ORIGINAL ARTICLE

# Association of Maternal and Paternal IQ With Offspring Conduct, Emotional, and Attention Problem Scores

## *Transgenerational Evidence From the 1958 British Birth Cohort Study*

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**Context:** Individuals with lower IQ scores have an increased risk of psychological disorders, mental health problems, and suicide; similarly, children with low IQ scores are more likely to have behavioral, emotional, and anxiety disorders. However, little is known about the effect of parental IQ on the mental health outcomes of their children.

**Objective:** To determine whether maternal and paternal IQ scores are associated with offspring conduct, emotional, and attention scores.

**Design:** Cohort study.

**Setting:** General population.

**Participants:** Members of the 1958 National Child Development Study and their offspring were studied. Of 2984 parent-offspring pairs with nonadopted children 4 years or older, 2202 pairs had complete data regarding all variables of interest and were included in the analyses.

**Main Outcome Measures:** Offspring conduct, emotional, and attention scores based on the Behavioral Problems Index for children aged 4 to 6 years or the Rutter A scale for children and adolescents 7 years and older.

**Results:** Little evidence was observed of any association of parental IQ with conduct or emotional problems in children aged 4 to 6 years. However, among children and adolescents 7 years or older, strong evidence was observed from age- and sex-adjusted models to support a decrease in conduct, emotional, and attention problems in those whose parents had higher IQ scores. These associations were linear across the full IQ range. Individual adjustments for socioeconomic status and the child's own IQ had limited effect. However, adjustments for Home Observation for Measurement of the Environment scores and parental malaise attenuated associations with the mother's IQ but had little effect on associations with the father's IQ (scores were available for only 1 parent for each child or adolescent). Strong associations were no longer evident in models that simultaneously adjusted for all 4 potential mediating variables.

**Conclusions:** Children whose parents score poorly on IQ tests may have an increased risk of conduct, emotional, and attention problems. The home environment, parental malaise, and the child's own IQ may have a role in explaining these associations.

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EMERGING EVIDENCE SUGgests that individuals who score poorly on IQ tests in childhood, adolescence, or early adulthood are more likely as adults to experience psychological distress,[1] are at increased risk of the whole range of mental disorders,[2,3] and have higher rates of attempted[4,5] and completed[6,7] suicide. Lower IQ scores in children also have been associated with an increased risk of behavioral and emotional problems[8] and anxiety disorders.[8,9] However, the extent to which these mental health outcomes also are influenced by parental IQ remains unknown.

Sparse literature suggests that maternal[10,11] or mean parental[12] IQ may be associated with behavioral and emotional problems in their offspring. However, the overall evidence is inconsistent, mainly relies on small-scale studies that are based on nonrepresentative groups, and tends to focus specifically on children and adolescents whose parents have below-average IQ. Chen et al,[10] for example, used follow-up data from a trial of 656 children with high blood lead levels and found an increase in behavioral problems in those whose mothers had lower IQ scores. However, this association was attenuated after controlling for the child's own IQ score. In a study of 121 adolescent mothers characterized by below-average intelligence,[11] maternal IQ was negatively correlated with children's socioemotional development scores. This association was not robust to adjustment for factors such



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as cognitive readiness for parenting and social support, although it is notable that both of these factors were correlated with maternal IQ and their inclusion might, therefore, have led to overadjustment. Goodman et al[12] targeted a sample of 411 twins and found that, after adjustment for socioeconomic status (SES) and the child's own IQ, children whose parents had a higher mean IQ had more emotional symptoms. Finally, results from the National Longitudinal Survey of Youth,[13] which included 2256 children aged 4 to 11 years, did not show any effect of maternal IQ on offspring behavioral scores in multivariable models that also included a number of factors, such as family income (self-reported), maternal smoking status, and maternal educational level. However, children whose parents provided less cognitive stimulation and emotional support, as measured by poorer scores on the Home Observation for Measurement of the Environment (HOME) Inventory, had more behavioral problems.

In this report from the 1958 National Child Development Study, we examine associations of parental IQ with offspring conduct, emotional, and attention problem scores. Our analyses are based on data drawn from a large, British, representative cohort of parent-offspring pairs with IQ measurements in childhood available for offspring and parents and with participants from across the full IQ range. A major advantage of this study is the availability of both maternal and paternal IQ test scores, which allows a comparison of the strength of association of each with offspring development and behaviors. Similar magnitudes of effect for maternal and paternal IQ would suggest that associations are generated by factors that are as likely to be transmitted from father to offspring as they are from mother to offspring; these might include, for example, nuclear genetic variation, SES, or shared lifestyle factors. In contrast, a stronger maternal IQ association might suggest that maternal or intrauterine characteristics are more important in determining children's development and behavior. Also, data are available regarding a number of potential mediating factors, which allows exploration of the possible mechanisms underlying any associations between parental IQ and offspring conduct, emotional, and attention problem scores. These mediating variables include SES, the child's own IQ score, the quality and quantity of cognitive stimulation and emotional support as measured by HOME scores, and parental malaise.

