Journal of Psycholinguistic Research, Vol. 11, No. 2, 1982

An Evaluation of Evidence for Innate Sex Differences in Linguistic Ability

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Accepted November 2, 1981

A female superiority in verbal ability is reported on many tests. It has been hypothesized that the female brain is more functionally symmetrical for language then the male, and that this is the cause of the alleged superiority. Recent research has suggested that factors other than sex are involved: handedness, age of maturity, and endocrine influences. It is not yet clear whether, despite its biological correlates, the female superiortiy is innate.

INTRODUCTION

A substantial body of evidence suggests that females as a group show a small but significant superiority over males in linguistic aptitude. It has also been argued that this difference is innate and due to sex differences in the organization of the brain. This interpretation of the data, and indeed the validity of the data themselves, have, however, been criticized on several grounds. This survey examines the claims that there is an innate sex difference in linguistic ability, and that the difference is due to brain organization.

The survey is organized as follows: The remainder of this section reviews sex-difference research in general. The second section discusses the basic hypotheses described above and considers the confounding effects of handedness. Some alternative hypotheses, including maturation rates, hormonal effects, and socialization, are considered in subsequent sections.

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0090-6905/82/0300-0095$03.00/0

Methodology in Sex-Difference Research

The study of sex differences, like that of race differences, is inherently difficult and controversial because of the confounding influence of cultural differentiation of the sexes, because of the possibility of unintentional experimenter bias, and because of the political consequences of the results. For example, in the related area of determining whether there is an inherent gender difference in mathematical ability, one can find both recent claims that any differences are due to socially assigned sex roles (Fox, Tobin, & Brody, 1979; Genshaft & Hirt, 1980) and ones claiming the converse (Benbow & Stanley, 1980).

Often the group differences are small compared to the range of individual differences, and they don't show up on all tests designed to reveal them, especially when a relatively small number of subjects is used. For example, to show that two groups differ in IQ by 4 points, using a two-tailed test with .05-level significance, one needs over 400 subjects in each group (Petersen & Wittig, 1979, p. 7). The fact that not all tests find differences often leads to the suggestion that when significant sex differences *are* found, they are not necessarily differences in the ability that the test purports to measure; if sex differences are found on just 5 out of 10 tests of, say, contrapositive thinking, then one wonders whether all the tests are really measuring just contrapositive thinking and nothing else.

In addition, tests may be sex-biased. Dwyer (1979) discusses several ways this can occur, such as the inclusion of a disproportionate number of male characters and the use of sexual stereotypes in the test questions. Bias may also be more subtle. Dwyer points out that it has been frequently observed that females do relatively better in mathematical tests on problems involving the solving of algebraic unknowns that on other problems. Therefore, the magnitude of observed sex differences, if any, may depend critically on the extent to which the test constructor tended to frame questions algebraically rather than, say, geometrically. Even the administration of the test can be biased: Children can do better on an intelligence test when the administrator is of their own sex (Nash, 1979).

The Politics of Sex-Difference Research

Sex-difference research has been criticized as a Bad Thing, with claims that its mere existence seems to presume the existence of sex differences and therefore serves to legitimize socially defined stereotyping of the sexes, and, in particular, the oppression of women. Furthermore, if unimpeachable group differences (or even impeachable ones)

were found, they may be used in support of socially malodorous claims of group superiority and of discrimination against individuals because of their sex. Some group differences might well be placed under the heading "Knowledge we'd be better off not having."

On the other hand, Petersen and Wittig (1979) stress the importance of determining the validity of already reported claims of gender differences, some of which are demonstrably misinterpretations of data.[2] Moreover, if there do exist demonstrable group differences, then their study will contribute to our knowledge of the general nature of cognitive mechanisms. For example, an explanation of the (alleged) sex differences in the occurrence of and recovery from aphasia (to be discussed below) could lead to new therapies for the disorder.

