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Special Section
Contemporary Developmental Behavioral
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The Minnesota Adoption Studies: Genetic Differences and Malleability

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SCARR, SANDRA, and WEINBERG, RICHARD A. *The Minnesota Adoption Studies: Genetic Differences and Malleability*. CHILD DEVELOPMENT, 1983, 54, 260-267. In 1974 we launched 2 large adoption studies for 2 quite different purposes. The Transracial Adoption Study was designed to test the hypothesis that black and interracial children reared by white families perform on IQ and school achievement tests as well as other adoptees because they are reared in the culture of the tests and the schools. In addition, transracial families provided a sample with large numbers of adopted and natural children in the same families. Sources of individual differences among siblings could be studied without fear of possible differences between adoptive families and those with their own children. The Adolescent Adoption Study was designed to assess the cumulative impact of differences among family environments at the end of the child-rearing period. All of the children were adopted in the first year of life and averaged 18.5 years at the time of the study. A comparison sample of families with their own adolescents was also studied. Black and interracial children scored as well on IQ tests as adoptees in other studies. Individual differences among them, however, were more related to differences among their biological than adoptive parents, whether they lived together or not. Young siblings were found to be intellectually quite similar, whether genetically related or not. Adolescents' IQ test scores were similar to those of their parents and siblings only if they were biologically related. Our interpretation of these results is that younger children are more influenced by differences among their family environments than older adolescents, who are freer to seek their own niches.

Social sciences have been plagued by the controversy over nature and nurture, as though the conjunction were "or." At the core of the controversy is the idea that genetic variation fixes individual and group differences in human behavior. Opponents of the idea believe that genetic differences are antithetical to malleability or change in behavior. A common error underlying this belief is a failure to distinguish environmental and genetic sources of individual differences in behavior from the necessary roles of both genes and environments in behavioral development. One cannot assess the relative impact of heredity or environment in behavioral domains because everyone must have both a

viable gene complement and an environment in which the genes can be expressed over development.

Behavioral differences among individuals, on the other hand, can arise in any population from genetic differences, from variations among their environments, or both. Imagine a population of genetically identical clones who are reared in family environments that vary from working to upper middle class. Any behavioral differences among the clones would necessarily arise from developing within those different environments. Next, imagine a genetically diverse human population reared in laboratory cages. All members experience exactly the same environments. Naturally, all

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differences among those individuals are accounted for by their genetic variability. Notice, however, that in the two fantasies the organisms all have both genes and environments for development (Scarr & Weinberg, 1980, p. 859). Because nearly all families share both genes and environments, it is usually impossible to know why individuals are similar or different from one another.

The Adoption Model

The adoption of children with biological backgrounds that are different from both their adopting parents and each other provides an opportunity to evaluate the impact of environments on children's development. If differences among the child-rearing environments provided by families determine differences in children's development, then the differences among adopted children ought to be correlated with differences among their adoptive families. Theoretically, regressions of adopted-child outcomes on adoptive-family characteristics will provide genetically unbiased estimates of true environmental effects in the population from which they are drawn.

Unfortunately, adoptive families are selected by agencies for being above average in many virtues, including socioeconomic status. Children in adoptive families are reared in nondeprived, nonabusive environments. However, the fact that the SES range of adoptive families usually includes at least two-thirds of the U.S. white population makes results of adoption studies compelling.

Comparisons of adopted and biological relatives assume that the greater behavioral similarity usually found among biological relatives is a result of their greater genetic similarity. Critics of the adoption model assert to the contrary that important biases can creep into comparisons of genetically related and unrelated families through parental and child expectations of greater similarity among biological than adopted relatives. Fortunately for the adoption model, knowledge of adoptive or biological relatedness does not constitute a bias in comparisons of measured behavioral differences in biological and adoptive families, because there are no correlations between perceived and actual similarities in intelligence or personality (Scarr, Scarf, & Weinberg, 1980).

The Minnesota Adoption Studies

Following in the tradition of Alice M. Leahy (1935), who conducted a pioneering

adoption study in Minnesota, we launched two large adoption studies in 1974 for two quite different purposes. The Transracial Adoption Study was carried out from 1974 through 1976 in Minnesota to test the hypothesis that black and interracial children reared by white families (in the culture of the tests and the schools) would perform on IQ tests and school achievement measures as well as other adopted children (Scarr & Weinberg, 1976). A second investigation, the Adolescent Adoption Study, was conceived to assess the cumulative impact of differences in family environments on children's development at the end of the child-rearing period (Scarr & Weinberg, 1978; Scarr & Yee, 1980). In both studies, we examined the levels of intellectual and personality development, as well as the degree of resemblance among family members, by comparing adoptive and biological relatives. The focus of this review is on IQ and school achievement tests, with briefer attention to personality, interests, and attitudes.

