Birth Order, Family Size, and Intelligence

A study of a total population of 19-year-old men born in the Netherlands is presented.

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In this article we explore the relation of birth order and family size to intellectual competence in a national population of roughly 400,000 19-year-old men in the Netherlands.

The relation of birth order and family size to individual differences in intellectual ability, personality, social behavior, and health has been of long-standing interest. With regard to intellectual competence, investigators have studied the association of ability with family size, on the one hand, and with birth order, on the other.

If one considers family size alone, the evidence seems clearly to show that it is negatively related to intellectual level (*1, 2*). Children from large families tend to make poorer showings on intelligence tests and on educational measures, even when social class is controlled (*3–5*). The effect of family size on test score, however, has usually been less pronounced in the upper social classes (*3, 5, 6*).

Since Schachter's (*7*) report of differences in affiliative behavior depending on birth order, there has been a revival of interest in the issue of birth order as it relates to a variety of behaviors. A number of reviews have explored the association of birth order and personality, social behavior, and achievement (*8–13*). The findings have generally been characterized as "tenuous" (*13*, p. 47), "inconsistent" (*11*, p. 220), or "not here, not now" (*12*, p. 161).

What seems to be clear is that birth order is related to eminence (outstanding intellectual achievement) (*8, 14*): firstborns are overrepresented among eminent men of science. The reason for this is not known. Eminence among firstborns could derive from increased opportunity for academic exposure; thus Schachter (*14*) suggested that the potentiality for outstanding achievement among firstborns is a consequence of their overrepresentation in college and graduate school. It could also derive from greater or different motivation and drive, higher intelligence, or even greater verbal aptitude.

When intelligence test scores or grades in school have been used as measures of intellectual competence, findings have been contradictory. Schachter (*14*) found that firstborns had better school grades (perhaps because firstborns are more "bookish") but interpreted the literature as indicating that there is no association between measured intelligence and birth order. Altus (*8, 15*), on the other hand, has reported that, among the very bright (college students, National Merit finalists, Terman's gifted group), firstborns achieved the highest scores, particularly in verbal aptitude. Chittenden and his associates (*16*) concluded from a study of sibling pairs that, not only among the very bright, but also within different ranges of ability, firstborns will be superior to later borns. Altus suggested that "there may be hierarchies of aptitude levels among the intellectually able related to birth order and family size" (*8*, p. 46).

Methodological Issues in Studies of Birth Order

Studies of birth order, more often than studies of family size, suffer from the use of such select samples as college students and patients in psychiatric settings. In some studies, the wide ranges in age encompass many different birth cohorts with differing birth rates and infant mortality. In addition, numbers are often relatively small (the distribution of birth order may suffer from this), and the size of the samples may be too small to control for confounding variables. It is possible that birth order effects are an artifact of family size or that family size effects are reflections of social class membership, or both. Since family size varies with social class, both of these variables should be taken into account in assessing the contribution birth order may make to differences in competence. This was done in our study.

Two other problems have been of concern in previous studies of birth order effects. One is bias introduced by the use of data on families that are not yet complete; several more or less successful devices have been invented to deal with this problem (*17*). Another problem of bias is created by changing patterns of fertility among different strata of society, which also need statistical control (*18*). These problems do not arise in our study because of the availability of a complete population that was born close in time. The subjects were 19 years of age, and it is reasonable to assume that virtually all of their respective families were complete at that time.

Two specific issues are examined in our study: (i) whether there are birth order effects that are independent of family size and (ii) whether there are family size effects that are independent of birth order position. These issues are, in addition, examined within the context of social class.

The Subjects

Our subjects consisted of a total population of almost 400,000 19-year-old men. They represented virtually all male survivors of the children born in the Netherlands in 1944 through 1947 who were still residing in the Netherlands at the time they reached 19 years of age. At that age, they were required to appear for an examination (*19*) to determine their fitness for military induction.

The information used in our study was originally acquired for a study of the effects of the Dutch famine of 1944–1945 on mental and physical development. The subjects of this survey

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Table 1. Percent distribution by family size and by birth order for 19-year-old males born in the Netherlands between 1944 and 1947 ($N = 408{,}015$).

