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A within-family analysis of birth order and intelligence using population conscription data on Swedish men

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ABSTRACT

This study examines the relationship between birth order and intelligence in Sweden. This research question has been of interest for decades, but only one study using a sibling comparison design has found that birth order has a negative effect on intelligence. The data used in this study is Swedish administrative register data, with data on cognitive ability drawn from the military conscription register for men born 1965 to 1977. Within-family comparison linear regression models are used to estimate the difference in cognitive ability by birth order amongst brothers. I find that there is a negative relationship between birth order and cognitive ability. This is consistent in sibling-group-size-specific analyses of sibling groups with two through to six children. Further analyses demonstrate that this negative relationship between birth order and intelligence is consistent in different socioeconomic status groups, and amongst individuals born in the 1960s and 1970s. Analyses of brothers in two-child sibling groups show that the relationship between birth order and intelligence varies by the birth interval. Second borns have a statistically significantly lower cognitive ability score if the birth interval is up to six years, but not if it is longer.

1. Introduction

While there have been hundreds of studies on the relationship between birth order and intelligence (Ernst & Angst, 1983), beginning as early as the 1870s (Galton, 1874), and continuing consistently since then (Apperly, 1939; Belmont & Marolla, 1973; Bjerkedal, Kristensen, Skjeret, & Brevik, 2007; Gini, 1915; McCall, 1984; Page & Grandon, 1979; Retherford & Sewell, 1991; Rodgers, 2014; Rodgers, Cleveland, van den Oord, & Rowe, 2000; Schachter, 1963; Thurstone & Jenkins, 1929, for example), researchers have yet to come to a firm conclusion about the nature of this relationship. Research on this topic has proved controversial, with critics arguing that the vast majority of studies examining the relationship between birth order and intelligence are based upon flawed study designs (Price & Hare, 1969; Rodgers, 2001; Schooler, 1972). More recently, a study using Norwegian military conscription data appeared to put this debate to rest (Bjerkedal et al., 2007), as this high quality data showed that there was a negative relationship between birth order and intelligence amongst Norwegian men. Nevertheless, critics argue that the finding remains inconclusive, as no other well-designed studies have shown a relationship between birth order and intelligence (Rodgers, 2014, for example). This study contributes to the debate by demonstrating that there is also negative relationship between birth order and cognitive ability amongst military conscripts in Sweden.

Early studies investigating the relationship between birth order and intelligence showed that first borns were over-represented amongst scientists, college students, and Rhodes scholars (Apperly, 1939; Galton, 1874; Gini, 1915; Schachter, 1963). However, these studies were criticised on the grounds of the prevalence fallacy, where selection bias precludes the ability to draw clear inferences about the importance of birth order (Price & Hare, 1969; Schooler, 1972). Research on this

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topic took a new turn in the 1970s, stimulated by a study based upon a large cross-sectional dataset of almost 400,000 Dutch adolescents, appearing in *Science*, showing that later born children had a lower IQ (Belmont & Marolla, 1973). The study by Belmont and Marolla (1973) encouraged the publication of many new empirical studies of the relationship between birth order and intelligence. Furthermore, while research on birth order and intelligence had previously been largely absent of any theoretical explanation for the existence of a relationship, the work by Belmont and Marolla (1973) stimulated the development of two new theories: the resource dilution hypothesis (Blake, 1981), and the confluence hypothesis (Zajonc & Markus, 1975).

1.1. Theoretical explanations

The resource dilution hypothesis states that earlier born children should do better than their later born siblings as they have a cumulative advantage in terms of access to parental resources and investment (Blake, 1981). In particular, earlier born children have access to a greater pool of parental resources early on in life, which has been shown to be particularly important for later development (Heckman, 2006). The confluence hypothesis also argued that earlier born children should perform better than later born siblings, but that the explanation is due to the level of intellectual stimulation available in the household (Zajonc & Markus, 1975). A first born child interacts exclusively with its parents, while later born children interact both with their parents as well as their much less cognitively stimulating siblings. As more children enter the household, the aggregate level of intellectual stimulation decreases, and this has been hypothesized to impact intellectual development. A later addition to the confluence hypothesis, developed to explain a discontinuity where last borns performed particularly badly, argued that earlier born children benefit intellectually from tutoring their younger siblings, which the last born child never has the advantage of experiencing (Zajonc, 1976).

