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INTELLIGENCE AND FAMILY SIZE: ANOTHER LOOK

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ABSTRACT

Periodically, fears are voiced that the intelligence level of the U.S. population is falling. Historically, this fear has been joined to the belief that fertility is inversely related to intelligence. Evidence for that belief is sparse, and may be an artifact of the failure of researchers to consider completed families. An inverse correlation between measures of intelligence and number of children in young samples may simply reflect differentials in timing and spacing of births, and not in ultimate family size.

Drawing on data from only ever-married and relatively older men in the NBER-Thorndike and Kalamazoo Brothers samples, the authors find no inverse relationship between test scores and number of children. Since ever-marrieds are expected to show the greatest negative relationship, these results are all the more telling.

Intelligence and Family Size: Another Look

1. INTRODUCTION

For more than fifty years, Americans have been making widespread use of standardized tests and then fretting about the results. The recent case of national jitters over the apparent decline in levels of scholastic achievement among students is another episode in America's continuing fascination with measured intelligence.

Periodically, fears are voiced that the intelligence level of the population is falling. Turn-of-the-century eugenicists and immigration restrictionists viewed with alarm high birth rates among immigrant nationalities, assumed to be of lower intelligence, and declining rates among well-educated, WASP elites (Haller, 1963). More recently, contemporary researchers have sought the explanation for declining college-admissions test scores in the negative effects of the larger families characteristic of the post-war baby boom (Bills, 1977). Thus, assumptions about both the effects of intelligence on fertility and the effects of family size on intelligence have figured in scholarly research and public debate. Our concern is specifically with the former, though if parental intelligence were to prove a strong determinant of number of offspring, the frequently reported inverse correlation between measured intelligence and number of siblings might be explained. We contend, however, that parental intelligence is not significantly related to number of children, and that alternative explanations for the relationship between youngsters' test scores and number of siblings must be sought.[1]

Early studies of family size and intelligence predicted a slowly declining level of intelligence in the general population. When these declines failed to materialize, the stable levels of measured intelligence were imputed to the smaller likelihood of low-ability individuals to marry, counteracting the effects of the presumed larger number of offspring they had if they did marry. Thus, inclusion of never-marrieds led to resolution of the so-called Cattell paradox: the stability of population intelligence level despite the negative relationship between intelligence and fertility (Higgins, Reed, and Reed, 1962).

But Cattell's paradox itself may have rested on a faulty premise. Studies on family size and intelligence were dominated by research on the relationship between test scores and number of siblings. Few studies related test scores to number of offspring. Those which did showed the expected negative relationship only for samples too young to have completed their families. Lower-scoring individuals may have tended to have children earlier, but not to have had larger completed family sizes than higher-scoring individuals (Anastasi, 1956). The results of our present investigation accord with this interpretation.

The study of the relationship between intelligence and fertility has most often been pursued by psychologists and demographers. Recently, however, economists have analyzed differential fertility within a household utility maximization framework (see, for example, Becker, 1960; Willis, 1973, and Schultz, 1974). They have included education, along with measures of taste, cost, and income, but they have not employed measures of intelligence. Within this framework, measured intelligence may be a taste factor influencing preferences between commodity consumption and so-called "child satisfaction"; it may also operate on the supply side affecting fecundity. As a factor influencing costs, it might increase market wages and, thus, increase the opportunity costs of additional children; it may also affect efficiency in contraceptive use; and, finally, it might exercise a positive income effect by influencing wages.

Very briefly, we assume each household has a utility function of the form

$$(1) \quad U = U(X,C)$$

where C = number of children and X = commodities consumed.
The utility function is determined by tastes, and therefore reflects an effect of parents' intelligence on number of children.

But the household faces a budget constraint of the form

$$(2) \quad P_x X = P_c C = Y = (T - \ell - hC) W$$

where P_x = price of X,

P_c = price of C,

Y = total income,

T = total time,

ℓ = leisure,

h = time spent per child,

w = market wage rate.

If higher intelligence increases the opportunity cost of time, and children are relatively more time-intensive than other commodities, there will be a substitution away from children which implies a negative relationship between fertility and test scores. But higher income lifts the burden of the income constraint, inducing a higher demand for children, all else constant. Thus, higher intelligence may be indirectly, positively related to fertility through its effect on income.