Children in family (No.)	Percent of total	Birth order	Percent of total
1	5.0	1	31.4
2	16.8	2	26.2
3	19.2	3	17.6
4	16.4	4	9.9
5	12.2	5	5.4
6	8.9	6	3.1
7	6.4	7	1.8
8	4.5	8	1.1
9+	8.5	9+	1.5
Unknown	2.0	Unknown	2.1

were born during and after World War II, and generally spent the formative years of childhood during peacetime. Further, a portion of this population was conceived or born during the period of localized famine. Intrauterine exposure to the famine produced no measurable adverse effects on the intellectual performance of survivors at military age (*20*).

The Data

The data from the military examination records of the Netherlands include the results of five tests measuring various kinds of abilities. The tests include measures of language, arithmetic, mechanical comprehension, perceptual speed, and nonverbal intelligence. Data on social factors include father's occupation, the number of children in the subject's family, and his birth order position.

Our article is concerned with the results achieved on the Raven Progressive Matrices (Dutch modification with 40 items). The raw scores were grouped by the Dutch military into six classifications (called "class scores"), from a high score of 1 to a low score of 6; these scores are used in our study. From a total of 408,015 subjects, Raven scores were available for 386,336 individuals. Of those with a Raven score, data on family size and birth order were missing for a small number of individuals; the population studied consisted, in all, of 386,114 subjects.

The index of social class we used was the occupation of the subject's father at the time of the military examination. The occupation codes assigned by the military were ordered into an 11-point scale. For our purposes, the 11-point occupational scheme was collapsed into three major groups: nonmanual (professionals and white-collar workers); manual (skilled, semiskilled, and unskilled workers); and farm (farmers and farm laborers). Of the total population on whom birth order, family size, and Raven score information is available, approximately 36 percent were in the nonmanual, 48 percent in the manual, and 12 percent in the farm occupational group. The remaining 5 percent were individuals for whom the father's occupation could not be coded —either because the father had been dead for more than 6 years, or because the description of the father's occupation did not fit into existing occupation codes.

Family size and birth order were each classified into nine categories, with categories of 1 through 8 representing one through eight children in the family (family size), or first through eighth birth order position (birth order); category 9 indicates nine or more for either family size or birth order. Table 1 shows the distribution of these variables among all those for whom the data were available. With respect to family size, the modal family included three children, and more than half of the population derived from one- to four-child families. One-child families were relatively rare, representing 5 percent of families. With respect to birth order, the first three ranks accounted for 75 percent of the population. Subsequent tables include those subjects for whom Raven test results were available; distributions of family size and of birth order shown in subsequent tables are not materially different from those shown in Table 1.

Results

Scores on the Raven Progressive Matrices are presented for family size and birth order separately and jointly,

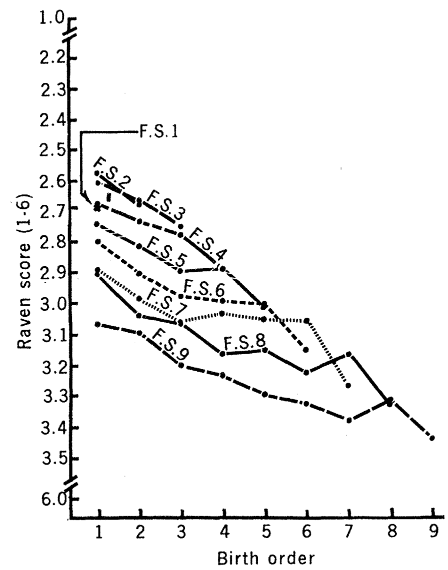

Fig. 1. Mean Raven class score by birth order within family size (*F.S.*) across the population ($N = 386{,}114$).

both for the entire population and for each social class group.

Table 2 presents the mean family size and the mean birth order for each of the six Raven class scores. It also shows the distribution of the scores for the population. For both mean family size and birth order, there was a consistent gradient in level of performance: as the test scores became poorer (that is, went from 1 to 6), mean family size and birth order became progressively larger.

