The Texas Adoption Project: Adopted Children and Their Intellectual Resemblance to Biological and Adoptive Parents

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HORN, JOSEPH M. *The Texas Adoption Project: Adopted Children and Their Intellectual Resemblance to Biological and Adoptive Parents.* CHILD DEVELOPMENT, 1983, **54**, 268–275. Intelligence test scores were obtained from parents and children in 300 adoptive families and compared with similar measures available for the biological mothers of the same adopted children. Results supported the hypothesis that genetic variability is an important influence in the development of individual differences for intelligence. The most salient finding was that adopted children resemble their biological mothers more than they resemble the adoptive parents who reared them from birth. A small subset of the oldest adopted children did not resemble their biological mothers. The suggestion that the influence of genes declines with age is treated with caution since other adoption studies report a trend in the opposite direction.

Adoption studies are important because they provide one of the few methods available for separating the effects of heredity and environment in studies of development. If randomly selected children could be separated from their biological parents immediately after birth and assigned randomly among existing families for rearing, a complete separation of influences would be achieved. That is, the parents supplying the genes would have no influence over the environmental experiences of their offspring, and correlations between separated but genetically related individuals would reflect only genetic influences. Similarly, correlations between genetically unrelated individuals who shared the same environment would reflect environmental influences exclusively. However, the realities of adoption do not permit the study of development under such ideal conditions. The most important complicating factors in adoption studies are delayed separation from biological parents, selective placement of children in homes resembling those they would have had with their biological parents, and the unrepresentativeness of both adoptive parents and parents who give up their children for adoption.

Delayed separation would vitiate an adoption design if early environmental influences were important in development of the traits being studied. In the intellectual domain, the early adoption work of Skodak and Skeels (1949) suggests a substantial role for early environment in raising the average IQ of a group of adopted children. Parent-child correlations from this same study revealed that the brighter children had the brighter biological mothers, indicating that heredity was playing a role in individual differences even while the environment was elevating the group mean. Nevertheless, the effect on mean IQ makes it highly desirable in an adoption study to obtain children who were separated from their biological parents as soon after birth as possible.

Selective placement is a problem because it spuriously elevates correlations used to estimate the influence of genetic or environmental factors in intellectual development. If adopted children could be assigned randomly to adoptive parents, the adoptive parent–adoptive child correlation would gauge only the operation of the common family environment. However, if intelligence is influenced by genetic factors, any correlation between IQ scores, even for unrelated individuals such as biological and adoptive parents, would reflect a certain amount of genetic similarity. Selective placement produces just such a correlation between the two sets of parents. Because the biological parents then share genes

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with their adopted-away offspring and are genetically correlated with the adopting parents, some genetic correlation must exist for adoptive parent–adopted child pairs. Thus, an otherwise informative correlation is contaminated with genetic similarity between unrelated adoptive family members.

A similar confounding of genetic and environmental factors as a result of selective placement can occur for the biological parent–adopted child pairs. Under conditions of random placement, this correlation would measure only the influence of shared genes; but when the two sets of parents resemble one another in intelligence, it is reasonable to suppose, under the hypothesis of some environmental influence over IQ, that the environments of the parents were similar. This means that the adopted children are exposed to an environment somewhat like the one the biological parents would have provided, thus adding an environmental component to the biological parent–adopted child correlation.

It is important to note that some estimate of the relative importance of genetic and environmental factors is required before any correction for selective placement can be made. This is because only the genetic component of IQ can produce an elevation in the adoptive parent–adopted child correlation, and only the environmental component of IQ can cause an increase in the biological parent–adopted child correlation. Hence, any correction applied to observed correlations must be based on the product of the selective placement correlation (s) and the proportion of the variance in the trait resulting from genes (h^2) or environment (e^2).

