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Patterns of Interest Similarity in Adoptive and Biological Families

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Twin studies have indicated that genetic differences among individuals also contribute to interest and personality differences among them. In this study, 114 biologically related families and 109 adoptive families were administered the Strong-Campbell Interest Inventory. The protocols of parents and their adolescent children (total $N = 870$) were scored on the six scales of Holland's model of interest styles (Realistic, Investigative, Artistic, Social, Enterprising, Conventional). Biological parent–child correlations ranged from $-.13$ to $+.40$, with 15 of the 24 scale correlations achieving significance; only 2 of the adoptive parent–child correlations were significant (range from $-.15$ to $+.25$). Biologically related pairs were also significantly more correlated than adoptive pairs for interest profiles. Same-sex biological siblings were more similar to each other than either opposite-sex sibling pairs or parent–child pairs. Pairs of unrelated children in the adoptive families were not too similar either on Holland's scales or the profile analysis.

One of the earliest observations made about a genetic contribution to vocational interest similarity appeared in 1934, when Carter reported an intensive case study of a pair of identical twins who had been raised together. After a 20-year separation in adulthood, these twins scored so similarly on the 23 scales of the Strong Vocational Interest Blank (Strong, 1927) that Carter (1934) stated, "It is likely that the same individual taking the test on two occasions would not receive scores any more similar than these" (p. 164).

Since that time a number of investigators have studied genetic contributions to vocational interests by looking at twin similarity, with the consistent and not too surprising finding that monozygotic twins are more similar than dizygotic twins. The convergence of results across studies is noteworthy, considering that the investigators used subjects of different ages as well as different test instruments (e.g., Carter, 1932; Roberts & Johansson, 1974; Vandenberg & Kelly, 1964; Vandenberg & Stafford, 1967).

In the past few years vocational choice theory has begun to be merged satisfactorily with vocational interest inventories, going beyond the purely empirical scales of the past (Campbell & Holland, 1972). This trend toward a more theoretical orientation is significant. Although the earlier studies *assumed* that genetic influences were operating via aptitudes and personality traits (e.g., Vandenberg & Kelly, 1964), a theory providing a description of the personality dimensions relating to vocational choice would allow a more direct test of this assumption.

The present study was designed to investigate genetic variance in interest styles using

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a behavior genetic strategy heretofore unused in such studies: the adoption design. The Strong-Campbell Interest Inventory (Campbell, 1974) was chosen for this research because it merged the separate men's and women's forms of the old Strong Vocation Interest Blank into one psychometrically sound instrument while incorporating John L. Holland's (1966, 1973) theoretical model of interests.

According to Holland, vocational interests may best be conceptualized as personality dimensions that characterize an individual's orientation to his environment. Holland's model proposes that there are six vocational interest styles, and that any individual may be described in terms of a rank-ordered series or profile of styles.

Holland's (1966, 1973) interest styles may be briefly described as follows: *realistic* (practical, rugged, aggressive persons who enjoy working outdoors and with their hands); *investigative* (scientifically oriented persons who enjoy thinking through problems); *artistic* (self-expressive and creative persons); *social* (responsible, humanistic, or religious persons concerned with the welfare of others); *enterprising* (persons who enjoy selling, dominating, and leading); and *conventional* (persons who prefer highly ordered verbal or numerical activities).

Holland's interest typology was based on reviews of factor analytic studies of interests as well as on his own counseling and clinical experience. Holland (1966) has especially acknowledged the contribution of Guilford's factor analytic work (Guilford, Christensen, Bond, & Sutton, 1954) to his model of interests. Guilford's factors (mechanical, scientific, social welfare, clerical, business, and aesthetic expression) closely parallel Holland's interest types. An earlier predecessor of these interest dimensions was Spranger's typology (theoretic, economic, esthetic, social, political, and religious), on which the Allport–Vernon–Lindzey *Study of Values* was based (Allport, 1966).