Table 3 presents the mean Raven score for each family size and birth order position. From the marginal distributions, two findings emerge: (i) Except for family size 1, Raven performance became "worse" as family size became larger, and (ii) Raven performance consistently decreased as birth order position increased.

Since family size and birth order are not independent of each other, each variable was examined within the context of the other. An examination of

Table 2. Mean family size and birth order for each Raven class score (S.D. is standard deviation; 1 is high; 6 is low).

Raven class score	Population with class score (%)	Family size by class score			Birth order by class score		
		Mean	S.D.	No.	Mean	S.D.	No.
1	18.8	4.0	2.1	72,773	2.3	1.5	72,768
2	30.1	4.3	2.2	116,147	2.5	1.7	116,136
3	21.3	4.5	2.3	82,437	2.6	1.8	82,424
4	14.3	4.6	2.3	55,352	2.8	1.9	55,332
5	10.4	4.9	2.4	40,255	3.0	2.0	40,244
6	5.0	5.1	2.4	19,283	3.1	2.0	19,249

Table 3. Mean Raven class scores by family size (F.S.) and birth order (B.O.) ($N = 386{,}114$). [Class score range is from 1 (high raw test score) to 6 (low raw test score). We have included standard errors of the mean (S.E.M.) to illustrate that a high level of statistical confidence can be placed on each mean because, in large part, of the size of N.]

Family size	Birth order 1	2	3	4	5	6	7	8	9	F.S. mean	S.E.M.	No.	Per-cent
1	2.688									2.688	.009	19,679	5.097
2	2.575	2.678								2.626	.005	66,002	17.094
3	2.608	2.663	2.749							2.671	.005	75,917	19.662
4	2.672	2.730	2.775	2.883						2.757	.005	64,830	16.790
5	2.743	2.812	2.897	2.883	3.016					2.860	.006	48,234	12.492
6	2.795	2.899	2.976	2.992	2.998	3.149				2.955	.007	35,072	9.083
7	2.890	2.982	3.060	3.034	3.054	3.056	3.267			3.036	.009	25,237	6.536
8	2.905	3.041	3.062	3.163	3.154	3.224	3.165	3.327		3.114	.011	17,667	4.576
9	3.064	3.091	3.197	3.229	3.290	3.321	3.374	3.309	3.434	3.265	.008	33,476	8.670
B.O. mean	2.670	2.745	2.860	2.972	3.084	3.189	3.288	3.315	3.434				
S.E.M.	.003	.004	.005	.007	.010	.013	.017	.023	.019				
Number	123,680	103,452	69,676	38,881	21,374	12,154	6,977	4,106	5,814				
Percent	32.032	26.793	18.045	10.070	5.536	3.148	1.807	1.063	1.506				

the effect of birth order position within each family size is graphically presented in Fig. 1. Within each family size (i) firstborns always scored better on the Raven than did later borns; and (ii) with few inconsistencies, there was a gradient of declining scores with rising birth order, so that firstborns scored better than secondborns, who in turn scored better than thirdborns, and so forth. At each family size, earlier borns performed better on the Raven than those in the adjacent birth order position; this gradient was present in 86 percent of the relevant comparisons. In order to obtain a more precise notion of how consistent the effect is, one can assign ranks for the mean scores of any given family size for each birth order position—with a rank of 1 assigned to the best mean Raven score, and a rank of 9 to the poorest. The analysis is concerned only with the pattern of ranks of mean scores obtained when one variable is considered within the context of the other. Evaluation of this pattern of ranks by a method independent of N is described elsewhere (*21*). This statistical analysis showed that, within each family size, the ranks of the mean scores differed very little from the consecutive birth order positions. Thus the observed gradient was highly significant ($P < 1 \times 10^{-13}$).

The question of the effect of birth order independent of family size was considered above; we now examine the effect of family size independent of birth order (Table 3). In general, as family size increased, there was a decrease in Raven performance within any particular birth order position. The clearest example of this trend was among thirdborns, where those from three-child families did better than thirdborns from four-child families, who in turn did better than thirdborns from five-child families, and so forth. (Discrepancies in family size effects within birth order position occurred almost exclusively among last borns of a given birth order position; however, the magnitude of the discrepancy was minor.) Within a particular birth order position, performance on the Raven was worse as family size increased. Excluding one-child families, this held true in 83 percent of the relevant comparisons. Statistical analysis (*21*) indicated that this pattern was highly significant ($P < 1 \times 10^{-15}$).

