Only children and cognitive ability in childhood: a cross-cohort analysis over 50 years in the UK

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Abstract

Only children's uniqueness have intrigued researchers for decades but many gaps in knowledge remain as to whether only children differ from children who have siblings. We use data from four British birth cohorts (born in 1946, 1958, 1970, 2000-2002) to investigate whether the association between being an only child and cognitive ability in childhood has changed over time and cross-cohort differences in the characteristics of only child families. Only children show similar scores to children from two child families and higher scores than children with two or more siblings across each of the cohorts analysed. However, the results also show that – consistent with the finding that across cohorts the composition of the only child group has become more associated with social disadvantage – the 'only child advantage' has weakened over time. Adjustment by family socio-demographic characteristics attenuates within and cross cohort differences. Moreover, the results show that the cognitive advantages associated with being an only child vary considerably by whether the cohort member has been exposed to parental separation or is growing up in a family with lower socioeconomic status. The results highlight diversity in being an only child whose characteristics are conditional on changes throughout time and society.

Introduction

Only children's – namely children who grow up without siblings – unusualness and uniqueness have intrigued and fascinated researchers, clinicians and society for decades. Because of the lack of siblings, only children have often been described as spoiled, overprotected and lonely (Falbo & Polit, 1986). The emergence of the negative views around only children dates back to the late 1800s when Stanley G. Hall, an eminent psychologist, defined the only child as a 'disease in itself' (Mancillas, 2006). Although these views were developed on the basis of questionable scientific methods and on extremely small samples of only children with mental health problems, they permeated the general views and contributed to develop negative stereotypes about only children (Mancillas, 2006). Despite the fact that the scientific evidence has either disproved or at least presented ample evidence to question these views, even in contemporary low-fertility societies, negative stereotypes about only children are still present. This might contribute to explain the persistence of the two child family ideal (Sobotka & Beaujouan, 2014). Figure 1, for example, shows an image circulated during the 2016 Italian Fertility Day[1] which conveyed the message that one of the negative consequences of childbearing postponement is that it leads to having an only child.

Figure 1 Image circulated during the 2016 Fertility Day in Italy

[1] The Italian fertility day was launched with the intention to attract attention to the topic of fertility and its protection, and to underline the danger of falling birth rates in the country. It was also meant to put focus on the beauty of maternity and paternity and medical help for those people who are having problems conceiving. The campaign was condemned by many for being sexist, ageist and anachronistic.

Note: Translation from Italian: "*Delaying motherhood leads to an only child. If any child at all*". The image was advertised as part of the 2016 Italian Fertility day, warning women and couples that one of the "dangers" of postponing childbearing is to have an only child.

But is being an only child really a disadvantage? Previous research shows that in terms of cognitive and educational outcomes, on average, only children do as well as children with few siblings and better than children from large families (Falbo & Polit, 1986). However, other studies report a disadvantage for only children compared to children who grow up with one or two siblings (Belmont & Marolla, 1973; Black et al., 2010). The context under study and, in particular, the characteristics of only child families have been identified as one of the explanations behind the mixed results (Choi & Monden, 2017). In countries where small families are more prevalent (e.g., Spain, Italy and Greece), only child families tend to be socio-economically advantaged. On the contrary, in countries where small families are less prevalent (e.g., Norway, Sweden and Ireland), only child families tend to be, on average, less advantaged than other families. The variation in the socio-demographic characteristics of only child families can explain why in some countries only children perform better than children from other sibship groups whilst in others they perform worse. This finding empirically supports the argument that the selection into being an only child family, i.e. the socio-demographic composition of this group, has at least as strong an influence on only children's outcomes as does their sibling position (Falbo & Poston, 1993). Yet, in the existing body of work on only children, this aspect has received limited attention and indeed we hold very limited knowledge about the socio-demographic characteristics of only child families.

Another potential source of variation across studies - many of which were conducted during the 1980s (Blake, 1981b) - is whether and how the development of only children has changed over time. The socio-demographic composition of one child families might change not only across contexts but also time (Präg et al., 2020). For example, having an only child has, over time, become more likely to be associated with couples marrying later and divorcing more frequently (Breton & Prioux, 2009; Gee, 1992). Systematic differences in these selection mechanisms may lead to differences in what the relationship between only childness and child well-being represents. This secular aspect remains largely untested in the literature. Moreover, in light of these secular changes, it is a limitation that the literature on only children has largely focused on sibship presence, and has tended to neglect to integrate parental presence or marital disruption.

With declining fertility and a gradual shift in family size ideals observed in many countries, one child families are becoming or are expected to become more common in many contexts (Präg et al., 2020; Sobotka & Beaujouan, 2014). We need more

systematic evidence on only children, their characteristics and their development to strengthen our understanding not only on *whether* but also *why* only children perform differently or similarly to children who grow up with siblings. In this study, we contribute to this aim by using data from four UK birth cohorts which cover children born during a 50-year period: in 1946, 1958, 1970, 2000-2002. First, we explore whether the socio-demographic composition of only child families compared to families with two, three, four or more children has changed over time in the UK. Second, we explore whether the cognitive ability of only children with respect to children who grow up with (one, two, three or more) siblings has changed over time and, if so, if it is explained by the changes in the socio-demographic characteristics of only child families over time compared to other sibship groups. Third, we examine if the association between being an only child and cognitive ability is heterogenous and varies by family structure (i.e. whether the cohort member is living with both biological parents at age 10/11) and by parental social class.

Background

In social science research three theories have focused on the consequences of being an only child. The first, the *resource dilution* theory, argues that siblings are competitors for parental resources such as time, money and energy. Because these resources are limited, each sibling reduces the amount of time and financial investment any one child can receive (Blake, 1989; Downey, 1995). This theory predicts that only children perform, particularly in terms of educational outcomes, better than children from large families and similarly to children from small families because they do not have to share parental resources with any or many siblings. Although for different reasons, the *confluence* theory also predicts that only children perform better than children with siblings. First introduced by Zajonc and Markus (1975), the theory predicts that a child's cognitive ability depends on the family intellectual environment, which declines as the number of siblings increases. The only child benefits from not having siblings as they are exposed to a higher quality intellectual environment. In contrast, the *socialization* theory argues that siblings constitute a resource (Goetting, 1986) since they provide children with opportunities to share, to learn how to negotiate and resolve conflict. Having younger siblings can also promote the development of tutoring skills, giving children the opportunity to refine their own cognitive skills whilst they teach their younger siblings. The socialization theory argues that, although only children might benefit in terms of educational outcomes from growing up without siblings, they will experience other kinds of disadvantages because they lack siblings with whom to interact resulting in worse personal adjustment, cooperativeness and ability to get along with peers (Falbo & Polit, 1986).

Existing research supports the arguments of the dilution and confluence theories (Blake, 1981a, 1981b; Falbo & Polit, 1986; Mancillas, 2006). When looking at educational outcomes in childhood and adulthood, most studies find only children to be either advantaged or no different from children in two child families and to clearly perform better compared to children from larger families (Blake, 1981a, 1981b; Gee, 1992; Sheppard & Monden, 2020)[2]. Similarly, existing evidence generally does not support the socialization theory as it finds that only children are comparable to children with siblings (especially those with few siblings) in terms of personality, parent-child relationships, achievement, motivation and personal adjustment (Falbo & Polit, 1986; Polit & Falbo, 1987). Although the work by Downey and Condron (2004) finds evidence of a social skills deficit amongst only children at kindergarten, more recent work by Bobbitt-Zeher and Downey (2016) show that these deficits appear to be overcome by adolescence.

On the other hand, albeit a minority, some studies present a picture of only children that does not fully conform with the resource dilution and confluence theories. Whilst only children tend to always outperform children with many siblings (four or more), the evidence on how only children fare compared to children from small families is not consistent across studies (Belmont & Marolla, 1973; Choi & Monden, 2017; Steelman et al., 2002). Work by Black et al. (2010), for example, shows that in Norway male only children have lower intelligence scores than children with two or three siblings before as well as after accounting for control variables capturing the socio-economic status of the family. Belmont and Marolla (1973) found that only children performed worse in intelligence scores than first and second-borns from two and three child families and worse than first-borns from four child families. Choi and Monden (2017) show important variations in PISA test scores of only children across Europe. Only children perform worse than other sibship groups in contexts (such as Sweden, Ireland and Belgium) where they represent a smaller proportion of children and where their parents are more disadvantaged. Taken together, the evidence points to the need of contextualizing the position of only children relative to other sibship groups based on family resources which might be more important in determining children's development and life chances than being an only child per se – an argument that is well supported by the cross-national study of Choi and Monden (2017).

[2] The studies focussing on China generally show that only children in this context tend to have better outcomes than children who grow up with siblings, reflected in lower levels of psychopathology and higher levels of education Falbo, T., & Poston, D. L., Jr. (1993). The academic, personality, and physical outcomes of only children in China. *Child Dev*, *64*(1), 18-35. https://doi.org/10.1111/j.1467-8624.1993.tb02893.x

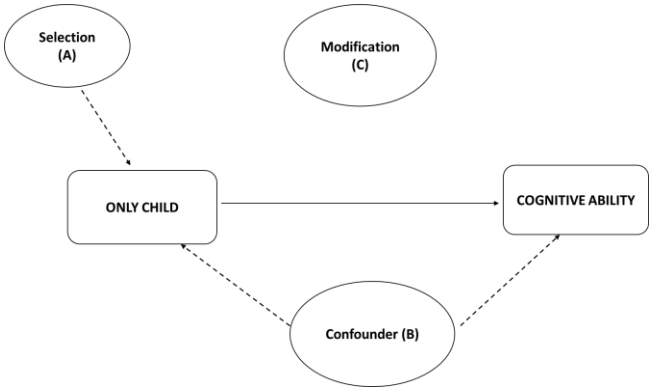
In this study we build and expand on this argument in two ways. First, we argue that the socio-demographic composition (i.e. the selection) into being an only child family and in other parity groups can vary systematically not only across contexts but also across time (Gee, 1992). Earlier in the 20th century, it was believed that only children were more likely to be born and grow up during times of economic hardships and wars (Falbo & Polit, 1986). For example, in the study by Belmont and Marolla (1973) only children's worse performance in intelligence scores is attributed to the fact that only child families were strongly negatively selected as they disproportionately represented families that were worst hit by the 1944-45 Dutch famine. The more recent increase in only children has been associated with other demographic trends such as the rising divorce rates, teenage pregnancy, the postponement of childbearing and changing social norms (Blake, 1981a). There is no direct empirical evidence which can speak to how these changes might have impacted the composition of only child families and, consequently, the link between only childness and cognitive ability. Work by Choi et al. (2020) shows that in some contexts, including the U.K., the educational disadvantage of an additional child/sibling in the family has decreased over time, but the authors did not look specifically at only children. Präg et al. (2020) find that disparities in parental education by sibship size have reduced over time, which was mainly driven by a reduction in number of large families. They found disparities by parental education among one child families to be more stable over time, but they focused on parental education and did not include other measures such as parental separation.