Transracial Adoption Study

Sample

The 101 transracial adoptive families included 176 adopted children, of whom 130 were socially classified as black. All of the adopted children were unrelated to the adoptive parents and to each other, with a few exceptions who were excluded from analyses. The sample also included 143 biological children of the adoptive parents. Among the adoptees, 111 were adopted in the first year of life and 65 after 12 months of age.

Results and Discussion

IQ levels of family members.—Both the parents and the biological children of the families scored in the bright average to superior range on age-appropriate IQ tests. The black and interracial adopted children were also found to score above the average of the white population, regardless of when they had been adopted. The black children adopted in the first 12 months of life scored on the average at IQ 110 (Scarr & Weinberg, 1976), 20 points above comparable children being reared in the black community. We interpreted the high IQ scores of the black and interracial children to mean that (a) genetic racial differences do not account for a major portion of the IQ performance difference between racial groups, and (b) black and interracial children reared in the culture of the tests and the schools perform as well as other adopted children in similar families

(Burks, 1928; Horn, Loehlin, & Willerman, 1979; Leahy, 1935; Scarr & Weinberg, 1978). The adopted children scored 6 points below the natural children of the same families, however, as Burks (1928) and our second adoption study also found.

Parent-child correlations.—Table 1 shows the correlations of the parents and children in the transracial adoption study. The adoptive families had adopted at least one black child, but there were also other adopted children and many biological offspring of these same parents. The children ranged in age from 4 to about 18. Because of the age range, children from 4 to 7 years were given the Stanford-Binet (1973 norms), children from 8 to 16 the WISC, and older children and all parents the WAIS. The average age of the adopted children was 7, and of the natural children about 10. Table 1 gives the parent-child IQ correlations for all of the adopted children in the transracial adoptive families, regardless of when they had been adopted. The total sample of adopted children is just as similar to their adoptive parents as the early-adopted group is to theirs. The midparent-child IQ correlation for all adoptees is .29;¹ for the early adoptees it is .30. Mothers are equally similar to all adopted children, and fathers are more similar to the total sample than they are to the early-adopted children.

Table 1 also shows the correlations between all adopted children's IQ scores and their natural parents' educational levels. Because we did not have IQ assessments of the natural parents, education is used here as proxy. Despite this limitation, the correlations of natural parents' education with their adopted-away offspring's IQ scores are as

high as the IQ correlations of biological parent-child pairs and exceed those of the adoptive parent-child IQ scores. The natural midparent-child correlation of .43 is significantly greater than the adopted midparent-child correlation of .29.

Because the adoptive parents are quite bright, their scores had restricted variance. In Table 1, the correlations between parents and their natural and adopted children are not corrected for restriction of range in the parents' IQ scores. When corrected, the midparent-biological child correlation is .66, and the adopted child-adoptive midparent IQ correlation is .37 (Scarr & Weinberg, 1977).

The correlations between natural parents of adopted children and the biological children of the same adoptive families is an estimate of the effects of selective placement (entries 2 and 4 in Table 1). If agencies match educational and social class characteristics of the natural mothers with similar adoptive parents, then the resemblance between adoptive parents and children is enhanced by the genetic resemblance of natural and adoptive parents in intelligence. Selective placement also enhances the correlation between natural parents and their adopted-away offspring, because the adoptive parents carry out the genotype-environment correlation that would have characterized the natural parent-child pairs, had the children been retained by their natural parents. Thus, neither the adoptive parent-child correlations nor the natural parent-adopted child correlations deserve to be as high as they are (Scarr & Weinberg, 1977). From the comparison of biological and adoptive parent-child correlations, each corrected for selective placement, we estimated that 40%–70% of the IQ vari-

TABLE 1
COMPARISONS OF BIOLOGICAL AND UNRELATED PARENT-CHILD IQ
CORRELATIONS IN 101 TRANSRACIAL ADOPTIVE FAMILIES

	<i>N</i> (pairs)	<i>r</i>
Parents-unrelated children:		
Adoptive mother-adopted child	174	.21 (.23) ^a
Natural mother-own child of adoptive family ^b . .	217	.15
Adoptive father-adopted child	170	.27 (.15) ^a
Natural father-own child of adoptive family ^b . . .	86	.19
Parents-biological children:		
Adoptive mother-own child	141	.34
Natural mother-adopted child ^b	135	.33
Adoptive father-own child	142	.39
Natural father-adopted child ^b	46	.43

^a Early adopted only (*N* = 111).