Some critics, e.g., Star (1979a, 1979b) and Lowe and Hubbard (1979), apparently believe a priori that there are no innate sex differences of any kind that are not directly connected with reproduction. They attribute findings to the contrary to social stereotyping and bias on the part of "patriarchal scientists"[3] (Star 1979a, p. 116) who merely find what they are looking for (regardless of reality) in order "to 'prove' things they would like to believe about men and women" (p. 114). Star and Lowe and Hubbard look without bias for problems and loopholes in the research, and find what they are looking for. However, simply pointing out a theory's problems does not actually prove the theory false.

Although important, a detailed discussion of political aspects of sex-difference research is beyond the scope of this paper. The interested reader is referred to the literature on this topic.[4]

VERBAL TEST PERFORMANCE AND BRAIN ASYMMETRY

Sex Differences in Verbal Test Performance

Many researchers have reported sex differences in performance on tests of cognitive ability, and, in particular, that females tend to do better on tests of "verbal ability," including such components as fluency, read-

[2] See Petersen and Wittig (1979, pp. 2–3) for a detailed example.

[3] In fact, it appears that a substantial number of current sex-difference researchers are female, and many make their feminist sympathies clear in their publications. See the papers in Wittig and Petersen (1979), for example.

[4] Hubbard and Lowe (1979) and Hubbard, Henifin, and Fried (1979) may serve as useful, albeit polemical, introductions. Petersen and Wittig (1979) defend the scientific and social usefulness of sex-difference research.

ing comprehension, analogies, and creative writing (Nash, 1979, p. 279). Among the tests on which females perform better are Wechsler similarities, memory for words, and word fluency (Guildford, 1967, p. 404). Conversely, males are better at tests measuring "the ability to perceive and deal with spatial relationships" such as mental rotation, maze tracing, map reading, and the rod-and-frame test (Gullahorn, 1979).

Women appear also to be better at verbal memory, while men show superior recall of spatial relationships. Kail and Siegel (1978) found that when presented with a field of digits, females had better recall for the digits but men remembered their positions better.

It should be stressed that these sex differences do not show up on all tests. For example, Johnson and Harley (1980) (whose work we will examine in detail in a later section) found no sex difference when an individual's scores on the verbal subtests of the Wechsler Adult Intelligence Scale were subtracted from those on visuospatial performance subtests. Thus, the exact nature of the sex-differing abilities is not yet clear; they may not be "pure" verbal or spatial ability but something different and yet related enough to show up on many tests of those abilities, or they may be wholly artifacts of testing.

Sometimes the same test will show sex differences only some of the time. For example, Waber (1976) found no sex differences when she administered tests "for which reliable sex differences . . . had previously been reliably reported" (p. 573). This suggests again that test administration can introduce (or remove) sex differences.

Moreover, it is not always clear that the tests employed are appropriate even to their users' goals. For example, Kail and Siegel used digits rather than letters or words as their "verbal" stimulus. However, it is by no means certain that digits, a more "mathematical" stimulus, would be processed by the subjects in the same manner as English words, especially since there is still controversy over sex differences in mathematical abilities. Similarly, a test that measured vocabulary size would not be a suitable measure of general verbal ability, as it has been shown that at least in children, vocabulary size and other measures of verbal ability are not necessarily correlated (Buffery & Gray, 1972, p. 132).

From an analysis of subtest scores, Hutt (1972) has suggested that the female superiority is primarily one of verbal *fluency* rather than verbal *reasoning*. For example, male children score better overall at verbal comprehension and verbal reasoning in the Differential Aptitude Test battery that nevertheless shows female children better at language usage (Buffery & Gray, 1972, p. 132). However, Buffery and Gray (1972) point out that there are also tests of verbal reasoning, such as the Primary

Mental Abilities Reasoning Test, in which females average higher scores than males.

The Lateralization Hypothesis

It has been hypothesized (e.g., Bradshaw and Gates, 1978) that the reported sex differences in verbal and spatial ability are causally related and due to sex differences in the degree to which language and/or other functions are lateralized in the brain. By lateralization is meant concentration in just one of the brain's hemispheres, so that a highly lateralized brain would be more functionally asymmetrical than one that is less lateralized. The conventional wisdom, of course, is that (in right-handers) verbal functions are wholly or predomininatly represented in the left hemisphere, and nonverbal functions in the right. The question at issue here is whether sex differences in verbal abilities are due to sex differences in the degree of such predominance.

