating autism. *Folia Phoniatr Logop.* 2010;62:166-177.

18. Borkowski JG, Ramey SL, Bristol-Power M, eds. *Parenting and the child's world: Influences on academic, intellectual, and social-emotional development.* Mahwah, NJ: Erlbaum; 2002.

19. Hipwell AE, Keenan K, Kasza K, Loeber R, Stouthamer-Loeber M, Bean T. Reciprocal influences between girls' conduct problems and depression, and parental punishment and warmth: A six year prospective analysis. *J Abnorm Child Psychol.* 2008;36:663-677.

20. Kroneman LM, Hipwell AE, Loeber R, Koot HM, Pardini DA. Contextual risk factors as predictors of disruptive behavior disorder trajectories in girls: the moderating effect of callous-unemotional features. *J Child Psychol Psychiatry.* 2011;52:167-175.

21. Malmberg LE, Flouri E. The comparison and interdependence of maternal and paternal influences on child mental health and resilience. *J Clin Child Adolesc Psychol.* 2011;40:434-444.

22. Stormshak EA, Bierman KL, McMahon RJ, Lengua LJ. Parenting practices and child disruptive behavior problems in early elementary school. *J Clin Child Psychol.* 2000;29:17-29.

23. Greenberg JS, Seltzer MM, Hong J, Orsmond GI. Bidirectional effects of expressed emotion and behavior problems and symptoms in adolescents and adults with autism. *Am J Ment Retard.* 2006;111:229-249.

24. Baker JK, Smith LE, Greenberg JS, Seltzer MM. Change in Maternal Criticism and Behavior Problems in Adolescents and Adults with Autism across a Seven-Year Period. *J Abnorm Psychol.* 2010;120:465-475.

25. Osborne LA, McHugh L, Saunders J, Reed P. The effect of parenting behaviors on subsequent child behavior problems in autistic spectrum conditions. *Res Autism Spectr Disord*. 2008;2:249-263.

26. Hastings RP. Parental stress and behaviour problems of children with developmental disability. *J Intellect Dev Disabil.* 2002;27:149-160.

27. Coldwell J, Pike A, Dunn J. Household chaos: Links with parenting and child behaviour. *J Child Psychol Psychiatry.* 2006;47:1116–1122.

28. Myers BJ, Mackintosh VH, Goin-Kochel RP. "My greatest joy and my greatest heart ache:" Parents' own words on how having a child in the autism spectrum has affected their lives and their families' lives. *Res Autism Spectr Disord.* 2009;3: 670-684.

29. Flouri E, Malmberg L. Fathers' involvement and preschool children's behavior in stable single-mother families. *Child Youth Serv Rev*. 2012;34:1237-1242.

30. Bornstein MH, Hahn CS, Suwalsky JTD. Language and behavioral adjustment: Developmental pathways from childhood to adolescence. *Development and Psychopathology*. 2013;25.

31. Farah MJ, Shera DM, Savage, JH, et al. Childhood poverty: specific associations with neurocognitive development. *Brain Res.* 2006;1110:166–174.

32. Johnson S, Hollis C, Kochhar P, Hennessy E, Wolke D, Marlow N. Psychiatric Disorders in Extremely Preterm Children: Longitudinal Finding at Age 11 Years in the EPICure Study. *J Am Acad Child Adolesc Psychiatry.* 2010;49:453-463.

33. Kraemer HC, Stice E, Kazdin A, Offord MD, Kupfer MD. How Do Risk Factors Work Together? Mediators, Moderators, and Independent, Overlapping, and Proxy Risk Factors. *Am J Psychiatry* 2001;158:848-856.

34. Plewis I. *The Millennium Cohort Study: Technical report on sampling*. 4th ed. London: Centre for Longitudinal Studies, Institute of Education, University of London; 2007.

35. Daniels AM, Rosenberg RE, Anderson C, Law JK, Marvin AR, Law PA. Verification of Parent-Report of Child Autism Spectrum Disorder Diagnosis to a Web-Based Autism Registry. *J Autism Dev Disord.* 2012;42:257-265

36. Goodman R. The Strengths and Difficulties Questionnaire: A research note. *J Child Psychol Psychiatry.* 1997;38:581-586.

37. Stone LL, Otten R, Engels RC, Vermulst AA, Janssens JM. Psychometric properties of the parent and teacher versions of the Strengths and Difficulties Questionnaire. Clin Child Fam Psychol Rev. 2010;13:254-274.

38. Iizuka C, Yamashita Y, Nagamitsu S, et al. Comparison of the strengths and difficulties questionnaire (SDQ) scores between children with high functioning autism spectrum disorder (HFASD) and attention-deficit/hyperactivity disorder (AD/HD). *Brain Dev.* 2010;32:609-612.