However, fewer or more children may be produced than purely demand considerations would warrant. To the extent that there are subfecundity problems that are correlated with intelligence, there will be a positive relation. But if more children would be born than desired, contraceptive knowledge and use must be entered into the analysis, generally through the budget constraint. These contraceptive costs might be viewed as changing relative costs and available income if used, so that the maximum possible expenditure (to achieve "no children") is subtracted from the maximum number of goods that could be consumed within a given budget constraint. This is equivalent, in effect, to a rise in the price of goods. Presumably, the effect of higher intelligence is to lower the costs of contraception, which may decrease fertility.

To this point, we have implicitly assumed that the quality of goods and children is given. The decision about the number of children desired is based on an assumed quality of child. One dimension of quality may be intelligence, a form of greater endowment. If quality were to enter the analysis directly, it might be considered a substitute for more children in producing satisfaction from children. If this were the case, a negative relationship between test scores and number of children would be expected. If, on the other hand, quality proved a complement in terms of producing satisfaction, a positive relationship would be expected.

In sum, the sign of the relationship between measured intelligence and number of offspring expected on the basis of economic reasoning is uncertain.

Factors working toward the often assumed negative association include less efficiency in contraceptive use, lower opportunity costs, and possibly preferences. Factors working toward a positive relationship include fecundity, affordability through an income effect, and possibly preferences.

Less direct influences may also be at work. Higher likelihood of marriage for the more intelligent would produce a positive relationship, while later age at marriage among those with higher education would produce a negative relationship between test scores and number of children. In our work, we look only at ever-marrieds, for whom a larger negative relationship is predicted than for the population in general. The absence of such a relationship in our data is, consequently, all the more telling.

First we describe our two data sets and methodology, then we present our empirical results, and finally we present a summary and conclusions.

2. DATA AND METHODOLOGY

Our data come from the National Bureau of Economic Research-Thorndike-Hagen (NBER-TH) sample (Wolfe, 1973; Taubman and Wales, 1974), and from the Kalamazoo Brothers sample (Olneck, 1976; 1977a, 1977b).

The NBER-TH sample comprises approximately 5000 white men born between 1917 and 1925 who took the U.S. Air Corps Aviation Cadet Qualifying Examination in 1943. The sample is relatively homogeneous with respect to education and measured intelligence. All respondents had at least high school equivalency, and scored at the median or above on the ACQ exam. The exam score we have used is drawn from a pooled composite from the battery of tests given, and represents general intellectual ability or scholastic aptitude.[2] If the relationship between tested intelligence and number of children is significantly negative in the low range of test scores but changes to positive in the high range, then the NBER-TH results are not generalizable. We have few theoretical reasons to expect this and no such pattern emerges in the Kalamazoo data, which include a representative range of test scores.

In a 1969 NBER follow-up to Thorndike and Hagen's 1955 survey, respondents were asked to answer the question "How many children do you have?" Because of the phrasing of this and some collateral questions concerning offspring, we believe it is safe to assume that respondents reported currently surviving children, rather than children ever-born or children currently at home.[3]

We exclude never-marrieds, and individuals who failed to respond to the questions on children, current income, or education. A total of 2.3% of the respondents reported never having been married. Years of education is measured by the reported number of completed years, and income is measured by reported annual earnings for 1969, converted to 1958 monthly dollars.

The use of an income figure for a point in time after number of children is determined is problematic. We do not know the extent to which conception decisions reflect current stable income, transitory fluctuations, or anticipated lifetime flow, nor do we know how well current income proxies anticipated lifetime income flow. Bowles (1972) reports that annual income and lifetime income correlate 0.84, so we are fairly confident that our estimates of income effects are generalizable, except for the impact of sudden changes in financial circumstances. Using the NBER-TH survey, it is possible to compare results of several alternative income measures, including one at an earlier point in time.[4] The results do not differ very much from those we report.

The use of test score data only for fathers is also problematic, but we do not have such data for wives. According to Higgins, Reed, and Reed (1962), the correlation between husbands' and wives' IQ's is 0.33 $\pm$ .03 or higher. They found similar relationships between test scores and number of children for both parents. In an earlier study of a Kalamazoo population, which includes never-married individuals, Bajema (1966) reports positive overall correlations between test scores and number of children for both males and females. The correlation for males was 0.05 greater than for females.