Moreover, we argue that even if the socio-demographic composition of the only child group does not vary over time, the link between the characteristics of only children and cognitive ability might change over time resulting in cross-cohort variation in the link between being an only child and cognitive ability. For example, the negative association between divorce and cognitive ability might weaken as it becomes more widespread and socially accepted (Amato & Cheadle, 2005). Finally, there could be changes over time in how only children are perceived and potentially stigmatised.

Figure 2 illustrate these arguments by showing the three main mechanisms that could explain potential cross-cohort changes in the association between being an only child and cognitive ability: 1) secular changes in the socio-demographic characteristics of the only child group or selection on the exposure (A-*Composition*) e.g. higher proportion of only children with teenage mothers over time, 2) changes over time in how the characteristics of only children are linked to cognitive ability or confounding effects e.g. the negative effects of parental separation on cognitive ability diminish

over time (B-*Confounding*) 3) between cohort modification or, in other words, a modifier plays a role in one or more cohorts but not in all e.g. teachers treat only children less favourably, but more so in the earlier cohorts (C – *Modification*).

Figure 2 Potential drivers of secular changes in the association between being an only child and cognitive ability



Notes: the dashed lines reflect the potential sources of cross-cohort variation.

The primary aim of this study is, by using cross-cohort data, to 1) compare the socio-demographic composition of only child families over time 2) compare cognitive ability scores between only children and children who grow up with siblings over time 3) explore the role of composition and confounding in explaining cross-cohort differences or lack thereof through a set of variables we observe in the data. The data does not provide us with information that could speak to the modification effect, but we nevertheless take it into consideration when discussing the results after we adjust for family characteristics.

Second, we argue that existing theories and the empirical literature have viewed and treated only children as a homogenous group or single category. Yet, there can be different family contexts and processes which are associated with being an only child. For example, a child might grow up without siblings as a result of a deliberate or constrained choice e.g. single parenthood, parental separation, secondary infertility or other factors such as complications around the birth of the first child (Elvander et al.,

2015). Because the selection into being an only child is likely to matter more than the only child status per se, looking at the “average” only child might mask important heterogeneity within this group and prevent us from identifying the underlying mechanisms linking only childness to child outcomes. This potential variation has not been integrated into the main theories applied to only children. Indeed, the resource dilution theory implicitly assumes a stable 2-parent family where the resources available to the individual child are reduced only by the addition of another child to the family, and not because of other family processes such as parental separation or growing up with a single parent. Similarly, the confluence theory does not allow for the possibility that an only child might grow up in a household with one single adult, who might not be able to provide the same level of adult conversations and intellectual stimulation. To the extent that over time only children have become more likely to grow up in single parent households, the applicability of these theories - which were developed primarily within the context of the nuclear family - to only children is unclear (Gibbs et al., 2016). To conclude, there is a need for analysis that takes a more nuanced approach to comparing only children and siblings which brings together literatures on sibling and parental access which so far have been siloed from each other. For this reason, *our secondary aim is to explore whether the association between being an only child and cognitive ability varies when we stratify the analyses by whether the cohort member is living with both parents at age 10/11 and by parental social class* thus distinguishing only children who grow up in more or less resourced environments.

Data and Methods

We used data from four British birth cohort studies. The 1946 National Survey for Health and Development (NSHD) is a longitudinal cohort study whose origins lie in a maternity survey of all 13,687 children born in England, Scotland or Wales during one week of March 1946. A socially stratified subsample of 5,362 singleton children born to married parents was selected for follow up. We use data from the birth survey (response rate for age 0-4 interviews was 95%) and from the age 11 survey (response rate for age 5-15 interviews was 89%).

The 1958 National Child Development Study (NCDS) is a longitudinal cohort study that followed 17,416 children born in England, Scotland, or Wales during a week of March 1958. We use data from the birth survey (response rate 99%) and from the age 11 survey (response rate was 88%).

The 1970 British Cohort Study (BCS) is a longitudinal cohort study that followed 16,571 children born in England, Scotland, or Wales during one week of April 1970. We use data from the birth survey (response rate 96%) and the age 10 survey (response rate was 87%).

The Millennium Cohort Study (MCS) is a longitudinal cohort study that followed 19,244 children born between September 2000 and January 2002 in England, Scotland, Wales, or Northern Ireland. The sample was selected from a random sample of electoral wards using a stratified sampling strategy to ensure the representation of all four of the UK countries, with an oversampling of disadvantaged and ethnically diverse areas. We used weights to account for the complex sampling design and non-response and overrepresentation of disadvantaged and ethnically diverse areas and the survey command to account for the clustering of samples within strata. In the analyses, we used data from the infancy survey (response rate 82%), which was collected when the children were around nine months old; and from the age 11 survey (response rate 72%) (Plewis et al., 2007) We refer to the MCS as the 2001 cohort study, since the majority of births in the sample occurred in 2001.

Variables

Cognitive ability: In each cohort, the dependent variable was a measure of verbal reasoning ability collected when the children were 10 or 11 years old (Moulton et al., 2020). In the 1946 and 1958 cohort studies verbal cognition was assessed using the verbal subscale of the General Ability Test which was administered by teachers to cohort members at age 11 (National Foundation for Educational Research) (Douglas, 1964). In the 1970 cohort study verbal cognition was assessed by a teacher using the Word Similarities subscale of the British Ability Scales , the precursor to the Verbal Similarities subscale (British Ability Scale, Second Edition (Elliott et al., 1978), administered by the interviewer in the 2001 cohort (Elliot et al., 1996). We adjusted for the children's age at interview to control for the fact that the children took the test at different ages and thus abilities. One of the strengths of this study lies in the fact that we relied on tests of cognitive ability that are comparable across the four birth cohorts, as they all measure verbal reasoning and were collected at similar ages. However, since different tests or versions of the tests were administered, all tests were standardised to a mean of zero and a standard deviation of one.

Sibling status: to define only children we were guided by the research question we are addressing in this study and by the information available in the data (Chanfreau & Goisis, 2022). Since we address theories arguing that in childhood only children benefit from a concentration of (time and financial) parental resources, we base our definition on co-residence with siblings or not. Thus, only children are defined as cohort members who do not grow up living with siblings. We adopt a broad definition of having a sibling as the data from the three older cohorts does not enable us to distinguish full and half siblings. Moreover, due to data limitations, we do not know if the cohort member shares parental resources with siblings outside of the home.[3] To identify the presence of siblings, we focused on age 10/11 because it was considered

[3] Since the cohort members are likely to continue living with their mothers after parental separation, we are overlooking the presence of non-resident siblings following paternal re-partnering. This omission might affect the results in that only children have lower levels of time and financial resources available, which would result in more conservative estimates.

to be late enough in the cohort members' life to capture the existence of younger siblings - as in the vast majority of cases siblings are not born more than 10 years apart - and also early enough that older siblings of cohort members would likely still be co-resident.

To identify the presence of siblings in the 1946 cohort study, we relied on fertility/childbirth history questions asked to the cohort members' mothers about live-born children born before or after the cohort child. In the 1958 cohort study, sibling status was defined based on whether the cohort member was reported as the mother's first birth at the time of the cohort member's birth, adjusted for cohort members who were twins or triplets, and whether at the age 11 survey the mother reported having had any subsequent births. If the information on subsequent births was missing from the age 11 interview, we categorized the cohort member as having siblings if the age 16 interview revealed the presence of siblings. In the 1970 cohort study, sibling status was defined based on whether the cohort members had any younger or older brothers or sisters at age 11 interview (or twin/triplet siblings). The data in these three cohorts does not enable us to distinguish full and half-siblings. In the 2001 cohort study, sibling status was defined based on whether the cohort member had any full, half, step or adoptive siblings reported as living in the household at any sweep up to and including age 11.

When looking at all those interviewed at age 10/11 (i.e. not focussing exclusively on this study's analytical sub-sample) 13.6% of those born in 1946 were only children, 6.8% of those born in 1958, 7.8% of those born in 1970 and 9.2% of those born in 2001. The general trend is similar to that of the proportion of women with one child only, as reported in official UK cohort fertility estimates and prior work on the historical decline in fertility in Britain (Anderson, 1998; ONS, 2011). Estimates from other sources suggest the prevalence of one child families has been relatively stable, fluctuating between 10 and 15% of women born between 1940 and the mid-1960s following a decline from over a fifth of women born in the early to mid-1920s (Breton & Prioux, 2009; Frejka & Sobotka, 2008). Anderson (1998) shows that from the earliest stages of the decline of fertility in Britain, the fall in average family size was accompanied by a significant increase in the proportion of married women who remained childless or had only one child. This trend was attributed primarily to the growing legitimacy of new behaviours across different strata of society who foresaw opportunities from limiting their fertility, and less to techniques of birth control, i.e. they were pioneers of fertility behaviours which then became more widespread. Over time, it is likely that only childness has become more associated with the emergence of changes in demographic behaviours, such as the rise of relationship break-up (Sigle-Rushton, 2008) and childbearing postponement (McLanahan, 2004).

In the analyses, we used the only child variable as a binary indicator (only child vs. with siblings) and as a categorical variable (only child; one sibling; two siblings; three or more siblings).

Other variables: The other independent variables were a set of child and family characteristics collected during the birth or age 10/11 survey of each cohort study. We used these variables to describe the socio-demographic selection into growing up as an only child and test whether it has changed over time, as well as to unpack the association between being an only child and cognitive ability. In terms of child characteristics, we considered the sex of the cohort child and his/her birth order i.e. the numerical order of the live birth (categories: first, second, third or higher) which is associated with cognitive ability (Barclay, 2015; Bjerkedal et al., 2007; Mare & Chen, 1986). In terms of family characteristics we considered mother's education (binary indicator; 1946/1958 cohort studies: whether the mother stayed in education until the minimum age; 1970: whether the mother had completed A-levels (pre-college) or had degree level education; 2001 cohort study: whether the mother had degree-level education), the father's (1946/1958 cohorts), or the family's social class (1970/2001 cohort, the highest in the household) based on the Registrar General Social Class (categories in all cohorts: professional occupation, managerial and technical occupations, skilled non-manual occupations, skilled manual occupations, partly skilled occupations, unskilled occupations). We also considered maternal age at the cohort member's birth (categorical: <20, 20-24, 25-29, 30-34, 35-39, 40+) and the mother's marital status at birth (categories 1958/1970 cohort: married or single; categories 2001 cohort: married, cohabiting or single). To capture family instability, we considered whether the cohort members parents were living together (1946/1958/1970 cohort studies which did not collect direct information on marital status) or were married/cohabiting in the 2001 cohort study at age 10/11 interview. We use this variable as a proxy for parental separation. Finally, we considered whether the mother breastfed the cohort member for at least one month (binary indicator) and whether the mother smoked during pregnancy (binary indicator). We did not adjust for marital status at birth in the 1946 cohort study (since all cohort members were born to married mothers) and for smoking during pregnancy (since the variable was not collected).