It can therefore be stated that the observed correlation (r_o) between adoptive parents and their adopted children under conditions of selected placement is equal to the correlation that would have been obtained under random placement (r_r) plus the amount r_r is increased by selective placement ($h^2 \cdot s \cdot r_r$). The corresponding equation for the observed correlation between biological parents and their adopted-away offspring is $r_o = r_r + e^2 \cdot s \cdot r_r$. The final term in both equations indicates that increases in r_r resulting from selective placement are greatest for traits with larger values for h^2 (or e^2 in the second equation) and when selective placement is extensive and the correlation under random placement is itself large.

This means that the correlations used to estimate genetic influences require corrections that depend on a prior estimate of the importance of hereditary factors. Solving a set of simultaneous equations is one way to handle this problem. Another approach would involve making corrections for a range of initial values of heritability and then calculating the effect of changing initial estimates on any subsequent estimate of heritability made from any corrected correlation. With both r_o and s observed empirically and a range of initial values for h^2 (or e^2) assumed, it is a simple matter to calculate the only remaining unknown, r_r, for each value of h^2 or e^2.

The unrepresentativeness of adoptive parents who give up their children for adoption poses another set of difficulties in interpreting results. Adoptive parents are usually favorably selected on a host of desirable characteristics, including emotional stability, employment history, and socioeconomic status. This restriction in environmental variance could limit the generalizability of adoption results. Since adoption agencies will continue to use these procedures, it will always be possible to say that, had some of the children been placed in particularly undesirable homes, the observed environmental effects would have been larger. It should be mentioned, however, that samples of adoptive parents typically show standard deviations for IQ, education, and occupation that vary between one-half and three-quarters of the population values (Horn, Loehlin, & Willerman, 1979, 1982; Scarr & Weinberg, 1978). If variables such as these exert a major influence on intellectual development, these effects are detectable in an adoptive design, even though they may be underestimated. Furthermore, the adoption studies mentioned above are as restricted in genetic variance (biological parent IQ) as they are on the environmental dimensions. This could just as likely produce underestimates of the influence of genetic factors. Ultimately, the question of generalizability will have to be answered through further research utilizing diverse populations and other methods.

Method

A total of 300 adoptive families participated in the Texas Adoption Project. These families were identified through the files of a large private adoption agency in the southwestern United States that had routinely administered IQ tests to unwed mothers living in the residential facility. In order to be eligible for inclusion in the project, a family had to have at least one child whose biological mother was tested.

Very few test data were available for the biological fathers. Some information concerning education and employment of these men indicated they approximated the unwed mothers in intellectual status, but the decision was made to confine the biological parent data to IQ scores from the unwed mothers.

There were IQ test scores available for 364 biological mothers of 469 adopted children in the 300 adoptive families. Children placed by other agencies and children from untested mothers account for the difference. Of the biological mothers, 94% were tested with the Revised Beta Examination. This is a performance IQ test that was also used, along with the Wechsler Adult Intelligence Scale (WAIS), in testing the adoptive parents. All children were tested with the Wechsler Intelligence Scale for Children (WISC) or WAIS, unless the child was age 3 or 4, in which case the Stanford-Binet test was administered. Children below the age of 3 were not tested. Since only performance IQs were available for most of the unwed mothers, the test data presented here for adoptive parents and all children will consist of performance IQs as well. This excludes Stanford-Binet scores from 78 3- and 4-year-old children.

A previous paper (Horn et al., 1979) gave the details of sample ascertainment and data collection. Since this paper will focus on a presentation and interpretation of the correlational and mean IQ data, it is important to specify here the strengths and limitations of the adoption design, with particular attention given to the complications mentioned in the introduction.

Delayed separation is not a problem in the Texas Adoption Project. All adopted children were permanently separated from their biological mothers within the week following birth, and most mothers never saw their children after delivery. The adoption agency did not reveal the names of the biological mothers to the adoptive parents or vice versa, and, as far as we know, there has been no contact between these women and their adopted-away offspring.

The adoption agency did practice selective placement. However, correlations of only +.14 and +.11 between the beta IQs of the biological mothers and the adoptive mothers and fathers, respectively, demonstrate that the matching of IQs was not the dominant consideration in placing these children. For this particular agency, considerations such as availability of a child of the desired sex and matching the biological and adoptive parents on physical attributes appear also to have been important. Nevertheless, the small effects of selective placement will be taken into account here by reporting correlations corrected for selective placement in addition to those observed empirically.

