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Appraisal of Parental Bias in Twin Studies
Ascribed Zygosity and IQ Differences in Twins

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A criticism of twin studies has been that the difference between the behavioral similarities of identical and fraternal twins is largely created by parental influences based on their perception of the twins' zygosity. This issue is examined for differences in the IQ scores found within pairs classified by parents and bloodtyping. The systematic differences in IQ scores could be attributed to zygosity classified by bloodtyping rather than by parental belief. The available evidence indicates that the twin method is still appropriate for human behavior genetics.

Key words: IQ, Twin method, Behavior genetics, Twin zygosity perception

INTRODUCTION

One of the more obvious objections raised against the twin method for human behavior genetics is that the shared experiences within pairs of twins may differ because of physical appearance, stated zygosity, and the like [3]. The within-family environments of identical twin pairs, although treated as equivalent to those of same-sex fraternal twin pairs, are thought to be more similar, thereby inducing a greater similarity of behaviors with identical pairs.

By now there is considerable evidence that treatment of identical and fraternal twins is not equal in every respect. Twin pairs identified as identical have been found to have years of exposure to more similar environments than fraternal pairs by being more often dressed alike and treated alike in a variety of ways, including infant care, child-rearing practices, and academic placement [4, 8]. In general, the results have suggested that similarity of treatment increasingly differentiates between the identical and fraternal pairs as the twins become older, but it is recognized that the anamnestic reports obtained from parents of older twins may have obscured the differential treatment actually being given at earlier times.

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The reported behaviors of the twins themselves have been found to be more concordant for identical than for fraternal pairs. The selections of friends, dress, foods, interests, and uses of leisure time have been examined in some detail, and inevitably, the results have indicated that identical pairs act more alike than same-sex fraternal pairs. For example, Smith [8] found that identical twins were more likely than fraternal twins to have the same friends (58% vs 33%), study together (40% vs 15%), and dress alike (64% vs 40%). After examining an extensive number of experiential variables, Loehlin and Nichols [4] found similar contrasts between identical and fraternal pairs. Their analyses, however, indicated that concordance for specific experiential behaviors tended to be weakly related to parental beliefs about zygosity or measures of personality, abilities, and interests. The range of correlations between differential experiences and within-pair differences for the measures was from –0.15 to +0.22, the typical correlation being about +0.05. Loehlin and Nichols concluded that "it is clear that the greater similarity of . . . identical twins' experience in terms of dress, playing together, and so forth cannot plausibly account for more than a small fraction of their greater observed similarity" [4, p 52].

If parental treatment of twins and the subsequent behaviors of the twins themselves are largely environmental in origin, it is apparent that parental beliefs about zygosity, no matter how gained, predispose parents to treat identical twins more alike than fraternal twins. Parents of supposed identical pairs would be "biased" in the direction of minimizing differences in treatment within identical pairs, while parents of supposed fraternal pairs would permit or even promote differences. The cumulative effects emanating from such beliefs would account for the typical differences later found between the psychometric measures of identical and fraternal pairs.

An appraisal of the bias brought about by parental classification of twin zygosity can be made by comparing the measures of identical and fraternal pairs with zygosities correctly and incorrectly classified by the parents. The rationale for this method has been explained in detail by Scarr [7]. Scarr showed that parents of a small number of identical and fraternal pairs incorrectly classified their twins' zygosity (established by bloodtyping), but measures of the twins' behaviors were more aligned with actual rather than believed zygosity. Other investigators have used this same method in one form or another applied to populations of twins from infancy to adolescence. The characteristics of those investigations are summarized in Table 1.

Several trends are apparent in the results from previous studies. Although the rate of error was about 20% for both identical and fraternal pairs, identical twins were more likely to be called fraternal among younger twin pairs and fraternal twins were more likely to be called identical among older twin pairs. The studies examined either the behavior of the twins or the parents' behavior toward the twins. The findings are too extensive to be provided in the table, but, in general, the conclusions were that within-pair differences in the behaviors of the twins were in accord with actual rather than presumed zygosity. Identical pairs called fraternals had within-pair differences of the same magnitude as correctly classified identicals; fraternal pairs called identicals had within-pair differences more like those of correctly classified fraternals. The degree of similarity in parental behaviors toward the twins fits the same pattern.

With the exception of the study by Lytton [5], none of the previous studies had a sizeable population of young twins whose zygosity was determined by bloodtyping. Such a population should be less subject to beliefs regarding zygosity other than those held by

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TABLE 1. Twin Studies Relating Misdiagnosis of Zygosity to Behavioral Measures

Reference	No. of pairs		Age (years)	Diagnosis		Pairs misdiagnosed (%)		Behavioral measures
	Identical	Fraternal		Source	Criterion	Identical	Fraternal	
Cohen et al [1977]	181	84	1–6	Parents	Questionnaire	13.8	–	Childhood personality scale; parental behaviors
Loehlin and Nichols [1976]	514	336	17	Parents	Questionnaire	17.7	15.8	California Psychological Inventory; Adjective Check List; Holland Vocational Preference Inventory; National Merit Examination; Parental and twin behaviors
Lytton [1977]	17	29	2–3	Parents	Bloodtyping	23.6	13.8	Maternal behavior
Munsinger and Douglass [1976]	37	37	3–17	Parents	Bloodtyping	21.5	32.5	Assessment of children's language comprehension; Northwestern Syntex Screening Test
Scarr [1968]	23	29	6–10	Parents	Bloodtyping	17.4	31.2	Adjective Check List; Vineland Social Maturity

immediate friends and relatives. Furthermore, the age-to-age consistency of behavior measures, such as IQ, begins to stabilize during the period prior to entry into school and the child's involvement with an ever-expanding circle of adults and children. Since it is thought that the first two years of life are the most formative and that parental influence is the most pervasive during that period, the parents' belief about zygosity should have the most pervasive influence during the preschool years.