In addition, there are two competing subhypotheses. One is that lateralization is greater in the female (Buffery & Gray, 1972), the other that it is greater in the male (Levy, 1972). (The latter is currently winning, as we shall see below.)

We can identify three separate claims in the basic hypothesis: (1) that verbal and spatial abilities are inversely correlated; individuals high in one will tend to be lower in the other; (2) that one sex is more lateralized than the other; (3) that degree of lateralization determines relative verbal and spatial abilities.

In this section we shall take the first claim as a given. (It will be challenged later on.) We have already noted that it is often reported for the sexes, and Petersen (1976) cites studies reporting even for single-sex groups, that spatial ability seems to be negatively correlated with performance in language courses.

Sex Differences in Lateralization. We now turn to the claim that there are sex differences in brain asymmetry. McGlone (1980) provides an extensive review and evaluation of the evidence to date on the matter, and it is far beyond the scope of the present paper to provide more than a sample of the current data. The interested reader should consult McGlone's review and the commentaries published therewith.

Dichotic listening tests are often used as a measure of lateralization. The degree to which one ear (usually the right) shows an advantage over the other on verbal material is inferred to be the degree to which the contralateral hemisphere dominates language. That is, a strong ear advantage implies strong lateralization. (Some of the studies we shall see in

the following sections test for ear advantage and equate this—sometimes only implicitly—with a lateralization test.) According to McGlone (1980), most studies that analyzed for sex differences in dichotic listening found none, but most of those that did find a difference found that males had a stronger ear advantage. However, she points out (1980, p. 220) there are many methodological problems in this approach; confounding factors include memory and possible sex differences in auditory thresholds.

Clinical studies of patients with unilateral brain lesions are another source of evidence. Two such studies have suggested that males show greater functional asymmetry for spatial and verbal processing than females do. McGlone and Kertesz (1973) found that females with left-hemisphere damage showed significantly reduced scores on spatial tasks as well as verbal ones, while males did not. (All subjects were right-handed.) In another study, McGlone (1978) found that right-handed males with left-hemisphere lesions averaged lower verbal IQ scores than left-damaged females or right-damaged patients of either sex, even when only nonaphasic patients were considered. This suggests that the females were more symmetrical in brain function.

These results are consistent with reports that male stroke victims are more likely than females to suffer aphasia, and that male aphasia victims have more residual disorders (McGlone 1980). If this is true, it is evidence that linguistic abilities are more localized—and so possibly more lateralized[5]—in the male. Unfortunately, there are few hard data on this alleged male vulnerability, and what there are are open to different interpretations. Fairweather (1980) cites the same study as McGlone (1980) to "suggest that female aphasia is a much less rare phenomenon than McGlone appears to want us to believe" (p. 235). Kinsbourne (1980) claims that if females are less lateralized, there should be right-hemisphere female aphasias, which there aren't, and that sex differences in aphasia are only artifacts of sex differences in the physical severity of brain damage.

Anatomical studies offer little support, as it is hard to relate anatomical differences to brain function, nor would an absence of sex differences in morphological brain asymmetry necessarily argue for an absence of them in functional brain asymmetry. Again, the data are equivocal. Witelson and Pallie (1973) found that in a small sample of neonates, the

[5] A possibility that has received little attention in the literature is that sex differences in aphasia are caused by *intrahemispheric* sex differences in brain organization. Kimura (1980) reports preliminary data suggesting that in males more language functions are located toward the left posterior region, where they are more vulnerable to stroke damage, while in females it is the left anterior region that is more critical for language.

females' brains were more asymmetrical, having the left temporal lobe significantly larger than the right; males showed no such difference. (The left temporal lobe is known to be important in language function.) Conversely, Wada, Clarke, and Hamm (1975) (whose sample was much larger) found the left lobe larger than the right in about 90% of both infants and adults. In general, males showed a slightly greater left-right difference (though not a statistically significant one). In adults, but not infants, females significantly predominated among those whose right temporal lobes were larger.

It is hard to conclude from present data that lateralization differs in the sexes. The data that do suggest a difference mostly favor greater lateralization in the male.