Inclusion criteria and exclusions

We excluded from the analyses observations with missing values on any of the variables used in the analyses (Mostafa et al., 2021). In families with multiple births, we randomly selected one cohort child. These exclusions reduced the 1946 cohort sample to 3,288 observations (out of 4,281 cases in the age 11 survey), 1958 cohort sample to 10,941 (out of 13,951 cases in the age 11 survey), the 1970 cohort sample to 8,612 (out of 14,350 cases in the age 10 survey), and the 2001 cohort sample to 11,805 observations (out of 13,287 cases in the age 11 survey).

Methods

In the first step of the analyses, we compared the family socio-demographic characteristics and the maternal health behaviours based on sibship status. The aim

of this step is to show whether and, if so, how the socio-demographic composition of only child families has changed over time.

In the second step of the analyses, in order to examine the association between being an only child and cognitive ability in childhood, we estimate a series of linear regression models. The analyses for the 1946 cohort are conducted using study design weights to adjust for the sampling procedure (births to married women with husbands and non-manual and agricultural employments and 1 in 4 of all comparable births to women with husbands in manual employment) (Wadsworth et al., 2006). The analyses for the 2001 are conducted using sample weighting and accounting for the complex survey design. All analyses are conducted in Stata 17.

We explore the association between sibship status and cognitive ability by estimating the following four models across the four birth cohorts:

(0) $$COGNITIVE\ ABILITY = \alpha + \beta_1 ONLY\ CHILD$$

(1)

(2) $$COGNITIVE\ ABILITY = \alpha + \beta_1 SIBSHIP\ STATUS$$

(3)

$$COGNITIVE\ ABILITY = \alpha + \beta_1 SIBSHIP\ STATUS + \beta_2 SOCIODEM - HEALTH$$

$$COGNITIVE\ ABILITY = \alpha + \beta_1 SIBSHIP\ STATUS + \beta_3 BIRTHORD + \beta_3 SOCIODEM - HEALTH + \beta_4 SEPARATION$$

where COGNITIVE ABILITY, the dependent variable, is the z-transformation of the verbal ability score measured at age 10/11. In Model 0, the baseline model, we adjust for ONLY CHILD which is a binary indicator measuring if the cohort child is an only child or has siblings living in the household. In this model, we compare cohort members who are only children to all the cohort members with siblings combined into a single category. In subsequent models 1-3, we expand on this variable and categorize children with siblings based on the number of brothers/sisters they have. SIBSHIP STATUS is a categorical variable for the number of siblings the cohort member has (0,1,2,3+). In Model 2, we adjust for BIRTHORD, namely the birth order of the cohort members in the family. In Model 3 we adjust for SOCIODEM-HEALTH i.e. family socio-demographic characteristics at birth (e.g., maternal age at the time of birth, level of education, marital status at the time of birth) and maternal health behaviours (smoking during pregnancy and breastfeeding) which may confound the association between only child and cognitive ability. Finally, Model 3 additionally adjusts for SEPARATION, namely whether the cohort member is living with both parents at the age 10/11 interview. We adjust for this variable separately as it could be a confounder as well as a mediator in the association between only childness and cognitive ability. The models that include adjustments for covariates are only partially comparable across cohorts, as in the 1946 cohort study we cannot adjust for all the variables we adjust for in the other cohort studies and there might be differences in the meaning of these variables across the four cohorts.

To explore whether the association between being an only child and cognitive ability is heterogenous across social categories, we run Model 1 interacting the sibship status variable by a binary indicator capturing whether the cohort members are living with both parents or only one parent at the age 10/11 interview (which we use as a proxy for parental separation) and, in a separate analysis, by a binary indicator capturing whether they are growing up in households with a higher social class (professional occupation and managerial and technical occupations) or lower social class (skilled non-manual occupations, skilled manual occupations, partly skilled occupations, unskilled occupations). Both parental separation and lower social class are associated with social disadvantage and reduced resources available to the family, and thus enable us to compare only children who grow up in poorer from those who grow up in better resourced environments.

Results

The socio-demographic composition of only child families

Tables 1-4 show the socio-demographic characteristics of the analytical samples by sibship size (0,1,2,3+ siblings) for each birth cohort. Table 1 shows the results for the 1946 cohort study, where 13.3% of cohort members are only children. In terms of family socio-economic status, only children appear to fall in between cohort members with one or two siblings and cohort members with three or more siblings – the latter being the most disadvantaged. For example, the percentage of children with a father in the top social class category is 4.1% among only children, 7-8% for children with one or two siblings and 3.3% for cohort members with 3+ siblings. 4.8% of only children have a father in the lowest social class category, 3.1% amongst cohort members with one sibling, 5% amongst cohort members with two siblings and 11% amongst cohort members with 3+ siblings. The patterns by maternal education are similar. In terms of maternal age at the birth of the cohort member, only children are less likely than all the other groups to have a younger mother (<20 years). Differences in the other maternal age categories are not evident until the mid-late thirties where only children are more likely to have a mother in the age category 35-39 compared to cohort members with one sibling and more likely to be born to a mother aged 40+ compared to the cohort members with one or two siblings. However, despite the differences in relative terms, the proportion of only children who are born to an older mother is small in absolute terms (4%). The results do not show substantial differences in the proportion of cohort members living with both parents at age 11 by sibship status and small differences in the percentage of mothers who breastfed their children by sibship size.

Table 2 shows the results for the 1958 cohort study, where 7% of cohort members are only children. In terms of socio-economic status only children – similarly to what we observe in the 1946 cohort study – fall in between cohort members with one or two

siblings and cohort members with 3+ siblings. Only children show the lowest percentage in terms of parents being married at the time of the birth but in absolute terms the great majority (93%) of only children are born to married parents. In terms of maternal age at birth the results are in line with the 1946 cohort ones. Only children are the group whose mothers are the most likely to have smoked during pregnancy (although differences by sibship size are small) and the least likely to have been breastfed. In contrast to what we observe in the 1946 cohort study, only children show the highest percentage (10.1%) of cohort members who are not living with both parents at age 11 (either because they have not lived with both parents from birth or because they have experienced parental separation by age 11[4]) followed by children with 3+ siblings (9%) and cohort members with 1 or 2 siblings (5.7% and 5.9% respectively).

Table 3 shows the results for the 1970 cohort study, where 7% of cohort members are only children. In terms of social class, the results mirror those of the 1946 and 1958 cohort studies. In contrast, there are differences when we look at other indicators. On one hand, only children have mothers who are more likely than any other sibship group to have completed their A-levels or gotten a university degree. On the other hand, differences by marital status at birth and at age 11 are more pronounced compared to the 1946 and 1958 cohort studies. 83.4% of only children are born to mothers who were married at the time of birth versus over 90% in the other sibling groups. 24% of only children are not living with both parents at age 11, compared to 10-12% of cohort members in the other sibship groups. Only children also show considerably higher rates of having a mother younger than 20 at the time of birth (16.6% vs. 7-9% in the other sibship groups).

Table 4 shows the results for the 2001 cohort study, where 9.3% of cohort members are only children. The characteristics of only children in this cohort are similar to those of only children born in 1970. In terms of maternal education, they tend to be in between cohort members with one or two siblings and cohort member with three or more siblings. In terms of relationship at the time of birth and at age 11, they tend to be more disadvantaged – even more so than amongst children born in 1970. For example, 44% of only children are born to mothers who are married at the time of birth in contrast to over 60% in the other sibship groups. 24.6% of only children have parents' who are not co-residing at the time of birth, in contrast to 13-14% of cohort members with one or two siblings. We observed similar disparities at age 11, where 58% of only children are not living with both biological parents vs. 30-40% in the other sibship groups. In this cohort, only children are more likely to have young and as well as older mothers.

[4] We see from the birth sweep that this is not much higher than the proportion born to unmarried parents – so in this cohort separation appears to make a relatively small contribution to the % not living with both parents at age 11.

Taken together, the results show similarities as well as differences in the socio-demographic composition of only child families across the birth cohorts analysed. Albeit, over time the results show continuity in the socio-economic characteristics of families whereby only children tend to be in between smaller (most advantaged) and larger (least advantaged) sibling families., they also become more 'represented' in categories which tend to be associated with disadvantage: teenage mothers, children born to single parents and children who do not live with both parents at age 10/11 (McLanahan, 2004). The results suggest that, over time, the socio-demographic composition of only children has changed in a way that this group has become, on average, more heterogenous and more disadvantaged. In contrast, the disadvantage of large families has remained remarkably stable across the cohorts, supporting our argument that we are seeing a change/diversification in the only child group rather than the pattern potentially being an artefact of change in the group(s) we are comparing them to.

The cognitive ability of only children

Table 5 shows the main model results exploring the association between sibship size and cognitive ability at age 10/11. The full model results are presented in Web Tables 1-4. Model (0) – which is unadjusted and compares only children to children with siblings grouped into one category – shows that in all the four cohort studies only children have higher cognitive ability scores than children with siblings. However, the results also show that there is a gradient in the association. Only children born in 1946 have cognitive scores 0.32 standard deviations (95% CI: 0.20-0.44) above cohort members with siblings whilst only children born in the most recent cohort 2001 perform 0.09 standard deviations (95% CI: 0.01-0.16) above cohort member who grow up with siblings. The confidence intervals around the 1946 and 2001 estimates do not overlap, leading us to conclude that the association between being an only child and cognitive ability at age 11 has weakened over time. The results for 1958 and 1970 fall in between the 1946 and 2001 results and their confidence intervals do not overlap with those of the 2001 cohort study, providing further evidence of the secular decline.