## METHODS

### STUDY POPULATION

The National Child Development Study (1958 cohort) comprises more than 17 000 live births in Great Britain occurring between March 3 and March 9, 1958.[14] Follow-up sweeps were performed in 1965, 1969, 1974, 1991, and 1999 to 2000. The 1991 follow-up collected data regarding the original cohort, then aged 33 years, and also from the offspring of 1 in 3 randomly selected cohort members. In the present analysis, parental data were obtained from the original study members of the 1958 cohort and offspring data from their children.

### PARENTAL DATA COLLECTION

The cohort members' mental abilities were assessed at school in 1969, at age 11 years, using a general-ability test devised by the National Foundation for Educational Research in England and Wales.[15] Scores from this test correlate strongly with verbal-ability test scores used to select 11-year-olds for secondary school,[15] which suggests a high degree of validity. Data regarding marital status and SES were collected 22 years later, in 1991; SES was based on one's own occupation for male cohort members and one's husband's occupation for female cohort members. Psychological distress and depression in 1991 were measured using the Malaise Inventory.[16]

### OFFSPRING DATA COLLECTION

Offspring cognitive ability–related tests, performed in 1991, were administered by interviewers and included the Peabody Picture Vocabulary Test–Revised (PPVT-R) (Form L), the McCarthy Scale of Children's Abilities (verbal subscale), and the Wechsler Intelligence Scale for Children (digit span subscale). The PPVT scores were measured in all children 4 years or older; we present results based on these data. However, results based on other IQ measures, which were available for a smaller subgroup of children, are broadly similar (results not shown; available on request from the authors). The PPVT is a widely used and recognized indicator of children's cognitive function and has been shown to correlate well with IQ-type measures.[17]

The quality and quantity of cognitive stimulation and emotional support provided to children in the home were assessed using HOME scores,[18] based on responses from mothers, regardless of the sex of the original cohort member. Similarly, conduct, emotional, and attention difficulties were assessed using mothers' responses to the Behavior Problems Index[19] for children aged 4 to 6 years or the Rutter A scale[16] for children 7 years and older. These scales have been widely used and validated.[19,20] The Behavior Problems Index consists of 32 items with 3 response options (often true, sometimes true, or not true). We subjected the mothers' responses to these 32 items to principal components analysis. The scree slope suggested the presence of 2 factors after oblique rotation (direct oblimin), which accounted for 23.2% of the total variance. High loading items (>0.50) were retained, and the 2 extracted factors were labeled *conduct problems* and *emotional problems*. The Cronbach $\alpha$ values for these scales were 0.84 and 0.75, respectively. The Rutter A scale consisted of 18 items with 3 response options (certainly applies, applies somewhat, or does not apply). The scree slope from a principal components analysis of these items suggested the presence of 3 factors after oblique rotation (direct oblimin), which accounted for 24.3% of the total variance. High loading items (>0.50) were retained, and the 3 extracted factors were labeled *conduct problems*, *emotional problems*, and *attention problems*. The Cronbach $\alpha$ values for these were 0.78, 0.60, and 0.80, respectively.

### STATISTICAL ANALYSIS

Parental IQ associations with offspring behavioral scores were based on cohort member–offspring pairs in which the offspring was nonadopted and aged 4 to 18 years at the time of data collection. Analyses were performed using least squares regression, and associations are presented as mean change in outcome per standard deviation increase in parental IQ score, having first checked that the associations were approximately linear. We performed separate analyses based on maternal vs paternal IQ to allow for differential effects and performed corresponding statistical tests for interaction or effect modifica-



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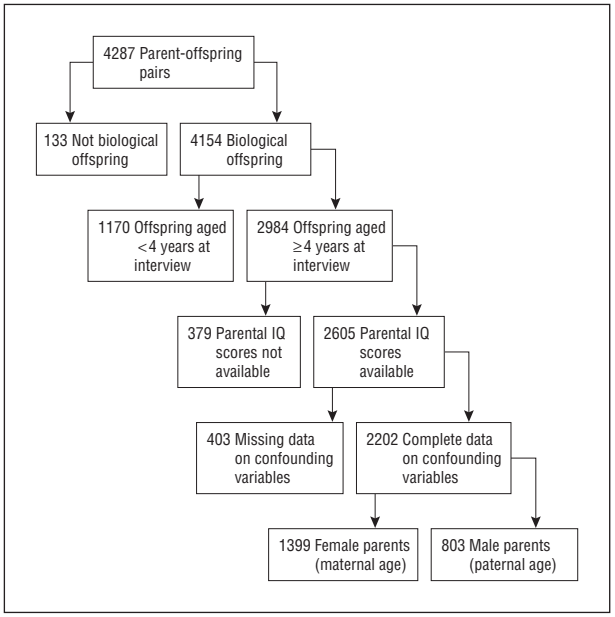