The Kalamazoo Brothers sample comprises approximately 1200 men traced and interviewed by Olneck in 1973 and 1974. The respondents were drawn from an original sample of approximately 3000 males who were identified as siblings and for whom sixth-grade test scores from 1928 to 1950 were available in the Kalamazoo, Michigan Public School records.[5] The present study analyzes 705 individuals, comprising 352 weighted pairs of brothers, for whom test score, age, and self-reported education, earnings, and marital status are available.[6]

From 1928 to 1943, the Kalamazoo school system administered the Terman groups test; after 1943, students were given the Otis test. Both tests, which measure similar skills, stress verbal rather than quantitative items (Buros, 1965). In our data, correlations involving the two tests are quite similar, and in the literature there is no evidence that the variances or reliabilities of the two tests differ significantly (Flemming, 1925; Cattell, 1930; Ratcliff, 1934; Buros, 1965). The Otis test, however, has historically been scaled to a lower mean than the Terman (Ratcliff, 1934). To compensate for this, after taking into account the effects of secular changes in parental education, father's occupation, and number of siblings, Olneck (1976; 1977a) adjusted the scores of men who had taken the Otis test, and pooled the subsamples. The range of test scores is quite representative. The mean in the present analysis is 100.4 and the standard deviation is 15.1. These do not differ appreciably from the mean of 98.5 and standard deviation of 15.3 found for 2,780 potential respondents.

Education in the Kalamazoo sample is measured by years of schooling completed, and earnings is measured by expected 1973 earnings. Reported earnings over $25,000 were coded $34,000, and few respondents reported earnings under $8,000. These restrictions, and the fact that the earnings data were originally recorded in grouped intervals, account for the rather low standard deviation of earnings shown in Table 1.

The Kalamazoo respondents are virtually all white, Protestant, and of non-farm origin. Their levels of education and economic attainment are higher than for men of comparable age in the nationally representative 1973 Occupational Changes in a Generation (OCG) replication data (Olneck, 1977b), but the relationships among attainment variables are quite similar to those in national data. While caution in viewing results from this sample is clearly warranted, there are no obvious biases in it which would greatly distort the findings in the present analysis.

The Kalamazoo data are valuable because they permit fuller controls for family background than are usually possible in survey analyses. Most analyses which attempt to control family background must rely on measures of socioeconomic variables such as parental education, parental occupation, and family size. But we know that socioeconomic variables are imperfect measures of family background. If socioeconomic variables measured

Table 1

Means and Standard Deviations of Selected Variables

Variable	Mean		Standard Deviation	
	NBER-TH	Kalamazoo	NBER-TH	Kalamazoo
1. Test score	-.029	100.37	1.78	15.10
2. Age	46.80	46.35	2.21	6.03
3. Education	15.05	13.05	2.40	2.68
4. Monthly earnings (1958 dollars)	1221.10	954.66	797.73	435.07
5. Not currently married	.02	.04	.14	.20
6. Number of children	2.83	2.95	1.42	1.59
N	4826	705		

family background adequately, the resemblance between brothers on various outcomes could be satisfactorily explained with such variables; in fact, it cannot be (Olneck, 1976; 1977b). If the unmeasured aspects of family background--defined broadly to include all factors producing resemblance among brothers[7]--affecting number of children are correlated with factors affecting other determinants of number of children, such as cognitive ability or education, ignoring them will lead to biased estimates of the effects of specific determinants. By analyzing the effects of differences between brothers on the variables of interest, we can hold constant all those aspects of background which brothers share, including those which would be controlled by explicitly including measured socioeconomic status.[8]

The following section reports the results of our empirical analyses. First, we report the results of regressing number of children on test scores and a small number of respondent's other characteristics; then for the NBER-TH sample, we report the results of including a wider range of independent variables and selected characteristics of the respondent's wife.

3. EMPIRICAL RESULTS

The simple correlation between test scores and number of children in both the Kalamazoo and the NBER-TH samples is 0.06. Thus, in neither sample do we find a gross negative relationship between a measure of ability and number of children. Nor is this finding altered by taking into account the respondent's age, current marital status, educational attainment, income, and, in the Kalamazoo sample, family background (see Table 2 for basic regression results). Indeed, in both samples the observed effect of measured ability

Table 2

Basic Regression Results

	NBER-TH	Kalamazoo	
		Individual	Within-Pairs
Test score	.027 (2.31)*	.014 (2.98)	.021 (2.56)
Age	.303 (.30)	.333 (2.25)	.405 (1.75)
$(Age)^2$	-.004 (1.13)	-.004 (2.47)	-.005 (1.93)
Education	.007 (.43)	-.133 (3.05)	-.142 (2.05)
B.A.[a]	-.023 (.29)	.097 (.38)	.304 (.76)
Monthly earnings (1958 dollars)	.0001 (4.13)	.0003 (1.78)	.0001 (.48)
Not currently married	-.705 (4.98)	-.834 (2.92)	-.689 (1.69)
Constant	-1.93	-3.776	0[b]
$\bar{R}^2$	.02	.049	.066[c]

*(t)

[a]Holds a BA = 1
Otherwise = 0

[b]Variables defined as sibling differences, and each pair entered twice, in reverse order.