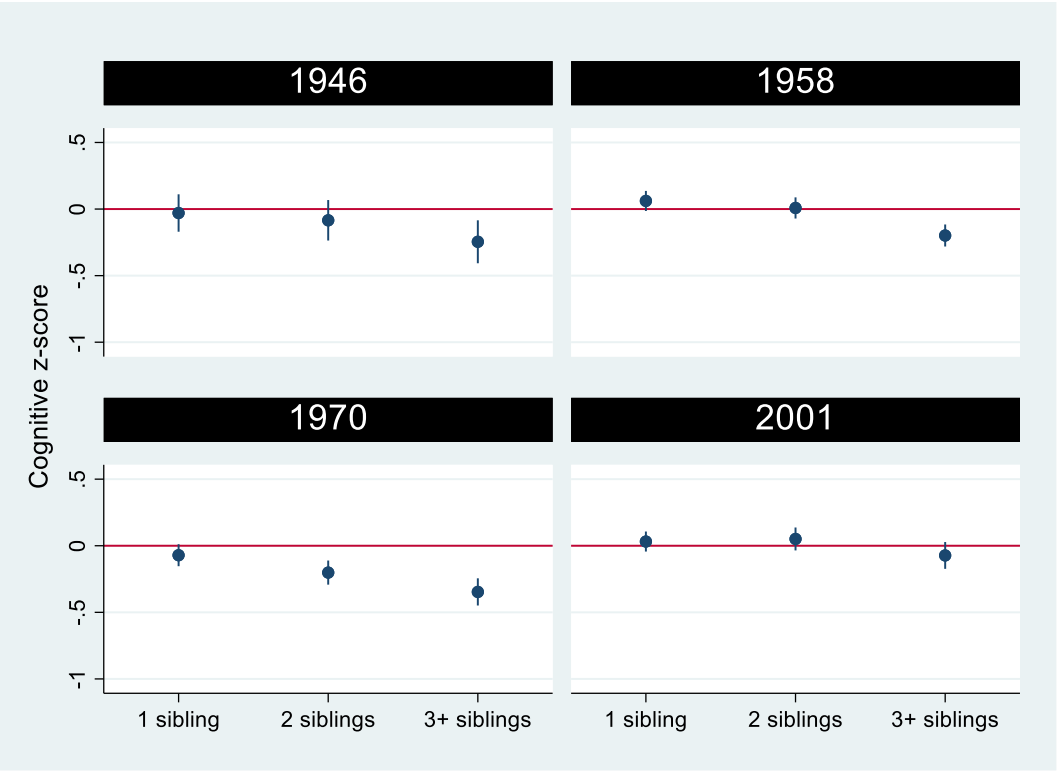
Model 1 is also unadjusted but this time cohort members with siblings are divided up based on their sibship size (1,2,3+), with only children as the reference category. The results shown in Figure 3, help us to further understand how only children perform in terms of cognitive ability relative to children with siblings. In all the cohort studies, only children have cognitive scores that are at par with the scores of cohort members with one sibling (i.e. two child families). The differences are small or non-existent and not statistically significant. The differences between only children and children with siblings become larger as the number of siblings increases. In the 1946, 1958 and 1970 cohort studies only children show significantly higher cognitive ability scores than cohort members with two siblings. In 1946 cohort members with two siblings perform 0.25 standard deviations (95% CI: -0.39; -0.12) below only children; in 1958 they perform 0.11 standard deviations (95% CI: -0.19; -0.04) below and in 1970 they

perform 0.32 standard deviations (95% CI: -0.41; -0.23) below only children. In contrast, differences between only children and children with two siblings in the 2001 cohort study are substantively small. Finally, only children outperform cohort members with three or more siblings in all the cohort studies. These are the largest differences in all the cohort studies but the pattern shows a gradient over time. In 1946, cohort members with three or more siblings perform 0.59 standard deviations (95% CI: -0.72;-0.45) below only children whilst in 2001 they perform 0.34 standard deviations (95% CI: -45;-0.24) below only children. Hence, differences between only children and the largest sibship size category have declined over time.

In Model 2 we include adjustment for family socio-demographic characteristics. The results show that the differences in cognitive scores between only children and cohort members with two or three or more siblings are attenuated in all the cohort studies. Differences between only children and children with two siblings are attenuated in all the cohort studies and no longer significant in all cohort studies except the 1970. Compared to Model 1 differences between only children and cohort members with three or more siblings are attenuated by nearly 60% in the 1946 and 1958 cohort studies, by 38% in the 1970 cohort study and by 80% in the 2001 cohort study. Like in Model 1, in Model 2 differences between only children and cohort members with one sibling are not statistically significant.

In the fully adjusted Model 3, in addition to the variables already included in Model (2), we adjust for parental separation. Compared to Model 2, there are only minor differences in the coefficients of the 1970 and 2001 cohort studies, whilst the results for the 1946 and 1958 cohort studies are virtually unchanged. Taken together, the results show that only children, on average, show higher cognitive ability scores than children who grow up with siblings but also that the advantage has weakened over time. They also show that the only child advantage varies when one disaggregates the group of cohort members with siblings based on sibship size. In all the cohort studies, only children have similar cognitive ability scores to cohort members who grow up with one sibling and higher scores than cohort members who grow up with two or more siblings – yet, differences appear to be smaller in the 2001 cohort study compared to the rest. Finally, within each cohort study, differences in the cognitive ability scores between only children and other sibship groups within and across cohort studies are attenuated on adjustment for family socio-demographic characteristics.

Figure 3 Regression coefficients for cognitive z-scores, reference category only children (Model 1), by birth cohort



What might explain the secular trends? The results suggest that both selection/compositional and confounding processes are likely to be involved (Figure 2). Over time, the composition of the only child group has changed in a way that a higher proportion of only children grow up with separated parents, which is associated with lower cognitive ability (Amato & Keith, 1991; Steele et al., 2009). For example, in 1958 around 10% of only children were living in households without both parents presents (Table 2), compared to over 50% in the 2001 cohort (Table 4). However, the regression models show that the link between parental separation and cognitive ability went from -0.18 standard deviations (significant at the 1% level) to 0.01 (not statistically significant) as shown in Appendix Tables 1-4. Being an only child has over time become associated with having experienced parental separation, but that has been partially compensated by the fact that the negative link between parental separation and cognitive ability has attenuated over time. In other words, the two mechanisms could be operating in opposite directions i.e. in the absence of a confounding effect, the decline between only childness and cognitive ability over time could have been more pronounced. A similar pattern is observed when we look at teenage pregnancies: the proportion of only children born to a teenage mother (which is negatively associated with children's cognitive abilities) has increased across cohorts, but the link between maternal teenage pregnancy and child cognitive ability diminishes over time (Appendix Tables 1-4).

To address the second aim of this study (that is if the association between being an only child and cognitive ability is heterogenous according to family structure and social class) we rerun Model 1 including an interaction term between the sibship status variable and whether the cohort member is living with both parents at age 10/11, and

a second interaction between sibship status and by the level of social class. For ease of exposition, we refer to cohort members who are living with both parents at the age 10/11 interview as children who have not experienced parental separation and to cohort members who are not living with both parents to have experienced parental separation.[5] The predicted scores obtained from running this model are presented in Figure 4. The results show that, in all the birth cohorts, cohort members who at age 10/11 are not living with both parents have lower cognitive scores compared to their counterparts living with both parents. In the 1946 cohort study, the differences are small and not statistically significant which could be due to the low prevalence of parental separation in this birth cohort and the fact that children born to unmarried mothers were excluded from the study. Differences in the 1958, 1970 and 2001 cohort studies (with the exception of the group with 3+ siblings where differences are statistically significant only for the 1958 cohort study) are statistically significant – showing evidence in line with the large body of work on the disadvantages associated with not growing up with two parents (McLanahan, 2004). Only children exposed to parental separation show significantly lower cognitive scores compared to only children who at age 10/11 live with both parents.

The results show that an only child who has experienced parental separation shows lower cognitive ability scores than children who are part of larger sibship groups but who grow up with both parents. On average, except for children growing up in the largest families, parental separation – because of its determinants and/or its consequences for household resources – seems to play a larger role in explaining variation in cognitive outcomes than the number of siblings a child has. Moreover, the parental separation gap (i.e. the difference in cognitive ability scores between children living with one or both parents) does not appear to be smaller for only children compared to larger sibling groups i.e. being an only child does not attenuate the negative association between parental separation and cognitive ability (Appendix Figure 1). The results for parental social class - presented in Figure 5 and Appendix Figure 2 – present a similar picture. Only children, as much as other sibship size groups, show higher cognitive ability scores when they are growing up in families with a higher level of social class. Moreover, only children do not experience a smaller reduction in the cognitive ability gap between more and less advantaged families at least when we compare them to children who grow up in two or three child families (additional analyses not shown here reveal that the confidence intervals for only children and children growing up with one or two siblings overlap). Cohort members who grow up in four child families show a smaller gap compared to the other groups.

[5] There could be other reasons explaining why cohort members are not living with both parents at age 10/11 such as parental death, single parenthood since birth, or one of the parents living elsewhere. We think parental separation or single parenthood are the most likely cause. The numbers would be too small to further disaggregate the only child category by whether the cohort member has been living with a single parent since birth or has experienced parental separation between birth and age 10/11.