The mean performance IQs of the adoptive parents and biological mothers indicate that both sets of parents are well above the standardization population mean of 100. With average beta IQs of 112.4 and 115.2, respectively, the adoptive mothers and fathers also evidence considerable restriction in variability—SDs of 7.68 and 7.52, compared with the standardization population value of 15. The biological mothers are almost as highly selected as the adoptive parents. Their mean beta IQ was 108.7, with an SD of 8.67. The restrictions of range accompanying such selectivity will reduce the size of the correlations obtained; but, since both genetic and environmental variables are equally restricted, they should not affect the comparisons among correlations that are used to estimate the relative importance of heredity and environment.

Results

The family correlations from an adoption study can be grouped according to the hereditary or environmental factors held in common by the pairs of family members being compared. Table 1 provides such a classification for the performance IQ correlations from the Texas Adoption Project. The correlations are divided into three groups: family members who share genes only, environment only, and genes plus environment. Looking first at the observed correlations for family members in the latter two categories, we find that the adoptive parents resemble their natural children more than their adopted children. Furthermore, the correlation for natural siblings exceeds that for unrelated children reared in the same family. This pattern of results is compatible with the idea that, in addition to family environment, genes are important in the creation of individual differences in intelligence.

One correlation is between relatives who share genes only. Although the adopted children have never seen their biological mothers, the resemblance between these genetically related individuals is still twice that found between these same children and the adoptive parents who have reared them from birth.

TABLE 1

PERFORMANCE IQ CORRELATIONS AMONG PAIRS OF RELATED AND UNRELATED INDIVIDUALS

CORRELATIONAL PAIRING	N OR df[a]	OBSERVED CORRELATIONS (r_o)	r_o CORRECTED FOR SELECTIVE PLACEMENT (r_r)[b]		
			$h^2 = 0$	$h^2 = .5$	$h^2 = 1.0$
Share genes only:					
Adopted child × biological mother...	297	.28	.25	.26	.28
Share environment only:					
Adopted child × adoptive mother....	401	.15	.15	.14	.13
Adopted child × adoptive father.....	405	.12	.12	.11	.11
All unrelated children...............	266[a]	.18	.18	.18	.18
Share genes and environment:					
Natural child × adoptive mother.....	143	.21	N.A.	N.A.	N.A.
Natural child × adoptive father......	144	.29	N.A.	N.A.	N.A.
Natural child × natural child........	40[a]	.33	N.A.	N.A.	N.A.

[a] df = degrees of freedom within families = $\Sigma(N_i - 1)$, where N_i is the number of children in family i entering into the correlations. This is used for sibling correlations only.

[b] According to the equations $r_o = r_r + h^2 \cdot s \cdot r_r$ for adopted child–adoptive parent correlations and $r_o = r_r + e^2 \cdot s \cdot r_r$ for adopted child–biological mother correlation. The r_o is from the column of observed correlations; and s (the selective placement coefficient) = +.14 for mothers or +.11 for fathers. The r_r equals the correlations between the pairs of individuals in the absence of selective placement. The h^2 equals the variance in IQ attributable to genes, and e^2 equals the variance resulting from the environment; $h^2 + e^2 = 1$.

This is strong support for the hypothesis that genes play an important role in the development of individual differences, particularly since the adoptive parents, who do not show much resemblance to their adopted children, are found to resemble their own natural children to about the same degree shown in the adopted child–biological mother pairing. That is, the genes-only correlation is about the same size as the genes-plus-environment correlations, and both of these exceed the measures of resemblance taken from individuals who only share their environments.

Table 1 also shows that correcting for selective placement would not alter the conclusions just drawn. Because the selective placement coefficients are so low to begin with, by the time these values are multiplied by the observed correlations and the estimate of the genetic or environmental components of IQ, the resulting corrections are quite small.