**Figure.** Selection of the analytical sample.

**Table 1. Characteristics of 2202 Parent-Offspring Pairs[a]**

| Characteristic | Mother-Offspring Pairs (n=1399) | Father-Offspring Pairs (n=803) |
|---|---|---|
| Parental IQ (NFER) score at 11 years of age, mean (SD) | 43.6 (15.5) | 42.0 (15.3) |
| Socioeconomic status level[b] | | |
| I | 42 (3.0) | 32 (4.0) |
| II | 102 (7.3) | 98 (12.2) |
| III | 919 (65.7) | 481 (59.9) |
| IV | 191 (13.7) | 105 (13.1) |
| V | 145 (10.4) | 87 (10.8) |
| Parental malaise score in 1991, mean (SD) | 3.1 (3.5) | 2.0 (2.8) |
| HOME score in 1991, mean (SD) | 22.0 (3.7) | 22.5 (3.3) |
| Offspring sex, No. (%) | | |
| Male | 691 (49.4) | 390 (48.6) |
| Female | 708 (50.6) | 413 (51.4) |
| Offspring age in 1991, mean (SD), y | 8.6 (3.2) | 7.3 (2.6) |
| Offspring IQ (PPVT-R) score in 1991, mean (SD)[c] | 34.4 (11.1) | 33.8 (10.6) |

Abbreviations: HOME, Home Observation for Measurement of the Environment; NFER, National Foundation for Educational Research; PPVT-R, Peabody Picture Vocabulary Test–Revised.

[a] Data are shown as number (percent) except where indicated. Percentages may not total 100 because of rounding.

[b] By occupational category, defined as follows: I, professional; II, managerial and technical/intermediate; III, skilled (nonmanual/manual); IV, partly skilled; and V, unskilled.

[c] Form L of the PPVT-R was used.

tion. The 95% confidence intervals are based on robust standard errors, which take into account the nonindependence of children from the same family.

All analyses were adjusted for the potential confounding effects of offspring age and sex. Evidence suggests that women with lower IQ scores are more likely to have their children at younger ages,[21] and it is, therefore, important to consider the role of parental age at the time of offspring birth in explaining any parental IQ associations. However, the parents in the current analysis were all born in the same week, and data regarding their offspring were collected during a short period in 1991, so adjustment for offspring age in this case is equivalent to adjustment for parental age at offspring birth; we have confirmed that additional adjustment for parental age has no effect on the results presented here (results not shown; available on request from the authors). Adjustment for marital status had no effect on the results because 98.8% of men and women, in 1991, stated that they were married (results not shown; available on request from the authors).

Possible mechanisms underlying parental IQ–offspring behavior associations were explored in more detail using models with additional adjustments for the mediating effect of parental SES and offspring IQ, both of which are likely to depend on parental IQ and might be expected to be associated with children's psychological well-being. Similarly, separate adjustments also were made for HOME scores, which have previously been associated with maternal IQ[22-24] and offspring behavior,[13] and for parental depression, which is known to be associated with IQ[1,2] and with offspring psychological development.[25-27] Also, for information, we present models that adjust for all 4 potential mediating factors simultaneously. As we show in the Results section, these factors are associated with parental IQ and offspring psychological development and also with each other. For example, offspring IQ depends on parental IQ; however, it also may be influenced by the home environment (as determined by the HOME score), which, in turn, may be affected by parental malaise (as determined by the Malaise Inventory score). A model that includes all factors simultaneously may, therefore, be overadjusted and should be interpreted with caution. Analyses are based on parent-offspring pairs with complete data regarding all variables of interest.

## RESULTS

The original sample consisted of 4287 parent-offspring pairs (**Figure**), and the offspring of 2984 (69.6%) were known to be nonadopted and 4 years or older in 1991 (when offspring IQ measurements were made). Parental IQ was unavailable for 379 (12.7%) of these pairs, and data regarding confounding variables were missing for a further 403 (13.5%), leaving an analytical sample of 2202 pairs. The characteristics of parents and offspring excluded from the analyses as a result of missing data were similar, although parental IQ, when available, was somewhat lower (mean [SD] parental IQ in those with missing vs complete confounding data, 38.4 [15.5] vs 42.8 [15.4]). For each child or adolescent, IQ scores were available for only 1 parent. Parental IQ and SES were higher in parent-offspring pairs who were excluded because the child was younger than 4 years in 1991, which would be consistent with higher-IQ cohort members choosing to have their children at later ages.

The analytical sample included a total of 1399 mother-offspring pairs (63.5%) and 803 father-offspring pairs (36.5%); their characteristics are given in **Table 1**. Just less than half of offspring were male, and this proportion, along with average offspring IQ, was similar in mother- vs father-offspring pairs. Almost two-thirds of cohort members were from SES III (the baseline category; skilled [nonmanual/manual] occupation), although fathers were slightly more likely to be from SES I (professional occupation) or II (managerial and technical/intermediate occupation), despite a slightly lower mean IQ at age 11. The main differ-



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ence between mother- and father-offspring pairs was the mean offspring age in 1991, which was 1.3 years lower in father-offspring pairs, suggesting that men tended to be slightly older than women when their children were born.

