Siblings and childhood mental health: evidence for a later-born advantage

Abstract

The social and health sciences have often emphasised the negative impacts of large family size and late birth order on childhood. For example, it is now well established that, other things being equal, children in large families and/or with many older siblings, receive lower allocations of care time from both parents, are more likely to grow up in conditions of economic hardship, and, as a likely consequence, exhibit relatively poor educational and physical health outcomes. Few researchers have however quantitatively assessed how siblings may influence indicators of mental health, where it is conceivable that social interactions with siblings may have a positive influence. Here, using data from a large British cohort survey (the Avon Longitudinal Study of Parents and Children), we explore the effects of family structure on the Strengths and Difficulties Questionnaire, as multidimensional index for mental health problems. We demonstrate a significant socio-economic gradient in mental health between the ages of three and nine years, but little evidence for negative effects of large family size. Rerunning this analysis to examine birth order, a much clearer pattern emerges; older siblings exert a relatively positive influence and younger siblings a negative influence. This suggests that being born into a large family, providing the child is not joined by subsequent siblings, may carry important benefits unconsidered by past research. We discuss possible interpretations of this pattern and the wider implications for understanding the family context of child development.

1. Introduction

Siblings, as far as most research in the social and health sciences is concerned, are bad news (Figure 1). Lawson and Mace (2009) for example, in a recent study of contemporary British families, demonstrate that family size has a strong negative influence on allocations of time spent caring for individual children from both mothers and fathers over the first decade of life; number of siblings has a larger influence on this measure of parental investment than any other covariate considered, including socio-economic indicators and parental age (see also: Blake, 1989; Downey, 1995; Hill & Stafford, 1974, 1980). In the struggle, to feed, clothe and house more children, parents in large family households also report increased levels of economic hardship, even after adjustment for a range of factors including differences income, education and ethnicity (Iacovou & Berthoud, 2006; Lawson & Mace, in press). As a likely consequence of these deficits, children with many siblings perform worse on IQ tests and on formal educational assessments throughout life, a pattern recognised as one of the most stable relationships in the study of education (Blake, 1989; Downey, 1995, 2001; Lawson, 2009; Steelman, Powell, Werum, & Carter, 2002). Number of siblings also has an important negative effect on achieved socio-economic status in adulthood, particularly on wealth ownership (Kaplan, Lancaster, Bock, & Johnson, 1995; Keister, 2003; Keister, 2004). Keister (2003) for instance, demonstrates that number of siblings is a strong determinant of the likelihood of receiving a trust fund or an inheritance (see also: Cooney & Uhlenberg, 1992). Finally, siblings are also associated with deficits in childhood growth and achieved adult height, which may stem from reduced parental attention or early-life nutrition (Lawson & Mace, 2008; Li, Manor, & Power, 2004; Li & Power, 2004). In most cases, later-born children are at the biggest disadvantage in terms of both the division of parental investment (Lawson & Mace, 2009; Price, 2008) and relatively poor educational and physical health outcomes

(Kristensen & Bjerkedal, 2007; Lawson, 2009; Lawson & Mace, 2008; see also: Modin, 2002). This pattern may be explained by the simple fact that older siblings, being alive both before and after a child's birth, have an increased potential to dilute parental resources (Downey 2001). It is also possible that parents systematically bias care by order of birth, reflecting cultural preferences for first and early born children (for discussion on the ultimate origins of such preferences see: Hrdy & Judge, 1993; Jeon, 2008; Rosenblatt & Skoogberg, 1974). Few studies have investigated the role of siblings in mental health.

[INSERT FIGURE 1]

1.1 Siblings and childhood mental health

The existing mental health literature has rarely been directed by the resource dilution and life history perspectives on the family which emphasise investment competition between siblings and the resulting trade-offs between quantity and 'quality' of offspring (Becker & Lewis, 1973; Downey, 2001; Lawson, in press; Mace, 2007). Nevertheless, like physical and educational development, measures of mental health follow a socio-economic gradient; with a lower incidence of behavioural problems in children from high socio-economic status backgrounds (Dunn, Deater-Deckard, Pickering, O'Connor, Goodman & Golding, 1998; Ford, Goodman, & Meltzer, 2004; Green, McGinnity, Meltzer, Ford, & Goodman, 2005; McMunn, Nazroo, Marmot, Boreham, & Goodman, 2001). Parenting style and quality are also assumed to be important in limiting behavioural problems (e.g. Dunn et al., 1998). As such, the dilution of material and interpersonal investments associated with large family size and late birth order can be expected to lead to negative consequences for childhood mental health.

To date, the best available data comes from two large national samples of UK families (Green et al., 2005; Meltzer, Gatward, Goodman, & Ford, 2000). The results of these analyses, not specifically designed to study the effects of sibling configuration, are difficult to interpret in the face of inconsistent conclusions and a generally poor regard for potential confounds. Meltzer et al. (2000) report that large family size is associated with increased prevalence of childhood mental health problems. This effect was largely driven by an increase in conduct disorders, with no significant relationship detected with emotional or hyperactivity problems in multivariate models. However, in a reanalysis of this data, adjusting for a wider range of covariates, Ford et al. (2004) report no independent effects of family size (they also provide a wider discussion of the problem of highly interrelated risk factors for childhood psychological morbidity ignored in many early studies). Green et al. (2005) report that large family size was not associated with the overall prevalence of mental disorders, but was associated with increased conduct and emotional problems. However, effect estimates were not adjusted for related socio-economic and demographic factors. Green et al. (2005) also considered autistic spectrum disorders, with no effect of family size detected. Using a distinct measure of peer-related mental health, Downey and Condron (2004), found that children in multiple child families were scored as having better social skills than only children in an American sample. This study, based on teacher ratings of child behaviour, adjusted the effects of family size for a range of socio-economic factors. Several studies specifically considering the development of 'theory of mind' have also reported that children in multiple child families tend to perform better for their age on theory of mind tasks (Peterson, 2000). None of the main childhood mental health surveys have tested for the existence of birth order effects (Meltzer et al. 2000; Ford et al. 2004; Green et al. 2005), while Downey and Condron (2004) report no difference in the effects of older and younger siblings on social skills. Gates, Lineberger, Crockett, & Hubbarb,

(1986) report a higher incidence of depression, anxiety and low self-concept in later-born children, but their findings can only be considered suggestive in the absence of multivariate analysis.

Here, we present new data on the influence of siblings on a multidimensional index for childhood mental health problems - the Strengths and Difficulties Questionnaire (Goodman, 1997, 2001). All data are sourced from the Avon Longitudinal Study of Parents and Children (ALSPAC), a large British cohort. Unlike most past studies we consider both the effects of family size and birth order simultaneously. Furthermore, replicating the methodology of our past research into related family structure effects on parental investment and child development in the ALSPAC sample (Figure 1), we use detailed longitudinal data to we estimate relationships net of unusually large range of important covariates.

2. Data and Methods

2.1 The Avon Longitudinal Study of Parents and Children (ALSPAC)

ALSPAC is a uniquely detailed, ongoing cohort study designed to examine environmental and genetic influences on the health and development of British children. Study recruitment began in pregnancy, enrolling women who had an expected delivery date between April 1991 and December 1992 from the three main Bristol-based health districts of the former county of Avon. 14,472 pregnant women (14,062 live births) were recruited into the initial sample. Avon has a predominantly white population, a mixture of rural and urban communities and a socio-economic mix similar to the rest of the UK (Golding et al. 2001). A major advantage of ALSPAC is the

exceptional frequency of data collection. Mothers complete up to three postal surveys a year, one relating to the characteristics of herself and the household in general and two relating to the child. The ALSPAC survey also includes data from other surveys including extraction from clinical records and school-based assessments and direct examination of children at specifically designed research clinics. The analyses presented in this paper are based on available data from the first 10 years of data collection. All data considered were collected by self-completed questionnaires. Further information on the distribution of each independent variable over the study period and descriptive statistics at each wave can be found in Lawson (2009) and Lawson and Mace (2008). Further information on data collection methodology can be found in (Golding, Pembrey, Jones & the ALSPAC Study Team, 2001). We refer readers to these publications for supplementary information on the cohort.

A number of exclusion criteria remove rare family configurations from our sample. Families where the study child is from a multiple birth (i.e. a twin or triplet), families recorded as experiencing the death of a child and families containing children unrelated to either the mother or her current partner (e.g. foster or adopted children) over the study period were all excluded. Cases where the study child's live in 'mother figure' is ever recorded as other than the biological mother, as absent or in a same-sex relationship were also excluded. Cases of biological father absence after birth were included. We also include cases where the mother is recorded as in a new relationship with someone other than the biological father. However, we exclude rare cases where the mother reports unsure paternity of the study child or starts a new relationship during this pregnancy. After implementing these criteria the key study sample contained 13,176 different families each containing a single study child.