The present study was undertaken to determine if the discrepancies between correct and incorrect classifications of zygosity of identical and fraternal twin pairs were related to within-pair differences in IQ scores. This study tested the hypothesis that correct classifications were related to similarity of IQ scores.

MATERIALS AND METHODS

Subjects

In the Louisville Twin Study, twins were recruited during infancy and brought to the study center for routine assessments throughout childhood and into adolescence. Zygosity of the twins is determined by bloodtyping obtained when the twins are about 3 years old. A description of the longitudinal study and characteristics of the twins and their families may be found elsewhere [9].

The present sample consisted of 172 same-sex pairs of white twins who were in the longitudinal study, and who had participated in one of the special visits for bloodtyping. The results from the bloodtyping indicated that 101 twin pairs were identical and 71 twin pairs were fraternal. Zygosity was determined by concordance or discordance for 22 or more antigens examined by the Minneapolis War Memorial Blood Bank. Pairs discordant on one or more of the antigens were classified as fraternal.

Measures

During the special visit for bloodtyping, the parents of the twins were given a questionnaire concerning their appraisal of the twins' zygosity and similarity of appearance. The format of the questionnaire was essentially like that described by Cohen et al [2] except that additional questions were added in order to determine what physicians had told the parents about the twins' zygosity.

The IQ test routinely given to twins about 3 years of age was the Stanford Binet (LM) with scores obtained from the tables of 1972 norms. In most instances, the Stanford Binet IQ had been obtained prior to the parents' being informed about the results of the bloodtyping, but some twins were tested during a routine visit scheduled shortly after the parents had been provided the bloodtyping results. Absolute within-pair differences for IQ scores were then examined for zygosity classification by parental appraisal or by bloodtyping, and then evaluated by analysis of variance.

RESULTS

With bloodtyping as the criterion, 18 (17.8%) of the 101 identical twin pairs and 7 (10%) of the 71 fraternal pairs were classified incorrectly by the parents. Interestingly enough, the physician's ascription of zygosity provided approximately the same margin of error; however, according to the parents, physicians did not provide information about zygosity for 51 of the pairs.

The averages of the absolute within-pair differences for the IQ scores are shown in Table 2. It is apparent from the table that the magnitude of the within-pair differences is related to actual zygosity rather than to the parental appraisal of zygosity. Identical twins, classified correctly or not by the parents, had mean difference scores of about 5 IQ points, and the fraternal pairs had mean difference scores of about 9 IQ points. Analysis of variance applied to bloodtyped identical and fraternal pairs revealed no significant effect of parental belief. Identical pairs classified by the parents as fraternal were as similar as cor-

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TABLE 2. Mean Within-Pair Differences for IQ Scores: Twin Pairs Classified by Parents and Bloodtyping

	Bloodtyping classification					
	Identical pairs		Fraternal pairs		Analysis of variance	
Parental classification	N	$\bar{d}$	N	$\bar{d}$	F	P
Identical pairs	83	5.68	7	9.50	4.23	<0.05
Fraternal pairs	18	5.44	64	8.67	4.10	<0.05
Analysis of variance: F, P	0.10,	P > 0.05	0.05,	P > 0.05		

rectly identified identical pairs, and in the same manner fraternal pairs classified as identical were as dissimilar as correctly identified fraternal pairs. Comparisons of the within-pair difference scores according to parental classification of zygosity essentially reiterated the general finding: Parental error in assigning zygosity was not systematically related to difference in IQ.

It is worth noting that there were five pairs of identical twins classified as fraternal by the parents *and* the physicians. The mean within-pair difference for IQ scores of this small sample was 4.6 points. Evidently, the combined weight of professional and parental judgments concerning zygosity did not contribute to differences markedly discrepant from those obtained from the larger sample.

DISCUSSION

The results from the present study, in combination with those from previous studies, indicate that parents most often correctly ascribe zygosity to same-sex twin pairs, but when errors occur, the pairs erroneously classified provide data similar to data from twin pairs correctly classified. When bloodtyping has been used as the criterion for determining zygosity, maternal behaviors [5], language measures [6], and personality and social maturity measures [7] have been found to be related to actual, rather than believed, zygosity. When physical appearance appraised through questionnaires has been used to determine zygosity [1, 4], essentially similar results have been found for a wide variety of measures of personality and ability.

Parental belief about young twins' zygosity evidently is not directly related to differences in intellectual skills prior to confirmation of belief, but it could be argued that such a relation could emerge later, perhaps even after the parents have been provided with the results from bloodtyping. Yet, the within-pair differences for the IQ scores of erroneously classified identical and fraternal pairs are not unlike differences found within actual identical and fraternal pairs at ages after bloodtyping has been performed. At 7 and 8 years, long after twin pairs in the Louisville Twin Study have been bloodtyped, the median within-pair differences in full-scale IQ scores have been found to be eight points for fraternal pairs and four points for identical pairs [10]. If there is a cumulative effect, it is not contributing to any appreciable changes within the pairs' IQ scores, even when the effect is coupled with a confirmation of the parental classification of zygosity.

Despite the concern about results from twin studies being distorted by the effects from parental belief about zygosity, the accumulating evidence is that genetic influences

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can be found for some representative behaviors of twins without regard to parental opinions or expectations. This evidence, which does not imply that parental treatment is unimportant in every respect, shows that whatever phenotypic similarities exist within pairs of twins are not simply determined by parental bias. Until strong evidence shows that parental bias results in an exaggeration of differences between identical and fraternal pairs, the rejection of data accruing from the study of twins does not seem warranted on empirical grounds.

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