^b Educational level, not IQ scores.

¹ The midparent value is the average of the two parents' scores.

ance in this sample was due to genetic differences among the children.

Sibling correlations.—In Table 2, the sibling correlations reveal a different picture. Young siblings are similar to each other, whether genetically related to each other or not. The IQ correlations of adopted siblings are as high as those of the biological siblings reared together. Children reared in the same family environments and who are still under the major influence of their parents score at similar levels on IQ tests. The IQ correlations of the adopted siblings result in small part from their correlations in background, such as their natural mothers' educational levels (.16) and age at placement in the adoptive home (.37), which are in turn related to the present intellectual functioning of the children—the earlier the placement, the higher the IQ score. Age of placement is itself correlated with many other background characteristics of the child and is a complex variable (Scarr & Weinberg, 1976). But note that the correlation among the early adopted siblings is .39. Even among the families who had early adoptees, differences in family environments and selective placement account for a substantial resemblance between unrelated children.

Although the sibling correlations between unrelated adopted children in this study may appear to be higher than those of comparable studies, such as the Texas Adoption Project (Horn et al., 1979), one should compare correlations of genetically related

and unrelated siblings within each study. In the Texas study the IQ correlations of biological siblings were as low as those of adopted siblings; both were lower than sibling IQ correlations in this study, probably because of procedural differences. All family members in the Minnesota studies were assessed by the same team, who were trained together. In the Texas study, different psychometricians administered tests around the state, sometimes with the same examiner for family members and sometimes with different examiners for family members (Willerman, Loehlin, Horn, Scarr, & Weinberg, 1980). Overall, their IQ correlations of family members, genetically related or not, were lower than those in the Minnesota studies.

The major point is that the heritabilities (percentage of genetic variance) calculated from young-sibling data in the Minnesota Transracial Adoption Study are very different from those calculated from the parent-child data. As Christopher Jencks pointed out in his earlier book (1972), the correlations of unrelated young siblings reared together do not fit any biometrical model because they are too high. This study of young children confirms his point. Our second study, of older adolescents, however, does not.

Adolescent Adoption Study

Sample

The adolescents in this study had spent an average of 18 years in their families—194 adopted children in 115 adoptive families and

TABLE 2
SIBLING IQ CORRELATIONS OF NATURAL AND ADOPTED
CHILDREN OF ADOPTIVE FAMILIES

	<i>N</i> (pairs)	<i>r</i>
Natural siblings:		
All IQ scores.....	107	.42
Stanford-Binet.....	10	.50
WISC + WAIS.....	63	.54
Natural sibling-adopted sibling:		
All IQ scores.....	230	.25
Stanford-Binet.....	57	.23
WISC + WAIS.....	63	.20
Natural sibling-early-adopted sibling:		
All IQ scores.....	34	.30
All adopted siblings:		
All IQ scores.....	140	.44
Stanford-Binet.....	36	.31
WISC + WAIS.....	50	.64
Early-adopted siblings:		
All IQ scores.....	53	.39

NOTE.—Sibling pairs include all children born to or adopted by the adoptive families. Pairs consist of two natural siblings, one natural and one adopted sibling, and two children adopted into the same family. Because IQ tests were given according to the child's age, same pairs received the same test and others different tests.

a comparison group of 237 biological children in 120 other families. All of the adoptees were placed in their families in the first year of life, the median being 2 months of age. From 1975 to 1977 both groups of children were 16–22 years old. Both samples of parents were of similar SES, from working to upper middle class, and of similar IQ levels on the WAIS. The IQ scores of parents in both adoptive and biological families averaged 115, approximately 1 SD above the population mean. The biological children scored, on the average, an IQ of 113, and the adopted children 7 points lower at 106.

Results and Discussion

Parent-child and sibling correlations.—The parent-child IQ correlations in the biological families were what we were led to expect from the Transracial Adoption Study and others—about .40 when corrected for restriction of range in the parents' scores. The biological midparent-child correlation was .52. The adoptive parent-child correlations were lower than those of the younger adoptive parents and their children—about .13; the adoptive midparent-child correlation was only .14.