Comparing the average IQs of adopted children from different genetic backgrounds provides an alternative method of estimating the importance of genetic predisposition. Dividing our sample of unwed mothers at the mean IQ of 108.7 produces two groups of women with a 14.4 difference in average IQ; under a genetic hypothesis, this ought to translate into a difference for their offspring. If genes were not important, we should find no difference, provided the offspring of the two groups of women were reared in comparable environments. The IQs of the adoptive parents and any natural children in the family probably provide the most direct index of the intellectual milieu of the families and can be used to judge the comparability of the environments in which the two groups of children were reared.

It might be argued that the comparison just suggested would favor a genetic hypothesis because only genetic factors are manipulated, while environmental influences are left to vary randomly. This objection can be mitigated by performing a similar operation using adoptive parent rather than unwed mother IQ. That is, the adoptive parents can be divided into higher- and lower-IQ groups, and the IQs of the adopted children examined for evidence that this environmental manipulation makes a difference. Tables 2 and 3 give the mean IQs of parents and children when unwed mother or adoptive midparent IQs are used to create subgroups of families.

The results are striking. From Table 2 it can be seen that the adopted-away offspring from the higher-IQ unwed mothers do have a higher average test score than the children from lower-IQ unwed mothers. Equally important is the finding that the two groups of children were reared in families with equivalent potential for stimulating intellectual development, as judged from the similar IQs of the adoptive parents and natural children.[1] This means that the influences on the adopted

[1] It should be mentioned that the families of the children from higher-IQ unwed mothers did have a higher SES than the other families. However, this did not yield a higher IQ for the natural children. Such a finding calls into question the adequacy of SES as a measure of trait-relevant aspects of the environment.

children are different from those on the natural children. Apparently, the adopted children are more influenced by their unknown biological mothers than by the intellectual milieu of the adoptive family.

Support for these conclusions is also found in Table 3, where the effects of varying the adoptive family environment can be seen. Here the natural children are more responsive to differences in adoptive parent IQ than are the adopted children, probably because the natural children share genes and environment with their parents, whereas the adopted children only share the environment.

The data have also been examined for any evidence that age or sex of child moderates the effect of genes on intellectual development. Table 4 presents the correlations for all the parent-child pairings when the sample of children is divided by sex. Table 5 shows what happens to the correlations when the sample is split, first at the median age of the adopted children (8 years), and second at the median age of the natural children (10 years). Sibling correlations are not presented, since the requirement that both siblings be of the same sex or in the same age classification so reduced the sample sizes (to $N = 4$ in one case) that the observed correlations for natural children became uninterpretable.

Sex of child does not appear to influence the outcome of this study. Although the adoptive parents resemble their adopted sons more than their adopted daughters, the same pattern is observed for the unwed mothers and their adopted-away sons and daughters. This leaves conclusions concerning the relative

TABLE 2

MEAN IQs WHEN THE SAMPLE IS DIVIDED ACCORDING TO UNWED MOTHER IQ

	Unwed Mothers			Number of Subjects	
	Low	High	Difference	Low	High
Unwed mother beta.........	100.1	114.5	14.4	106	173
Adopted child PIQ.........	108.0	114.7	6.7	125	144
Adoptive mother beta.......	110.8	113.4	2.6	95	145
Adoptive father beta........	114.9	115.7	.8	93	148
Natural child PIQ..........	113.2	111.8	−1.4	52	74

TABLE 3

MEAN IQs WHEN THE SAMPLE IS DIVIDED ACCORDING TO ADOPTIVE MIDPARENT BETA IQ

	Adoptive Parents			Number of Subjects	
	Low	High	Difference	Low	High
Adoptive mother beta.......	107.6	116.5	8.9	136	156
Adoptive father beta........	110.0	119.6	9.6	136	156
Natural child PIQ..........	107.8	114.6	6.8	55	87
Adopted child PIQ.........	110.0	113.1	3.1	175	221
Unwed mother beta.........	108.0	109.6	1.6	153	182