1.2. Between-family and within-family comparisons

However, despite this renewed interest in the topic, many researchers continued to be sceptical about both the relationship between birth order and intelligence, as well as the newly developed confluence hypothesis (Page & Grandon, 1979). Studies such as that by Belmont and Marolla (1973) were based upon cross-sectional data, where children of different birth orders were compared across different families. For example, the data used by Belmont and Marolla (1973) consisted of a cohort of adolescents, born 1944–1947. This meant that the first and lower birth order individuals in the sample came from families that were predominantly started after World War II, whereas the high birth order individuals came from families that were started during the Great Depression. Even though they were all born in roughly the same year, they were drawn from families which had vastly different access to resources and experiences during this particularly traumatic period of the 20th century (Blake, 1989). More generally it has been argued that between-family comparisons, comparing children of different birth orders across different families, leave room for serious confounding, as there are so many unmeasured and unobserved differences between families (Page & Grandon, 1979; Rodgers et al., 2000; Wichman, Rodgers, & MacCallum, 2006), also known as the admixture hypothesis. For example, if lower intelligence parents have larger families, this could explain a negative relationship between birth order and intelligence (Rodgers et al., 2000). Furthermore, the theoretical explanations for why birth order should matter for intelligence are based upon within-family dynamics, meaning that a within-family comparison is needed to draw inferences about this relationship (Rodgers, 2001).

1.3. Research using within-family comparisons

While the vast majority of studies on the relationship between birth order and intelligence have been based upon between-family comparisons, a small number have used sibling data. This kind of data made it possible to perform a within-family comparison. A within-family comparison, meaning sibling fixed effects, compares siblings within the same family to one another, thereby minimising residual confounding. The majority of these studies using a within-family comparison have shown no relationship between birth order and intelligence (Galbraith, 1982; Mascie-Taylor, 1980; McCall, 1984; Olneck & Bills, 1979; Retherford & Sewell, 1991; Rodgers, 1984; Rodgers et al., 2000; Wichman et al., 2006), though one study conducted in the 1960s found that later born siblings had lower intelligence when tested at age 11 (Record, McKeown, & Edwards, 1969). An important recent exception is a study using Norwegian administrative register data (Bjerkedal et al., 2007). This study used military conscription data, and using both a within-family comparison and a between-family comparison found that later born brothers had lower intelligence than their older male siblings (Bjerkedal et al., 2007). The size of the effect was relatively small, translating to a difference of approximately 2.3 IQ points between the first and the second born, and 1.1 IQ points between the second and third born (Bjerkedal et al., 2007, page 512). No data was available for women as they were not required to attend conscription tests in Norway. The use of this large and high quality data source was considered by some to provide definitive support for the relationship between birth order and intelligence.

Although Bjerkedal et al. (2007, page 513) encouraged other researchers in the Nordic region to examine the relationship between birth order and intelligence using their own military conscription register data, nobody has yet heeded that call. While the high quality population-based nature of the Norwegian study means that the research community can be confident that there is a negative relationship between birth order and intelligence in Norway, it is not clear why there is a discrepancy with other research findings. Although other studies have been based upon survey data, they should not necessarily be discounted simply because they have a smaller sample size, although in some cases greater statistical power might be necessary to detect a birth order effect (Bjerkedal et al., 2007, page 513). Another potential explanation is that there is some unobserved context-specific factor that accounts for the relationship being found in Norway, but not elsewhere. Most of the survey-based studies that found no relationship between birth order and intelligence have been based upon data from the United States (Rodgers et al., 2000; Wichman