Table 1
Sample Characteristics

Families	*n*	Mean education	Mean age (yr.)	Age range (yr.)
Biological				
Fathers	114	15.6	48.9	38.7–59.8
Mothers	114	14.6	46.3	36.7–57.0
Sons	108		18.4	14.8–23.6
Daughters	139		18.7	15.8–24.3
Adoptive				
Fathers	102	14.9	51.5	42.1–62.8
Mothers	108	13.9	49.6	41.7–60.0
Sons	85		18.3	14.6–24.8
Daughters	100		18.1	14.1–22.0

Method

Subjects

The 870 subjects in this sample included the members of 114 biological and 109 adoptive families from Minnesota. Sample characteristics are shown in Table 1. Biological parents have had almost 1 more year of education than adoptive parents, but this was not a statistically significant difference between the fathers, $t = 1.74$, *ns;* for mothers, $t = 2.48$, $p < .05$, two-tailed. Educational levels are not reported for the children, since many of them were still in school. Adoptive parents were roughly 3 years older than the biological parents. The children in both families had about the same average age of 18 years 6 months. In addition, both adoptive and biological families have mean annual family incomes of approximately $25,000. It appears, then, that these two samples are reasonably similar in terms of parental education and income as well as children's age.

A crucial methodological consideration for any adoption study is the age at which the children are placed with their adopting families. Only early placements can guarantee that potentially confounding early environmental experiences are minimized. Data for age of placement were available for 171 of the 185 adopted children in this study. The mean age of placement into the adopted children's present homes was 2.6 months. Of those 171 children, 158 of them were placed on or before the age of 6 months. All but 6 of the 171 were placed by age 9 months. All adopted children were genetically unrelated to their adoptive parents and to each other. The biological children were all full siblings and the biological offspring of both parents tested.

Adoptive families were largely recruited through the Minnesota State Department of Public Welfare, which sent letters on behalf of the study to all families in Minnesota who adopted children between 1953 and 1959. Other adoptive families and the biological families were recruited by newspaper

Table 2
Means and Standard Deviations for Holland (1973) Interest Styles

	Fathers (*n* = 114)		Mothers (*n* = 114)		Sons (*n* = 108)		Daughters (*n* = 139)	
Scale	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
			114 biological families					
Realistic	58.2	10.3	41.8	8.6	55.5	10.0	46.3	9.3
Investigative	51.2	9.9	46.4	9.5	50.6	10.6	46.8	9.9
Artistic	46.0	10.5	52.4	9.3	47.9	11.5	53.9	10.6
Social	46.8	9.7	54.4	10.3	45.6	11.2	51.7	9.4
Enterprising	51.8	9.2	50.3	8.9	47.9	8.9	45.8	7.5
Conventional	51.4	10.1	51.5	9.8	48.6	10.4	46.0	9.6
			109 adoptive families					
Realistic	59.2	9.1	42.5	8.8	52.1	10.8	44.9	9.9
Investigative	49.7	11.0	42.8	9.7	44.0	11.7	42.8	10.6
Artistic	42.6	11.1	51.1	9.4	45.4	11.3	50.9	10.1
Social	47.8	10.5	51.7	9.5	44.3	13.0	50.0	10.4
Enterprising	54.3	10.1	51.0	8.2	48.8	10.3	48.3	9.1
Conventional	52.2	9.7	52.9	9.5	46.3	10.9	45.9	10.1

articles and advertisements and by referral of other participating families. Subjects received small payments for their participation and for recruiting other families. Data were collected between July 1974 and June 1976. All subjects in this sample were Caucasian. This sample is completely independent of the transracial adoptive sample described in Scarr and Weinberg (1976).

Procedure

Subjects in this sample were administered a 3-hour battery of tests at the University of Minnesota in a behavior genetic study of intellectual, personality, and attitudinal similarities within and between families. The data reported in this study are from the Strong-Campbell Interest Inventory, which the families completed at home and returned by mail, and a demographic questionnaire completed during the test session. The answer sheets for the Strong-Campbell Interest Inventory were scored by National Computer Systems, Inc., an agency licensed to score the test. Scored profiles were sent to each participant as part of the feedback on their test results.