2.2 Mental health: The strengths and difficulties questionnaire

Assessments of mental health are based on the Strengths and Difficulties Questionnaire (SDQ), a recently developed instrument for assessing psychological morbidity in children (Goodman 1997; Goodman 2001). The SDQ measures four domains of poor mental health status, on separate scales with five items each: emotional problems, hyperactivity, conduct problems and peer problems (Goodman 1997; Goodman 2001). Responses to questions from the emotional problems, behavioural problems, hyperactivity and peer problems subscales are added to give a total difficulties score (TDS), with a range of 0-40. This can be used as a dimensional outcome measure of mental health problems (Goodman & Goodman, in press). The SDQ was assessed by parents at three points over the study period available at three years eleven months, six years nine months and nine years. Table 7.1 provides descriptive data on the SDQ scores along each subscale. For the TDS there are 23,991 cases available for analysis on 9,826 individual children.

[INSERT TABLE 1]

2.3 Family size and birth order

Siblings are defined for the purpose of this study as all maternally related siblings (i.e. including siblings with different biological fathers, but excluding children from different mothers). Family size and birth order data (number of younger siblings and number of older siblings) are available at six questionnaires from the birth of the study child to 10 years of age (Lawson and Mace 2008). The final three points of data collection correspond closely to the age at which mental health assessments were made (i.e. three years eleven months, seven years one month and 10 years).

Half (51%) of the study children were first-borns, around a third (33%) were second-borns, and a significant number (16%) had two or more older siblings (i.e. third-born or later). A majority of children experienced the arrival or at least one younger sibling (43% one younger sibling, 16% two or more). At all points of data collection subsequent to the birth of the study child modal family size was two. At 10 years 27% of children had two siblings and 10% had three or more.

2.4 Covariates

We include mother's educational attainment (coded in pregnancy) as a time invariant measure of socio-economic status (educational status rarely changes during motherhood). In addition we use three time-varying measures of wealth – self reported 'take home' household income, home ownership and neighbourhood quality. Two measures of social support were also incorporated, both based on questionnaires distributed to the mother in pregnancy. These measures were recorded only once and so could not be entered as time-varying variables. The 'social network score' comprises ten items which ascertain the quality and frequency of social contact with friends and family and ranges from 0-30. The 'social support score' measures perceived social support from family, friends and official agencies using a set of ten items specifically designed for the cohort. The item presents statements relating to emotional, financial and instrumental support, with a summed overall score also ranging between 0-30. This measure shows a strong association with the mother's emotional well-being during pregnancy (Thorpe, Dragonas, & Golding, 1992). Both measures were banded into three groups of equal size, coded as 'low', 'medium' and 'high'. We also incorporate a banded measure of maternal emotional problems assessed in pregnancy (the Edinburgh Postnatal Depression Score: Cox, Holden, & Sagovsky, 1987). Mother's employment status and ethnicity were included as an additional dichotomous covariate terms in

all models. Mother's employment status was measured at three intervals over the study period, with between 55% -72% of mothers engaged in employment between a study child age of three years eleven months and 10 years respectively. A large majority (95%) of the ALSPAC population is recorded as white.

Fathers are coded as present provided the mother states the study child has a biological father as the live-in 'father-figure' at the time of the questionnaire. In cases where the father is coded as absent, the mothers are either coded as alone or as with a new live-in partner. These data do not distinguish between different partners of the mother subsequent to the biological father of the study child. Father presence was assessed at the same intervals as family size data, with almost a quarter of mothers (24%) known to be separated from the father of the study child at 10 years (composed of 7% with new partners, 10% remaining single and 8% of unknown relationship status). A majority of parents were aged between 25-29 years at the birth of their study child, with a mean maternal age of 28.0 years (SD:5.0) and mean paternal age of 30.7 (SD:5.7).

2.5 Analysis strategy

Relationships between family size, birth order and repeated assessments of childhood mental health were assessed using multi-level models for change over time (Singer & Willett, 2003). These models can be used to estimate multivariate relationships between time-varying categorical or continuous independent variables and a continuous dependent variable over time. Individual children are treated as level-two units and the timing of measures as level-one units. The major advantage of a multi-level modelling strategy is that it enables incorporation of all available outcome data, rather than restricting analysis to individuals with complete assessments at a

specific subset of time points. In order to have unbiased estimates in the presence of missing data, it must be assumed that responses are missing at random (MAR); that is, the probability of any outcome measure being missed may depend on observed, but not unobserved, measures (Little and Rubin 1987). Although we do not formally investigate this issue, given the large range of relevant independent variables considered in each model, it is likely that presented analyses conform to the MAR assumption.

Modelling data in this also way requires contemporaneous data on independent and dependent variables, a feature is not strictly met by the temporal distribution of variables considered in the presented analyses (e.g. mental health assessments at made at three years eleven months, six years nine months and nine years, while household income is assessed twice at three years eleven months and seven years one month – see Lawson and Mace 2008). To overcome this issue we use the closest available measure of time-varying independent variables to the months when outcome data was recorded. This serves as a reasonable approximation given the small gaps in convergence between measures (particularly for sibling configuration and mental health data), and the relatively short total study period (just over five years).

Our analysis strategy followed three steps. Firstly, for the TDS and each of its individual component scores we first determined 'unconditional growth models' which establish the overall relationship of the outcome with time (age of the study child in years). This gives an impression of how assessed mental health varies as children grow older and allows us to adjust for this pattern in later multivariate models. Secondly, we specified 'univariate associations' between each independent variable and outcome variables to get a general sense of the relationships in the data.

These univariate models only include adjustment for the relationship between time and the outcome. For each independent variable, effects are estimated by both a main effect term (effect on 'initial status' i.e. point of first measurement) and an interaction term with time (effect on rate of change per year). Statistical significance of each predictor term is assessed (as in standard linear regression) by dividing the regression coefficient by its standard error and 95% confidence intervals are calculated. For the sake of brevity these univariate associations are not presented here, but can be consulted in Lawson (2009).

Finally, multivariate models were constructed to assess the effects of family structure, net of influential covariates. These modes were constructed in a stepwise fashion for the TDS and each of its component scores (to allow for the possibility that different aspects of mental health are influenced independently by family structure). All variables relating to family structure (except sibling age) were entered in the initial block. This model was then reduced down by a backwards procedure removing predictor terms that did not reach significance at the $p<0.05$ level. All family structure variables maintained in the model at this stage were carried forward to a final presented model. The second block entered all remaining variables (social support, maternal emotional problems, etc). Predictor terms were maintained if $p<0.05$ or their presence affects notable change on any of the family structure coefficients. In multi-level models for change, total outcome variation is partitioned into several within and between-person variance components. For each of these components a pseudo-R^2 statistic can be calculated based on the reduction of this term from 'unconditional models' containing only a constant and age terms (Singer and Willett 2003). These pseudo-R^2 statistics are presented to estimate the fit of final models to the data. Final multivariate models were then also rerun replacing the independent variable of family size with number of

younger and number of older siblings to assess the effects of birth order on mental health. All analyses are carried out using MLwiN 2.02 (Rasbash, Browne, Healy, Cameron, & Charlton, 2005).

3. Results

3.1 Mental health over the study period (unconditional growth models).

Unconditional growth models estimated overall relationships of each behavioural score with child age (linear functions are estimated only to keep models easy to compute and compare directly). For the TDS, initial status (i.e. at three years, 11 months) was estimated at 8.83 (CI: 8.74 – 8.92, $p<0.001$) decreasing at -0.40 units per year (CI: -0.42 – -0.38, $p<0.001$) indicating the prevalence of behavioural problems decreases slightly as children age (at least between the ages of three and nine years). This pattern was confirmed for all component measures of the TDS: Hyperactivity Score - initial status: 3.96 (CI: 3.91 – 4.01, $p<0.001$), rate of change: -0.19 (CI: -0.20 – -0.18, $p<0.001$); Emotional Score - initial status: 1.45 (CI: 1.42 – 1.48, $p<0.001$), rate of change: -0.01 (CI: -0.02 – 0.00, $p<0.005$); Conduct Score - initial status: 1.97 (CI: 1.94 – 2.00, $p<0.001$), rate of change: -0.13 (CI: -0.14 – -0.12, $p<0.001$); Peer Score - initial status: 1.46 (CI: 1.43 – 1.49, $p<0.001$), rate of change: -0.09 (CI: -0.10 – -0.08, $p<0.001$).

A consideration of univariate associations revealed that independent variables were significantly associated with initial status more often than rate of change effects. Socio-economic measures, measures of social support and maternal emotional problems were significant in every univariate model at high levels of significance. Family structure variables demonstrated a mixed pattern of association across measures (for details see Lawson 2009).