39. Flouri E, Mavroveli S, Tzavidis N. Modeling risks: Effects of area deprivation, family socio-economic disadvantage, and adverse life events on young children's psychopathology. *Soc Psychiatry Psychiatr Epidemiol.* 2010;45:611-619.

40. Pianta RC. *Child-Parent Relationship Scale.* Charlottesville, VA: University of Virginia; 1992.

41. Matheny AP, Wachs TD, Ludwig JL, Phillips K. Bringing order out of chaos: Psychometric characteristics of the Confusion, Hubbub, and Order scale. *J Appl Dev Psychol.* 1995;16:429-444.

42. Elliott C, Smith P, McCulloch K. *British Ability Scales.* 2nd ed. London: Nelson; 1997.

43. Goldstein H. *Multilevel statistical models*. 3rd Ed. London: Arnold Publishers; 2003.

44. Rice K, Moriuchi JM, Jones W, Klin A. Parsing heterogeneity in autism spectrum disorders: visual scanning of dynamic social scenes in school-aged children. *J Am Acad Child Adolesc Psychiatry*. 2012;51:238-248.

45. Brereton AV, Tonge BJ, Einfeld SL. Psychopathology in children and adolescents with autism to young people with intellectual disability. *J Autism Dev Disord.* 2006;36:863-870.

46. Totsika V, Hastings RP, Emerson E, Berridge DM, Lancaster GA. Behavior problems at 5 years of age and maternal mental health in autism and intellectual disability. *J Abnorm Child Psychol.* 2011;39:1137-1147.

47. Thomas KC, Ellis AR, McLaurin C, Daniels J, Morrissey JP. Access to care for autism-related services. *Journal of Autism and Developmental Disorders*. 2007;37:1902–1912.

48. McBride BA, Schoppe SJ, Rane TR. Child characteristics, parenting stress, and parental involvement: Fathers versus mothers. *J Marriage Fam.* 2002; 64:998-1011.

49. El-Ghoroury NB, Romancyzk RG. Play interactions of family members towards children with autism. *J Autism Dev Disord.* 1999;29:249-258.

50. Belsky J, Bakermans-Kranenburg MJ, van IJzendoorn MH. For better and for worse: differential susceptibility to environmental influences. *Curr Dir Psychol Sci.* 2007;16:300-304.

51. Tonge BJ, Brereton AV, Gray KM, Einfeld SL. Behavioural and emotional disturbance in high-functioning autism and Asperger's syndrome. *Autism*. 1999;3:117-30.

52. Dominick KC, Davis NO, Lainhart J, Tager-Flusberg H, Folstein S. Atypical behaviors in children with autism and children with a history of language impairment. *Res Dev Disabil.* 2007;28:145-162.

53. Green JG, McLaughlin KA, Berglund PA, et al. Childhood adversities and adult psychiatric disorders in the national comorbidity survey replication I: associations with first onset of DSM-IV disorders. *Arch Gen Psychiatry*. 2010;67:113–123.

Table 1

Model summary

Model	Specification
Model 1	Design variables + covariates[a] + age + SED + (SED x age)
Model 2a	Model 1 + warmth + (warmth x age)
Model 2b	Model 1 + involvement + (involvement x age)
Model 2c	Model 1 + chaos + (chaos x age)
Model 2d	Model 1 + warmth + (warmth x age) + involvement + (involvement x age) + chaos + (chaos x age)
Model 3a	Model 2d + (warmth x SED) + (warmth x SED x age)
Model 3b	Model 2d + (involvement x SED) + (involvement x SED x age)
Model 3c	Model 2d + (chaos x SED) + (chaos x SED x age)
Model 3d	Model 2d + (warmth x SED) + (warmth x SED x age) + (involvement x SED) + (involvement x SED x age) + (chaos x SED) + (chaos x SED x age)

Note: 'x' indicates interaction. SED = Socio-economic disadvantage. [a]Gender, verbal IQ, low birthweight, and maternal qualifications. Models 1 and 2d are nested, as are Models 2d and 3d. Likelihood ratio test comparisons were made for these two sets of models.

Table 2

Key predictors of psychopathology at age 3 for ASD and non-ASD groups

	ASD			**Non-ASD**				
Variable	*n*	*M*	*SD*	*n*	*M*	*SD*	*t*	*df*
Warmth	133	59.26	7.71	10386	64.61	6.76	-7.98**	134.62
Involvement	122	21.26	2.76	9480	21.01	2.80	0.99	9600.00
Chaos	181	7.62	2.45	12491	7.00	2.18	3.43*	184.12
Socio-economic disadvantage	158	1.08	1.21	10661	0.81	1.13	2.95*	10817.00

Note: * p<.01; **p<.001.