Figure 4 Predicted cognitive z-scores, by parental separation and birth cohort

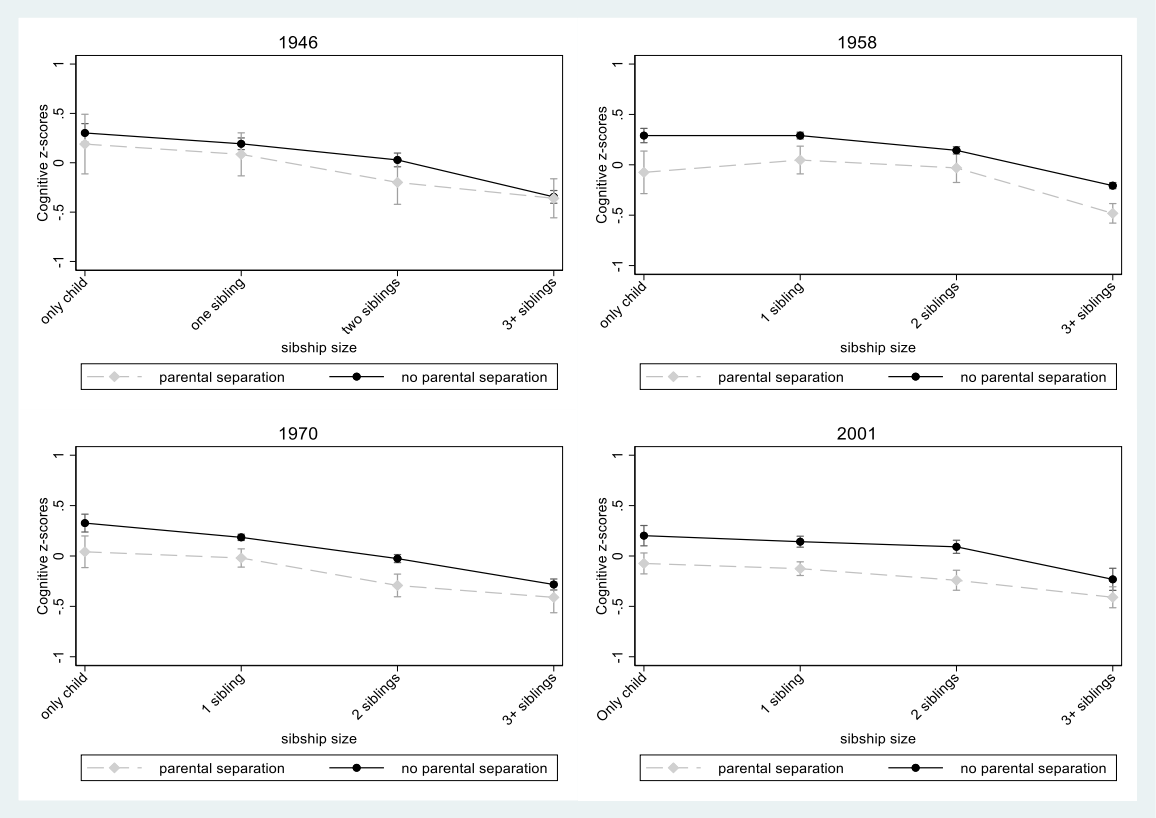
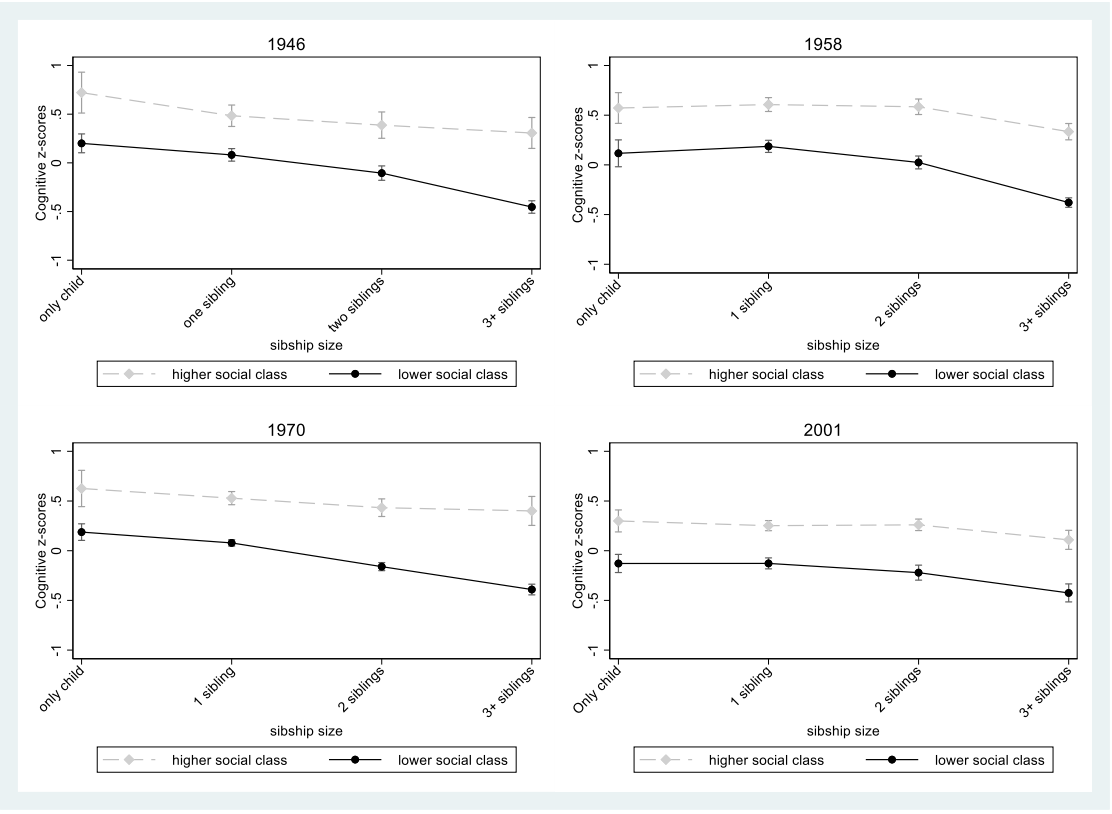


Figure 5 Predicted cognitive z-scores, by lower vs. higher social class and birth cohort



Sensitivity analyses

To test the robustness of the results, we conducted additional analyses. First, we ran the models by transforming the dependent variable into percentiles and the results were fully consistent with the main model results using standardized cognitive ability scores. Second, we ran the models on non-verbal reasoning ability outcomes in the 1946, 1958 and 1970 cohort studies (the measure was not available in the 2001 cohort study) and the results were consistent with those on verbal cognitive ability. Third, we ran the models for the 2001 cohort with an adjustment for ethnicity and the results were identical to those presented in the main text. Fourth, we did a missing data sensitivity check and the imputed results were highly similar to the results presented in the main text. All the additional analyses results are available upon request.

Conclusions

Despite the (projected) increasing numbers of only child families in many advanced societies (Sobotka & Beaujouan, 2014), many fundamental gaps in knowledge remain about whether only children are different from children who grow up with siblings and why. Only child research on cognitive and educational outcomes has produced mixed results. Whilst the majority of studies show that only children have better outcomes than children from large families and similar outcomes to children from small families, other studies show that they have worse outcomes to children who grow up with one or two siblings. The mixed findings support the argument that the characteristics of only child families have at least as strong an influence on only children's outcomes as does their sibling position (Falbo & Poston, 1993), an aspect which has received limited attention by the extant literature. In this paper, we build on this argument, and we use unique data from four British birth cohort studies which cover children born during a 50 year period (in 1946, 1958, 1970, 2001) to analyse the socio-demographic characteristics of only child families and if they change over time, and to compare cognitive ability scores over time between only children and children who grow up with siblings.

The results show that, on average, only child families tend to be relatively advantaged in terms of socio-economic status and more similar to the most advantaged groups (families with two children) than to the least advantaged ones (larger families). However, they also show that, over time, being an only child has become more associated with disadvantaged conditions such as growing up with separated parents and being born to a teenage mother. The socio-demographic composition of only child families has changed in a way that this group has become more heterogenous and disadvantaged. In terms of cognitive ability, only children show similar scores to children from two child families and higher scores than children growing up with two or more siblings. However, even though this pattern of associations is observed in all cohorts analysed, the only child 'advantage' appears to be weaker in the most recent cohort (2001) compared to the older cohorts. We hypothesize that the secular decline can be attributed to both changes in the composition of the only child group – which has become more disadvantaged over time i.e. a higher proportion of only children growing up in separated families and to confounding effects e.g. the negative association between parental separation and children's cognitive ability has declined. Adjustment for family socio-demographic characteristics largely attenuates differences within and across cohorts supporting the idea that the (in this case positive) association between being an only child and cognitive ability is tightly linked to background family characteristics. Finally, the stratified analyses show that being an

only child exposed to parental separation and/or to growing up in a household with a lower level of social class is not associated with a reduced disadvantage in cognitive ability compared to cohort members growing up with siblings who are also exposed to parental separation.

The results have several implications for research and theory on only children and more generally. First, they show that the association between being an only child and cognitive ability is nuanced. Indeed, even in a context where it is consistently positive, the strength of the association varies across birth cohorts. Our results suggest that being an only child is not a constant entity but one that varies and is conditional on changes throughout time and society, and these changes are reflected in the characteristics of only child families. Going forward, we should avoid generalising findings from one study, a single moment in time or indeed a specific context as indicative of only children, as the sense of being an only child and the processes it reflects might vary in different situations. Our proposed framework (Figure 2) could prove useful to unpack, make hypotheses around and test potential drivers of change in the only child-child outcomes association not only across time but also contexts and sub-population groups.

Second, the results provide evidence which challenges the arguments presented by the resource dilution and confluence theories. In the unadjusted models, only children have higher cognitive ability scores than children who grow up with two or more siblings, but the differences are largely or fully attenuated on adjustment for family characteristics thus providing little evidence to support the argument that only children do better because they do not share resources with other siblings or because they benefit from growing up with adults only. On the contrary, the results support the argument that only children have higher cognitive ability outcomes than children in larger families because, on average, they constitute a relatively more advantaged sub-population group. Moreover, the analyses by parental separation and social class show that the negative link between separation or growing up in a poorer household and cognitive ability is present and not attenuated for only children, who do not have to share resources with siblings, compared to larger sibling groups. They also show that these social categories appear to play a larger role in explaining variation in children's cognitive ability outcomes than the number of siblings. The limited or lack of applicability of these theories to only children is consistent with prior work highlighting their limitations in explaining variations across studies and contexts in whether, and if so how, overall sibling size matters (Gibbs et al., 2016; Rodgers, 2001; Steelman et al., 2002). The context, state and community can modify the resource dilution and confluence processes.

Third, taking together the empirical evidence and these theoretical considerations, the results call for the development and application of theoretical approaches which explicitly and more comprehensibly integrate the overall level of resources associated with the number of siblings and the children's birth order in the family. Our results and arguments for reframing the conversation around only children fit well with the admixture hypothesis, a relatively unknown theory first introduced by Page and Grandon (Rodgers, 2001). In contrast to the resource dilution and confluence theories which focus on processes occurring inside the family – the admixture hypothesis theory argues that between-family processes i.e. processes which distinguish families from each other which are also associated with family size, such as the level of socio-economic status, are the most likely explanation for systematic differences amongst children growing up in smaller and larger families. Building on this alternative theory, work on the topic of only children should refrain from seeing socio-demographic composition and selection into only child families as an inherent "threat" to the interpretation of only child effects on cognitive ability; instead, selection should be seen as critical to understanding the phenomenon at hand and for understanding differences across time periods, contexts and types of families.

The results need to be interpreted whilst taking into account a few limitations. First, the data provided us with little information on the different selection mechanisms at play for different families and in particular if the only childness was the result of a choice or a constraint. Second, we explored differences by whether cohort members were living with both parents at age 10/11 or not, but had limited sample size to further disaggregate by whether children grew up in a single parent household or experienced parental separation after birth and if so when. There are other sources of variation (e.g. by sex of the child, health or subfertility) that should be explored in the future using different data as these sort of analyses will help us refine our understanding of only children, their wellbeing and underlying mechanisms. Third, the data did not provide us with any information to explore between cohort modification effects i.e. whether a modifier played a role in one or more cohorts but not in all. For example, we had no information on societal views about only children, stigmatization, whether teachers might have treated only children differently – factors which could play a role in across cohort differences between only children and children growing up with siblings. The existence of between cohort modification effects e.g. differences in the level of stigma around only children might help explain why the associations attenuated to a smaller extent in the 1970 birth cohort than in the earlier cohorts. Alternatively, the weaker attenuation could be due to unobserved selection i.e. characteristics of only child families in the 1970 cohort but not in others. Despite the weaker attenuation, it is important to highlight that the inclusion of covariates partially explained the only child advantage and it is therefore unlikely that the selection mechanisms were substantively different from those of the other cohort studies.

To conclude, the paper highlights the need for theoretical, analytical and interpretative approaches that are sensitive to the context where only childness takes place. We should make efforts to explore the possibility that there can be diverse selection processes into only childness which can operate differently on sub-sets of families and which might matter for child outcomes. Paying more attention to context and exploring heterogeneity within the only child group will not only increase our understanding of this growing subpopulation and associated life course outcomes and trajectories, but also contribute to debunk the stereotyping around only children, which tend to persist in general society (Figure 1), school and clinical settings (Steward 2004 cited in Mancillas (2006)).