3.2 Family size

The effects of family size failed to show a consistent pattern across measures of mental health. For the TDS, significant main effects and rate of change effects were retained in the final model for some comparisons but these effects run in the opposite direction (Table 2). Similar mixed effects are found on the hyperactivity score (Table 3). Family sizes of two, and to a lesser extent three, were associated with more emotional problems compared to single child families. However, family sizes of four or five plus were not significantly different from only child families (Table 4). Conduct problems followed a clearer trade-off pattern with incremental increases in family size associated with more problems (Table 5). Peer problems followed the reverse pattern with increased family size associated with reduced problems, particularly in later childhood (Table 6). Figure 2 displays the mixed effects of family size graphically when (for simple comparison) only main effects are fit for the TDS and all component measures.

[INSERT TABLES 2-6 and FIGURE 2]

3.3 Birth order

Analysing the effects of siblings on mental health in childhood by sibling age rather than total family size provides a much clearer pattern of results across measures. For every measure the effects of older siblings are relatively negative compared to the effects of younger siblings, indicating a later-born *advantage* in childhood mental health (Table 7). In fact, in most cases older siblings are actually associated with reduced mental health problems, while younger siblings are associated with increased mental health problems. These effects are compared graphically in Figure 7.3 which shows main effects only.

[INSERT TABLE 7 AND FIGURE 3]

3.4 Covariates

Consistent with prior research (Dunn et al. 1998; McMunn et al. 2001; Ford et al. 2004; Green et al. 2005) the TDS shows a clear socio-economic gradient across the study period. Improved maternal education, family income, home ownership status and neighbourhood quality all demonstrate independent negative effects on the prevalence of behavioural difficulties in childhood (Table 2). This pattern is shared by all component measures of the TDS, albeit to varying degrees with, for example, emotional problems showing relatively weak socio-economic effects (Tables 3 - 6).

Higher levels of maternal social support and better social networks were also strongly associated with reduced mental health problems on all measures (Tables 2 – 6). Maternal employment failed to be retained in most final models. However, employed mothers reported that their children had slightly lower peer problems (Tables 2 – 6). Children of mothers recording high depressive symptomology in pregnancy had higher levels of difficulty on all measures (see also Dunn et al. 1998). These effects remained significant even after socio-economic and demographic variables had been taken into account and are consistently the strongest predictors of childhood mental health across all measures considered (Tables 2 – 6).

Children of older mothers had improved mental health on the TDS and all component scores (Tables 2 – 6). Boys tended to have more mental health problems than girls across the study period, represented both in the TDS (Table 2) and component scores for hyperactivity, conduct

problems and peer problems (Tables 3, 5 and 6). However, girls were scored as having higher levels of emotional problems than boys (Table 4).

In general, the absence of father figures and particularly the presence of unrelated father figures was associated with increased mental health problems relative to children with biological fathers recorded as present (See the TDS model, Table 2). However, for several of the individual component score of the TDS these effects failed to reach significance (Tables 3 – 6). The negative effects of unrelated father presence compared to biological father presence (see also McMunn et al. 2001) appear to be driven largely by an increase in hyperactivity problems (Table 3).

4. Discussion

4.1 Siblings and childhood mental health

We find no consistent pattern between family size and childhood mental health (Figure 7.2). The only evidence for predicted quantity-quality trade-off effects is on conduct problems (see also Meltzer et al. 2000). Peer problems were actually reduced in the presence of siblings. Other measures display mixed and largely non-significant associations with family size. This mix of patterns occurs despite of the existence of strong socio-economic gradients in mental health for all measures, even though large families in the same cohort face higher levels of economic hardship (Lawson and Mace in press; Figure 1). It is also generally considered that good parenting practice leads to positive child mental health outcomes (e.g. Dunn et al. 1998). So it is surprising that the presence of siblings do not reduce mental health through decreasing parental time investment

(Lawson and Mace 2009; Figure 1). These findings suggest that siblings offset their negative effects on parental resource dilution by other means.

Interactions with siblings may provide some supportive or socialising benefit to children who otherwise may spend more time in isolation from their peers. Downey and Condron (2004) found that children in multiple child families had better social skills than only children, but found little difference between children within multiple child families by number of siblings. This pattern of results is very similar to the presented findings for peer problems in this study (Figure 2). Thus, there is some evidence that exposure to siblings have a positive influence on social maturation. Perhaps, by becoming accustomed to sharing resources with at least one other child, children with siblings learn how to navigate social relationships more easily (Downey and Condron 2004; see also Peterson et al. 2000).

Considering mental health problems by the relative age of siblings presents a much clearer pattern. Across all measures, with the exception of the conduct score, older siblings are associated with reduced mental health problems (Figure 3). These results reverse the pattern of later-born disadvantage found consistently across previous analyses of the ALSPAC cohort on parental time investment (Lawson and Mace 2009) and physical health and educational domains of child development (Lawson and Mace 2008; Lawson 2009). As far as we are aware this study is the first to show a broad trend of *later-born advantage* in childhood mental health. Previous research has either not tested for birth order effects, or has done so only with very poor consideration of potential confounding factors.

With the lack of previous research on this topic, and in direct contraction to the expectations of the resource dilution and life history theoretical frameworks which have guided our previous studies of sibling effects, it is difficult to provide a definitive explanation for this result. Nevertheless, the current findings suggest that social interaction with older siblings may hold important mental health benefits over and above their negative effects on parental resource dilution. In a recent study using a small subset of ALSPAC cohort, Grass, Jenkins and Dunn (2007) found that self-reported affectionate relationships between siblings had a protective effect on adjustment to stressful life events. Thus, older siblings may be more effective in providing a buffering role to social stress. Alternatively, it is possible that the existence of older children may ensure that children are born into a household environment that is already socially and emotionally prepared for family life and so more conducive to positive mental health outcomes, even though time and money are in shorter supply. Consistent with this interpretation, transitions to parenthood are often associated with decreased marital satisfaction as both the new mother and father adjust and negotiate the responsibilities of raising children (reviewed in: Johns & Belsky, 2008). Later-born children are born at a time when such transitions have already taken place.

In contrast, the effects of younger siblings are largely negative, particularly for emotional and conduct problems (Figure 3). This result is consistent with a number of studies noting the difficulty of adjusting to a new sibling (Dunn and Kendrick, 1980; Baydar, Hyde, Brooks-Gunn, 1997; but see Strohschein, Gauthier, Campbell & Kleparchuk, 2008). It also gives some support for the Alder's theory of birth order in which early-born children are seen to suffer feelings of 'dethronement' with the arrival of younger siblings (see: Gates et al. 1986). The behavioural

problems of these children are thus seen as a stress response to the sudden arrival of a competitor for parental investment.

4.2 Future directions

Poor mental health in childhood is predictive of poor mental health in later life (e.g. Caspi, Moffitt, Newman, & Silva 1996) suggesting the results of the present analysis may persist into differentials in adult mental health. We know of few quantitatively sophisticated studies addressing this issue. For example, Elliot (1992) summarizes a small number of studies of adult psychopathology which have suggested birth order effects on specific conditions such as alcoholism and anorexia nervosa. However, this research has been based solely on univariate associations and has reported mixed results. Elliot (1992) concludes these findings are impossible to interpret clearly in the face of a wide range of potential confounding factors. Of course sibling relationships also change over the life course, so it is also possible that the associations reported here are not extended into later years.

One limitation of the analyses presented in this manuscript is that mental health scores are based on parent ratings. Parent-rated measures of childhood mental health may be open to perception biases in the presence of other children in the household. Future research should therefore consider whether the reported birth order pattern holds up for alternative ratings of mental health, such as teacher-rated scores. It is not obvious however how parent ratings could create a perception bias of low incidence of mental health problems in later-borns. For example, it is conceivable that because children's mental health problems tend to decline with age, having older children in the house may bias the mother towards feeling her children in general have fewer

problems. But the reduction of assessed mental health with age is quite modest in comparison to the effects associated with number of older siblings. Future research also needs to directly estimate the role of parenting quality and economic hardship in mediating family size and birth order effects on child mental health outcomes. This would be possible with data from the ALSPAC cohort, but is beyond the scope of the present study.

4.3 Conclusions

Research from across the social and health sciences has emphasised the negative impacts of large family size and late birth order on child development. Siblings are envisaged as competitors for parental investment which reduce individual allocations of parental attention and financial investment (Becker & Lewis, 1973; Downey, 2001; Lawson, in press; Mace, 2007). Here, using the same methodology and study sample used to confirm the existence of anticipated deficits in other dimensions of parenting and child development, we show that childhood mental health bucks the trend. There is no generalised relationship between family size and childhood mental health, with only conduct problems following the predicted trade-off pattern; increasing in incidence incrementally as family size increases. Moreover, in contrast to physical and educational development we find no evidence of a predicted later-born disadvantage; instead children born into large families are assessed as having better mental health than first-borns or children born into small families. Thus, it appears that alternative mechanisms to family resource division mediate associations between family structure and childhood mental health. This result highlights the importance of considering multiple measures of child development and supports the largely folk hypothesis that siblings can play an important role in social maturation and emotional support.