Results

Means and standard deviations on the Holland (1973) scales are presented for biological and adopted fathers, mothers, sons, and daughters in Table 2. Table 3 presents the results of a Family Type × Sex × Generation analysis of variance. Differences due to family type are indicated in the first two columns: Members of biological families scored higher on the Investigative and Artistic scales than members of adoptive families, who scored higher on the Enterprising scale than biological family members. These differences may be related to the slightly higher educational level of the biological parents, since academic orientation is positively correlated with a number of items on the Investigative and Artistic scales and negatively correlated with some items on the Enterprising scale. These differences may also be due in part to the fact that more biological than adoptive families were recruited from the University community.

Sex differences are indicated in the next two columns of Table 3. Males scored higher than females on the Realistic, Investigative, and Enterprising scales; females scored higher than males on the Artistic and Social scales. These sex differences are precisely the ones found in the 1973 Strong General Reference standardization sample (Campbell, 1974).

Generational differences are presented in the next two columns of Table 3. Adolescents had higher Artistic interests than their par-

Table 3
F *Values for Family Type × Sex × Generation Analysis of Variance for Holland (1973) Interest Styles*

Scale	Family type (A)		Sex (B)		Generation (C)			
	Bio > Ad	Ad > Bio	M > F	F > M	Ch > Par	Par > Ch	A × C	B × C
Realistic			365.9***				6.0*	38.9***
Investigative	30.3***		35.9***					4.8*
Artistic	12.4***			85.9***	4.3*			
Social				67.7***		9.7**		
Enterprising		7.3**	9.6**			46.1***		
Conventional						60.1***		

Note. Abbreviations: Bio = biological, Ad = adoptive; M = male, F = female; Ch = child, Par = parent. F values not reported are not significant at $p < .05$. None of the F values for either the A × B or A × B × C interactions was significantly different from zero. Total $N = 870$; $df = 1, 862$ for each test.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

ents, while parents had higher Social, Enterprising, and Conventional interests than their children. Given the remarkable stability of interests through adulthood (Strong, 1943, 1955), it is likely that these were cohort rather than developmental differences.

The significant Sex × Generation interaction effects for the Realistic and Investigative scales illustrate what might well be another indication of cohort differences. Although males scored higher than females on the average on both scales, sex differences in the parental generation were more pronounced than in the adolescent cohort, in both biological and adoptive families. This appears to reflect the movement of young women into more outdoor, scientific, and mechanically oriented interests and activities.

Because of the mean differences due to family type, sex, and generation discussed above, all of the correlational analyses that follow are based on scores standardized to a mean of 0 and a standard deviation of 1 within each family type, sex, or cohort group.

Correlations between parents for the interest styles are presented in Table 4. The lack of parental similarity reflected in the nonsignificant mean correlations is striking, considering that most of these couples have been married to each other for 20 years or more. This finding is consistent with Vandenberg's (1972) review, which showed very low correlations for assortative mating on measures of personality.

Parent–Child Similarity

Parent–child correlations for both family types are presented in Table 5. The first point of interest is that parent–child pairs were not equally correlated on the six interest styles; rather, certain clusters of similarity seemed to emerge. For example, the biological father–son and father–daughter pairs were most highly correlated on Artistic, Social, Enterprising, and Conventional interests. However, biological mother–son and

Table 4
Parent/Parent Correlations for Holland (1973) Interest Styles

Scale	Biological (n = 114 pairs)	Adoptive (n = 101 pairs)
Realistic	.02	.28**
Investigative	.10	.12
Artistic	.09	.20*
Social	.00	.07
Enterprising	.20*	.23*
Conventional	.06	−.08
Mean r	.08	.14

* $p < .05$.
** $p < .01$.

