

## Sex, Handedness and Allergy: Are They Related to Academic Giftedness?

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*This study attempted to replicate findings that left-handedness and allergy occur more frequently in highly gifted students (Benbow, 1986). Samples of highly gifted and less gifted twelve-year-olds were identified through a regional talent search and subsequently administered questionnaires. In agreement with Benbow's findings, the highly gifted (those with extremely high scores on the Scholastic Aptitude Test) were disproportionately male. However, the present study failed to replicate the finding that the highly gifted were more likely to be left-handed and to have allergies. The theoretical importance of these findings as well as their practical implications for the identification of the gifted are discussed.*

Middle-school age children who score at extremely high levels on college entrance examinations have been described as extremely precocious. [The terms "extremely precocious", preferred by Benbow and "highly gifted", preferred by the present authors, will be used interchangeably in this manuscript.] Benbow (1986) reported several physiological correlates of such extreme precocity, including a higher incidence of left- or mixed-handedness, symptomatic atopic disease (asthma, eczema, other allergies), and myopia. There were also slightly more males than females with extremely high verbal

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reasoning ability, and many more males than females with extremely high mathematical reasoning ability. The ratio of males to females qualifying for the math group was 12:1 (Benbow & Stanley, 1983).

Benbow's study was based primarily on theories of left-handed correlates presented by Geschwind and Behan (1982) and Geschwind and Galaburda (1984) who reported an elevated frequency of left-handedness in immune disorder patients and in the learning-disabled. From this observation Geschwind and Behan (1982) developed a hypothesis that left-handedness and learning disorders are caused by some neurological insult related either to exposure to excessive levels of testosterone or high sensitivity to testosterone perinatally. Because testosterone has a retarding effect on the growth of the left-hemisphere, excessive exposure or sensitivity leads to the cognitive dominance of the right hemisphere, and therefore increased incidence of left-handedness.

Geschwind and Behan (1982) also found that the incidence of certain immune disorders was significantly higher in left-handers than in right-handers. Studies have found that excess testosterone also affects the thymus, which plays an important role in the development of the immune system (Halpern & Coren, 1989).

Geschwind and Behan (1982) further hypothesized that the occurrence of excessive levels of testosterone would be more common in males than in females, since male fetuses are exposed to testosterone through two sources, their developing testes as well as maternal ovaries. In support of this theory, several studies including Benbow's (1986) have found a greater frequency of left-handedness among males (Bryden, 1977; Oldfield, 1971; Porac & Coren, 1981).

Benbow (1986) extended Geschwind and Behan's hypothesis to predict that left-handedness and immune disorders should be more frequent in highly mathematically talented individuals. Because mathematical talent (or reasoning ability) is thought to depend on parts of the right hemisphere, it should be benefited by right-hemispheric dominance caused by testosterone shock. Consistent with this hypothesis, Benbow found elevated frequencies associated with being male, being left-handed and having allergies among high scorers on both the mathematical and verbal sections of the SAT.

Benbow's hypothesis is extremely provocative, and, if confirmed, has profound theoretical and practical implications. Theoretically, an established link between extraordinary academic talent and hormonal mechanisms suggests a significant and specific physiological basis for academic giftedness. Further, male dominance in samples of the mathematically gifted would be interpretable as biologically

inevitable. Practically, an established link between extraordinary academic talent and hormonal mechanisms suggests that physiological markers may be useful tools in the process of identifying the gifted.

Consequently, the relationships among sex, handedness, allergy, and giftedness must be explored with care and results must be interpreted with caution. There are at least two reasons why Benbow's data deserve careful scrutiny. First, her hypothesis is highly speculative and based upon questionable physiological assumptions (Faust-Sterling, 1985; Lewontin, Rose, & Kamin, 1984). Second, confidence in Benbow's findings is limited by the fact that she studied a single sample of extremely precocious students, namely those from the Johns Hopkins University Talent Search. Clearly, additional evidence needs to be gathered from an independent sample. The purpose of the present investigation is to attempt to replicate Benbow's findings with a comparable but independent sample of extremely precocious adolescents.