The relations described above were examined within each of the three social class groups. As one would expect, there was a difference in level of performance among the three groups. Figure 2 and Tables 4 to 6 (see marginal distributions) contrast the mean Raven score pattern for the major social groups (nonmanual, manual, and farm) by family size (Fig. 2a) and by birth order (Fig. 2b). The inverse relations noted across the population—between family size and Raven score and between birth order and Raven score—were present to varying degrees within the major social groups. The relation of family size to Raven performance was more pronounced in the manual and nonmanual groups and less pronounced in the farm group (Fig. 2a). Also, the effect of birth order position on mean Raven performance was similar in the nonmanual and manual social groups, whereas in the farm group only the earlier birth orders (first through fifth) showed the expected decrease in mean Raven performance (Fig. 2b).

The data for an examination of the question of birth order and family size, each within the context of the other, are presented in the cross-classifications of mean Raven scores by family size and birth order for each of the three social classes in Tables 4 to 6. In all three social classes, the birth order gradients within specific family sizes were generally highly consistent. Within each social class, firstborns tended to do better than later borns. Also, a gradient of Raven performance by birth order position was most clearly present in two- through four-child families, less sharply present in five- and six-child families, and least apparent in seven-, eight-, and nine-child families. Thus, for example, in four-child families in all three social classes, firstborns achieved the best mean Raven score and were followed in ability by secondborns, who scored better than thirdborns, who in turn scored better than fourthborns. At each family size, earlier borns showed better performance than those in the adjacent birth order position. This pattern was present in 72 percent of the relevant comparisons for the nonmanual group, 78 percent for the manual group, and 81 percent for the farm group. Statistical analysis (*21*) showed that this pattern was highly significant for all three social classes ($P < 1 \times 10^{-12}$, $P < 1 \times 10^{-7}$, and $P < 1 \times 10^{-11}$, respectively).

The question of whether family size has an effect on Raven scores independent of birth order position was next examined for the three social class groups separately. Whereas the findings for the population indicated that, as

Table 4. Mean Raven class scores by family size (F.S.) and birth order (B.O.) within the nonmanual social group ($N = 137,823$). [Class score range is from 1 (high raw test score) to 6 (low raw test score). We have included standard errors of the mean (S.E.M.) to illustrate that a high level of statistical confidence can be placed on each mean because, in large part, of the size of N.]

Family size	Birth order 1	2	3	4	5	6	7	8	9	F.S. mean	S.E.M.	No.	Percent
1	2.375									2.375	.014	7,624	5.532
2	2.240	2.358								2.297	.007	28,355	20.573
3	2.224	2.281	2.368							2.287	.006	31,451	22.820
4	2.240	2.324	2.359	2.418						2.327	.007	24,682	17.908
5	2.284	2.308	2.422	2.383	2.534					2.371	.009	16,740	12.146
6	2.330	2.327	2.443	2.441	2.425	2.615				2.412	.012	10,748	7.798
7	2.364	2.454	2.504	2.471	2.551	2.533	2.714			2.490	.015	6,964	5.053
8	2.429	2.513	2.499	2.597	2.578	2.663	2.595	2.872		2.563	.020	4,499	3.264
9	2.579	2.483	2.624	2.677	2.741	2.765	2.780	2.887	2.990	2.716	.017	6,760	4.905
B.O. mean	2.276	2.333	2.402	2.449	2.546	2.642	2.710	2.880	2.990				
S.E.M.	.005	.006	.008	.011	.017	.026	.036	.053	.049				
Number	48,981	40,438	24,900	11,920	5,693	2,835	1,439	744	873				
Percent	35.539	29.341	18.067	8.649	4.131	2.057	1.044	0.540	0.633				

Table 5. Mean Raven class scores by family size (F.S.) and birth order (B.O.) within the manual social group ($N = 184,334$). [Class score range is from 1 (high raw test score) to 6 (low raw test score). We have included standard errors of the mean (S.E.M.) to illustrate that a high level of statistical confidence can be placed on each mean because, in large part, of the size of N.]