Table 5
Parent/Child Correlations in Biological and Adoptive Familes for Holland (1973) Interest Styles

	Father–son		Mother–daughter		Father–daughter		Mother–son	
Scale	Bio	Ad	Bio	Ad	Bio	Ad	Bio	Ad
Realistic	.09	.08	.28***	−.01	.04	.15	.28**	.25*
Investigative	.11	.15	.40***	−.10	.07	.11	.16*	.06
Artistic	.16*	.03	.28***	.14	.20*	.10	.25**	.04
Social	.26**	.17	.08	−.05	.18*	−.02	−.13	.22*
Enterprising	.16*	.13	.08	.02	.17*	−.06	.15	.11
Conventional	.23**	.17	.26**	.16	.12	−.15	.20*	−.11
Mean *r*	.17*	.12	.23**	.03	.13	.02	.16*	.10
n pairs	108	81	139	96	139	89	108	84

Note. Underlined pairs of correlations denote significant differences between biological and adoptive pairs for the scales indicated. Abbreviations: Bio = biological, Ad = adoptive.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

mother–daughter pairs were most highly related on the Realistic, Investigative, Artistic, and Conventional scales. Father–child pairs were more similar than mother–child pairs on the Social scale, while mother–child pairs were more similar than father–child pairs on Realistic and Investigative interests. Similar clusters failed to emerge in the adoptive parent–child data because all the adoptive parent–child correlations were generally low.

Second, 15 of the 24 scale correlations and 3 of the 4 mean correlations for biological pairs were significantly different from zero, while only 2 of the scale correlations for adoptive pairs were different from zero. In computing 24 correlations, one would expect to find at least one significant value at the .05 level by chance.

Third, significant differences between biological and adoptive pairs for any given scale are indicated in Table 5 by underlining the two correlations. There were five such significant differences in the predicted direction of greater similarity for biological pairs. Tests of significance for the differences are as follows: mother–daughter Realistic $z = 2.21$, $p < .05$; mother–daughter Investigative $z = 3.88$, $p < .001$; father–daughter Enterprising $z = 1.67$, $p < .05$; father–daughter Conventional $z = 1.96$, $p < .05$; and mother–son Conventional $z = 2.09$, $p < .05$. The mean correlations for each biological pair were also higher than the corresponding adoptive correlations.

Finally, Table 5 shows that there was approximately the same degree of similarity within each family type for like-sex pairs as for opposite-sex pairs. For biological pairs, the mean correlation for like-sex pairs was .20, and for opposite-sex pairs, .14. For adoptive families, the mean like-sex correlation was .07 and .06 for opposite-sex pairs. This indicates that neither like-sex nor opposite-sex children were dramatically more similar to their parents, which replicated the finding of Roff (1950).

Sibling Similarity

Correlations for same-sex biological siblings and same-sex unrelated children reared together are presented in Table 6. It is clear that same-sex siblings more closely resembled each other than they resembled their parents. All of the sibling correlations were statistically significant, ranging from .26 to .51. Even though the theoretical genetic correlation between sibs is close to that between parents and offspring, siblings also share similarity of rearing environment and generation, which they do not share with their parents. Sibling correlations calculated separately for the 27 brother–brother pairs and the 48 sister–sister pairs were slightly higher than the correlations reported in Table 6, which includes all same-sex sib pairs. The mean brother–brother correlation was .41; the mean sister–sister correlation was .37.

Correlations between the same-sex unrelated adopted children reared together were lower than the biological sibling correlations. One-tailed tests of the difference between the correlations achieved significance for three scales: Investigative ($z = 2.37$, $p < .01$); Artistic ($z = 1.98$, $p < .05$); and Social ($z = 2.41$, $p < .01$). The contrast between the mean same-sex sibling correlation of .36 ($p < .001$) and the mean same-sex adopted child–child correlation of .11 (*ns*) was even more striking than that between related and unrelated parent–child pairs (see Table 5).

Interest correlations between opposite-sex siblings (presented in Table 7) provide an interesting contrast to the same-sex sib correlations. Children's scores were first standardized separately by sex, and then all brother–sister pairs were formed for both family types. The opposite-sex biological sibling correlations were substantially smaller than those for same-sex sibs. On the average, however, adopted brother–sister correlations were about the same as adopted same-sex child–child correlations (.09 and .11, respectively). Similarity of sex, therefore, appears to make an important contribution to interest similarity among biologically related adolescent siblings. Unrelated children reared together were not very similar to each other regardless of sex. Nevertheless, opposite-sex biological siblings were more highly correlated on the Artistic scale than unrelated opposite-sex pairs ($z = 2.38$, $p < .01$).