### Method

#### *Subjects*

Subjects were selected through the Talent Identification Program at Duke University (TIP) Talent Search, which covers a 16 state region in the southeastern and midwestern United States. Seventh-graders who score in the top three-percent on their in-school achievement tests are invited to take the Scholastic Aptitude Test (SAT). More than 30,000 students participate annually. Data for this study were collected during the 1986 and 1987 Talent Searches, using a Talent Search Questionnaire (TSQ) that contained self-report measures of handedness and allergy. In total 33,724 TSQs were received, yielding a response rate of 83.1%.

The Talent Search is representative of the general population in that 52% of the participants are female. Compared to Census data for the 16 state region, Whites and Asian-Americans are overrepresented, while Blacks, Hispanics, and American Indians are underrepresented. Talent Search participants are more likely to come from two parent homes and have parents with a higher level of income and education than early adolescents in the general population (Wiley, Kahn, & Goldstein, 1990).

#### *Procedure*

From this sample, a subject pool of highly gifted students was selected using Benbow's criterion: a score of 700 or higher on the math section of the SAT or a score of 630 or higher on the verbal section of the SAT before age 13. These scores are comparable to the scores obtained by 95th percentile of college-bound males. As a result, 96 students were identified as highly gifted.

In addition, a comparison group of 96 students was randomly selected from Talent Search participants who scored less than or equal to 540 on both sections of the SAT combined (scores near or at chance) and matched with the highly gifted group for year participating. This procedure for obtaining a control group parallels that used by Benbow. By contrast, because it has been well established that left-handedness is more frequent in males, a second comparison group of 96 students was created to insure that the differing frequency of non-right-handedness that Benbow found was not biased by the difference in the frequency of males in the two groups. This second control group was matched for sex to the highly gifted sample, but like the first control group, scored at or below chance on the SAT.

### Results

The sex and ethnic background of the highly gifted and control samples may be seen in Table 1. While Benbow found significant differences in the frequency of left-handedness among Asians due to cultural bias, in our sample the highly gifted Asians displayed a frequency similar to non-Asians (11%), and were included in the sample. Mean SAT-Verbal and SAT-Math scores for these three groups may be found in Table 2.

#### *Sex Ratio*

Of the 96 highly gifted subjects, 69 (71.9%) were male and 27 (28.1%) were female. By contrast, of the 96 randomly selected less gifted control subjects 25 (26.0%) were male and 71 (74.0%) were female. There is a highly significant sex by group difference,  $\chi^2(1) = 40.35$ ,  $p < .01$  (phi coefficient SY equals .46).

The preponderance of males among the highly gifted does not differ reliably from the sex ratio reported by Benbow: 74.1% of her extremely precocious subjects were male ( $z = .44$ ,  $p > .05$ ). In both our

Table 1  
**Numbers of Highly Gifted and Less Gifted (Control)  
 Subjects by Sex and Ethnicity**

	Highly gifted		Less Gifted		Total	
	F	M	Total	Total		
Asian	5	12	17	1	0	1
Black	1	0	1	4	0	4
Hispanic	1	0	1	9	1	10
White	20	57	77	57	23	80
Other	0	0	0	0	1	1
TOTAL	27	69	96	71	25	96

Table 2

**Mean and Standard Deviation of Math and Verbal SAT  
 for Highly Gifted and Control Subjects, by Sex**

	Highly Gifted		Less Gifted		Total
	F	M	F	M	
SAT:Math	569.26 (115.26)	682.32 (85.37)	622.59 (52.89)	541.45 (100.74)	564.27 (96.82)
	n = 27	n = 69	n = 27	n = 69	n = 96
SAT:Verbal	275.63 (24.94)	265.20 (24.00)	241.69 (19.57)	238.80 (28.91)	240.94 (22.25)
	n = 71	n = 25	n = 71	n = 25	n = 96

sample and Benbow's, highly gifted males outnumber highly gifted females by a ratio of nearly 3 to 1.