Correlations between parental IQ and malaise scores, HOME score, and offspring IQ are given in **Table 2**. Offspring IQ and HOME scores were positively correlated with maternal and paternal IQ. Malaise scores were negatively correlated with parental IQ, most markedly in mothers, indicating that parents with higher IQ were less likely to be depressed. Pairwise correlations between SES, offspring IQ, HOME scores, and malaise scores were modest in magnitude but statistically significant ($P < .001$ for all correlations), with coefficients ranging from –0.10 (offspring IQ–parental malaise) to 0.22 (offspring IQ–HOME score).

Associations of parental IQ with behavioral problem scores are presented in **Table 3** (mothers) and **Table 4** (fathers). Approximately one-third of children were aged 4 to 6 years at data collection. Among this group, no marked associations were observed between conduct problem scores and maternal or paternal IQ. In adjusted models, it was suggested that children with fathers with higher IQ and, to a lesser extent, mothers with higher IQ might have slightly higher scores for emotional problems, but this association was only of borderline statistical significance.

Age- and sex-adjusted maternal IQ associations for offspring 7 years and older (Table 3) indicated that children whose mothers had higher IQ scores at 11 years of age tended to have lower scores for conduct problems, emotional problems, and attention problems. These associations were only affected marginally by adjustments for SES and the child's own IQ. Individual adjustments for HOME score and, in particular, the mother's malaise score led to a more marked attenuation of associations; however, 95% confidence intervals for those with conduct and attention problems remained below 0. Associations adjusted for all 4 factors simultaneously no longer were statistically significant at conventional levels. Paternal IQ associations (Table 4) were based on smaller numbers of parent-offspring pairs but were similar to those for maternal IQ, with the children of fathers with higher IQ scores having lower conduct, emotional, and attention scores, although associations with emotional scores were not conventionally statistically significant. Again, these associations were largely unaffected by individual adjustment for SES and offspring IQ. However, in contrast to maternal IQ associations, individual adjustment for HOME scores and paternal malaise also had little or no effect on these results. Again, multiply adjusted models were not conventionally statistically significant.

The marked attenuation of associations in multiply adjusted models is consistent with a mediating role of at least 1 of SES, offspring IQ, HOME score, or parental malaise. However, results from individually adjusted models suggest that these mediating effects were modest, and no evidence was shown that any single factor explained the associations between parental IQ and offspring conduct, emotional, and attention scores.

**Table 2. Correlations of Parental IQ Score With Parental Malaise, HOME, and Offspring IQ Scores[a]**

| Variable | Maternal | Paternal |
|---|---|---|
| Offspring IQ score | 0.30 | 0.31 |
| HOME score | 0.28 | 0.24 |
| Parental malaise score | –0.24 | –0.17 |

Abbreviation: HOME, Home Observation for Measurement of the Environment.
[a] $P < .001$ for all comparisons.

## COMMENT

We have explored associations between parental IQ and offspring conduct, emotional, and attention problems. No evidence was shown to suggest that parental IQ had an effect on the conduct problems of children aged 4 to 6 years. Also, an unexpected increase in emotional problems in younger children whose fathers, in particular, had a higher IQ score was weakly suggested. Conversely, among children 7 years or older, age- and sex-adjusted analyses indicated that those with parents with higher IQ scores had fewer conduct, emotional, and attention problems. These associations were attenuated to some extent by individual adjustments for SES, the child's own IQ score, and, in the case of mothers particularly, HOME scores and level of malaise; simultaneous adjustment for all 4 factors markedly attenuated associations.

The current analyses have a number of advantages compared with previous studies. In addition to the relatively large sample size, the original cohort from which our sample was drawn is representative of all men and women born in Great Britain at around this time and, most important, includes those with IQ scores from across the full IQ range. Parental IQ was measured in childhood, before any substantial effect of education on IQ test performance. We also had data on potential mediating factors, such as SES, offspring IQ, HOME scores, and parental malaise, which has allowed a more detailed exploration of the possible mechanisms underlying parental IQ–offspring behavior associations. The Behavior Problem Index and Rutter A tests used to measure children's conduct, emotional, and attention problems are well validated and widely used. Also, to our knowledge, this analysis is unique in using IQ data from both mothers and fathers.