The adopted children's IQ scores were more closely correlated with the educational levels of their natural mothers (.28) and fathers (.43) than with those of their adoptive mothers (.09) and fathers (.11). In fact, adopted children's IQ scores were as highly correlated with their natural parents' education as were those of the adolescents in the biological sample (.17 and .26, respectively) (Scarr & Weinberg, 1980).

The IQ correlation of the biologically related siblings was .35, similar to that of the siblings in the Transracial Adoption Study. However, the IQ correlation of adopted children reared together for 18 years was zero! Unlike the younger siblings, who are of different races, these white adolescents reared together from infancy did not resemble their genetically unrelated siblings. The heritabilities calculated from the adolescent IQ data varied from .38 to .61, much like the parent-child data in the study of younger, transracial adoptees but unlike data on these younger siblings.

In support of the IQ results are the standardized test data, collected from many different school districts and uncontaminated by biases that might have inadvertently influenced testing in our studies. Most important, they represent a "real-life" criterion of

intellectual achievement. As shown in Table 3, the effects of being reared in the same family, neighborhood, and school are negligible unless one is genetically related to one's brother or sister. The correlations of the biological siblings were modest but statistically different from zero, whereas the aptitude and achievement scores of the adopted siblings were virtually unrelated.

Our interpretation of these results (Scarr & Weinberg, 1978) is that older adolescents are largely liberated from their families' influences and have made choices and pursued courses that are in keeping with their own talents and interests. Thus, the unrelated siblings have grown less and less alike. This hypothesis cannot be tested fully without longitudinal data on adopted siblings; to date all of the other adoption studies sampled much younger children, at the average age of 7 or 8. We can think of no other explanation for the markedly low correlations between the adopted siblings at the end of the child-rearing period, in contrast to the several studies of younger adopted siblings, who are embarrassingly similar.

Discussion

We interpret the results of the two studies to mean that younger children, regardless of their genetic relatedness, resemble each other intellectually because they share a similar rearing environment. Older adolescents, on the other hand, resemble one another only if they share genes. Our interpretation is that older children escape the influences of the family and are freer to select their own environments. Parental influences are diluted by

TABLE 3
SIBLING CORRELATIONS OF APTITUDE AND ACHIEVEMENT TEST SCORES OF ADOPTED AND BIOLOGICALLY RELATED ADOLESCENTS

	BIOLOGICAL		ADOPTED	
	N (pairs)	r	N (pairs)	r
Aptitude:				
Verbal.....	141	.29	68	.13
Numerical....	61	.32	49	.07
Total.....	61	.32	49	.09
Achievement:				
Reading.....	106	.27	73	.11
Math.....	104	.35	58	-.11
Total.....	104	.33	58	-.03

the more varied mix of adolescent experiences.

The results support the idea that older children and adolescents build their own niches, which can be seen as an active genotype-environment correlation (Plomin, DeFries, & Loehlin, 1977). Different people select different aspects of their environments that they find compatible. Choices of environments are influenced by genetic differences in what individuals enjoy and at which they are competent. Adopted children, not genetically related to their parents or to one another, build niches that are related to their own genotypes but not to those of their family members. Biologically related children also create niches that are correlated with their genotypes, but their choices are also correlated with those of their genetically related family members (see Scarr & McCartney, in this issue).

Malleability.—What are the implications of these results for developmental plasticity? First, it is clear from the IQ scores of the transracially adopted children that they, like other adoptees, are responsive to the rearing environments in adoptive families, which as a group provide intellectual stimulation and exposure to the skills and knowledge sampled on IQ tests. The mean IQ scores of both samples of adoptees are above the average of age-mates, primarily because they benefit from their rearing environments.

Second, individual adoptees differ in their responses to the environmental advantages of adoptive families. Those with natural parents of higher educational levels, and by implication higher intellectual abilities, are more responsive to the rearing environments of adoptive families than are those with natural parents of more limited intellectual skills. Children adopted into families of adoptive

parents at and above the average educational and IQ levels of adoptive parents score higher on the WAIS than children of comparable natural mothers adopted into families with less bright adoptive parents. Table 4 shows that the adolescents whose natural mothers and adoptive parent are both below average score 10.4 IQ points below those whose natural mothers and adoptive parents are both above average.