Table 3

Growth curve models of broad psychopathology

Predictors	Model 1		Model 2d		Model 3d	
	b	**se**	**b**	**se**	**b**	**se**
			Fixed effects			
SED	0.949*	0.394	0.683	0.470	-1.335	7.043
SED x age	0.034	0.170	0.135	0.209	-2.164	3.032
Warmth			-0.263**	0.082	-0.266*	0.107
Warmth x age			0.065*	0.032	0.038	0.041
Involvement			0.408	0.238	0.391	0.280
Involvement x age			0.066	0.090	0.038	0.110
Chaos			0.426	0.229	0.408	0.276
Chaos x age			0.005	0.088	0.063	0.104
Warmth x SED					0.013	0.070
Warmth x SED x age					0.028	0.030
Involvement x SED					0.037	0.224
Involvement x SED x age					0.054	0.095
Chaos x SED					0.040	0.195
Chaos x SED x age					-0.069	0.083

England-advantaged *(ref)*						
England-disadvantaged	1.036	1.244	-0.611	1.223	-0.609	1.268
England-ethnic	4.319	3.248	5.030	3.467	5.401	3.708
Wales-advantaged	3.853	3.463	3.033	7.479	2.683	7.591
Wales-disadvantaged	0.893	1.649	2.556	1.864	2.650	1.875
Scotland-advantaged	2.942	1.846	4.529*	1.894	4.548*	1.912
Scotland-disadvantaged	-0.850	1.732	-0.182	1.470	0.116	1.494
Northern Ireland-advantaged	-3.363	2.757	-1.010	2.492	-0.802	2.601
Northern Ireland-disadvantaged	-0.393	2.379	1.288	2.303	1.733	2.336
Age	0.893***	0.242	-4.490	2.753	-2.275	3.302
Female	-2.110	1.466	-1.052	1.471	-1.201	1.519
Verbal ability	-0.074	0.040	-0.091*	0.041	-0.088*	0.041
Low birthweight	0.157	2.361	-3.408	4.253	-3.320	4.276
NVQ level 1 *(ref)*						
NVQ level 2	-5.256*	2.354	-10.830*	4.428	-11.163*	4.469
NVQ level 3	-3.291	2.493	-9.586*	4.502	-10.172*	4.573
NVQ level 4	-5.962*	2.412	-11.716**	4.442	-12.194**	4.485
NVQ level 5	-8.346**	2.883	-14.042**	4.744	-14.118**	4.778
Constant	22.846***	2.919	33.275***	7.747	34.208***	9.042

Random effects						
Between-child intercept variance	18.810***	3.533	15.739***	3.755	16.422***	3.835
Between-child slope variance	1.269*	0.609	1.389	0.700	1.334	0.683
Between-child intercept-slope variance covariance	2.544**	0.955	5.026***	1.190	5.512***	1.196
Between-occasion variance	19.985***	2.784	18.360***	3.125	18.037***	3.068
Log likelihood	2116.274		1348.282		1345.271	

Note: *p<.05; **p<.01; ***p<.001. SED=Socio-economic disadvantage. NVQ=National Vocational Qualification. England advantaged-Northern Ireland-disadvantaged=MCS design variables.

Figure 1
Click here to download high resolution image

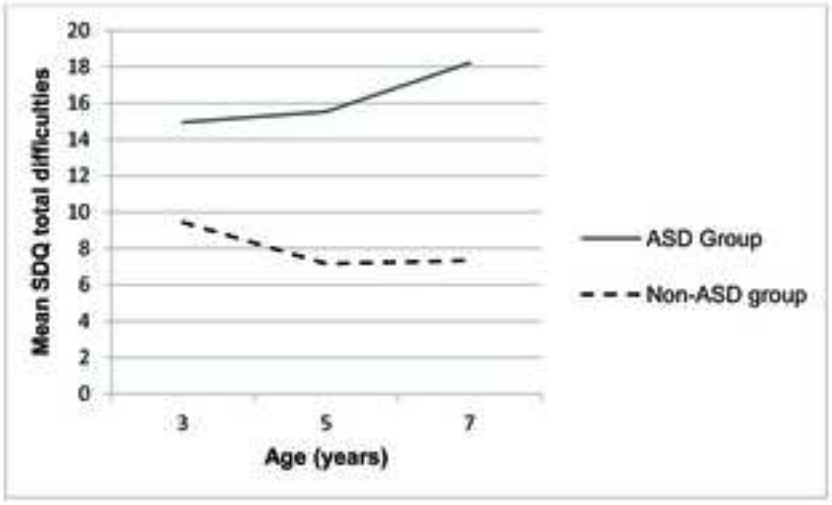

Figure 1

Weighted mean trajectories of broad psychopathology for children in the ASD and non-ASD groups