References

Amato, P. R., & Cheadle, J. (2005). The long reach of divorce: Divorce and child well-being across three generations. *Journal of marriage and family*, *67*(1), 191-206.

Amato, P. R., & Keith, B. (1991). Parental divorce and the well-being of children: a meta-analysis. *Psychological bulletin*, *110*(1), 26.

Anderson, M. (1998). Highly Restricted Fertility: Very Small Families in the British Fertility Decline. *Population Studies*, *52*(2), 177-199. http://www.jstor.org/stable/2584748

Barclay, K. J. (2015). A within-family analysis of birth order and intelligence using population conscription data on Swedish men. *Intelligence*, *49*, 134-143. https://doi.org/http://dx.doi.org/10.1016/j.intell.2014.12.007

Belmont, L., & Marolla, F. A. (1973). Birth order, family size and intelligence. *Science*, *182*.

Bjerkedal, T., Kristensen, P., Skjeret, G. A., & Brevik, J. I. (2007). Intelligence test scores and birth order among young Norwegian men (conscripts) analyzed within and between families. *Intelligence*, *35*(5), 503-514. https://doi.org/http://dx.doi.org/10.1016/j.intell.2007.01.004

Black, S. E., Devereux, P. J., & Salvanes, K. G. (2010). Small Family, Smart Family? Family Size and the IQ Scores of Young Men. *The Journal of Human Resources*, *45*(1), 33-58. http://www.jstor.org/stable/20648936

Blake, J. (1981a). Family size and the quality of children. *Demography*, *18*(4), 421-442.

Blake, J. (1981b). The Only Child in America: Prejudice versus Performance. *Population and Development Review*, *7*(1), 43-54. https://doi.org/10.2307/1972763

Blake, J. (1989). *Family size and achievement* (Vol. 3). Univ of California Press.

Bobbitt-Zeher, D., Downey, D. B., & Merry, J. (2016). Number of siblings during childhood and the likelihood of divorce in adulthood. *Journal of family issues*, *37*(15), 2075-2094.

Breton, D., & Prioux, F. (2009). The one-child family

France in the European context. *Demographic Research*, *20*, 657-692. http://www.jstor.org/stable/26349331

Chanfreau, J., & Goisis, A. (2022). *Defining and Identifying Only Children*.

Choi, S., & Monden, C. (2017). Where It Matters to Be the Only One: School Performance Outcomes of Only-children across 31 Countries.

Choi, S., Taiji, R., Chen, M., & Monden, C. (2020). Cohort Trends in the Association Between Sibship Size and Educational Attainment in 26 Low-Fertility Countries. *Demography*, *57*(3), 1035-1062. https://doi.org/10.1007/s13524-020-00885-5

Douglas, J. (1964). *The home and the school*. Macgibbon and Kee.

Downey, D. B. (1995). When Bigger Is Not Better: Family Size, Parental Resources, and Children's Educational Performance. *American Sociological Review*, *60*(5), 746-761. https://doi.org/10.2307/2096320

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*(2), 333-350.

Elliot, C., Smith, P., & McCulloch, K. (1996). British ability scales second edition (BAS II). Administration and scoring manual. In: London: Nelson.

Elliott, C., Murray, D., & Pearson, L. (1978). *British Ability Scales*.

Elvander, C., Dahlberg, J., Andersson, G., & Cnattingius, S. (2015). Mode of delivery and the probability of subsequent childbearing: a population-based register study. *BJOG: An International Journal of Obstetrics & Gynaecology*, *122*(12), 1593-1600. https://doi.org/https://doi.org/10.1111/1471-0528.13021

Falbo, T., & Polit, D. F. (1986). Quantitative review of the only child literature: Research evidence and theory development. *Psychological Bulletin*, *100*(2), 176.

Falbo, T., & Poston, D. L., Jr. (1993). The academic, personality, and physical outcomes of only children in China. *Child Dev*, *64*(1), 18-35. https://doi.org/10.1111/j.1467-8624.1993.tb02893.x

Frejka, T., & Sobotka, T. (2008). Overview Chapter 1: Fertility in Europe: Diverse, delayed and below replacement. *Demographic Research*, *19*(3), 15-46. http://www.demographic-research.org/volumes/vol19/3/19-3.pdf

Gee, E. M. (1992). Only children as adult women: Life course events and timing. *Social Indicators Research*, *26*(2), 183-197.

Gibbs, B. G., Workman, J., & Downey, D. B. (2016). The (conditional) resource dilution model: State-and community-level modifications. *Demography*, *53*(3), 723-748.

Goetting, A. (1986). The developmental tasks of siblingship over the life cycle. *Journal of Marriage and the Family*, 703-714.

Mancillas, A. (2006). Challenging the Stereotypes About Only Children: A Review of the Literature and Implications for Practice. *Journal of Counseling & Development*, *84*(3), 268-275. https://doi.org/https://doi.org/10.1002/j.1556-6678.2006.tb00405.x

Mare, R. D., & Chen, M. D. (1986). Further Evidence on Sibship Size and Educational Stratification. *American Sociological Review*, *51*(3), 403-412. https://doi.org/10.2307/2095310

McLanahan, S. (2004). Diverging Destinies: How Children Are Faring Under the Second Demographic Transition. *Demography*, *41*(4), 607-627. http://muse.jhu.edu/journals/dem/summary/v041/41.4mclanahan.html

Mostafa, T., Narayanan, M., Pongiglione, B., Dodgeon, B., Goodman, A., Silverwood, R. J., & Ploubidis, G. B. (2021). Missing at random assumption made more plausible: evidence from the 1958 British birth cohort. *Journal of Clinical Epidemiology*, *136*, 44-54. https://doi.org/https://doi.org/10.1016/j.jclinepi.2021.02.019

Moulton, V., McElroy, E., Richards, M., Fitzsimons, E., Northstone, K., Conti, G., Ploubidis, G. B., Sullivan, A., & O'Neill, D. (2020). *A guide to the cognitive measures in five British birth cohort studies*.

ONS. (2011). *Summary of statistics available about only children*. http://webarchive.nationalarchives.gov.uk/20160107122105/http://www.ons.gov.uk/ons/rel/fertility-analysis/cohort-fertility--england-and-wales/2010/only-kids-sum.html

Plewis, I., Calderwood, L., Hawkes, D., Hughes, G., & Joshi, H. (2007). Millennium Cohort Study: Technical Report on Sampling. http://www.cls.ioe.ac.uk/library.asp?section=00010001000600060018

Polit, D. F., & Falbo, T. (1987). Only children and personality development: A quantitative review. *Journal of Marriage and the Family*, 309-325.

Präg, P., Choi, S., & Monden, C. (2020). The sibsize revolution in an international context: Declining social disparities in the number of siblings in 26 countries. *Demographic Research*, *43*(17), 461-500. https://doi.org/https://www.demographic-research.org//volumes/vol43/17/files/readme.43-17.txt

https://www.demographic-research.org//volumes/vol43/17/files/demographic-research.43-17.zip

Rodgers, J. L. (2001). What causes birth order–intelligence patterns? The admixture hypothesis, revived. *American Psychologist*, *56*(6-7), 505-510. https://doi.org/10.1037/0003-066X.56.6-7.505

Sheppard, P., & Monden, C. (2020). When does family size matter? Sibship size, socioeconomic status and education in England. *Evolutionary Human Sciences*, *2*, e51, Article e51. https://doi.org/10.1017/ehs.2020.54

Sigle-Rushton, W. (2008). England and Wales : Stable fertility and pronounced social status differences. *Demographic Research*, *19*, 455-502.

Sobotka, T., & Beaujouan, É. (2014). Two Is Best? The Persistence of a Two-Child Family Ideal in Europe. *Population and Development Review*, *40*(3), 391-419. https://doi.org/https://doi.org/10.1111/j.1728-4457.2014.00691.x

Steele, F., Sigle-Rushton, W., & Øystein, K. (2009). Consequences of family disruption on children's educational outcomes in Norway. *Demography*, *46*(3), 553-574 http://muse.jhu.edu/journals/demography/toc/dem.46.3.html

Steelman, L. C., Powell, B., Werum, R., & Carter, S. (2002). Reconsidering the Effects of Sibling Configuration: Recent Advances and Challenges. *Annual Review of Sociology*, *28*(1), 243-269. https://doi.org/10.1146/annurev.soc.28.111301.093304

Wadsworth, M., Kuh, D., Richards, M., & Hardy, R. (2006). Cohort profile: the 1946 national birth cohort (MRC National Survey of Health and Development). *International journal of epidemiology*, *35*(1), 49-54.

Zajonc, R. B., & Markus, G. B. (1975). Birth order and intellectual development. *Psychological Review*, *82*(1), 74-88. https://doi.org/10.1037/h0076229

Tables

Table 1: Descriptive characteristics 1946 cohort, by sibship size

	Sibship size				
	only child	1 sibling	2 siblings	3+ siblings	Total
	%	%	%	%	%
Sibship size	13.3	33.2	24.4	29.1	
CM father social class					
I (top)	4.1	8.0	7.0	3.3	5.9
II	19.9	22.1	20.3	12.7	18.6
III non-manual	21.0	19.6	15.2	7.7	15.3
manual	30.1	31.7	34.0	38.8	34.1
VI	18.9	14.8	17.7	25.5	19.2
V	4.8	3.1	5.0	11.0	6.1
not available, no men, unemployed, sick, dead	1.1	0.7	0.9	0.9	0.9
Total	100.0	100.0	100.0	100.0	100.0
CM mother school beyond min age	30.8	32.3	31.5	17.3	27.6
Maternal age at CM birth					
under 20	1.4	1.8	2.1	2.2	1.9
20-24	24.4	21.6	22.5	22.5	22.4
25-29	32.2	32.0	29.6	27.3	30.1

30-34	22.6	29.9	27.8	26.2	27.3
35-39	15.3	11.9	15.1	15.0	14.1
40 and over	4.1	2.8	2.9	6.8	4.1
Total	100.0	100.0	100.0	100.0	100.0
Parental separation by age 11	8.9	6.9	9.0	9.5	8.4
CM breastfed over one month	61.4	65.7	68.2	63.4	65.1
First order birth	100.0	46.5	29.3	14.4	40.1
Sample size	438	1,090	803	957	3,288