Relating Lateralization to Verbal Ability. Although sex differences in lateralization and in cognition have not been unequivocably demonstrated, it has been argued that if they *did* exist, the former would be the cause of the latter. The status of these arguments at present is that of models whose testability is weak or nil. We shall review them briefly.

Buffery and Gray (1972, p. 144) made the following three assumptions:

1. Bilateral representation of language, spreading it into the nondominant hemisphere, leaves more room in the dominant hemisphere for spatial functions. That is, spatial ability can be more symmetrically distributed when linguistic ability is.
2. Greater lateralization of language is beneficial, for the more localized it is, the better the "quick associations and serial ordering" demanded by linguistic skills can be served by "fast and intricate neural mechanisms" (p. 144).
3. Conversely, spatial skills benefit from bilateral representation, as such skills need to involve perceptors and effectors on both sides of the body.

It follows from these assumptions, and the assumption of female-verbal/male-spatial superiorities, that females must be more lateralized. Buffery and Gray review some evidence for greater female lateralization. The assumptions on which the causal relationship is predicated, however, are virtually untestable, at least given present-day knowledge, and, as we saw, the data no longer seem to support Buffery and Gray's conclusion anyway.

Unfortunately, the converse hypothesis, greater lateralization in the male as a cause of sex differences in verbal ability, does not fare much better, being based mostly on speculation. The hypothesis is usually associated with Levy (1969, 1972).

Levy speculated as follows: Male left-handers do poorly in spatial tests (Levy 1969) and show less lateralization than right-handed males. The same is true of females. Perhaps this is not a coincidence.[6] The suggestion is, as Bradshaw and Gates (1978) put it, that "the frequently reported verbal superiorities (and visuospatial inferiorities) of females may stem from an invasion of right hemisphere space otherwise reserved for visuospatial processing" (p. 183). It is postulated that this leads to competition between verbal and nonverbal processing in the same hemisphere, producing the differences in abilities.

Alas, the data on left-handers are as equivocal as for the sexes. Warrington and Pratt (1973) used verbal tests in conjunction with unilateral electroconvulsive therapy; they found that only about 25% of left-handers have an appreciable degree of bilaterality. Marshall's (1973) review of ECT and sodium amytal studies suggests that the figure may be even lower.

Partially supporting Levy, McGlone and Davidson (1973) found (along with the usual sex differences) that while not all left-handers had poor spatial scores, those who did were those who showed higher left-ear scores in a dichotic listening test. However, the competition hypothesis was not borne out: Subjects were tested for hemispheric dominance in spatial processing by seeing which visual field was superior in estimating the number of dots in a tachistoscopically presented stimulus. It was found that subjects (of either handedness) who showed the same hemispheric dominance for both verbal and spatial processing did *not* do significantly worse on spatial tests than those who had different dominances.

Johnson and Harley (1980) hypothesized that if left-handers and females show similar cognitive styles, the effects of handedness and sex would be additive, and that therefore sinistral females would show particularly poor spatial ability but full or superior verbal competence. They classified subjects as either "firm-right" or "firm-left" if they consistently preferred the hand named, or "mixed-left" if variable in hand preference. Tests administered were a short form of the WAIS (two verbal and two performance subtests) and two group tests, the Mill Hill Vocabulary Scale synonyms test and the Flags test of spatial thinking.

Because the male and female groups were not matched for overall IQ, the difference between each subject's verbal and performance scores was used as that person's score on the WAIS. On the WAIS, no effects of

[6] Levy considered only spatial ability differences, not verbal differences, as verbal superiority for left-handers had apparently not then been shown. Johnson and Harley (1980) subsequently reported it; see below.

sex or handedness were found. However, when all tests were considered together, the predicted effect of handedness was found: Firm-left subjects scored significantly better than the others on the Mill Hill Test and significantly worse on the Flags test. However, sex differences were still not found: The females performed worse overall than the males, but there was no sex difference in subjects' verbal-spatial score differences.