Table 6
Same-Sex Sibling Correlations for Holland (1973) Interest Styles

Scale	Biological ($n = 75$ pairs)	Adopted ($n = 23$ pairs)	z between correlations
Realistic	.29**	.36*	*ns*
Investigative	.37***	−.21	2.37**
Artistic	.51***	.06	1.98*
Social	.38***	−.21	2.41**
Enterprising	.26*	.18	*ns*
Conventional	.35***	.43*	*ns*
Mean r	.36***	.11	

* $p < .05$.
** $p < .01$.
*** $p < .001$.

Table 7
Opposite-Sex Sibling Correlations for Holland (1973) Interest Styles

Scale	Biological ($n = 77$ pairs)	Adopted ($n = 60$ pairs)	z between correlations
Realistic	.10	.22*	*ns*
Investigative	.19*	.12	*ns*
Artistic	.33**	−.08	2.38**
Social	.09	.11	*ns*
Enterprising	−.23	.13	*ns*
Conventional	−.04	.04	*ns*
Mean r	.08	.09	

* $p < .05$.
** $p < .01$.

Correlations were also calculated for all possible sibling pairs. Scores were first standardized separately by sex, and then all possible brother–brother, sister–sister, and brother–sister pairs were formed for both family types. The results of this analysis are presented in Table 8. The biological sibling correlations for all but the Enterprising scale were significantly different from zero. In contrast, only one of the correlations for unrelated children reared together reached significance. In addition, there were significant differences between the biological and adopted pairs on the Investigative, Artistic, and Social scales.

This pattern of sibling correlations shows more striking and consistent differences between biologically related and unrelated pairs than did the parent–child correlations. Unrelated children were only correlated with each other on one of the scales, while the biological sib pairs were as highly correlated as the most strongly related parent–child pairs. The biological/adopted difference reflected in Table 8 may be slightly inflated, since approximately one half of the biological sib pairs were same sex, while approximately one

Table 8
Sibling Correlations for Holland (1973) Interest Styles

Scale	Biological (n = 152 pairs)	Adopted (n = 83 pairs)	z between correlations
Realistic	.18*	.24*	*ns*
Investigative	.28***	.04	1.80*
Artistic	.41***	−.07	3.65***
Social	.26***	.02	1.78*
Enterprising	.01	.14	*ns*
Conventional	.17*	.15	*ns*
Mean r	.22**	.09	

* $p < .05$.
** $p < .01$.
*** $p < .001$.

third of the adopted child–child pairs were of the same sex.

Profile Analysis

In addition to examining family similarities on each of the six individual scales, comparisons of overall profile contour (shape) and elevation are also meaningful. Holland's (1973) model states that an individual is most clearly characterized by the rank-order *configuration* of his six interest styles rather than by merely his highest scale score.

To compute similarity of profiles, Wilson's (1968) adaptation of the repeated measures analysis of variance was used, with pairs as a random factor and scales as the repeated measure. Using scores standardized within each distribution as input, intraclass correlations for profile contour and elevation were calculated. Significance levels of the correlations may be somewhat inflated, since all scale-to-scale correlations were not equal (see McCall & Applebaum, 1973). The intraclass correlations for profile contour or shape are presented in Table 9.

None of the parent–parent, parent–child, or child–child correlations for adoptive family pairs was significantly different from zero. This was quite similar to the negligible correlations which were found for individual scales. Again, there were not enough same-sex unrelated children reared together to calculate adopted brother–brother or sister–sister correlations.