However, our study has some limitations. Although all cohort members were included in the main study follow-up, only a third of cohort members with offspring were invited to take part in the portions of the survey that involved the offspring. Cohort members excluded from our analyses tended to have somewhat higher SES, although it is reassuring that their mean IQ was almost identical to those included in the analyses. Also, although we adjusted for age and sex and also looked at the additional effect of adjustments for potential mediating factors, such as SES, offspring IQ, HOME scores, and parental malaise, we cannot rule out residual confounding by other unmeasured confounding or mediating factors. Conversely, it is important to recognize that the 4 mediating factors were all corre-



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**Table 3. Association of the Mother's IQ at 11 Years of Age With Offspring Conduct, Emotional, and Attention Problem Scores at 4 Years or Older[a]**

| Variable | No. | Mean (SD) | Regression Coefficient (95% CI) by Adjustments | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Offspring Age and Sex | Offspring Age, Sex, and SES | Offspring Age, Sex, and IQ | Offspring Age, Sex, and HOME Score | Offspring Age and Sex and Parental Malaise | Multiple[b] |
| **Children Aged 4 to 6 Years[c]** | | | | | | | | |
| Conduct problems score | | | | | | | | |
| SD increase[d] | 420 | 22.8 (5.1) | −0.33 (−0.91 to 0.25) | −0.33 (−0.93 to 0.28) | −0.20 (−0.79 to 0.40) | 0.04 (−0.55 to 0.63) | −0.14 (−0.66 to 0.37) | 0.17 (−0.40 to 0.74) |
| *P* value[e] | | | .26 | .29 | .52 | .89 | .58 | .55 |
| Emotional problems score | | | | | | | | |
| SD increase[d] | 422 | 15.9 (3.3) | 0.05 (−0.31 to 0.41) | 0.08 (−0.30 to 0.45) | 0.04 (−0.32 to 0.40) | 0.21 (−0.15 to 0.57) | 0.13 (−0.21 to 0.47) | 0.23 (−0.13 to 0.59) |
| *P* value[e] | | | .79 | .69 | .83 | .25 | .46 | .22 |
| **Offspring 7 Years or Older[f]** | | | | | | | | |
| Conduct problems score | | | | | | | | |
| SD increase[d] | 833 | 9.4 (2.3) | −0.49 (−0.73 to −0.25) | −0.53 (−0.78 to −0.28) | −0.44 (−0.69 to −0.19) | −0.33 (−0.57 to −0.09) | −0.31 (−0.54 to −0.09) | −0.22 (−0.45 to 0.02) |
| *P* value[e] | | | <.001 | <.001 | .001 | .01 | .01 | .07 |
| Emotional problems score | | | | | | | | |
| SD increase[d] | 831 | 7.5 (1.9) | −0.16 (−0.31 to −0.02) | −0.19 (−0.34 to −0.03) | −0.17 (−0.32 to −0.02) | −0.11 (−0.27 to 0.04) | −0.03 (−0.17 to 0.11) | −0.05 (−0.21 to 0.11) |
| *P* value[e] | | | .03 | .02 | .03 | .15 | .66 | .56 |
| Attention problems score | | | | | | | | |
| SD increase[d] | 835 | 4.3 (1.6) | −0.25 (−0.36 to −0.13) | −0.24 (−0.36 to −0.11) | −0.22 (−0.34 to −0.09) | −0.18 (−0.30 to −0.05) | −0.14 (−0.26 to −0.02) | −0.08 (−0.21 to 0.06) |
| *P* value[e] | | | .001 | .001 | .001 | .01 | .02 | .27 |

Abbreviations: HOME, Home Observation for Measurement of the Environment; SES, socioeconomic status.
[a] For each child or adolescent, IQ scores were only available for 1 parent.
[b] Adjusted for offspring age, sex, and IQ; HOME score; SES; and parental malaise.
[c] Based on the Behavior Problems Index score.
[d] Mean change per SD increase.
[e] For linear trend.
[f] Based on the Rutter A score.

lated with parental IQ and with each other and that models that contain all 4 simultaneously (multiply adjusted models presented in Tables 3 and 4) may, therefore, be overadjusted. Also, although it is informative to consider the degree of attenuation due to statistical adjustment for these factors, we cannot draw any conclusions regarding direct causality. Finally, the possibility of biases cannot be ruled out. Children with behavioral problems may have performed particularly poorly in IQ tests, which could potentially inflate the confounding effects of offspring IQ. In addition, all of our outcome measures were based on maternal responses rather than direct observation of the children and may, therefore, be subject to reporting biases if mothers with higher or lower IQ scores were more likely to perceive or to report problems with their children's behavior.

Parental IQ generally had little effect on the conduct scores of younger (aged 4-6 years) offspring in these data, although it is worth noting that analyses were based on smaller numbers than those for older (≥7 years) children and that psychological assessments in this younger group are likely to have been less reliable. The isolated finding of increased emotional problems in younger children with parents with higher IQ scores, particularly fathers, is consistent with a previous finding by Goodman et al,[12] who reported an increased risk of behavioral problems in children whose parents had a higher mean IQ. These authors suggested a number of mechanisms for this association, including higher academic expectations and pressures applied by higher-IQ parents or a style of parenting that is more overprotective, which may lead to more emotional symptoms in the child. Although plausible, it is difficult to explain why these factors would apply more to fathers in the present analyses. Also, although associations in offspring 7 years and older were weakest for the emotional dimension of the Rutter A scores, they were, nonetheless, consistent with a decrease in problems in children of parents with higher IQ scores. Therefore, this result may simply be a chance finding as a result of multiple comparisons.