It is not clear what to make of these results. Johnson and Harley's original goal was to investigate the relationship between left-handers and females of either handedness with regard to their cognitive abilities. But since they found no sex differences,[7] it is hard to conclude that the handedness differences they did find are related to the gender differences others have reported. And since the WAIS found no group differences at all, Johnson and Harley suggest that it is not clear in exactly what "verbal" and "spatial" abilities sex (or handedness) differences occur. And, a fortiori, we might add, it is not clear that it is the same set of abilities that varies with sex or handedness; indeed, the Johnson and Harley results lend weight to the converse suggestion.

Let us now consider what their results can tell us about brain lateralization. The title of their paper ("Handedness and sex differences in cognitive tests of brain laterality") and some of their remarks seem to imply that there are laterality consequences in their results. However, these consequences would seem to be very small. Subjects were not given any test, such as dichotic listening, for lateralization. Instead, Johnson and Harley simply rely on the fact that "previous studies have inferred less clear lateralization [in sinistrals]" (p. 79), but then caution future researchers that firm-left subjects must be carefully distinguished from mixed-left subjects, as the latter appear more like dextrals. But in view of (1) the uncertainty that left-handers are less lateralized, (2) the presumption that most previous studies did not make a firm-left/mixed-left distinction,[8] (3) the failure of Johnson and Harley to do any lateralization tests of their own and correlate them with the ability-test results, and (4) the few left-handed subjects (about 15 firm and mixed of each sex), it does not seem possible to draw any conclusions about brain lateralization on the basis of their results.

We see then, from the Johnson and Harley results, that handedness is a better predictor than sex of superior verbal and inferior spatial abilities on at least some tests. It is by no means clear, however, how to relate this

[7] Except that their males had a higher overall IQ, an effect that they make no attempt to explain.

[8] Though McGlone and Davidson (1973) attempted to exclude ambidextrous subjects.

fact to brain lateralization or other putative innate sex differences in linguistic ability.

Lateralization: Some Conclusions. It is clearly not possible on the basis of the present data to relate sex (or handedness) differences in brain organization (if any) to differences in verbal ability (if any). Neither Buffery and Gray's hypothesis nor Levy's can really cut the mustard. Neither explains all the data that need explanation, and both are founded on assumptions that are untrue or presently untestable.

OTHER PREDICTORS OF VERBAL ABILITY

We have seen in the research examined above that sex may be a predictor, albeit a poor one, for verbal ability and/or brain lateralization. However, some studies have found other predictors that are more powerful than sex: age of maturity and physical androgyny.

Maturity

It has been suggested that adolescent girls may have developed a stronger verbal ability than boys simply because they are on the whole more mature. Waber (1976) sought to test this hypothesis. She controlled for maturation by comparing the verbal and spatial abilities of early- and late-maturing girls and boys. Using the Tanner criteria for maturity as a measure, she took subjects who were at least 1 standard deviation above or below the mean for their age in maturation. Subjects were also either classed as young (10-year-old girls, 13-year-old boys) or older (13-year-old girls, 16-year-old boys). Waber used a battery of six verbal or spatial tests on which sex differences had been previously reported, and, like Johnson and Harley, used the difference between an individual's verbal and spatial scores as a measure of "intraindividual strengths and weaknesses independent of overall intelligence" (p. 573).

She found that early maturers scored better in the verbal than in the spatial tests, while the converse was true for late maturers. However, this was due only to a variation in spatial scores, which increase significantly with late maturity; there was no relationship between maturity and verbal scores. Nor did sex differences, "although in the predicted direction, . . . reach a conventional level of significance" (p. 573). This all remained true even when age was controlled for, that is, even when the 13-year-old boys and 13-year-old girls were compared.

In the dichotic listening test, late maturers showed greater ear ad-

vantages than early maturers in the older group, but there was no such difference in the younger group, nor were there any sex differences.

These results strongly suggest that it is the age of maturation rather than sex that is important in determining spatial abilities, verbal-spatial score differences, and lateralization. Apparent sex differences, at least in adolescents, are "explained" by girls being generally more mature than males of the same age and having just the characterisitics that early maturers of either sex were found to have. (Why age of maturation should matter, of course, remains to be understood.) It requires a leap of faith, however, to generalize this result to adults, that is, to suggest that the earlier a person matures, the less lateralized that person's language will be and (hence?) the poorer their spatial ability for the rest of their life, and that since females on the whole mature earlier than males, this is why as a group they exhibit the consequent characteristics.