#### *Left-handedness*

Frequency data on handedness for the highly gifted and control subjects are presented in Table 3. Of the 96 highly gifted, 11 (11.46%) reported themselves to be left-handed. By contrast, of the 96 control subjects 9 (9.38%) reported left-handedness. This difference was not significant,  $\chi^2(1) = .22, p > .05$ .

By comparison, Benbow reported that 15.1% of her extremely precocious and 10.2% of her control subjects were left-handed. Once again, a comparison of the proportion of left-handers in the two samples of highly gifted did not yield a significant difference ( $z = .91, p > .05$ ). A comparison of the proportion of left-handers in the two control samples did not yield a significant difference either ( $z = .23, p > .05$ ).

Our data do not suggest that the highly gifted are more likely to be left-handed than controls. In addition, the proportions of left-handers among the highly gifted and controls do not differ significantly from the corresponding proportions reported by Benbow, despite the fact that Benbow reported a significant relationship between left-handedness and "extreme precocity." Some possible implications of this discrepancy will be raised in the discussion.

The frequency of left-handedness in the general population varies considerably as a function of age. For individuals between the ages of 10 and 20, approximately 15% are left-handed. By contrast, for individuals between the ages of 50 and 60, approximately 7% are left-handed (Porac, Coren, & Duncan, 1980, Figure 2).

#### *Sex and handedness*

Highly gifted males had a higher frequency of left-handedness (10 of 69 or 14.5%) than less gifted males (2 of 25 or 8%), while highly gifted females had a lower frequency of left-handedness (1 of 27, or 3.7%) than did control females (7 of 71 or 9.9%). Unfortunately, there were not enough females in the highly gifted group nor males in the less gifted group for valid statistical comparison. While the small number of females in the highly gifted group reflects their actual rarity, a valid comparison of highly gifted and control males was made possible via the selection of the second control group, matched for sex with the

Table 3  
Frequency of Physiological Traits by Sex  
among the Highly Gifted and Less Gifted Control Groups

	Highly Gifted	Less Gifted	Less Gifted (matched for sex)
male	N = 69	25	69
female	N = 27	71	27
Left-Handed	M 10 (14.5%) F 1 (3.7%)	M 2 (8.0%) F 7 (9.9%)	M 13 (18.8%) F 2 (7.4%)
Allergies or Asthma	24 (34.8%) 7 (25.9%)	8 (32.0%) 25 (35.2%)	25 (36.2%) 10 (37.0%)

highly gifted sample. The number of left-handed males in this control group (13 or 18.8%) did not differ reliably from the number of highly gifted left-handed males:  $\chi^2(1) = .47, p > .05$ .

The highly gifted subjects were further divided according to talent (SAT math  $\geq$  700 or SAT verbal  $\geq$  630). For the males, there was a higher rate of left-handedness among the mathematically talented, 8 of 48 (16.7%), than among the verbally talented, 2 of 23 (8.7%). There was only one left-handed highly gifted female in the sample. Note that the rate of left-handedness for mathematically talented males is below that for matched control males (16.7% vs. 18.8%).

#### Allergies or Asthma

Frequency data on allergies or asthma for the highly gifted and control subjects are presented in Table 3. By self-report, 31 of 96 (32.3%) of the highly gifted group and 33 of 96 (34.4%) of their less gifted counterparts had allergies or asthma, a difference that was not significant:  $\chi^2(1) = .10, p > .05$ . The frequency of allergies or asthma among males, 32 of 94 (34.0%) was equal to the frequency among females, 32 of 98 (32.7%),  $\chi^2(1) = .04, p > .05$ .

These rates are lower than those reported by Benbow for her extremely precocious sample (approximately 53%) but comparable to her control sample (approximately 35%). Benbow cited a rate of "20-

25% for a population of average ability individuals" (1986, p. 722) as a baseline. Neinstein (1984), citing data from the National Health Survey conducted by the National Center for Health Statistics, reported a rate of allergies in the general adolescent population of 20%.

In sum, while 33.3% of our sample reported having allergies or asthma, a figure higher than that in the general population but lower than that reported by Benbow for her extremely precocious sample, there were no differences between the highly and the less gifted or between males and females in this regard.