Family size	Birth order 1	2	3	4	5	6	7	8	9	F.S. mean	S.E.M.	No.	Percent
1	2.869									2.869	.014	8,722	4.732
2	2.815	2.892								2.853	.008	29,941	16.243
3	2.867	2.912	2.984							2.918	.007	34,747	18.850
4	2.942	2.981	3.014	3.083						3.000	.008	30,963	16.797
5	2.989	3.094	3.154	3.102	3.193					3.100	.009	23,530	12.765
6	3.027	3.149	3.207	3.218	3.191	3.312				3.175	.010	17,689	9.596
7	3.134	3.208	3.295	3.239	3.220	3.206	3.397			3.238	.012	12,929	7.014
8	3.136	3.266	3.260	3.332	3.341	3.422	3.378	3.433		3.308	.007	8,983	4.873
9	3.232	3.318	3.411	3.417	3.439	3.472	3.562	3.396	3.551	3.428	.011	16,830	9.130
B.O. mean	2.911	2.990	3.102	3.181	3.261	3.353	3.461	3.410	3.551				
S.E.M.	.005	.006	.007	.013	.014	.019	.025	.032	.028				
Number	57,381	49,142	33,523	19,318	10,639	6,019	3,457	2,039	2,816				
Percent	31.129	26.659	18.186	10.480	5.772	3.265	1.875	1.106	1.528				

Table 6. Mean Raven class scores by family size (F.S.) and birth order (B.O.) within the farm social group ($N = 45,196$). [Class range is from 1 (high raw test score) to 6 (low raw test score). We have included standard errors of the mean (S.E.M.) to illustrate that a high level of statistical confidence can be placed on each mean because, in large part, of the size of N.]

Family size	Birth order 1	2	3	4	5	6	7	8	9	F.S. mean	S.E.M.	No.	Percent
1	3.254									3.254	.041	1,151	2.547
2	3.075	3.139								3.106	.021	4,388	9.709
3	3.115	3.172	3.192							3.160	.017	6,332	14.010
4	3.060	3.148	3.271	3.308						3.193	.017	6,325	13.995
5	3.071	3.210	3.234	3.344	3.413					3.248	.018	5,804	12.842
6	3.018	3.240	3.327	3.301	3.370	3.408				3.271	.020	5,093	11.269
7	3.043	3.215	3.334	3.274	3.326	3.240	3.450			3.263	.022	4,252	9.408
8	2.969	3.212	3.253	3.444	3.363	3.365	3.282	3.413		3.282	.022	3,468	7.673
9	3.118	3.158	3.217	3.320	3.377	3.451	3.437	3.402	3.471	3.342	.015	8,383	18.548
B.O. mean	3.090	3.175	3.248	3.324	3.376	3.382	3.409	3.405	3.471				
S.E.M.	.013	.014	.016	.019	.023	.029	.035	.046	.035				
Number	11,211	9,620	8,079	5,689	3,811	2,535	1,613	1,015	1,623				
Percent	24.805	21.285	17.875	12.587	8.432	5.609	3.569	2.246	3.591				

family size became larger Raven performance decreased, this relation was not consistent within all three social classes.

The most consistent pattern was in the manual group (Table 5); effects of family size within particular birth order positions indicated that better Raven performance for smaller over adjacent family size occurred in 83 percent of the relevant comparisons ($P < 1 \times 10^{-17}$). For the nonmanual group (Table 4), family size was less systematically related to Raven score within particular birth order positions; it was least consistent for secondborns. Nevertheless, for any particular birth order, there was a general tendency for those from smaller families to do better than those from larger families. Effects of family size within particular birth order positions were present in 69 percent of the relevant comparisons; this pattern was highly significant ($P < 1 \times 10^{-13}$). In the farm group, family size bore little systematic relation to level of Raven performance for the various birth order positions. Thus, firstborns from eight-child families achieved the best score, followed in sequence by firstborns from six-child, seven-child, four-child, five-child, two-child, three-child, and nine-child families. (This finding suggests that the family size effect for the farm group, shown in Fig. 2a, is an artifact of birth order effects.) Family size effects occurred in less than half (47 percent) of the relevant comparisons; this pattern was not statistically significant.