FIGURE CAPTIONS

Figure 1: Family size, parental investment and child development in contemporary British families

*The relationship between family size and **(a)** maternal and paternal allocations of care time between 1 - 9 years (from Lawson and Mace 2009); **(b)** maternal perception of economic hardship from 0 - 7 years (from Lawson and Mace in press); **(c)** school test results at 7 years (from Lawson 2009); **(d)** height at age 10 years (from Lawson and Mace 2008; see also Lawson 2009). Children with more siblings receive less time from parents, grow up in more economically stressed households and exhibit relatively poor physical and cognitive/educational development. Data are from the Avon Longitudinal Study of Parents and Children, a large cohort study (n = 14,000+) of children born in 1991/1992. Confidence intervals are set at 95%.*

Figure 2: Family size and childhood mental health over the study period (main effects only).

Overall there is very little evidence for a trade-off between family size and childhood mental health. Only conduct problems were increased incrementally with family size, and peer problems are reduced in the presence of siblings. Estimated relationships are adjusted for a range of demographic and socio-economic measures (see Tables 2-6 for full models). Confidence intervals are set at 95%.

Figure 3: Number of older and younger siblings and mental health over the study period (main effects only).

Overall and for a majority of component measures, the presence of older siblings is associated with improved mental health. In contrast, the presence of younger siblings is usually associated with relatively poor mental health. Estimated relationships are adjusted for a range of demographic and socio-economic measures (see Tables 2-6 for full models). Confidence intervals are set at 95%.

TABLES AND FIGURES

Table 1 Strengths and difficulties score

		Child Age		
		3y11m	*6y9m*	*9y0m*
		n = 8,900	*n = 7,891*	*n = 7295*
		Mean (Standard Deviation)		
Total Difficulties Score (TDS)		8.85 (4.54)	7.45 (4.74)	6.79 (4.90)
Components	Hyperactivity Score	3.95 (2.30)	3.38 (2.36)	2.94 (2.25)
	Emotional Score	1.44 (1.50)	1.50 (1.67)	1.50 (1.76)
	Conduct Score	1.95 (1.40)	1.60 (1.46)	1.27 (1.42)
	Peer Score	1.51 (1.48)	1.05 (1.41)	1.11 (1.49)

Note that these values refer to the sample available at each study wave. They should not be directly interpreted as evidence of change over time due to selective attrition.

Total N: TDS – 23,991 for 9,826 individuals; Hyperactivity Score – 24,019 for 9,826 individuals; Emotional Score – 24,020 for 9,828 individuals; Conduct Score– 24,046 for 9,829 individuals; Peer Score– 24,028 for 9,829 individuals.

Table 2 Final multivariate model: total difficulties score (TDS)

			Initial Status (at 3y11m) Coefficient (B)	*95%CI*	**Rate of Change (per year)** Coefficient (B)	*95%CI*
Intercept†			10.64 ***	*10.12 -11.16*	-0.33 ***	*-0.42 – -0.29*
Family Structure	Family Size *(Ref: 1)*	2	0.38 **	*0.11 – 0. 65*	-0.14 **	*-0.23 – -0.05*
		3	0.15 ns	*-0.17 – 0.47*	-0.11 *	*-0.21 – -0.01*
		4	0.07 ns	*-0.39 – 0.53*	-0.12 ns	*-0.25 – 0.01*
		5 +	0.15 ns	*-0.55 – 0.85*	-0.18 ns	*-0.38 – 0.02*
	Sex of Child *(Ref: Male)*	Female	-0.84 ***	*-1.02 – -0.66*	-	-
	Mother's Age *(Ref:<25)*	25-29	-0.40 **	*-0.68 – -0.12*	-	-
		30-34	-0.55 ***	*-0.84 – -0.26*	-	-
		35+	-0.79 ***	*-1.15 – -0.43*	-	-
	Father's Age *(Ref: <25)*	25-29	-	-	-	-
		30-34	-	-	-	-
		35+	-	-	-	-
	Father Figure Status *(Ref: Biological Father)*	Mother Alone	0.29 *	*0.02 – 0.56*	-	-
		Unrelated Male	0.50 **	*0.15 – 0.85*	-	-
Socio-economic Measures	Mother's Education *(Ref: <O-level)*	O-level	-0.40 **	*-0.68 – -0.12*	0.02 ns	*-0.05 – 0.09*
		A-level	-0.84 ***	*-1.14 – -0.54*	0.05 ns	*-0.03 – 0.13*
		Degree	-1.19 ***	*-1.54 – -0.84*	0.15 ***	*0.07 – 0.23*
	Family Income *(Ref: <£200 per week)*	£200-299	-0.07 ns	*-0.31 – 0.17*	-	-
		£300-399	-0.38 **	*-0.64 – -0.12*	-	-
		£400+	-0.46 ***	*-0.73 – -0.19*	-	-
	Neighbourhood *(Ref: <V. Good)*	V. Good	-0.37 ***	*-0.50 – -0.24*	-	-
	Home Ownership *(Ref: Rented)*	Mortgaged/ Buying	-0.60 ***	*-0.89 – -0.31*	-	-
		Owned	-0.46 *	*-0.87 – -0.05*	-	-
Social Support	Social Network Score *(Ref: Low)*	Med	-0.34 ns	*-0.69 – 0.01*	-	-
		High	-0.79 ***	*-1.12 – -0.46*	-	-
	Social Support Score *(Ref: Low)*	Med	-0.59 ***	*-0.82 – -0.36*	-	-
		High	-1.17 ***	*-1.46 – -0.88*	-	-
Other	Ethnicity of Child *(Ref: White)*	Non-White	-	-	-	-
	Maternal Employment (*Ref: No*)	Yes	-	-	-	-
	Maternal Emotional Problems (*Ref: Low*)	Med	1.05 ***	*0.84 – 1.26*	-	-
		High	2.35 ***	*2.12 – 2.58*	-	-

† -The estimated mean value for initial status and rate of change for the group with the baseline values for every factor included in the model.

ns – non significant, * - p<0.05, ** - p<0.01, *** - p<0.001

Model Fit (Pseudo R^2): Within-Person (over time) – 0.29 ; Initial Status – 0.19; Rate of Change – 0.02

Final N – 16,526

Table 3 Final multivariate model: hyperactivity score

			Initial Status (at 3y11m) Coefficient (B)	*95%CI*	**Rate of Change (per year)** Coefficient (B)	*95%CI*
Intercept†			4.76 ***	*4.51 – 5.01*	-0.16 ***	*-0.21 – -0.11*
Family Structure	Family Size *(Ref: 1)*	2	0.27 ***	*0.14 – 0.40*	-0.09 ***	*-0.13 – -0.05*
		3	0.15 ns	*-0.01 – 0.31*	-0.08 ***	*-0.12 – -0.04*
		4	0.06 ns	*-0.16 – 0.28*	-0.08 **	*-0.14 – -0.02*
		5 +	-0.05 ns	*-0.39 – 0.29*	-0.05 ns	*-0.15 – -0.05*
	Sex of Child *(Ref: Male)*	Female	-0.55 ***	*-0.65 – -0.45*	-0.05 ***	*-0.07 – -0.03*
	Mother's Age *(Ref:<25)*	25-29	-0.17 *	*-0.33 – -0.01*	-0.04 ns	*-0.08 – 0.00*
		30-34	-0.29 ***	*-0.46 – -0.12*	-0.05 *	*-0.09 – -0.01*
		35+	-0.43 ***	*-0.63 – -0.23*	-0.04 ns	*-0.09 – 0.01*
	Father's Age *(Ref: <25)*	25-29	-	-	-	-
		30-34	-	-	-	-
		35+	-	-	-	-
	Father Figure Status *(Ref: Biological Father)*	Mother Alone	0.04 ns	*-0.08 – 0.16*	-	-
		Unrelated Male	0.49 ***	*0.33 – 0.65*	-	-
Socio-economic Measures	Mother's Education *(Ref: <O-level)*	O-level	-0.22 **	*-0.36 – -0.08*	0.01 ns	*-0.02 – 0.04*
		A-level	-0.53 ***	*-0.68 – -0.38*	0.03 ns	*0.00 – 0.06*
		Degree	-0.99 ***	*-1.16 – -0.82*	0.11 ***	*0.07 – 0.15*
	Household Income *(Ref: <£200 per week)*	£200-299	-	-	-	-
		£300-399	-	-	-	-
		£400+	-	-	-	-
	Neighbourhood *(Ref: <V. Good)*	V. Good	-0.10 **	*-0.16 – -0.04*	-	-
	Home Ownership *(Ref: Rented)*	Mortgaged/ Buying	-0.19 **	*-0.33 – -0.05*	-	-
		Owned	-0.19 ns	*-0.38 – -0.19*	-	-
Social Support	Social Network Score *(Ref: Low)*	Med	-0.18 *	*-0.35 – -0.01*	-	-
		High	-0.32 ***	*-0.48 – -0.16*	-	-
	Social Support Score *(Ref: Low)*	Med	-0.18 **	*-0.29 – -0.07*	-	-
		High	-0.46 ***	*-0.60 – 0.32*	-	-
Other	Ethnicity of Child *(Ref: White)*	Non-White	-	-	-	-
	Maternal Employment (*Ref: No*)	Yes	-	-	-	-
	Maternal Emotional Problems (*Ref: Low*)	Med	0.40 ***	*0.30 – 0.50*	-	-
		High	0.81 ***	*0.70 – 0.92*	-	-