In contrast, age- and sex-adjusted associations in older (≥7 years) offspring were consistent with decreasing problems in children whose parents had higher IQ scores. Although some literature exists regarding the delayed development and worse behavior of children born to mothers with specific intellectual disabilities[28-30] or below-average IQ scores,[10,11] little is known about the effect on child behavior problems of parental IQ across the full IQ range. The associations among older children in the current analyses were linear across all parental IQ scores, suggesting that it is not parents' intellectual disability that is associated with behavioral difficulties but rather that a gradient of effect can be observed across the full IQ range. To explore the possible mechanisms underlying these associations, we examined the effect of adjusting for a number of potential mediators, namely, SES, the child's own IQ score, HOME scores, and parental malaise. The strong associations observed in age- and sex-adjusted models no longer were apparent in multiply adjusted models, suggesting that at least



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**Table 4. Association of the Father's IQ at 11 Years of Age With Offspring Conduct, Emotional, and Attention Problem Scores at 4 Years or Older[a]**

| Variable | No. | Mean (SD) | Regression Coefficient (95% CI) by Adjustments | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Offspring Age and Sex | Offspring Age, Sex, and SES | Offspring Age, Sex, and IQ | Offspring Age, Sex, and HOME Score | Offspring Age and Sex and Parental Malaise | Multiple[b] |
| **Children Aged 4 to 6 Years[c]** | | | | | | | | |
| Conduct problems score | | | | | | | | |
| SD increase[d] | 313 | 22.9 (5.2) | −0.36 (−1.05 to 0.32) | −0.30 (−1.00 to 0.40) | −0.29 (−0.98 to 0.40) | −0.03 (−0.68 to 0.62) | −0.22 (−0.91 to 0.48) | 0.05 (−0.62 to 0.72) |
| *P* value[e] | | | .29 | .40 | .41 | .92 | .54 | .88 |
| Emotional problems score | | | | | | | | |
| SD increase[d] | 320 | 15.5 (2.7) | 0.33 (−0.07 to 0.73) | 0.42 (−0.01 to 0.84) | 0.30 (−0.09 to 0.69) | 0.42 (0.01 to 0.83) | 0.38 (−0.02 to 0.79) | 0.47 (0.05 to 0.88) |
| *P* value[e] | | | .11 | .05 | .13 | .04 | .07 | .03 |
| **Offspring 7 Years or Older[f]** | | | | | | | | |
| Conduct problems score | | | | | | | | |
| SD increase[d] | 388 | 9.4 (2.3) | −0.29 (−0.56 to −0.01) | −0.23 (−0.51 to 0.05) | −0.22 (−0.50 to 0.06) | −0.20 (−0.47 to 0.07) | −0.29 (−0.57 to −0.01) | −0.12 (−0.42 to 0.17) |
| *P* value[e] | | | .04 | .10 | .12 | .15 | .05 | .41 |
| Emotional problems score | | | | | | | | |
| SD increase[d] | 387 | 7.4 (1.9) | −0.09 (−0.28 to 0.11) | −0.08 (−0.27 to 0.12) | −0.11 (−0.32 to 0.10) | −0.07 (−0.28 to 0.13) | −0.06 (−0.26 to 0.14) | −0.06 (−0.28 to 0.16) |
| *P* value[e] | | | .38 | .45 | .31 | .46 | .58 | .58 |
| Attention problems score | | | | | | | | |
| SD increase[d] | 393 | 4.3 (1.7) | −0.26 (−0.42 to −0.10) | −0.25 (−0.41 to −0.08) | −0.21 (−0.38 to −0.04) | −0.22 (−0.39 to −0.06) | −0.25 (−0.41 to −0.09) | −0.16 (−0.35 to 0.02) |
| *P* value[e] | | | .001 | .004 | .02 | .01 | .002 | .09 |

Abbreviations: HOME, Home Observation for Measurement of the Environment;
[a] For each child or adolescent, IQ scores were only available for 1 parent. SES, socioeconomic status.
[b] Adjusted for offspring age, sex, and IQ; HOME score; SES; and parental malaise.
[c] Based on the Behavior Problems Index score.
[d] Mean change per SD increase.
[e] For linear trend.
[f] Based on the Rutter A score.

some of these factors had a mediating effect. However, results from analyses that adjusted for each factor individually showed only a modest degree of attenuation, if any, such that, although they each appeared to play some part, no single factor completely explained parental IQ–childhood behavior associations.