TABLE 4

CORRELATIONS OF BETA IQ (Adults) AND WECHSLER PERFORMANCE IQ (Children) BY SEX OF CHILDREN

	Boys		Girls	
Pairing	*r*	*N*	*r*	*N*
Adopted child–biological mother......	.309	161	.224	136
Adopted child–adoptive mother......	.236	217	.045	184
Adopted child–adoptive father.......	.177	219	.038	186
Natural child–adoptive mother.......	.223	75	.191	68
Natural child–adoptive father........	.260	75	.323	69

TABLE 5

CORRELATIONS OF BETA IQ (Adults) AND WECHSLER PERFORMANCE IQ (Children) FOR SAMPLES SPLIT AT MEDIAN AGES OF ADOPTED AND NATURAL CHILDREN

	Split at Median Age of Adopted Children				Split at Median Age of Natural Children			
	Ages 5–7		Ages 8+		Ages 5–9		Ages 10+	
Pairing	*r*	*N*	*r*	*N*	*r*	*N*	*r*	*N*
Adopted child–biological mother	.362	169	.164	128	.360	235	−.024	62
Adopted child–adoptive mother	.107	188	.196	213	.139	280	.185	121
Adopted child–adoptive father	.194	188	.045	217	.079	280	.230	125
Natural child–adoptive mother	.284	42	.170	102	.243	66	.186	78
Natural child–adoptive father	.261	41	.291	102	.158	66	.367	77

roles of heredity and environment in the two subsamples unchanged from those drawn from the sample as a whole.

The data in Table 5 indicate that environmental influences may exert a greater influence over individual differences in intelligence as the adopted children grow older. Dividing the sample into a 5–7-year-old group and an 8-and-older group based on the median age of the adopted children yields a significantly lower adopted child–biological mother correlation in the older group of children ($z = 1.85$). None of the other correlations shows significant differences. Dividing the sample at the median age of the natural children produces a smaller group of adopted children in the older category but reveals that it is the 10-and-older adopted children, with a −.024 correlation with their biological mothers, who are responsible for the lower correlation in the larger group of 8-and-older adopted children from the first split of the sample.

The adopted child–biological mother correlation for the younger children does not change when the 5–7 group is enlarged by including 8- and 9-year-olds in the younger category. This indicates that the 8- and 9-year-olds are quite similar to the children from the 5–7 age range in terms of resemblance to their biological mothers and that the 10+ children are quite different from the other two age groups in this regard. Since the upper age limit for adopted children whose biological mothers were tested is 14, this discrepant result should not be attributed to a greater age variance in the older group. Likewise, the mean IQs and SDs for the children and both their adoptive parents and biological mothers did not differ significantly between the age groups. However, the fact that the 62 adopted children in the 10-and-older group constitute only a fifth of the total sample is reason enough for caution in drawing inferences from these comparisons.

Discussion

The significance of these results is best established by placing the findings alongside predictions made from theories that do not consider the role of genes in the development of individual differences. According to these theories, children with the same culture, social class, parents, neighborhoods, schools, and peers should have similar levels of intelligence and show the same resemblance to family members regardless of where their genes came from. Furthermore, there should be little resemblance between strangers unless they were reared in similar circumstances. This study does not confirm these predictions, as the adopted children resemble strangers (their biological mothers) more than the lifelong providers and caretakers in their environment. In addition, children from higher-IQ unwed mothers surpassed those from lower-IQ unwed mothers, even though the intellectual potential in their environments was comparable. Finally, comparison of adoptive families with different intellectual potentials, as judged from the IQ of the adoptive parents, revealed a greater impact on the natural children than on the adopted children. In all these findings, there is a clear indication that the influence of genes needs to be recognized in the creation of individual differences for intelligence.

Such results should not be surprising. Burks (1928), Fisch, Bilek, Deinard, and Chang (1976), Leahy (1935), Scarr and Weinberg (1977, 1978), and Skodak and Skeels (1949) have all reported results from foster and adoption studies that point to a major role for genes in intellectual development. At the same time, none of these researchers concluded environment was unimportant, only that genetic factors seemed to exert a strong influence. The Texas Adoption Project confirms this judgment in a way that adds considerably to the weight of the evidence, because it is the only study so far to provide IQ data for both biological mothers and adoptive parents.