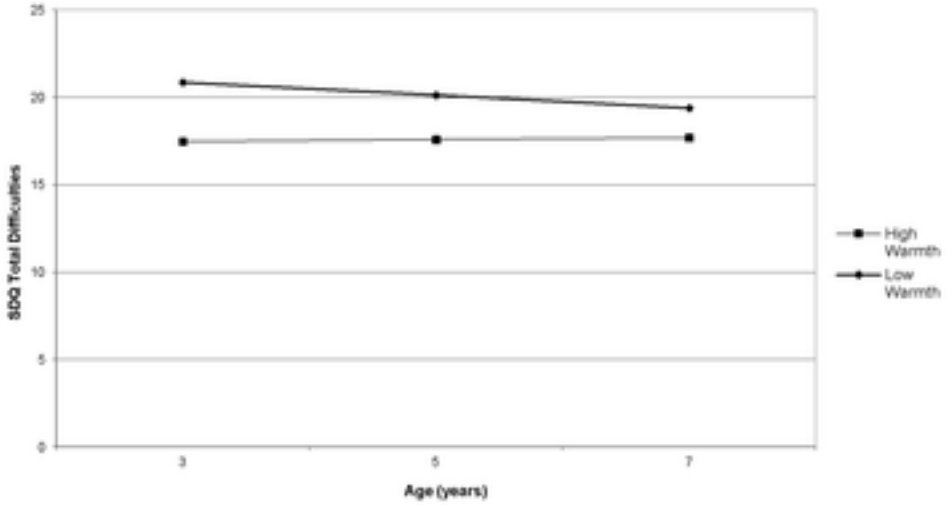

Figure S1.
Predicted trajectories of children with ASD by high/low warmth

Table S1

Broad and specific psychopathology at time 1 (3 years), time 2 (5 years) and time 3 (7 years) for the ASD and non-ASD groups

		ASD group			Non-ASD group					
	Variable	*n*	*M*	*SD*	*n*	*M*	*SD*	*t*	*df*	95% *CI*
Time 1	Broad Psychopathology									
	Total Difficulties	170	14.95	6.04	11705	9.44	5.20	11.83*	172.66	[4.59, 6.43]
	Specific Psychopathology									
	Emotional Symptoms	175	1.93	1.82	11959	1.35	1.47	4.17*	177.39	[0.30, 0.85]
	Conduct Symptoms	175	3.91	2.10	11980	2.78	2.05	7.25*	12153.00	[0.82, 1.44]
	Hyperactivity/Inattention	175	6.09	2.56	11866	3.85	2.34	11.46*	178.32	[1.85, 2.62]
	Peer Problems	170	3.11	2.16	11892	1.51	1.57	9.64*	171.59	[1.27, 1.93]
Time 2	Broad Psychopathology									
	Total Difficulties	190	15.53	7.03	12647	7.16	4.83	16.36*	191.69	[7.36, 9.38]
	Specific Psychopathology									
	Emotional Symptoms	192	2.60	2.36	12747	1.37	1.57	7.22*	193.57	[0.70,1.60]
	Conduct Symptoms	194	2.90	1.77	12763	1.48	1.48	11.12*	197.12	[1.17,1.68]
	Hyperactivity/Inattention	194	6.49	2.80	12696	3.22	2.33	16.20*	197.10	[2.87, 3.67]
	Peer Problems	192	3.63	2.43	12740	1.12	1.40	14.24*	192.90	[2.16, 2.85]
Time 3	Broad Psychopathology									

Total Difficulties	201	18.21	7.34	13326	7.34	5.27	20.91*	203.12	[9.84, 11.89]
Specific Psychopathology									
Emotional Symptoms	204	3.65	2.59	13403	1.51	1.74	11.75*	205.79	[1.78, 2.50]
Conduct Symptoms	204	3.21	2.20	13432	1.37	1.52	11.90*	205.94	[1.54, 2.15]
Hyperactivity/Inattention	204	7.16	2.56	13382	3.31	2.48	22.00*	13584.00	[3.51, 4.19]
Peer Problems	201	4.23	2.43	13415	1.19	1.50	17.72*	202.28	[2.70, 3.38]

Note: *p<.001.