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The Flynn effect in sibships: Investigating the role of age differences between siblings

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ABSTRACT

The aim of the study was to investigate the relationship between the Flynn effect and the effects of age differences between siblings on the intelligence difference between them. In Norway, the secular trends in intelligence-test score means vary both in magnitude and direction. We identified three periods: one period where the mean intelligence increased across birth cohorts (1950–1956), one period where the means decreased (1976–1983), and one period with no appreciable Flynn effect (1960–1965). In a data base comprising birth year and intelligence data on more than 900,000 males meeting at mandatory conscription between their 18th and 21st birthday, we identified more than 69,000 brother pairs where both brothers had been born in exactly one of the periods mentioned above. In this study group the relationship between age differences between brothers and the intelligence difference could be studied. The results showed that in the period with increasing intelligence means across cohorts, the intelligence difference between brothers decreased with increasing age differences. In the period with decreasing means, the difference between the later-born and the earlier-born brother increased across age differences. No systematic effects of age difference on mean intelligence differences were found in the period without a Flynn effect. Regression analyses showed that the Flynn effect can be quite well predicted from the effects of the age differences between brothers on their intelligence-test scores. We conclude that the factors causing the Flynn effect also work within sibships. Hypotheses positing that the Flynn effect is solely caused by between-families factors (e.g. the heterosis hypothesis) are weakened. The present results also entail that the birth order effect observed in Norway is in part conditional on the Flynn effect.

1. Introduction

Secular increases of mean intelligence-test scores — coined the Flynn effect by Herrnstein and Murray (1994) — have been intensely studied since the seminal papers by Flynn (1984, 1987). Secular increases of intelligence-test score means have been found in a number of countries in Europe, North America and Asia (Flynn, 1984, 1987, 1998a). More recently, a Flynn effect has been found in Africa (Daley, Whaley, Sigman, Espinosa, & Neumann, 2003). In some Northern European countries, like Norway and Denmark, the Flynn effect has shown decreasing gains, and have stopped or even reversed (Sundet, Barlaug, & Torjussen, 2004; Teasdale & Owen, 2005). Rodgers (1999) pointed out that the secular changes of intelligence means may be unevenly distributed across ability levels. In Denmark and Norway it was found that the intelligence gains were to a large extent caused by decreasing prevalence of low scorers, resulting in decreasing variances (Sundet et al., 2004; Teasdale & Owen, 1989, 2000). In other countries, the gains seem to be

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more evenly distributed across levels of ability (Flynn, 1998a). Recently, it has been shown that the mean intelligence in sibships of different sizes increases across cohorts, and that these increases are close to parallel over wide ranges of cohorts (Sundet, Borren, & Tambs, 2008). An independent but modest effect of the increase of the proportions of small families at the expense of the proportions of larger ones on the mean intelligence scores has also been demonstrated, especially in the cohorts born in the late 1930's compared to the cohorts born later (Sundet, Borren, & Tambs, 2008).

The cause(s) of the Flynn effect are still very much under debate. Rodgers (1999) distinguished between factors working between families and factors working within families. A majority of the hypotheses concerning the Flynn effect have proposed environmental factors including improved education, better health care, improved nutrition and changing test-taking attitudes (cf. Neisser, 1998). Common to the environmental hypotheses is that they propose that there are some environmental change(s) across generations that influence all the individuals in a population in a more or less similar way. Thus, the Flynn effect should be visible both within and between families. For instance, in periods with distinct secular increases in intelligence scores, the age differences between siblings should influence the relationship between their scores such that the scores of the later-born siblings are expected to be relatively high compared to the scores of earlier-born siblings, and more so with larger age gaps.

With a few notable exceptions, the possible contributions of genetic factors to the Flynn effect have largely been disregarded. Dickens and Flynn (2001) introduced gene–environment correlations to account for the combination of a substantial heritability of intelligence and increasing means across generations (for a critique of the Dickens and Flynn model, see Rowe and Rodgers, 2002). Mingroni (2004, 2007) pointed to the possible contribution of changing mating patterns. While it is clear that the gene pool of a population cannot change appreciably within the small time intervals of a few generations, the *distribution* of the genes in the gene pool may change quite dramatically. In fact, this is just what is happening when a group of people change their mating habits from marrying biological relatives to marrying biologically unrelated persons. Mating with biologically related persons may lead to inbreeding depression of psychological traits. There is some evidence that inbreeding depression of intelligence may occur (Schull & Neel, 1965). When mating habits change along the lines indicated above, the inbreeding depression will decrease with decreasing rates of inbreeding, entailing a Flynn effect. It follows that the Flynn effect will come to an end when the rate of inbreeding approaches zero. The benevolent effects of decreasing inbreeding are, broadly speaking, due to increasing rates of hetereozygotes at the expense of homozygotes, and the phenomenon is commonly termed heterosis or hybrid vigor.

Michael Mingroni (2004, 2007) has argued that the Flynn effect is caused by heterosis. The heterosis hypothesis entails that the Flynn effect is a *between-families* effect (Rodgers, 1999). Consider a period with increasing secular trends in intelligence means. According to the heterosis hypothesis, the secular trends should not appear *within families* (i.e. within sibships). The relationship between the intelligence-test scores of earlier-born and later-born siblings should be unaffected by the secular increases of intelligence-test scores in the population at large. Accordingly, the mean intelligence difference between e.g. the first-born and second-born siblings should remain the same irrespective of the age difference between the siblings.

In sharp contrast, hypotheses that propose that increasing means across generations ("positive" Flynn effect) are caused by changing environments, predict that the intelligence of the later-born siblings should increase relative to the intelligence of the earlier-born, and more so the farther they are separated in age. In periods where the Flynn effect is absent, no such age-difference effects should appear (according to both the heterosis hypotheses and environmental hypotheses). Also, changing environments should be expected to cause *decreasing* intelligence-test scores in later-born siblings relative to earlier-born siblings in periods of decreasing secular trends in intelligence ("negative" Flynn effect).

While the relationship between age spacing and intelligence has been studied in some detail (Brackbill & Nichols, 1982; Grotevant, Scarr, & Weinberg, 1977; Nuttal & Nuttal, 1979; Zajonc, 1976), only a few studies have directly addressed the effect of age differences between siblings on the intelligence difference between them. Belmont, Stein and Zybert (1978) investigated the intelligence difference between brothers in 535 Dutch brother pairs in two-child sibships and did not detect any age-difference effects on intelligence differences. In a recent large-scale study of birth order effects in Norwegian conscripts (a subset of the material used in the present paper), it has been found that the age differences between brothers influence the intelligence differences between them (Bjerkedal, Kristensen, Skjeret, & Brevik, 2007). Clearly, more studies of the effects of age differences between siblings on intelligence-test scores are needed.

In Norway, there have been periods with a substantial positive Flynn effect, a comparatively weak Flynn effect, and periods with a distinct negative Flynn effect (Sundet et al., 2004). We also have access to within-sibship data, including age differences between siblings for all these periods. This data set gives an excellent opportunity to test one of the central predictions of the heterosis hypothesis. The main aim of the present study is to investigate the intelligence-test score differences between siblings as a function of the age spacing between them. The age-difference effects on intelligence-test score differences will then be compared to the secular changes of the intelligence score means in periods with varying direction and magnitude of the Flynn effect. We have also investigated how the birth order that seems to be present in Norway (Bjerkedal et al, 2007) is related to the Flynn effect.

2. Methods and materials

2.1. Measures

The intelligence-test scores analyzed in the present paper were obtained from the National Conscript Service. In Norway, military service is mandatory for all able young men. Before entering the service, they meet before a conscript