The biological parent–child correlations, however, were all significantly different from zero as well as significantly different from their adoptive family counterparts. This is the most convincing evidence in our data that there is a small but reliably heritable influence on the *patterning* of interests in individuals. As with the individual scale comparisons, parents were not very similar to each other, and same-sex siblings were the most similar of all. Profile contour correlations for all possible sibling pairs regardless of sex were .25 for biological pairs and .08 for adopted pairs ($z = 2.92$, $p < .01$).

The profile elevation analysis is shown in Table 10. These correlations measure the degree to which the two members of a pair responded in an equally positive or negative direction to the scale items. Each of the Holland (1973) scales is composed of 20 items, each receiving a weight of +1 for a "like" and −1 for a "dislike" response. In addition to using Wilson's (1968) measure of elevation similarity, correlations between total scores across all six scales were calcu-

Table 9
Profile Contour Correlations for Holland (1973) Interest Styles

Pair	Biological	Adopted	z between correlations
Father–mother	.11	.11	*ns*
Father–son	.29**	.13	2.56**
Mother–daughter	.24**	.13	1.84*
Father–daughter	.19*	.06	2.12*
Mother–son	.24**	.07	2.58**
Brother–brother	.33*	—	—
Sister–sister	.34**	—	—
Child–child	.25***	.08	2.92**

Note. The test of differences is based on the following formula (Wilson, 1972; Dworkin, Note 1):

$$z = \frac{z_1 - z_2}{\sqrt{\dfrac{1}{(\text{tests}-1)(\text{pairs}_1-2)} + \dfrac{1}{(\text{tests}-1)(\text{pairs}_2-2)}}}.$$

* $p < .05$.
** $p < .01$.
*** $p < .001$.

Table 10
Profile Elevation Correlations for Holland (1973) Interest Styles

Pair	Biological	Adopted	z between correlations
Father–mother	.02	.17*	*ns*
Father–son	−.04	.11	*ns*
Mother–daughter	.21**	−.09	2.23*
Father–daughter	.02	−.03	*ns*
Mother–son	−.01	.12	*ns*
Brother–brother	.50**	—	—
Sister–sister	.41**	—	—
Child–child	.18*	.10	*ns*

Note. The test of differences is based on the following formula (Hays, 1973):

$$z = \frac{z_1 - z_2}{\sqrt{\frac{1}{(\text{pairs}_1 - 3)} + \frac{1}{(\text{pairs}_2 - 3)}}}.$$

* $p < .05$.
** $p < .01$.

lated for each subject. The results of Wilson's measure of elevation similarity and the correlations between total scores were virtually identical.

The striking feature of Table 10 is the paucity of significant correlations or significant biological/adopted differences for parent–child pairs. The only parent–child correlation different from zero was for the biological mother–daughter pairs, who were also different from their adoptive counterparts ($z = 2.23, p < .05$).

Like-sex sibling pairs, however, again showed the strongest degree of similarity. Similarity of response style, then, appears to be more a function of cohort and sex similarity and common rearing environment than of genetic relatedness, since parent–child pairs who likewise share half of their genes in common were virtually uncorrelated.

Discussion

These data indicate that biologically related family members modestly resemble each other on measures of Holland's (1973) interest styles. Adoptive family members, however, are, on the average, no more similar than parents and children paired randomly from the population. These data corroborate and extend the findings from past studies of biologically related families. For example, three investigations of parent–child resemblance on interest scales found average correlations similar to ours: Lessing (1959) found the average mother–daughter correlation on the Kuder Preference Record to be .28, while the mean correlation in the present study was .23. Forster (Note 2) and Strong (1957), in two studies of father–son resemblance, found average interest correlations of .33 and .29, respectively—slightly higher than our mean r of .17.

Our data also confirm the findings of a number of twin studies. The correlations of same-sex dizygotic twins should be very similar to those for same-sex full siblings, since members of both types of pairs share half of their genes, on the average, and also share similarity of sex, generation, and rearing condition. Nichols (Note 3), in an extensive review of the twin literature, found the average dizygotic correlation across interest scales to be .30. Our same-sex biological siblings had a slightly higher mean correlation of .36, which fell within the sampling error of Nichols's values. In addition, the average *difference* between monozygotic–dizygotic correlations of .18 (Nichols, Note 3) is very similar to the difference of .26 found in the present study between mean same-sex biological and adoptive sibling correlations. In each comparison, the more similar pairs share 50% more additive genetic variance than the less highly correlated pairs.