It is not surprising that adjustment for the child's own IQ attenuated some of these associations but, notably, the degree of attenuation was relatively small and, in some cases, nonexistent. This indicates that parental IQ may have an independent effect on these outcomes beyond that conferred by inherited intellectual ability. Similarly, adjustment for SES had little effect on our results, suggesting that the potential material aspects of low parental IQ, such as unemployment, low household income, or living in an economically deprived area, did not play a substantial role in explaining these associations.

Previous studies suggest that parents with lower IQ scores may provide a less stimulating or supportive home environment[22-24] and that this may negatively affect their children's IQ[31,32] and behavior.[13] HOME scores in the current cohort were positively correlated with parental IQ, and adjustments for HOME scores generally attenuated parental IQ–offspring behavior associations, particularly those with the mother's IQ. Although adjustment for HOME scores did not completely explain these associations, the attenuation indicates that parenting quality and style may have a mediating role in explaining parental IQ–offspring behavior associations (ie, parents with lower IQ scores may provide less cognitive stimulation and emotional support, which may result in an increase in behavioral problems).

Similarly, lower IQ is known to be associated with an increased risk of depression in this[1] and other[2] populations. Adjustment for paternal malaise left associations of the father's IQ with offspring behavior almost unchanged. Conversely, adjustment for maternal malaise had the greatest effect of any variable on associations with the mother's IQ. Evidence exists that parental psychiatric disorders are associated with behavioral problems in children,[25-27] and the results from the current analyses would support a mediating role of depression in explaining the mother's IQ–offspring behavior associations. However, it is also worth considering previous evidence that indicates that the presence of depression may influence how mothers rate childhood behavior,[33] with depressed mothers tending to overreport child behavior problems. In this context, it is notable that the attenuating influence of parental malaise in the current analyses was restricted to mothers and that, regardless of the sex of the original cohort member, it was the mothers who provided responses to the behavioral questions regarding their children.

We are not aware of any previous studies that have examined directly the potential associations with maternal vs paternal IQ. In the current analyses, associations based on mother- and father-offspring pairs were similar, which is perhaps not surprising, given that couples are likely to have similar IQ scores. What is of interest is



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the relative effect of adjustments for mediating factors in mothers and fathers. Although the effects of adjustment for SES and offspring IQ were similar for both groups of parents, the effect of adjustment for HOME scores and, in particular, malaise was much greater in maternal IQ associations with offspring behavior. It is possible that this greater effect is simply a result of mothers providing offspring behavioral data. However, it also may reflect the more influential parenting role among mothers, who are more commonly the primary caregiver.

The etiology of child behavioral problems is complex, with many interrelated factors playing an important role. Our results suggest that the children of parents with lower IQ scores may be at high risk of conduct, emotional, and attention problems and that this may be a result, at least partially, of lower IQ in the child, a poorer home environment, and greater malaise in the parents. Further studies are needed to explore these mechanisms in more detail and to determine whether families of this type might benefit from additional or targeted education and support.