† -The estimated mean value for initial status and rate of change for the group with the baseline values for every factor included in the model.

ns – non significant, * - p<0.05, ** - p<0.01, *** - p<0.001

Model Fit (Pseudo R^2): Within-Person (over time) – 0.27; Initial Status – 0.13; Rate of Change – 0.06

Final N – 18,512

Table 4 Final multivariate model: emotional problems score

			Initial Status (at 3y11m) Coefficient (B)	*95%CI*	**Rate of Change (per year)** Coefficient (B)	*95%CI*
Intercept†			1.27 ***	*1.12 – 1.42*	-0.01 *	*-0.02 – 0.00*
Family Structure	Family Size *(Ref: 1)*	2	0.17 ***	*0.09 – 0.25*	-	-
		3	0.10 *	*0.01 – 0.19*	-	-
		4	0.07 ns	*-0.05 – 0.19*	-	-
		5 +	0.13 ns	*-0.06 – 0.32*	-	-
	Sex of Child *(Ref: Male)*	Female	-	-	0.05 ***	*0.03 – 0.07*
	Mother's Age *(Ref:<25)*	25-29	-0.04 ns	-0.13 – 0.05	-	-
		30-34	-0.11 *	-0.20 – -0.02	-	-
		35+	-0.18 **	-0.29 – -0.07	-	-
	Father's Age *(Ref: <25)*	25-29	-	-	-	-
		30-34	-	-	-	-
		35+	-	-	-	-
	Father Figure Status *(Ref: Biological Father)*	Mother Alone	0.18 ***	*-0.27 – -0.05*	-	-
		Unrelated Male	-0.05 ns	*-0.17 – 0.07*	-	-
Socio-economic Measures	Mother's Education *(Ref: <O-level)*	O-level	-0.05 ns	*-0.13 – 0.03*	-	-
		A-level	-0.10 *	*-0.18 – -0.02*	-	-
		Degree	0.06 ns	*-0.04 – 0.16*	-	-
	Household Income *(Ref: <£200 per week)*	£200-299	-	-	-	-
		£300-399	-	-	-	-
		£400+	-	-	-	-
	Neighbourhood *(Ref: <V. Good)*	V. Good	-0.08 ***	*-0.13 – -0.03*	-	-
	Home Ownership *(Ref: Rented)*	Mortgaged/ Buying	-	-	-	-
		Owned	-	-	-	-
Social Support	Social Network Score *(Ref: Low)*	Med	-0.05 ns	*-0.16 – 0.06*	-	-
		High	-0.11 *	*-0.22 – 0.00*	-	-
	Social Support Score *(Ref: Low)*	Med	-0.10 **	*-0.17 – -0.03*	-	-
		High	-0.19 ***	*-0.28 – -0.10*	-	-
Other	Ethnicity of Child *(Ref: White)*	Non-White	-	-	-	-
	Maternal Employment (*Ref: No*)	Yes	-	-	-	-
	Maternal Emotional Problems (*Ref: Low*)	Med	0.30 ***	*0.23 – 0.37*	-	-
		High	0.68 ***	*0.61 – 0.75*	-	-

† -The estimated mean value for initial status and rate of change for the group with the baseline values for every factor included in the model.

ns – non significant, * - p<0.05, ** - p<0.01, *** - p<0.001

Model Fit (Pseudo R^2): Within-Person (over time) – 0.15 ; Initial Status – 0.09; Rate of Change – 0.03
Final N – 19.307

Table 5 Final multivariate model: conducts problems score

			Initial Status (at 3y11m) Coefficient (B)	*95%CI*	**Rate of Change (per year)** Coefficient (B)	*95%CI*
Intercept†			2.33 ***	*2.18 – 2.48*	-0.13 ***	*-0.14 – -0.12*
Family Structure	Family Size *(Ref: 1)*	2	0.15 ***	*0.08 – 0.22*	-	-
		3	0.19 ***	*0.11 – 0.27*	-	-
		4	0.19 ***	*0.08 – 0.30*	-	-
		5 +	0.24 ***	*0.08 – 0.40*	-	-
	Sex of Child *(Ref: Male)*	Female	-0.14 **	*-0.19 – -0.09*	-	-
	Mother's Age *(Ref:<25)*	25-29	-0.18 ***	*-0.27 – -0.09*	-	-
		30-34	-0.18 ***	*-0.29 – -0.07*	-	-
		35+	-0.26 ***	*-0.33 – -0.19*	-	-
	Father's Age *(Ref: <25)*	25-29	-	-	-	-
		30-34	-	-	-	-
		35+	-	-	-	-
	Father Figure Status *(Ref: Biological Father)*	Mother Alone	0.09 *	*0.01 – 0.17*	-	-
		Unrelated Male	0.10 ns	*-0.01 – 0.21*	-	-
Socio-economic Measures	Mother's Education *(Ref: <O-level)*	O-level	-0.09 *	*-0.16 – -0.02*	-	-
		A-level	-0.13 *	*-0.21 – -0.05*	-	-
		Degree	-0.19 ***	*-0.28 – -0.01*	-	-
	Household Income *(Ref: <£200 per week)*	£200-299	-	-	-	-
		£300-399	-	-	-	-
		£400+	-	-	-	-
	Neighbourhood *(Ref: <V. Good)*	V. Good	-0.13 ***	*-0.17 – -0.09*	-	-
	Home Ownership *(Ref: Rented)*	Mortgaged/ Buying	-0.19 ***	*-0.27 – -0.11*	-	-
		Owned	-0.14 *	*-0.24 – 0.04*	-	-
Social Support	Social Network Score *(Ref: Low)*	Med	-0.09 ns	*-0.19 – 0.01*	-	-
		High	-0.20 ***	*-0.30 – -0.10*	-	-
	Social Support Score *(Ref: Low)*	Med	-0.13 ***	*-0.20 – -0.06*	-	-
		High	-0.20 ***	*-0.28 – -0.12*	-	-
Other	Ethnicity of Child *(Ref: White)*	Non-White	-	-	-	-
	Maternal Employment (*Ref: No*)	Yes	-	-	-	-
	Maternal Emotional Problems (*Ref: Low*)	Med	0.23 ***	*0.17 – 0.29*	-	-
		High	0.51 ***	*0.44 – 0.58*	-	-

† -The estimated mean value for initial status and rate of change for the group with the baseline values for every factor included in the model.

ns – non significant, * - p<0.05, ** - p<0.01, *** - p<0.001

Model Fit (Pseudo R^2): Within-Person (over time) – 0.19; Initial Status – 0.11; Rate of Change – 0.00
Final N – 17,757

Table 6 Final multivariate model: peer problems score

			Initial Status (at 3y11m) Coefficient (B)	*95%CI*	**Rate of Change (per year)** Coefficient (B)	*95%CI*
Intercept†			2.33 ***	*2.15 – 2.51*	-0.04 *	*-0.08 – 0.00*
Family Structure	Family Size *(Ref: 1)*	2	-0.21 ***	*-0.31 – -0.11*	-0.04 **	*-0.07 – -0.01*
		3	-0.23 ***	*-0.35 – -0.11*	-0.04 **	*-0.08 – 0.00*
		4	-0.19 ns	*-0.36 – -0.02*	-0.04 ns	*-0.09 – 0.01*
		5 +	0.07 ns	*-0.19 – 0.33*	-0.16 ***	*-0.24 – -0.08*
	Sex of Child *(Ref: Male)*	Female	-0.18 ***	*-0.24 – -0.12*	-	-
	Mother's Age *(Ref:<25)*	25-29	-0.10 *	*-0.19 – -0.01*	-	-
		30-34	-0.11 *	*-0.20 – -0.02*	-	-
		35+	-0.06 ns	*-0.18 – 0.06*	-	-
	Father's Age *(Ref: <25)*	25-29	-	-	-	-
		30-34	-	-	-	-
		35+	-	-	-	-
	Father Figure Status *(Ref: Biological Father)*	Mother Alone	0.04 ns	*-0.08 – 0.16*	-	-
		Unrelated Male	0.08 ns	*-0.01 – 0.17*	-	-
Socio-economic Measures	Mother's Education *(Ref: <O-level)*	O-level	-0.14 **	*-0.24 – -0.04*	0.01 ns	*-0.02 – 0.04*
		A-level	-0.19 ***	*-0.03 – -0.08*	0.02 ns	*-0.03 – 0.05*
		Degree	-0.22 ***	*-0.34 – -0.10*	0.04 *	*0.01 – 0.07*
	Household Income *(Ref: <£200 per week)*	£200-299	-	-	-0.01 ns	*-0.04 – 0.02*
		£300-399	-	-	-0.02 ns	*-0.05 – 0.01*
		£400+	-	-	-0.03 *	*-0.06 – 0.00*
	Neighbourhood *(Ref: <V. Good)*	V. Good	-0.19 ***	*-0.29 – -0.09*	-	-
	Home Ownership *(Ref: Rented)*	Mortgaged/ Buying	-0.28 **	*-0.45 – -0.11*	-	-
		Owned	-0.21 ***	*-0.28 – -0.14*	0.03 **	*0.01 – 0.05*
Social Support	Social Network Score *(Ref: Low)*	Med	-0.11 *	*-0.22 – 0.00*	-	-
		High	-0.28 **	*-0.38 – -0.18*	-	-
	Social Support Score *(Ref: Low)*	Med	-0.17 ***	*-0.24 – -0.10*	-	-
		High	-0.28 ***	*-0.37 – -0.09*	-	-
Other	Ethnicity of Child *(Ref: White)*	Non-White	-	-	-	-
	Maternal Employment (*Ref: No*)	Yes	-0.08 **	*-0.13 – -0.03*	-	-
	Maternal Emotional Problems (*Ref: Low*)	Med	0.16 ***	*0.09 – 0.23*	-	-
		High	0.37 ***	*0.30 – 0.44*	-	-