Although both siblings and parent–child pairs share, on the average, one half of their genes, one would expect sibling correlations to be higher than parent–child correlations, reflecting the impact of common generation and rearing environment. Common environment variance "contributes more often and in greater amount to the covariance of full sibs than to that of any other sort of relative" (Falconer, 1960, p. 161). In addition, full siblings share one quarter of the variance due to genetic dominance; parents do not share dominance variance with their offspring. Our data confirm the prediction of greater sibling than parent–child similarity, finding a mean same-sex sibling correlation of .36 and mean parent–child *r*s ranging from .13 to .23.

The consistent adoptive–biological difference for profile contour provides support for the hypothesis that the *patterning* of interests in individuals is at least as heritable as specific interests. We interpret this as supporting the construct validity of Holland's (1973) model, describing individuals in terms of configurations or profiles of interest styles.

Any hypothesis of a genetic influence on behavior automatically raises the question of *how* such influences occur. Critics of a trait approach might argue that the heritability and stability of interests are merely artifacts of a relation between interests and intellectual abilities. Although some interest styles were correlated with Wechsler Adult Intelligence Scale IQ scores in this family sample (see Scarr & Weinberg, Note 4, for a report of the IQ data), only the Investigative and Artistic scales achieved statistically significant correlations with IQ for all family members. Investigative-IQ correlations were .41, .33, .45, and .37 (for fathers, mothers, sons, and daughters, respectively) and Artistic-IQ correlations were .32, .27, .23, and .32, respectively. The other 16 interest-IQ correlations were generally low, averaging .07. Therefore, the relation between interests and intellectual ability in no way fully accounted for the adoptive/biological differences observed in this study.

It is most likely that genetic factors make their impact on interests through personality orientations related to temperament, introversion–extraversion, activity level, and so on. For example, Tyler (1964) gathered interest and achievement data longitudinally on subjects from Grades 1–12 and then looked at her subsample of males who had decidedly scientific interests at Grade 12. She concluded that "interests characteristic of scientists became crystallized sometime between the 10th and 14th years, but that the temperamental matrix out of which they emerge goes back to a much earlier developmental stage" (Tyler, 1964, pp. 223–224). Heritable components of variation in temperament and personality were recently reviewed by Nichols (Note 3).

While such personality factors do not directly dictate one's interests, they influence which activities, hobbies, or occupations a person will select to participate in or to avoid. For example, a very sociable person with a high activity level would not likely find satisfaction in a very routinized occupation such as that of a keypunch operator.

Another possible avenue of biological influence on interests, especially at adolescence, relates to rate of physical maturation. It is known that the timing of the adolescent growth spurt is controlled hormonally and, ultimately, genetically (Tanner, 1970). It is also known that "masculinity" or "femininity" of interests is related to very early and very late physical maturation for boys (Mussen & Jones, 1957; Weatherly, 1964). It is therefore possible that the interests of sons come to resemble those of their biological fathers because they both had similar *social* experiences as a result of a *biologically* controlled process (physical maturation).

Thus, behavior genetic methodology addresses both issues of genetic and environmental inputs to phenotypes such as interests. The confirmation of results from twin studies found in the present adoption study strongly suggests that genetic differences among individuals contribute to interest differences among them. In addition, Nichols's (Note 3) conclusion that there are low environmental correlations for interests and personality between both sets of monozygotic and dizygotic twins suggests that family environmental effects may be very complex and subtle.

There are, however, a number of social avenues through which the family may well influence interest development, none of which has been studied adequately. Some likely sources include family structural variables (such as birth order, family size, and child spacing); degree of parental similarity; parental child-rearing attitudes; and processes such as identification. A fuller understanding of interest development awaits incorporation of all these sources of variance into one satisfactory model.

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