Discussion of Results

This study serves to confirm the existence of independent relations of birth order and of family size to intellectual performance.

When the variables were examined separately, a relatively straightforward set of findings emerged. We found that there was an inverse relation between family size and Raven score; as family size increased, level of ability declined. So too, as birth order position became greater, the level of ability declined. In fact, there was a tendency for a gradient to exist such that firstborns showed better ability than secondborns, who in turn were better in Raven performance than thirdborns, and so forth.

Since family size and birth order are not independent of each other, each variable was examined within the context of the other. The results indicated that, in general, birth order and family size had separate effects on intellectual performance. For most family sizes, independent effects of family size were clear except for last borns. When these effects of family size were examined within the three social groups, the findings were not uniform. The effects were strongest in the manual group and less marked in the nonmanual group. Furthermore, in the farm group, family size bore no systematic relation to level of Raven performance when birth order was controlled.

In contrast to effects of family size, the effect of birth order position on intellectual performance within each family size was relatively consistent across social groups. The effect of birth order was regular and systematic in smaller (two- through four-child) families, present but less consistent in five- and six-child families, and present but inconsistent in large families. We have, then, several indications of birth order effects: firstborns, excluding individuals from one-child families, consistently showed better Raven performance than later borns. Also, there was a gradient in level of ability related to birth order position, and this gradient was particularly marked in the smaller families.

The consistency of the gradient of each parameter taken independently of the other has been established as has the fact that it is more consistent for birth order. The more complex question of the extent to which each variable contributes to intelligence will be explored later; such effects appear to be small.

Discussion of Issues

Our findings on family size and intellectual performance are in accord with those of others (*1, 2*). With regard to birth order and intellectual performance, there have been no other studies in which proportions of individuals in different birth order positions were determined for a total population. It is difficult, therefore, to compare our findings on birth order with those of others. Among the more recent studies is one by Eysenck and Cookson (*22*), who analyzed the results of three achievement tests (reading, mathematics, and English) and one test of verbal reasoning given to approximately 4000 11-year-old school children. When we applied our method (*21*) to their published data, a weak birth order effect in verbal reasoning emerged. Eysenck and Cookson did not consider social class in their analyses. A study that did report birth order differences in aptitude (*8, 15*) reflected the limitations inherent in using a select social group (University of California undergraduates) and a relatively small sample (approximately 1500).

The effect of family size on intelligence has not been explained; the hypotheses advanced (*1*) relate to the tendency for less adequate parents to have larger families—some saying this tendency is genetic, others saying the sheer size of a large family leads to fewer material goods or less maternal