So, most adoption studies agree that genes are important. Does the adoption approach to the study of development introduce certain systematic errors so that outcomes are biased in a genetic direction? Selective placement qualifies as a potential source of such error, but we have seen that it cannot explain the results presented in this paper. The narrower range of environments provided by adoptive parents might also reduce the importance of environmental influences relative to genetic factors. But this is unlikely for two reasons. First, the variance in performance IQ among both natural and adopted children remains substantial—SD = 12.54 and 12.00, respectively. When these figures are compared with an SD of 15 for the general population, it becomes obvious that the factors creating individual differences in IQ are still operating. Second, since the unwed mother IQs are also restricted, there is a corresponding reduction in genetic variance among the adopted children that may offset whatever environmental restriction is observed.

Kamin (1974) has suggested that adoptive parents are atypical. He cited some earlier evidence that correlations between them and their natural children are lower than for parent-child correlations in nonadoptive families. If something about adoptive parents reduces their influence over children, comparisons of adoptive parent–adoptive child correlations with correlations between unwed mothers and their adopted-away offspring could favor the latter and cause an overestimation of the importance of genetic influences. The two studies by Scarr and Weinberg (1977, 1978) provide the best recent test of Kamin's hypothesis. From the first investigation, parent–natural child correlations in a group of families with both adopted and natural children can be compared with the same correlations found in the second study for control families with only natural children. The adoptive mothers and fathers correlated +.35 and +.39, respectively, with their natural children; the parent-child correlations in the nonadoptive families were +.41 and +.40. It seems that adoptive parents are not atypical, at least in the correlations they show with their natural children.

It appears that the objections usually raised in interpreting adoption data can be overcome (Loehlin, 1980), but the strongest case for the validity of adoption study results would follow the demonstration that other methods of investigation, with different assumptions behind them, produced similar conclusions. Brody and Brody (1976), Fuller and Thompson (1978), and Plomin, DeFries, and McClearn (1980) are among the recent reviewers of twin research in the area of intellectual development. In spite of some recent criticisms directed toward this research, their overall conclusions are that the twin and adoption studies agree; genes are important influences in intellectual development. Wilson (1978) has shown that this conclusion may apply to the timing of intellectual growth as well as level.

The evidence is mixed concerning the question of age differences for the influence of genes on intelligence. The older children from the Texas Adoption Project evidenced less genetic influence than did the younger children. However, this pattern is opposite to that found by Scarr and Weinberg (1977, 1978) and Skodak and Skeels (1949). Still other investigators (Fisch et al., 1976) have failed to identify a trend in either direction. Given that the studies used different age groups and the small samples involved in some comparisons, it seems prudent to suspend judgment until further work is completed. A 10-year follow-up of the Texas Adoption Project sample is being planned and might provide some useful data on this point.

A word is in order concerning the meaning of these results for intervention programs. Far from negating the utility of intervention per se, adoption studies actually demonstrate that *radical* interventions succeed in permanently raising the average IQ of adopted children over what it would have been if the children were reared by their natural parents. Such results are found in Scarr and Weinberg (1977) and Skodak and Skeels (1949) as well as the Texas Adoption Project. What remains problematical is the success of programs with interventions milder than being adopted at an early age (Horn, 1981). It should also be noted that, at the same time the IQs are being raised through environmental enrichment (i.e., adoptive placement), the genes are at work in the individual differences. Even after receiving the benefits of the adoptive environment, the brighter children are those from the brighter biological parents.

There is a way adoption studies can serve to sharpen environmental strategies for research. Recognition that the between-families environment is less important than we thought should direct attention toward other environmental sources of variance. That such a change has been too long in coming was noted by Willerman (1979) when he pointed out that we have known for some time that within-family differences are larger than those between families. Perhaps now is the time to direct more research effort toward the identification of specific factors operating in genotype-environment covariations and events that have heretofore been labeled unique.

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