[c]It is the $\bar{R}^2$ we would observe if the dependent variable were regressed on the independent variables and dummy variables representing family membership. This $\bar{R}^2$ is comparable to the $\bar{R}^2$ reported for the other equations. It is computed by 1) transforming the standard deviation of the residuals for sibling differences to residuals of the deviations of individuals from family means, 2) multiplying this standard deviation by 1.414 to adjust for appropriate degrees of freedom, and 3) using this calculated residual in conjunction with the total standard deviation to determine $\bar{R}^2$.

increases when these variables are included. However, while in both samples the remaining effect is statistically significant, the coefficients are very small. Our evidence, therefore, suggests that intelligence, insofar as it is measured by standardized tests, is not an important determinant of fertility. This may be because it truly plays no significant role in the childbearing process, or because it plays multiple and conflicting roles, producing, for example, positive or negative taste effects, positive fecundity and negative efficiency of contraception effects. In any event, our evidence offers no support for the belief that low ability individuals are more likely to produce larger families. The evidence is all the stronger in that we have looked only at ever-marrieds, and because the correlations between test scores and number of siblings in our samples are negative and consistent with those in previous studies. The correlations found in other studies between test scores and number of siblings range between -.2 and -.3. For the basic Kalamazoo sample, from which the present subsample is drawn, the correlation is -.28, and for the NBER-TH sample among those who responded to the sibling questions, it is -.10. The consistency of these results with those found in other studies makes the present results more convincing, despite our reliance on specialized samples.

The estimated effects of the other variables warrant some comment. Older respondents tend to have had more children. This is as expected, given spacing decisions and secular trends in family size. Better educated individuals tend to have had fewer children in the Kalamazoo sample, though there is an inconclusive suggestion that men who completed college have more children than would be expected on the basis of the number of years of school they completed. This is consistent with Bajema's (1966) findings. We would expect a negative relationship between fertility and education attainment on the basis of both contraceptive knowledge and opportunity costs. We might account for the positive effect of holding a B.A. as a reflection of taste or permanent income. In the NBER-TH sample, the significance of the education coefficient is virtually zero. Because that sample is restricted to men with at least high school equivalency, and because the Air Corps may have exercised homogenizing effects with respect to contraceptive knowledge and tastes, the insignificance of the education effect in the NBER-TH sample is not surprising.

The effect of monthly income is trivial in both our samples. For theoretical reasons, the reduction of the income coefficient in the within-pair equations is of particular interest. Easterlin (1973) hypothesizes that fertility is dependent on income relative to aspirations, and assumes that aspirations are substantially shaped by parental standard of living. By holding family background constant as we have, we control parental standard of living and other factors tending to produce shared aspirations among brothers. To the extent that sibling differences in income accurately measure income relative to aspirations, our results are inconsistent with Easterlin's hypothesis.[9]

Not surprisingly, both samples suggest that among ever-marrieds, those who are currently married have more children, though the effect is not quite significant in the Kalamazoo sample.

In the Kalamazoo sample, we controlled family background by defining sibling differences on the variables of interest (see Table 2, column 3). The coefficient for test score in those analyses is significant and, interestingly, it is larger than at the individual level. This suggests that the unmeasured aspects of family background which affect fertility directly are correlated with test scores. For example, the unmeasured aspects of family background that positively affect fertility may be negatively correlated with test score. This is consistent with the strong effect of religion in the NBER-TH sample (see Table 3).

Table 3 shows that including a selection of socioeconomic background measures in the NBER-TH sample raises the coefficient of test score from 0.027 (t=2.31) to 0.044 (t=3.82). This is still small, suggesting that individuals in the top fifth of the test score distribution would have only 2.8 (.044) = .22 number of children more than individuals in the bottom fifth, after adjusting for the effects of other characteristics. Nevertheless, the direction of this finding is clearly inconsistent with assumptions that intelligence and fertility are negatively related.