† -The estimated mean value for initial status and rate of change for the group with the baseline values for every factor included in the model.

ns – non significant, * - p<0.05, ** - p<0.01, *** - p<0.001

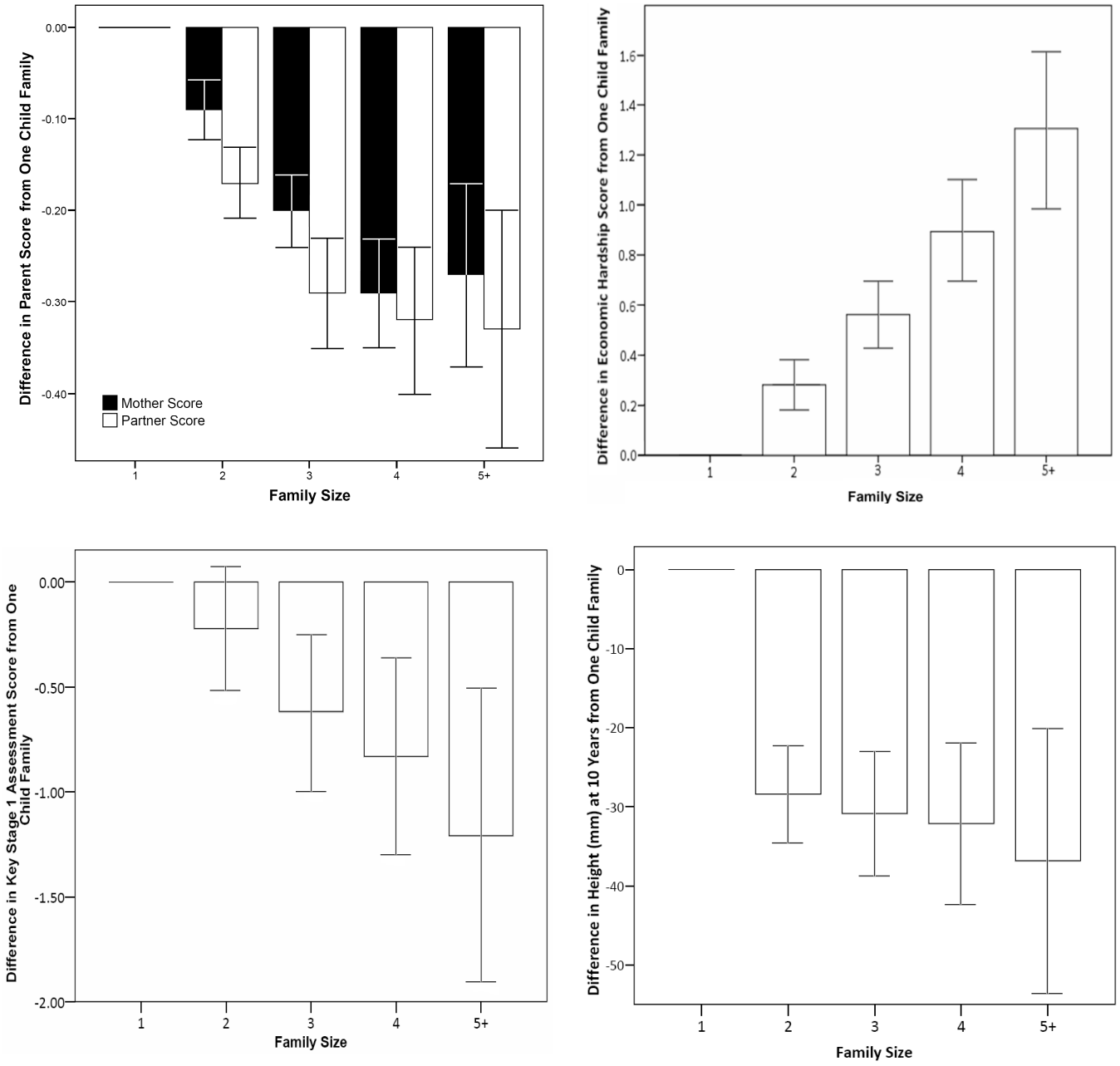
Model Fit (Pseudo R^2): Within-Person (over time) – 0.21; Initial Status – 0.13; Rate of Change – 0.02
Final N –15,066

Table 7 Final mental health score models for sibling age configuration
a) total difficulties score **(b)** hyperactivity score **(c)** emotional problems score **(d)** conduct problems score **(e)** peer problems score

			Initial Status (at 3y11m)		**Rate of Change (per year)**	
			Coefficient (B)	*95%CI*	Coefficient (B)	*95%CI*
(a) Total Difficulties Score	Number of older siblings *(Ref: 0)*	1	-0.12 ns	*-0.34 – 0.10*	-	-
		2	-0.67 ***	*-0.99 – -0.35*	-	-
		3+	-1.00 ***	*-1.57 – -0.43*	-	-
	Number of younger siblings *(Ref: 0)*	1	0.32 ***	*0.13 – 0.51*	-	-
		2	0.27 ns	*-0.01 – 0.55*	-	-
(b) Hyperactivity Score	Number of older siblings *(Ref: 0)*	1	0.25 ***	*0.14 – 0.36*	-0.09 ***	*-0.12 – -0.06*
		2	-0.19 *	*-0.36 – -0.02*	-0.02 ns	*-0.06 – 0.02*
		3+	-0.22 ns	*-0.51 – 0.07*	-0.03 ns	*-0.10 – 0.04*
	Number of younger siblings *(Ref: 0)*	1	-	-	-	-
		2+	-	-	-	-
(c) Emotional Problems Score	Number of older siblings *(Ref: 0)*	1	-0.10 **	*-0.17 – -0.03*	-	-
		2	-0.21 ***	*-0.31 – -0.11*	-	-
		3+	-0.25 **	*-0.43 – -0.07*	-	-
	Number of younger siblings *(Ref: 0)*	1	0.27 ***	*0.20 – 0.34*	-0.03 **	*-0.05 – -0.01*
		2+	0.32 ***	*0.19 – 0.45*	-0.05 **	*-0.09 – -0.01*
(d) Conduct Problems Score	Number of older siblings *(Ref: 0)*	1	0.11 ***	*0.04 – 0.18*	-	-
		2	0.10 ns	*0.00 – 0.20*	-	-
		3+	-0.11 ns	*-0.29 – 0.07*	-	-
	Number of younger siblings *(Ref: 0)*	1	0.10 **	*0.03 – 0.17*	0.03 ***	*0.01 – 0.05*
		2+	0.16 *	*0.03 – 0.29*	0.03 ns	*0.00 – 0.06*
(e) Peer Problems Score	Number of older siblings *(Ref: 0)*	1	-0.22 ***	*-0.29 – -0.15*	-	-
		2+	-0.20 ***	*-0.30 – -0.10*	-	-
		3+	-0.13 ns	*-0.32 – -0.06*	-	-
	Number of younger siblings *(Ref: 0)*	1	-0.12 ***	*-0.19 – -0.05*	-	-
		2+	-0.12 *	*-0.22 – -0.02*	-	-