Individual differences among the adopted children at both younger and older ages are related to intellectual variation among adoptive parents and their biological parents, even though the average IQ of adoptees most likely exceeds that of their natural parents. Human beings are not infinitely plastic; malleability does not mean that given the same environment, all individuals will end up alike.

Attitudes, Interests, and Personality

In the adolescent adoption study, we expected that genetic differences would account for substantial variation in IQ scores but would have nothing to do with social attitudes or vocational interests. Surprisingly, we found that scores on the California *F*-Scale, a measure of authoritarianism, rigidity in belief, and prejudice, were similar for biological but not adoptive relatives, even though the adoptees had been exposed to their parents' attitudes since infancy. The solution to this mystery was that *F*-Scale scores were negatively correlated with WAIS vocabulary ($-.42$) and showed the same pattern of family correlations (Scarr & Weinberg, 1981). Apparently, the *F*-Scale measures moral reasoning ability that reflects the general level of verbal intelligence. One could conclude that authoritarian views are not learned either by rote or by imitation of one's parents or siblings. These data challenge the belief that children acquire attitudes and beliefs by

TABLE 4
ADOPTED CHILD MEAN IQ BY ADOPTIVE PARENTS' IQ AND NATURAL MOTHER'S EDUCATION

	NATURAL MOTHER'S EDUCATION (Years)						COLUMN MEAN
	≤ 11		12		> 12		
	<i>M</i>	<i>N</i>	<i>M</i>	<i>N</i>	<i>M</i>	<i>N</i>	
Adoptive parents' IQ:							
Lowest third.....	99.8 (9.07)	16	107.0 (8.59)	22	106.7 (9.66)	18	104.8
Middle third.....	106.2 (10.91)	14	107.8 (7.42)	33	105.8 (6.52)	12	107.0
Top third.....	106.5 (7.58)	8	106.6 (8.22)	31	110.2 (9.85)	18	107.7
Row Means.....	103.6		107.2		107.8		

NOTE.—Figures shown in parentheses are standard deviations.

modeling themselves after their families because the adopted children's attitudes did not bear any resemblance to those of their parents or siblings.

There was also evidence for genetic differences in vocational interest profiles, based on Holland's model. Biological family members shared modestly similar interests and disinterests on the Strong-Campbell Interest Inventory, whereas adoptive relatives did not (Grotevant, Scarr, & Weinberg, 1977). Once again, the expectation that children would model themselves after their parents was not fulfilled.

In the personality domain, we expected biological relatives to be moderately similar and adoptive relatives to be less so. These expectations were fulfilled. Indeed, the median correlation for parents and children on nine personality scales tapping introversion-extroversion and neuroticism was .15, and the midparent-child r was .20. In adoptive families, these figures were .04 and .06, respectively. Sibling correlations were .20 and .07 for biological and adopted siblings, respectively (Scarr, Webber, Weinberg, & Wittig, 1981).

There is evidence for genetic differences in interests and personality. There is little evidence that environmental differences among families account for variability in these psychological domains. However, most of the variance in personality and interests is not accounted for by either genetic or environmental differences among families. Most of the variance lies among individuals within families.

Some of the differences in results between intellectual and personality measures may lie in the lower reliabilities of the latter. Family correlations for personality measures may be lower than those for abilities because of lower reliabilities. Given that the reliabilities of personality measures used in this study range in the .70s to .80s, however, family members could be much more similar than they are. It must be that the unique genotypes and experiences of individuals shape the development of personality and interest patterns.

So What?

We have found evidence of genetic sources of variability for all of the psychological characteristics we have studied, from early childhood to the end of the child-rear-

ing period. The same studies also provide evidence for the malleability of development—the responsiveness of genotypes to differences in their environments. We think that developmentalists ought to be concerned with individual differences in development under similar rearing conditions, as well as the average level of development expressed under varying environmental conditions. An evolutionary view incorporates both perspectives, because individuals vary genetically in their responses to diverse rearing conditions.

Such a view does not lead inevitably to passive pessimism about the potential effects of interventions to improve children's lives (Scarr, 1982). Ironically, the major contribution of behavioral genetic studies is to clarify the impact of environmental differences on human development. In fact, we can do a better job of designing interventions if we know which variations in the environment make a difference and which do not. We can invest our resources in changing those circumstances that clearly have deleterious effects on development. In addition, we can make more realistic predictions about the efficacy of interventions if we take into account individual differences in responsiveness to those changes (Axelrod & Scarr, in press). It is in the best interest of children to know about their differences as well as their average development.

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