Notes: CM=Cohort Member; Social class is the average in 1950, 1957, 1961

Table 2: Descriptive characteristics 1958 cohort, by sibship size

	sibship size				
	only child	1 sibling	2 siblings	3+ siblings	Total
	%	%	%	%	%
Sibship size	7.0	29.6	25.8	37.5	
Father social class					
I (top)	4.0	5.0	4.5	2.6	3.9
II	13.8	15.9	14.6	9.3	12.9
III non-manual	8.3	12.3	10.5	7.2	9.6
manual	51.2	48.2	50.0	47.8	48.7
VI	10.0	9.4	10.6	15.3	12.0
V	5.1	5.6	6.7	13.0	8.6
not available, no men, unemployed, sick, dead	7.5	3.6	3.1	4.9	4.3
Total	100.0	100.0	100.0	100.0	100.0
Mother stayed in school after minimum leaving age	24.6	30.0	28.3	19.4	25.2
Mother is married at birth	93.0	97.7	97.8	96.3	96.9
Maternal age at CM birth					
under 20	4.2	4.4	4.8	5.6	4.9
20-24	25.0	27.9	31.8	26.4	28.1
25-29	35.2	38.6	33.3	28.7	33.3
30-34	21.5	20.0	19.4	21.7	20.6
35-39	11.6	7.8	8.8	13.7	10.5
40 and over	2.6	1.5	1.9	4.0	2.6
Total	100.0	100.0	100.0	100.0	100.0

Mother smoked during pregnancy	32.2	28.1	29.3	37.2	32.2
CM breastfed over one month	61.5	72.0	70.9	67.0	69.1
Not living with both biological parents at age 11	10.1	5.7	5.9	9	7.3
First order birth	100.0	50.8	34.6	16.2	37.1
Sample size	769	3,241	2,823	4,108	10,941

Notes: CM=Cohort Member

Table 3: Descriptive characteristics 1970 cohort, by sibship size

	sibship size				
	only child	1 sibling	2 siblings	3+ siblings	Total
	%	%	%	%	%
Sibship size	7.0	47.9	29.4	15.8	
Parents' social class					
I (top)	4.7	5.5	4.9	2.7	4.8
II	12.6	13.7	12.7	9.3	12.6
III non-manual	17.4	16.7	12.5	6.7	13.9
manual	43.4	46.1	47.0	49.9	46.8
VI	16.0	13.9	16.4	21.5	16.0
V	5.5	4.0	6.2	9.3	5.6
not available, no men, unemployed, sick, dead	0.5	0.2	0.4	0.7	0.4
Mother is educated	8.8	8.5	7.5	5.5	7.8
Mother is married at birth	83.4	90.2	93.4	96.0	91.6
Maternal age at CM birth					
under 20	16.6	8.9	7.7	6.4	8.7
20-24	36.1	39.6	38.8	26.5	37.1
25-29	26.4	33.8	31.0	32.2	32.2
30-34	11.1	12.6	15.8	23.4	15.2
35-39	6.8	3.9	5.6	9.3	5.5
40 and over	3.0	1.2	1.2	2.3	1.5
Mother smoked during pregnancy	41.9	37.3	41.8	46.7	40.4
CM breastfed over one month	18.6	21.3	21.4	20.2	21.0
Not living with both biological parents at age 10	23.9	10.6	11.2	11.3	11.8

First order birth	100.0	47.6	25.2	10.3	38.8
Sample size	602	4,124	2,529	1,361	8,616

Notes: CM=Cohort Member

Table 4: Descriptive characteristics 2001 cohort, by sibship size

	sibship size				
	Only child	1 sibling	2 siblings	3+ siblings	Total
	%	%	%	%	%
Sibship size	9.3	45.6	27.8	17.3	
Parents' social class					
I (top)	6.1	8.6	8.5	4.2	7.6
II	35.7	40.5	34.6	22.3	35.3
III non-manual	28.8	25.3	24.1	21.5	24.6
manual	12.5	11.2	12.7	15.2	12.4
VI	11.3	9.4	12.7	18.4	12.1
V	1.3	1.5	2.0	3.2	1.9
no job or not stated	4.5	3.5	5.4	15.2	6.1
Total	100.0	100.0	100.0	100.0	100.0
Mother has degree level education	33.2	38.0	34.5	19.5	33.4
Household income quintile					
Bottom	19.7	14.9	21.5	39.0	21.4
Second	16.0	16.7	22.7	31.6	20.9
Third	19.9	21.8	19.0	13.6	19.4
Fourth	19.5	24.2	19.1	9.4	19.8
Top	24.8	22.4	17.6	6.4	18.5
Total	100.0	100.0	100.0	100.0	100.0
Relationship at the time of birth					
married	44.1	63.0	63.5	61.0	61.1
cohabiting	31.3	23.8	21.8	19.1	23.1
not cohabiting	24.6	13.1	14.7	19.9	15.8

Total	100.0	100.0	100.0	100.0	100.0
Maternal age at CM birth					
under 20	13.1	6.2	6.2	8.2	7.2
20-24	15.8	13.3	18.9	24.6	17.1
25-29	24.1	28.0	29.0	28.8	28.0
30-34	24.1	34.7	30.1	26.0	30.9
35-39	18.9	15.6	13.9	10.8	14.6
40+	3.9	2.1	2.0	1.6	2.2
Total	100.0	100.0	100.0	100.0	100.0
Mother smoked during pregnancy	27.3	21.0	22.5	26.1	22.9
CM breastfed over one month	43.4	51.9	50.1	46.4	49.6
Not living with both biological parents at age 11	58.0	33.9	35.7	40.6	37.8
First order birth	97.8	45.5	32.1	19.4	42.1
Sample size	1,099	5,378	3,287	2,041	11,805

Notes: CM=Cohort Member; Parents' social class = highest level in the family

Table 5: Linear regression model results on cognitive z-scores at age 10/11, by sibship size and birth cohort (Full model results Web Tables 1-4)

1946 cohort (n=3,288)

	Model 0: unadjusted			Model 1: unadjusted			Model 2: Socio-demographic characteristics			Model 3: Fully Adjusted		
	Coeff	SE	95% CI	Coeff	SE	95% CI	Coeff	SE	95% CI	Coeff	SE	95% CI
Only child	0.32	0.06	0.20,0.44	Ref.			Ref.			Ref.		
1 sibling				-0.08	0.07	-0.21,0.05	-0.03	0.07	-0.17,0.11	-0.03	0.07	-0.17,0.11
2 siblings				-0.25	0.07	-0.39,-0.12	-0.08	0.08	-0.24,0.07	-0.08	0.08	-0.24,0.07
3+ siblings				-0.59	0.07	-0.72,-0.45	-0.25	0.08	-0.41,-0.08	-0.25	0.08	-0.41,-0.09

1958 cohort (n=10,941)

	Model 0: unadjusted			Model 1: unadjusted			Model 2: Socio-demographic characteristics			Model 3: fully adjusted		
	Coeff	SE	95% CI	Coeff	SE	95% CI	Coeff	SE	95% CI	Coeff	SE	95% CI
Only child	0.22	0.04	0.14,0.29									
1 sibling				0.03	0.04	-0.04,0.11	0.06	0.04	-0.01,0.14	0.05	0.04	-0.02,0.13
2 siblings				-0.11	0.04	-0.19,-0.04	0.01	0.04	-0.07,0.09	0	0.04	-0.08,0.08
3+ siblings				-0.48	0.04	-0.55,-0.41	-0.2	0.04	-0.28,-0.12	-0.2	0.04	-0.29,-0.12

1970 cohort (n=8,612)

	Model 0: unadjusted			Model 1: unadjusted			Model 2: Socio-demographic characteristics			Model 3: fully adjusted		
	Coeff	SE	95% CI	Coeff	SE	95% CI	Coeff	SE	95% CI	Coeff	SE	95% CI
Only child	0.25	0.04	0.17,0.33	Ref.			Ref.			Ref.		

1 sibling	-0.1	0.04	-0.18,-0.02	-0.07	0.04	-0.15,0.01	-0.09	0.04	-0.17,-0.01
2 siblings	-0.32	0.04	-0.41,-0.23	-0.2	0.05	-0.29,-0.11	-0.22	0.05	-0.31,-0.13
3+ siblings	-0.56	0.05	-0.66,-0.47	-0.35	0.05	-0.45,-0.24	-0.37	0.05	-0.47,-0.27

Table 5 continued

2001 cohort (n=11,805)

	Model 0: unadjusted			Model 1: unadjusted			Model 2: Socio-demographic characteristics			Model 3: fully adjusted		
	Coeff	SE	95% CI	Coeff	SE	95% CI	Coeff	SE	95% CI	Coeff	SE	95% CI
Only child	0.09	0.04	0.01,0.16									
1 sibling				0	0.04	-0.07,0.07	0.03	0.04	-0.04,0.11	0.02	0.04	-0.06,0.09
2 siblings				-0.07	0.04	-0.15,0.01	0.05	0.04	-0.04,0.14	0.03	0.04	-0.05,0.12
3+ siblings				-0.34	0.05	-0.45,-0.24	-0.07	0.05	-0.17,0.03	-0.09	0.05	-0.19,0.01

Online Appendix

Web Table 1: Linear regression models on cognitive z-scores at age 11, 1946 cohort study

	Model 0: unadjusted		Model 1: unadjusted		Model 2: socio-demographic characteristics around birth		Model 3: fully adjusted	
	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
Only child	0.32***	0.06	Ref.		Ref.		Ref.	
One sibling			-0.08	0.07	-0.03	0.07	-0.03	0.07
Two siblings			-0.25***	0.07	-0.08	0.08	-0.08	0.08
Three or more siblings			-0.59***	0.07	-0.25**	0.08	-0.25**	0.08
CM girl	0.24***	0.04	0.24***	0.04	0.25***	0.04	0.25***	0.04
CM age at interview	-0.02	0.02	-0.02	0.02	-0.02	0.02	-0.02	0.02
CM first born (*reference: third or higher order birth*)					0.32***	0.07	0.32***	0.07
CM second order birth					0.16**	0.06	0.16**	0.06
social_class==I (*reference: not available, no men, unemployed, sick, dead*)					0.60**	0.19	0.58**	0.19
social_class==II					0.34	0.18	0.33	0.19
social_class==III non-manual					0.32	0.18	0.3	0.19
social_class== manual					-0.01	0.18	-0.03	0.18
social_class==VI					-0.09	0.18	-0.11	0.19
social_class==V					-0.22	0.19	-0.23	0.19
CM mother school beyond min age					0.34***	0.05	0.34***	0.05
CM mother's age at birth: < 20 (*reference 40+*)					-0.38*	0.16	-0.39*	0.16
CM mother's age at birth: 20-24					-0.29**	0.1	-0.30**	0.1
CM mother's age at birth: 25-29					-0.06	0.09	-0.07	0.09
CM mother's age at birth: 30-34					-0.04	0.09	-0.05	0.09

CM mother's age at birth: 35-39					-0.03	0.09	-0.04	0.09
CM breastfed over one month					0.11**	0.04	0.11**	0.04
Parental separation by age 11							-0.04	0.07
Constant	2.29	2.46	1.86	2.44	1.63	2.44	2.23	2.35
N	3288		3288		3288		3288	

Note: CM=Cohort Member; * 0.05 ** 0.01 *** 0.001

Web Table 2: Linear regression models on cognitive z-scores at age 11, 1958 cohort study