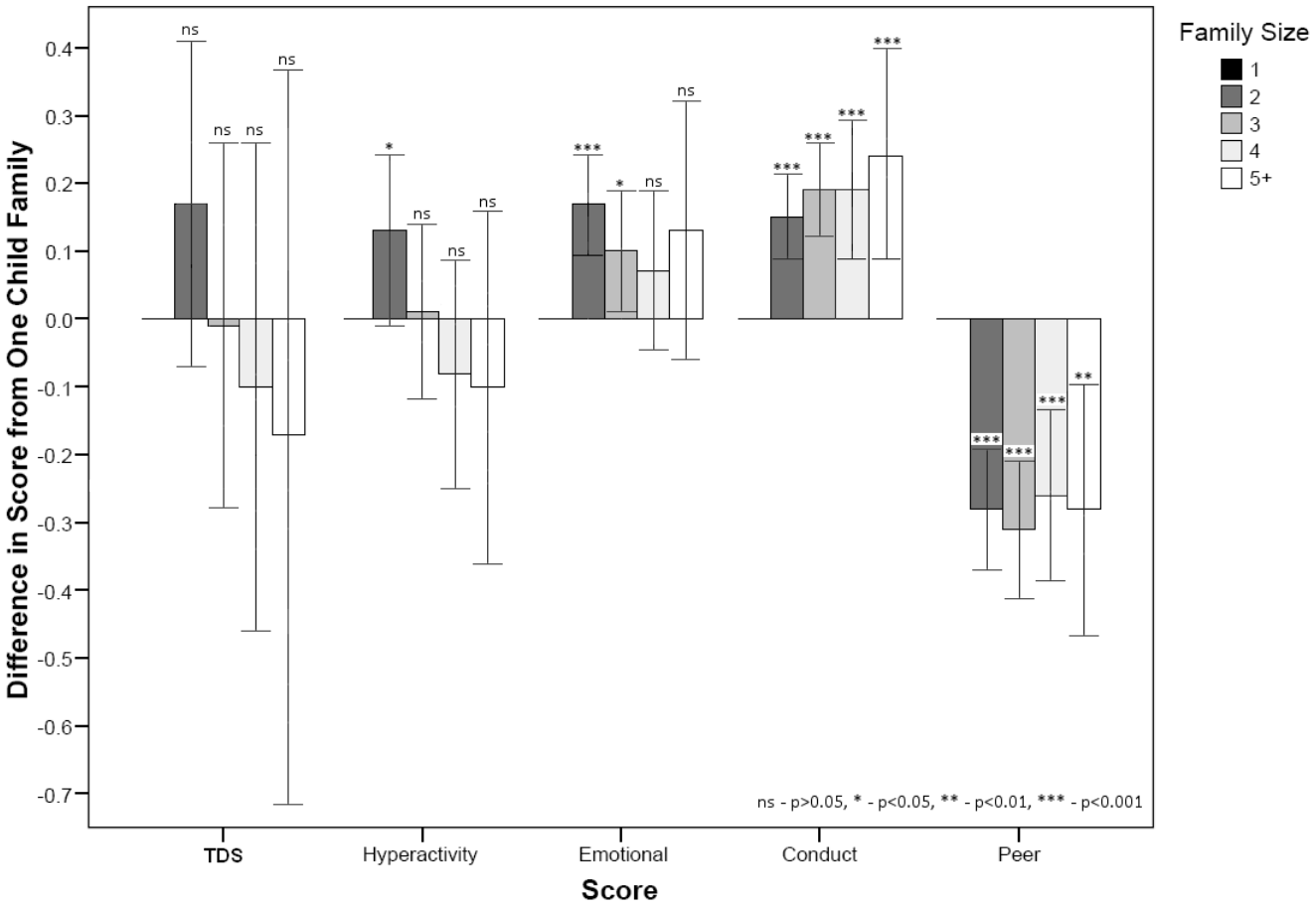
Models contain control variables for additional aspects of family structure and parental resources (see Tables 7.2 – 7.7)
ns – non significant, * - p<0.05, ** - p<0.01, *** - p<0.001
Final Ns: TDS – 16,158; Hyperactivity – 18,702; Emotional – 15,536; Conduct – 15,536; Peer – 14,741;

Figure 1: Family size, parental investment and child development in contemporary British families



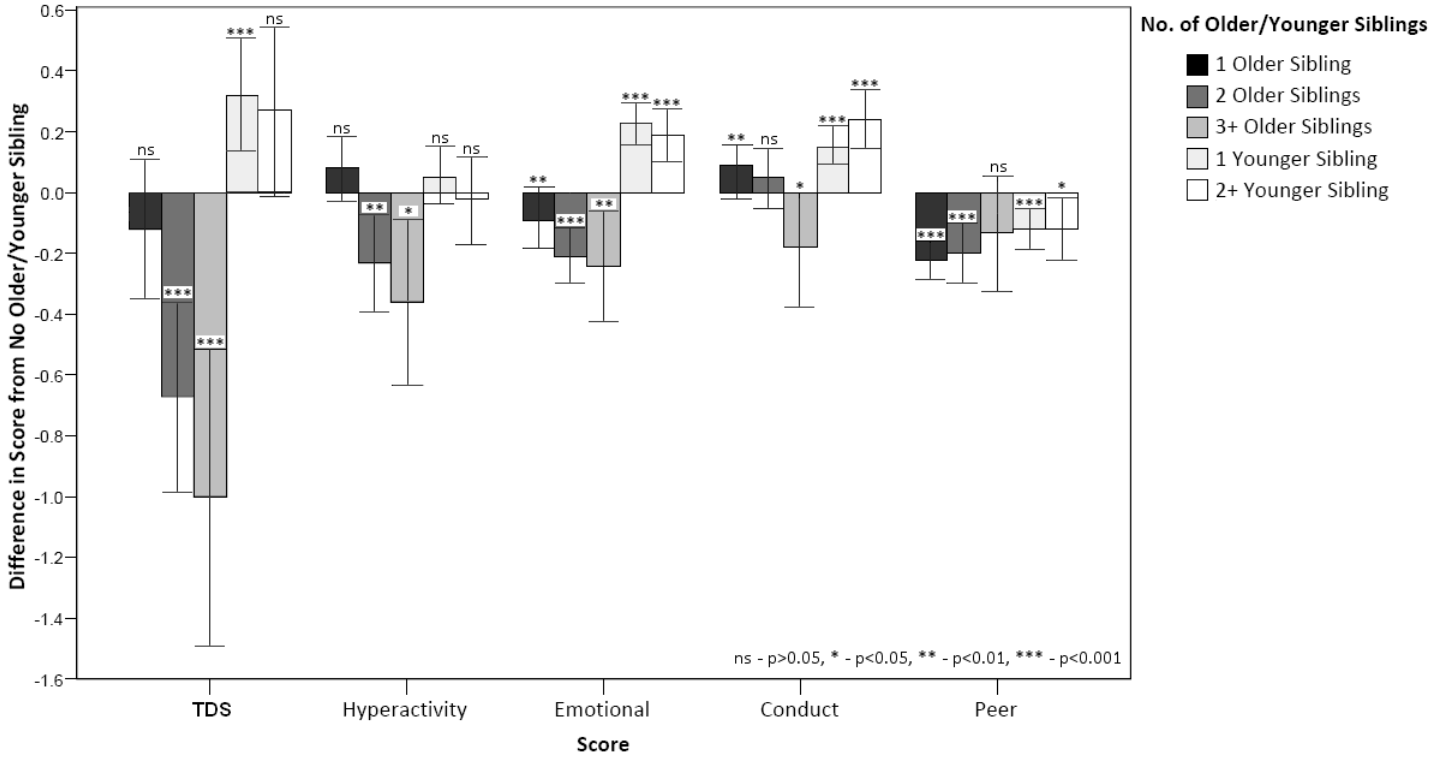
The relationship between family size and ***(a)*** *maternal and paternal allocations of care time between 1 - 9 years (from Lawson and Mace 2009);* ***(b)*** *maternal perception of economic hardship from 0 - 7 years (from Lawson and Mace in press);* ***(c)*** *school test results at 7 years (from Lawson 2009);* ***(d)*** *height at age 10 years (from Lawson and Mace 2008; see also Lawson 2009). Children with more siblings receive less time from parents, grow up in more economically stressed households and exhibit relatively poor physical and cognitive/educational development. Data are from the Avon Longitudinal Study of Parents and Children, a large cohort study (n = 14,000+) of children born in 1991/1992. Confidence intervals are set at 95%.*

Figure 2: Family size and childhood mental health over the study period (main effects only).



Overall there is very little evidence for a trade-off between family size and childhood mental health. Only conduct problems were increased incrementally with family size, and peer problems are reduced in the presence of siblings. Estimated relationships are adjusted for a range of demographic and socio-economic measures (see Tables 2-6 for full models). Confidence intervals are set at 95%.

Figure 3: Number of older and younger siblings and mental health over the study period (main effects only).



Overall and for a majority of component measures, the presence of older siblings is associated with improved mental health. In contrast, the presence of younger siblings is usually associated with relatively poor mental health. Estimated relationships are adjusted for a range of demographic and socio-economic measures (see Tables 2-6 for full models). Confidence intervals are set at 95%.

References

Baydar, N., Greek, A., & Brooks-Gunn, J. (1997). A longitudinal study of the effects of the birth of a sibling during the first six years of life. *Journal of Marriage and the Family*, 59, 939-956.