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## REFERENCES

1. Gale CR, Hatch SL, Batty GD, Deary IJ. Intelligence in childhood and risk of psychological distress in adulthood: the 1958 National Child Development Survey and the 1970 British Cohort Study. *Intelligence*. 2009;37(6):592-599.
2. Gale CR, Deary IJ, Boyle SH, Barefoot J, Mortensen LH, Batty GD. Cognitive ability in early adulthood and risk of 5 specific psychiatric disorders in middle age: the Vietnam experience study. *Arch Gen Psychiatry*. 2008;65(12):1410-1418.
3. Gale CR, Batty GD, Tynelius P, Deary IJ, Rasmussen F. Intelligence in early adulthood and subsequent hospitalization for mental disorders. *Epidemiology*. 2010; 21(1):70-77.
4. Batty GD, Whitley E, Deary IJ, Gale CR, Tynelius P, Rasmussen F. Psychosis alters association between IQ and future risk of attempted suicide: cohort study of 1 109 475 Swedish men. *BMJ*. 2010;340:c2506. doi:10.1136/bmj.c2506.
5. Osler M, Nybo Andersen AM, Nordentoft M. Impaired childhood development and suicidal behaviour in a cohort of Danish men born in 1953. *J Epidemiol Community Health*. 2008;62(1):23-28.
6. Gunnell D, Magnusson PKE, Rasmussen F. Low intelligence test scores in 18 year old men and risk of suicide: cohort study. *BMJ*. 2005;330(7484):167. doi:1136/bmj.38310.473565.8F.
7. Andersson L, Allebeck P, Gustafsson JE, Gunnell D. Association of IQ scores and school achievement with suicide in a 40-year follow-up of a Swedish cohort. *Acta Psychiatr Scand*. 2008;118(2):99-105.
8. Fergusson DM, Horwood LJ, Ridder EM. Show me the child at seven II: childhood intelligence and later outcomes in adolescence and young adulthood. *J Child Psychol Psychiatry*. 2005;46(8):850-858.
9. Martin LT, Kubzansky LD, LeWinn KZ, Lipsitt LP, Satz P, Buka SL. Childhood cognitive performance and risk of generalized anxiety disorder. *Int J Epidemiol*. 2007;36(4):769-775.
10. Chen A, Schwarz D, Radcliffe J, Rogan WJ. Maternal IQ, child IQ, behavior, and achievement in urban 5-7 year olds. *Pediatr Res*. 2006;59(3):471-477.
11. Sommer KS, Whitman TL, Borkowski JG, Gondoli DM, Burke J, Maxwell SE, Weed K. Prenatal maternal predictors of cognitive and emotional delays in children of adolescent mothers. *Adolescence*. 2000;35(137):87-112.
12. Goodman R, Simonoff E, Stevenson J. The impact of child IQ, parent IQ and sibling IQ on child behavioural deviance scores. *J Child Psychol Psychiatry*. 1995; 36(3):409-425.
13. Weitzman M, Gortmaker S, Sobol A. Maternal smoking and behavior problems of children. *Pediatrics*. 1992;90(3):342-349.
14. Power C, Elliott J. Cohort profile: 1958 British birth cohort (National Child Development Study). *Int J Epidemiol*. 2006;35(1):34-41.
15. Douglas J. *The Home and the School: A Study of Ability and Attainment in the Primary School*. London, England: MacGibbon & Kee; 1964.
16. Rutter M, Tizard J, Whitmore K. *Education, Health and Behaviour*. London, England: Longman Publishing Group; 1970.
17. Dunn LM, Dunn LM. *Peabody Picture Vocabulary Test–Revised*. Circle Pines, MN: American Guidance Service; 1981.
18. Bradley RH, Caldwell BM, Rock SL, Hamrick HM, Harris P. Home Observation for Measurement of the Environment: development of HOME Inventory for use with families having children 6 to 10 years old. *Contemp Educ Psychol*. 1988; 13(1):58-71.
19. Graham P, Rutter M. The reliability and validity of the psychiatric assessment of the child, II: interview with the parent. *Br J Psychiatry*. 1968;114(510):581-592.
20. Kresanov K, Tuominen J, Piha J, Almqvist F. Validity of child psychiatric screening methods. *Eur Child Adolesc Psychiatry*. 1998;7(2):85-95.
21. Neiss M, Rowe DC, Rodgers JL. Does education mediate the relationship between IQ and age of first birth? a behavioural genetic analysis. *J Biosoc Sci*. 2002; 34(2):259-275.
22. Drotar D, Sturm L. Influences on the home environment of preschool children with early histories of nonorganic failure-to-thrive. *J Dev Behav Pediatr*. 1989; 10(5):229-235.
23. Baker-Henningham H, Powell C, Walker S, Grantham-McGregor S. Mothers of undernourished Jamaican children have poorer psychosocial functioning and this is associated with stimulation provided in the home. *Eur J Clin Nutr*. 2003; 57(6):786-792.
24. Watson JE, Kirby RS, Kelleher KJ, Bradley RH. Effects of poverty on home environment: an analysis of three-year outcome data for low birth weight premature infants. *J Pediatr Psychol*. 1996;21(3):419-431.
25. Ramchandani P, Psychogiou L. Paternal psychiatric disorders and children's psychosocial development. *Lancet*. 2009;374(9690):646-653.
26. Downey G, Coyne JC. Children of depressed parents: an integrative review. *Psychol Bull*. 1990;108(1):50-76.
27. Goodman SH, Gotlib IH. Risk for psychopathology in the children of depressed mothers: a developmental model for understanding mechanisms of transmission. *Psychol Rev*. 1999;106(3):458-490.
28. Feldman MA, Walton-Allen N. Effects of maternal mental retardation and poverty on intellectual, academic, and behavioral status of school-age children. *Am J Ment Retard*. 1997;101(4):352-364.
29. McConnell D, Llewellyn G, Mayes R, Russo D, Honey A. Developmental profiles of children born to mothers with intellectual disability. *J Intellect Dev Disabil*. 2003;28(2):122-134.
30. Aunos M, Feldman M, Goupil G. Mothering with intellectual disabilities: relationship between social support, health and well-being, parenting and child behaviour outcomes. *J Appl Res Intellect*. 2008;21(4):320-330.
31. Bradley RH, Whiteside L, Caldwell BM, Casey PH, Kelleher K, Pope S, Swanson M, Barrett K, Cross D. Maternal IQ, the home environment, and child IQ in low birth weight premature children. *Int J Behav Dev*. 1993;16(1):61-74.
32. van Bakel HJA, Riksen-Walraven JM. Parenting and development of one-year-olds: links with parental, contextual, and child characteristics. *Child Dev*. 2002; 73(1):256-273.
33. Fergusson DM, Lynskey MT, Horwood LJ. The effect of maternal depression on maternal ratings of child behavior. *J Abnorm Child Psychol*. 1993;21(3):245-269.



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