	Model 0: unadjusted		**Model 1: unadjusted**		**Model 2: socio-demographic characteristics around birth**		**Model 3: fully adjusted**	
	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
Only child	0.22***	0.04						
One sibling			0.03	0.04	0.06	0.04	0.05	0.04
Two siblings			-0.11**	0.04	0.01	0.04	0	0.04
Three or more siblings			-0.48***	0.04	-0.20***	0.04	-0.20***	0.04
CM girl	0.22***	0.02	0.22***	0.02	0.22***	0.02	0.22***	0.02
Age at interview	0.01*	0.01	0.01**	0.01	0.01*	0.01	0.01*	0.01
CM first born (*reference: third or higher order birth*)					0.30***	0.03	0.30***	0.03
CM second order birth					0.16***	0.03	0.16***	0.03
Mother is married at birth					0.02	0.07	-0.03	0.07
social_class==I (*reference: not available, no men, unemployed, sick, dead*)					0.54***	0.07	0.54***	0.07
social_class==II					0.41***	0.06	0.40***	0.06
social_class==III non-manual					0.28***	0.07	0.27***	0.07
social_class== manual					0.13*	0.06	0.12*	0.06
social_class==VI					0.05	0.06	0.04	0.06
social_class==V					-0.18**	0.07	-0.18**	0.07
Mother stayed in school after minimum leaving age					0.32***	0.02	0.31***	0.02

CM mother's age at birth: < 20 (*reference 40+*)					-0.37***	0.07	-0.36***	0.07
CM mother's age at birth: 20-24					-0.23***	0.06	-0.23***	0.06
CM mother's age at birth: 25-29					-0.13*	0.06	-0.13*	0.06
CM mother's age at birth: 30-34					-0.04	0.06	-0.05	0.06
CM mother's age at birth: 35-39					-0.02	0.06	-0.03	0.06
Parental separation by age 11							-0.18***	0.03
CM breastfed for over one month					0.10***	0.02	0.10***	0.02
CM mother smoked during pregnancy					-0.11***	0.02	-0.11***	0.02
Constant	-1.88*	0.77	-1.81*	0.75	-1.97**	0.75	-1.85**	0.72
Number of observations	10941		10941		10941		10941	

Note: CM=Cohort Member; * 0.05 ** 0.01 *** 0.001

Web Table 3: Linear regression models on cognitive z-scores at age 10, 1970 cohort study

	Model 0: unadjusted		**Model 1: unadjusted**		**Model 2: socio-demographic characteristics around birth**		**Model 3: fully adjusted**	
	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
Only child	0.25***	0.04						
One sibling			-0.10*	0.04	-0.07	0.04	-0.09*	0.04
Two siblings			-0.33***	0.04	-0.20***	0.05	-0.22***	0.05
Three or more siblings			-0.57***	0.05	-0.35***	0.05	-0.37***	0.05
CM girl	-0.14***	0.02	-0.15***	0.02	-0.16***	0.02	-0.16***	0.02
Age at interview	0.23***	0.05	0.23***	0.05	0.20***	0.05	0.21***	0.05
CM first born (*reference: third or higher order birth*)					0.23***	0.04	0.22***	0.04
CM second order birth					0.10**	0.03	0.09**	0.03
Mother is married at birth					0.03	0.04	0.03	0.04

social_class==I (*reference: not available, no men, unemployed, sick, dead*)					0.77***	0.17	0.72***	0.18
social_class==II					0.58***	0.17	0.54**	0.17
social_class==III non-manual					0.50**	0.17	0.45**	0.17
social_class== manual					0.26	0.17	0.21	0.17
social_class==VI					0.16	0.17	0.12	0.17
social_class==V					-0.04	0.17	-0.08	0.17
CM mother's age at birth: < 20 (*reference 40+*)					-0.30**	0.09	-0.27**	0.09
CM mother's age at birth: 20-24					-0.11	0.09	-0.1	0.09
CM mother's age at birth: 25-29					0	0.08	0	0.08
CM mother's age at birth: 30-34					0.03	0.09	0.03	0.09
CM mother's age at birth: 35-39					0	0.09	-0.01	0.09
Mother is educated (A-level or degree level education)					0.39***	0.04	0.39***	0.04
CM breastfed for over one month					0.19***	0.03	0.19***	0.03
CM mother smoked during pregnancy					-0.10***	0.02	-0.10***	0.02
CM parents separated by age 11							-0.13***	0.03
Constant	-2.27***	0.54	-1.96***	0.54	-2.26***	0.54	-2.20***	0.54
N	8612		8612		8612		8612	

Note: CM=Cohort Member; * 0.05 ** 0.01 *** 0.001

Web Table 4: Linear regression models on cognitive z-scores at age 11, 2001 cohort study

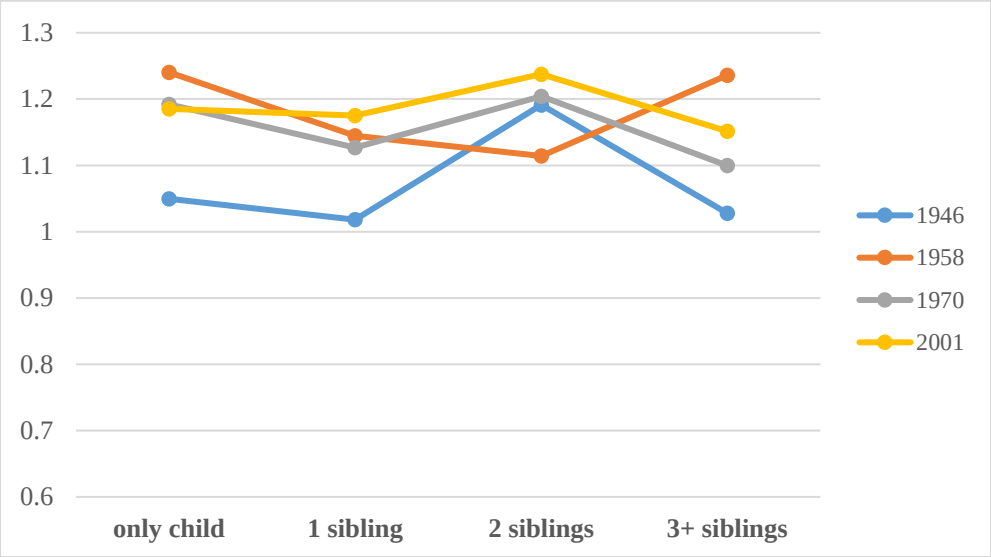
	Model 0: unadjusted		**Model 1: unadjusted**		**Model 2: socio-demographic characteristics around birth**		**Model 3: fully adjusted**	
	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
Only child	0.09*	0.04						

One sibling			0	0.04	0.03	0.04	0.02	0.04
Two siblings			-0.07	0.04	0.05	0.04	0.03	0.04
Three or more siblings			-0.34***	0.05	-0.07	0.05	-0.09	0.05
Age at interview (in days)	0.00***	0	0.00***	0	0.00***	0	0.00***	0
CM girl	-0.08***	0.02	-0.08***	0.02	-0.08***	0.02	-0.08***	0.02
CM first born (*reference: third or higher order birth*)					0.26***	0.04	0.25***	0.04
CM second order birth					0.14***	0.03	0.13***	0.03
social_class==I (*reference: not available, no men, unemployed, sick, dead*)					0.47***	0.07	0.46***	0.07
social_class==II					0.33***	0.07	0.32***	0.07
social_class==III non-manual					0.16*	0.07	0.16*	0.07
social_class== manual					0.1	0.07	0.1	0.07
social_class==VI					0.06	0.07	0.06	0.07
social_class==V					-0.23*	0.09	-0.23*	0.1
CM mother's age at birth: < 20 (*reference 40+*)					-0.15	0.08	-0.13	0.08
CM mother's age at birth: 20-24					-0.12	0.08	-0.1	0.08
CM mother's age at birth: 25-29					0.01	0.08	0.02	0.08
CM mother's age at birth: 30-34					0.05	0.07	0.05	0.07
CM mother's age at birth: 35-39					0.1	0.08	0.1	0.08
Mother is married at birth (*reference: single*)					0	0.04	-0.02	0.04
Mother is cohabiting at birth					0	0.04	-0.02	0.04
Mother has degree level education					0.17***	0.02	0.17***	0.02
CM breastfed for over one month					0.01	0.03	0.02	0.03
CM mother smoked during pregnancy					0.11***	0.02	0.11***	0.02
CM parents separated by age 11							-0.08**	0.03

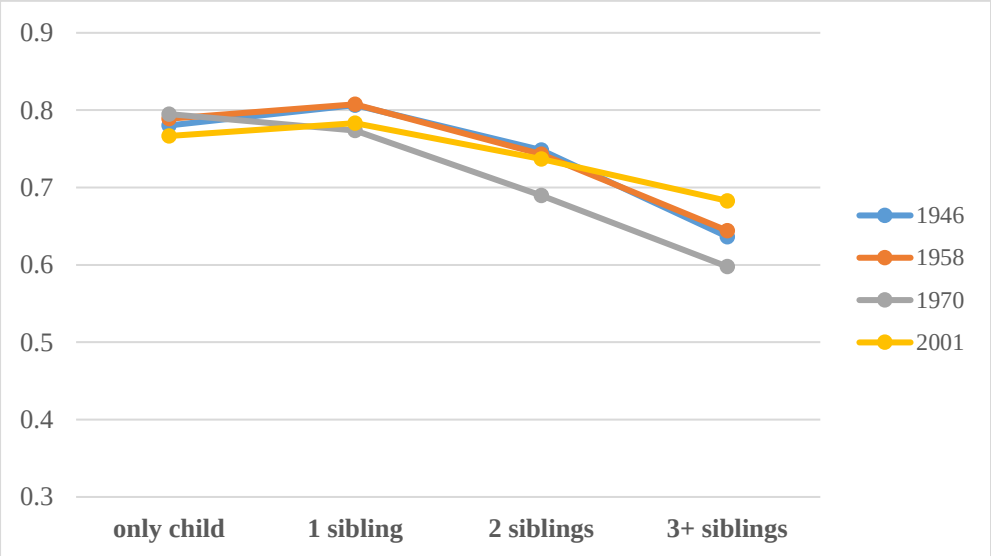
Constant	-1.95***	0.42	-1.91***	0.42	-2.72***	0.41	-2.69***	0.4
N	11,805		11,805		11,805		11,805	

Note: CM=Cohort Member; * 0.05 ** 0.01 *** 0.001

Appendix Figure 1 Ratio of margins non-separated/separated, by sibship size group and cohort



Appendix Figure 2 Ratio of margins lower social class/ higher social class, by sibship size group and cohort



Note: higher social class categories (professional occupation and managerial and technical occupations) or lower social class categories (skilled non-manual occupations, skilled manual occupations, partly skilled occupations, unskilled occupations).