Becker, G. S., & Lewis, H. G. (1973). Interaction between quantity and quality of children. In T. W. Schultz (Ed.), Economics of the Family: Marriage, Children and Human Capital pp. 81-90). Chicago: University of Chicago Press.

Blake, J. (1989). Family Size and Achievement. Los Angeles: University of California.

Caspi, A., Moffitt, T. E., Newman, D. L., Silva, P.A. (1996). Behavioral observations at age 3 years predict adult psychiatric disorders – longitudinal evidence from a birth cohort. Archives of General Psychiatry, 53, 1033-1039.

Cooney, T., M, & Uhlenberg, P. (1992). Support from parents over the life course: the adults perspective. *Social Forces,* 71, 63-84.

Cox, J., Holden, J., & Sagovsky, R. (1987). Development of the Edinburgh Postnatal Depression Scale. *British Journal of Psychiatry,* 150, 782-786.

Downey, D. B. (1995). When Bigger is Not Better: Family Size, Parental Resources and Children's Educational Performance. *American Sociological Review,* 60, 746-761.

Downey, D. B. (2001). Number of Siblings and Intellectual Development: The Resource Dilution Explanation. *American Psychologist,* 56 497-504.

Downey, D. B., & Condron, D. J. (2004). Playing Well with Others in Kindergarten: The Benefit of Siblings at Home. *Journal of Marriage and Family,* 66, 333-350.

Dunn, J., Deater-Deckard, K., Pickering, K., G. O'Connor, T., & Golding, J. (1998). Children's Adjustment and Prosocial Behaviour in Step-, Single-parent, and Non-stepfamily Settings: Findings from a Community Study. *Journal of Child Psychology and Psychiatry,* 39, 1083-1095.

Dunn, J., & Kendrick, C. (1980). The arrival of a sibling: Changes in patterns of interaction between mother and first-born child. *Journal of Child Psychology and Psychiatry*, 21, 19-132.

Elliott, B. A. (1992). Birth order and health: Major issues. *Social Science & Medicine,* 35, 443-452.

Ford, T., Goodman, R., & Meltzer, H. (2004). The relative importance of child, family, school and neighbourhood correlates of childhood psychiatric disorder. *Social Psychiatry and Psychiatric Epidemiology,* 39, 487-496.

Gates, L., Lineberger, M. R., Crockett, J., & J, Hubbarb. (1986). Birth order and its relationship to depression, anxiety, and self-concept test scores in children. *Journal of Genetic Psychology,* 149, 29-34.

Golding, J., Pembrey, M., Jones, R., & Team, A. S. (2001). ALSPAC - The Avon Longitudinal Study of Parents and Children I. Study Methodology. *Paediatric and Perinatal Epidemiology,* 15, 74-78.

Goodman, A., & Goodman, R. (in press). The strengths and difficulties questionnaire (SDQ) as a dimensional measure of child mental health. *Journal of the American Academy of Child and Adolescent Psychiatry*.

Goodman, R. (1997). The Strengths and Difficulties Questionnaire: A Research Note. *Journal of Child Psychology and Psychiatry,* 38, 581-586.

Goodman, R. (2001). Psychometric properties of the Strengths and Difficulties Questionnaire (SDQ). *Journal of the American Academy of Child & Adolescent Psychiatry,* 40, 1337-1345.

Grass, K., Jenkins, J., & Dunn, J. (2007). Are sibling relationships protective? A longitudinal study. *Journal of Child Psyhcology and Psychiatry,* 48, 167-175.

Green, H., McGinnity, A., Meltzer, H., Ford, T., & Goodman, R. (2005). Mental health of children and young people, 2004. London: Palgrave MacMillan.

Hill, C. R., & Stafford, F. P. (1974). Allocation of Time to Preschool Children and Educational Opportunity. *The Journal of Human Resources,* 9, 323-341.

Hill, C. R., & Stafford, F. P. (1980). Parental Care of Children: Time Diary Estimates of Quantity, Predictability, and Variety. *The Journal of Human Resources,* 15, 219-239.

Hrdy, S., & Judge, D. (1993). Darwin and the puzzle of primogeniture. *Human Nature,* 4, 1-45.

Iacovou, M., & Berthoud, R. (2006). The Economic Position of Large Families. Leeds: DWP Research Report No. 358, Corporate Document Services.

Jeon, J. (2008). Evolution of parental favoritism among different-aged offspring. *Behav. Ecol.,* 19(2), 344-352.

Johns, S., & Belsky, J. (2008). Life transitions: becoming a parent. In C. Salmon & T. Shackelford (Eds.), Family relationships: An evolutionary perspective pp. 71-90). Oxford: Oxford University Press.

Kaplan, H., Lancaster, J. B., Bock, J., & Johnson, S. (1995). Fertility and fitness among Albuquerque men: a competitive labour market theory. In R. I. M. Dunbar (Ed.), Human Reproductive Decisions: Biological and Social Perspectives pp. 96-136). London: Macmillan.

Keister, L. A. (2003). Sharing the Wealth: The Effect of Siblings on Adults' Wealth Ownership. *Demography,* 40, 521-542.

Keister, L. A. (2004). Race, family structure, and wealth: the effect of childhood family on adult asset ownership. *Sociological Perspectives,* 47, 161-187.

Kristensen, P., & Bjerkedal, T. (2007). Explaining the Relation Between Birth Order and Intelligence. *Science,* 316, 1717.

Lawson, D. W. (2009). The Behavioural Ecology of Modern Families: A Longitudinal Study of Parental Investment and Child Development. Unpublished PhD Thesis. Anthropology. London: University College London.

Lawson, D. W. (in press). Life history theory and human reproductive behaviour. In V. Swami (Ed.), Evolutionary Psychology: A Critical Introduction. Oxford: Wiley-Blackwell.

Lawson, D. W., & Mace, R. (2008). Sibling configuration and childhood growth in contemporary British Families. *International Journal of Epidemiology,* 37, 1408-1421.

Lawson, D. W., & Mace, R. (2009). Trade-offs in modern parenting: a longitudinal study of sibling competition for parental care. *Evolution and human behavior,* 30, 170-183.

Lawson, D. W., & Mace, R. (in press). Optimising modern family size: trade-offs between fertility and the economic costs of reproduction. *Human Nature*.

Li, L., Manor, O., & Power, C. (2004). Early environment and child-to-adult growth trajectories in the 1958 British birth cohort. *American Journal of Clinical Nutrition,* 80, 185-192.

Li, L., & Power, C. (2004). Influences on childhood height: comparing two generations in the 1958 British birth cohort. *International Journal of Epidemiology,* 33, 1320-1328.

Mace, R. (2007). The evolutionary ecology of human family size. In R. Dunbar & L. Barrett (Eds.), The Oxford Handbook of Evolutionary Psychology pp. 383-396). Oxford: Oxford University Press.

McMunn, A. M., Nazroo, J. Y., Marmot, M. G., Boreham, R., & Goodman, R. (2001). Children's emotional and behavioural well-being and the family environment: findings from the Health Survey for England. *Social Science & Medicine,* 53, 423-440.

Meltzer, H., Gatward, R., Goodman, R., & Ford, T. (2000). The mental health of children and adolescents in Great Britain. London: The Stationary Office.

Modin, B. (2002). Birth order and mortality: a life-long follow-up of 14,200 boys and girls born in early 20th century Sweden. *Social Science & Medicine,* 54, 1051-1064.

Peterson, C. (2000). Kindred spirits: Influences of siblings' perspectives on theory of mind. *Cognitive Development,* 15, 435-455.

Price, J. (2008). Parent-Child Quality Time: Does Birth Order Matter? *Journal of Human Resources,* 43, 240-265.

Rasbash, J., Browne, W., Healy, M., Cameron, B., & Charlton, C. (2005). MLwinN (Version 2.02): Interactive software for multilevel analysis. Bristol, UK: Centre for Multilevel Modelling, Graduate School of Education, University of Bristol.

Rosenblatt, P. C., & Skoogberg, E. L. (1974). Birth order in cross-cultural perspective. *Developmental Psychology,* 10, 48-54.

Singer, J. D., & Willett, J. B. (2003). Applied Longitudinal Data Analysis: Modelling Change and Event Occurrence. Oxford: Oxford University Press.

Steelman, L., Powell, B., Werum, R., & Carter, S. (2002). Reconsidering the Effects of Sibling Configuration: Recent Advances and Challenges. *Annual Review of Sociology,* 28, 243-269.

Strohschein, L., Gauthier, A. H., Campbell, R., & Kleparchuk, C. (2008). Parenting as a dynamic process: a test of the resource dilution hypothesis. *Journal of Marriage and the Family*, 70, 670-683

Thorpe, K. J., Dragonas, T., & Golding, J. (1992). The effects of psychosocial factors on the emotional well-being of women during pregnancy: a cross-cultural study of Britain and Greece. *Journal of Reproductive and Infant Psychology* 10, 191-204.