In the NBER-TH sample, the background variable most significantly affecting fertility is religion. Religion is entered in dummy variable form where "no religion" is the omitted group. Catholics have relatively larger families than all other religious groups, other religions is second, Protestant next and Jewish the smallest. All but the results for Jewish are statistically significant. "Father currently living on a farm,"

Table 3

More Extensive Fertility Results, NBER-TH

Variable	Coefficient	
Test Score	.04	(3.82)
Age	.24	(.76)
$(Age)^2$	-.003	(.90)
Education	.02	(1.24)
B.A.	-.03	(.41)
Monthly income, 1969 (1958 dollars)	.0001	(3.62)
Not currently married	-.76	(5.57)
Mother's education	.01	(1.67)
Father's education	.01	(1.37)
Catholic	1.03	(10.68)
Protestant	.19	(2.13)
Jewish	-.11	(.88)
Other religions	.51	(3.57)
Father farms	.20	(2.83)
Monthly income, 1955 (1958 dollars)	.0001	(1.85)
Years married	.03	(5.77)
Wife's education	-.01	(.79)
Wife's age	.17	(4.17)
$(Wife's\ age)^2$	-.003	(5.28)
$\bar{R}^2$		.11

Note: t-statistics are in parentheses.

a proxy for the individual being raised on a farm, also is positive, as expected, and significantly so. Other background variables are not significant. In the Kalamazoo sample, the effects of measured background variables (results not shown) are similarly insignificant. (No measure of religion is available for the Kalamazoo sample.)

Adding further measures of early income, years married, wife's education, and wife's age does not alter the coefficient for test score. Not surprisingly, respondents with lengthier marriages and older wives have more children. Somewhat surprisingly, wife's education has no significant effect, and does not appear to be more important than husband's education. This may again be due to the higher education level of the sample, so that there is no differential contraceptive knowledge (although we would expect differential opportunity costs).

4. SUMMARY AND CONCLUSIONS

Our principal finding is that there is not a negative relationship between intelligence test score and family size. This finding applies to individuals who married, the group expected to show the strongest negative result. In fact, we have found a slight positive effect, which increases somewhat with better specifications of the model.

Part of the difficulty in the debate on the relationship between fertility and intelligence is that most researchers have looked at evidence on intelligence and number of siblings, rather than evidence on intelligence and number of children. These are clearly not the same, and looking at them both may shed some light on underlying phenomena. Most studies have found a negative correlation between intelligence and number of siblings, and so have we. But, the nonnegative relationship between intelligence and number of children suggests that explanations other than a genetic one for the sibship-I.Q. relationship are required. Olneck and Bills (1977) suggest, however, that family size and test scores are not causally related at all, but that both reflect a common underlying cause.

In terms of explaining differential fertility, intelligence appears to be a minor factor. This may be because it plays conflicting roles or has little effect. As a production side phenomenon it is expected to be associated with increased fecundity and decreased costs of efficient use of contraceptives. It may influence tastes in a positive or negative direction. By increasing wages, it may indirectly increase opportunity costs (and so be negatively associated) but increase potential income--move out the feasible consumption set--and so be positively associated with fertility. All of these may cancel each other out. Finally, greater parental intelligence may reduce the cost of having a child of any particular quality--either through greater child endowment or greater efficiency. If this is so, then, depending on whether child quality is a substitute or a complement for number of children, the expected relationship would be negative or positive. The negative association between sibship and intelligence may possibly indicate that child quality and quantity are substitutes.

NOTES

[1]For analysis of the effects of family size on test scores in one of our data sets, see Olneck and Bills (1977). Burt (1947, p. 181) maintains the opposite, arguing that "it would surely be truer to suggest that lack of intelligence in the parent is an important cause of the larger family rather than that the large family is the cause of the lack of intelligence in the children."

[2]For discussion of construction of the composite, see Thorndike and Hagen (1962).

[3]The mean age of first child for the reporting sample is 21.6, with a range of 2 to 39 years.

[4]For more detail, see Wolfe (1977).

[5]We are grateful to Dr. William Coates and Dr. David Bartz of the Kalamazoo Public School System for permitting Olneck to use the Kalamazoo school records, and to Dr. Stanley Robin, Director of the Center for Sociological Research at Western Michigan University, for extending the courtesies of the Center to Olneck during the interviewing phase of his study.

[6]We also analyzed individual-level data for 857 individuals, ignoring sibling composition, and 426 individuals corresponding to NBER-TH restrictions on education and test score. The results did not differ significantly across samples, and only the results for the complete brother data sample are reported here.

[7]Our definition of family background includes the effects of genetic endowments to the extent that genes are the same for brothers. The correlation between brothers' genotype would be higher than the theoretical level of 0.50 under assortative mating, and lower under dominance and epistasis. Our definition does not include genetic effects unique to brothers, or the effects of within-family environmental differences that nevertheless depend upon background.

[8]Analogous results could be achieved by defining deviations from pair means, or representing family membership with dummy variables.

[9]See Olneck and Wolfe (forthcoming) for more discussion.

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