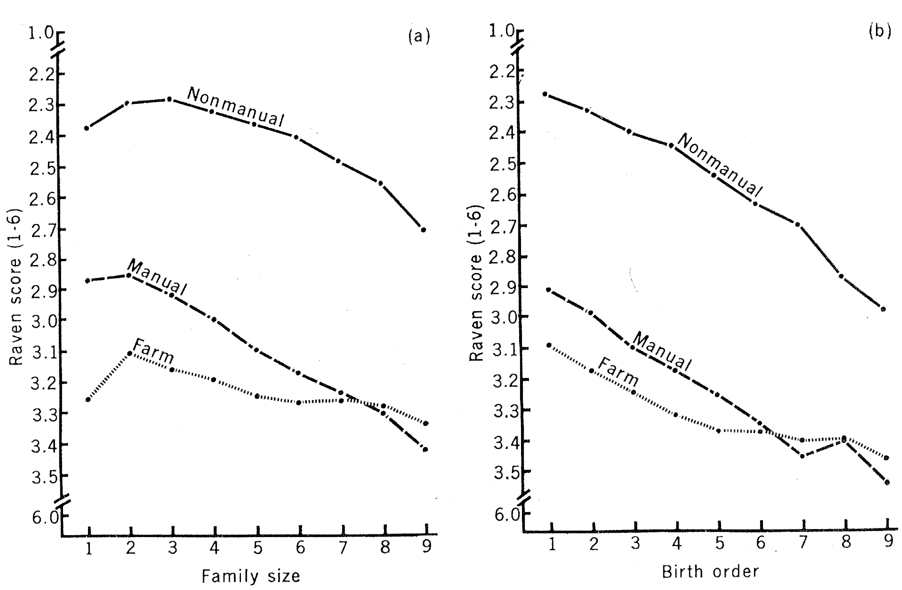

Fig. 2. Mean Raven score for the three social class groups by (a) family size and (b) birth order (nonmanual, $N = 137{,}823$; manual, $N = 184{,}334$; farm, $N = 45{,}196$).

attention for each child, still others citing both factors. Such explanations, of course, do not consider the effects of birth order.

The effects of birth order on intelligence had not previously been established and therefore called for no explanation. The effect found in our study does not admit of a genetic explanation; there is no known way in which genetic characteristics can be associated with birth order (*23*). All genetic models assume the combinations of the genetic contributions from each parent's pool of genes to be random for each birth and without regard to birth order. Some would advance interpersonal explanations and argue, for example, that parents pay increasingly less attention to each additional child as the family becomes larger. Perhaps biological explanations are also tenable; mothers might become less effective reproducers with an increasing number of children. Social class differences have been advanced by others to explain birth order effects on intelligence (*12, 24*). However, the role of social class is ruled out here. We examined effects of birth order within each social class in a total population and found that the effects hold in all three social groups.

Future Studies

We intend to consider other issues related to birth order and family size in the future. One factor that may be relevant to differences in test scores is educational level. Education might affect adult Raven scores, and if some kind of educational primogeniture is operative in the Netherlands, then effects of birth order may be an artifact of educational inequality.

It was noted that children from one-child families did not follow a family size gradient, despite the expectation, based on the findings of others, that only children would achieve the best scores. We have included data on this group for the sake of completeness. It could be argued that the only child could be characterized as either the firstborn or the last born. Their assignment to a particular birth order thus has an arbitrary element. It was noted that only children are a relatively small proportion of the population and may represent an atypical family in the Netherlands.

The population in this series of studies is restricted to males. Sex differences in the effects of birth order have been reported (*10, 11*), and this question will be considered in future analyses, as will the question of the age interval between siblings.

We also plan to consider the question of whether different aspects of competence, as measured on tests other than the Raven, are differentially related to birth order and family size. Previous reports (*5, 25*) would suggest that birth order and family size make a greater difference in performance on language tests than in performance on nonlanguage tests such as the Raven Progressive Matrices.

Summary

The relation of birth order and family size to intellectual performance, as measured by the Raven Progressive Matrices, was examined among nearly all of 400,000 19-year-old males born in the Netherlands in 1944 through 1947. It was found that birth order and family size had independent effects on intellectual performance. Effects of family size were not present in all social classes, but effects of birth order were consistent across social class.

References and Notes

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21. Mean Raven scores for each birth order position were ranked in order of increasing magnitude for each family size separately. Deviations from consecutive birth order positions were computed, squared, and added. For a family size of k (1 through to 9), the probability that $\Sigma D^2 \leq 0$, 2, or 4 is $1/k!$, $1/(k-1)!$, and $(k^2 - 3k + 6)/2k!$, respectively. When $\Sigma D^2 > 4$, approximate probabilities were obtained from the .05 and .01 percentage points of the distribution of Spearman's *r* [G. Snedecor and W. G. Cochran, *Statistical Methods* (Iowa State Univ. Press, Ames, ed. 6, 1967), table 7.11.2, p. 195]. A two-tailed test was used. If the one-tail probability for family size k is P_k, the overall two-tail significance level when all Spearman *r*'s have the same sign is $P = 2\Pi^{9}_{k=1}P_k$. Computations are similar for family size within birth order position. We are indebted to Janet Wittes, adjunct assistant professor of epidemiology, Columbia University School of Public Health, for this statistical analysis.
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