#### Discussion

The results of this study provide only limited support for Benbow's previous findings that sex, handedness, and allergy are related to academic giftedness. More importantly, perhaps, the present data do not lend any support to Benbow's speculations concerning the role of hormonal factors in the development of giftedness.

The results of this study do provide clear support for previous findings of a sex difference in the number of highly gifted. Indeed, our data replicate almost exactly those of Benbow (1986). Males constitute nearly three-fourths of the highly gifted, as measured by SAT scores, even though the Talent Search population is 48% male. However, it would be premature to interpret this finding as support for Benbow's theory.

Rather, the imbalance of the sexes may have more to do with the type of test that is currently used to identify giftedness (specifically, the SAT). There is a large body of literature suggesting that females do less well on these tests than males (Halpern, 1986). Further, the SAT has been found to underpredict the performance of females in college as compared to their male peers (Holden, 1989). Recent research also suggests that the time limit on the SAT adversely influences female performance. In untimed administrations of the SAT, female performance improved to match that of males (Dreyden, Gallagher, & Brownstein, 1990). A similar improvement in female performance on a test of visual-spatial ability has also been recently reported (Goldstein, Haldane, & Mitchell, 1990). These findings suggest that if the SAT were administered as an untimed test, females might not be underrepresented among the highest scorers.

Turning now to the data on handedness and allergy, we found no support for the claim that these variables are related to high levels of giftedness. There are two aspects of the handedness issue that

deserve comment. First, the failure to find differences between the highly gifted and the less gifted controls is not merely the result of a sample size that is smaller than Benbow's. The phi coefficient upon which our chi-square analysis of handedness by group was based was .034. This coefficient, which may be interpreted in a manner similar to that of a correlation coefficient (Bruning & Kintz, 1968), indicates that the link between left-handedness and high giftedness is *extremely weak*. Such a link, even if significant in a study with very large sample sizes, cannot meaningfully be seen as a major aspect of giftedness. Second, the left-handed rate of 7.2% that Benbow uses for comparison, based upon Geschwind and Behan (1982) is for an adult population. Porac and Coren (1981; Porac, Coren, & Duncan, 1980) have reported an uneven distribution of handedness across age groups. Based upon a compilation of studies, they reported that the proportion of left-handed subjects in the population decreases, from around 15% for subjects less than twenty years of age, to 7% for those in their fifties, and to virtually 0% for those in their 80's. A sample of adult subjects, as in Geschwind and Behan's (1982) study, is clearly inappropriate as a comparison for adolescent subjects. The rate of left-handedness in the general population should be lower than that of any adolescent sample. Because the rate of left-handedness in our sample of highly gifted was 11.5%, there appears to be no basis for the claim that left-handedness is a characteristic of the highly gifted. Even Benbow's report of 15.1% left-handers in her extremely precocious sample is not particularly notable in this light.

Finally, no support for a link between allergies and high giftedness was found. Both the highly gifted and the less gifted samples had rates of self-reported allergies of roughly 33%. It is notable, however, that this figure is markedly higher than the 20% rate found in the general adolescent population (Neinstein, 1984). Several variables in addition to giftedness might explain the elevated rate in the present sample. For example, the Talent Search sample from which the highly gifted and control groups were drawn come from significantly higher SES backgrounds than the population at large (Wiley, Kahn, & Goldstein, 1990) and presumably have parents with greater involvement in their child's health and education, both factors which could easily explain the higher rate of reported allergies. Nevertheless, the link between academic talent and allergy remains unclear.

In conclusion, the present study casts considerable doubt on the utility of the search for physiological "markers" of giftedness. Indeed, the contemporary emphasis on the role of physiological, and more broadly, genetic, influences on behavior has led even this school's

most committed supporters to the conclusion that this approach "has little to say about average differences between groups [e.g., why girls perform better than boys on verbal tests]" (Plomin, 1988, p. 105). Obviously, this critique extends to the problem of why boys perform better than girls on mathematical tests. For the present, at least, the clues to the mystery of giftedness are more likely to be found by studying the way in which factors—such as family and school influence—nurture talent, rather than by searching for the physiological correlates of that talent.

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