This hypothesis has apparently not yet been tested. (Indeed, a test commenced after the publication of Waber's results could not be complete as this survey is written, for the study would necessarily take several years.) Groups of early- and late-maturing children would need to be identified and tested. Then they would be retested at, say, 21, to see if each group had maintained its abilities relative to the other into adulthood, or whether the effect was merely a transitory one of adolescence. If the former result were found, it could then be posited that lateralization of language in the brain is primarily a hormonal rather than a gender effect. (We will return to this point shortly.)

It is important to note that Waber did not find sex differences in verbal ability, even though they had been reported earlier for the tests she used. But if one is to say that sex differences are an artifact of maturity differences, then when Waber compared the 13-year-olds she should have found those artifactual sex differences (Fairweather, 1976). Her failure to do so suggests that perhaps the maturity factor is not as straightforward as it appears. On the other hand, since statistically nonsignificant sex differences *were* found, perhaps the failure was nothing more than the caprice of probability or an inadequate sample size. (Waber used only 10 subjects in each of the eight groups.)

Moreover, Waber's results showed significant maturity differences only in intraindividual verbal-spatial differences, not in absolute verbal scores. However, such absolute sex differences, as we saw above, have been shown on many tests, including those Waber used. Therefore, maturity does not seem to explain the female superiority on verbal tests. Again, this may be statistical misfortune, and a replication with a larger sample would be useful.

But let us suppose that Waber has *not* been let down by statistics. This would then suggest that verbal and spatial abilities are not inversely correlated, that spatial abilities may be correlated with age of maturity but that verbal skills are not. It would follow that not both skills are related to brain lateralization, but that at least one of them—probably verbal ability—is independent of it. When we look below at the work of Petersen, we will see another hint of such a dissociation.

The Role of Hormones

Waber's experiment suggested that hormones influence cognitive ability and/or lateralization. Indeed, there is a growing section of behavioral endocrinology concerned with the relation between hormones and general cognitive functioning (Petersen, 1979). Unfortunately, the data on hormones and language do not yet support much more than speculation, as they are seemingly inconsistent.

For example, on the one hand, there are the results of psychological tests performed on victims of kwashiorkor, a protein-deficiency disease that prevents inactivation of estrogen in the male, resulting in "feminization" such as breast enlargement. Buffery and Gray (1972, p. 130) report that West African male victims as a group show superior verbal abilities and lower spatial and numerical abilities than control subjects.

On the other hand, there are the data from children afflicted with Turner's syndrome, an absence of or defect in one sex chromosome, which results in a child who is externally female but who cannot produce female hormones. These people have normal or superior verbal comprehension but deficits in spatial ability (Reinisch, Gandelman, & Spiegel, 1979; Waber, 1979).[9] In addition, Turner's-syndrome patients are more likely to have a left-ear advantage (Waber, 1979).

So in one case we have a *surfeit* of female hormones correlated with increased verbal ability and decreased spatial ability; in the other case an *absence* of such hormones correlates with much the same effect. Waber (1979) reports the suggestion that there are certain hormones (presumably occurring more in the male) that are necessary for left-hemisphere lateralization of language; in their absence, language goes to either side or both. Of course, this does not account for any variation in lateralization due to handedness.

[9] These results, incidentally, show that superior spatial ability cannot be directly determined by a sex-linked gene, for if it were X-recessive, then it would occur in Turner's-syndrome patients with the same frequency as in males (Harris, 1978).

Even more intriguing are the results of Petersen (1976, 1979), who investigated the relationship between "somatic measures of hormone influence" (1979, p. 203) and cognitive performance. These somatic measures included such things as muscle and fat distribution, breast or penis size, and the distribution of pubic hair. Adolescent subjects (13, 16, or 18 years old) were classified along a continuum ranging from "extremely masculine" through "androgynous" to "extremely feminine" according to the degree they were either sex-stereotypic or androgynous.[10]

Tests were given for spatial ability and fluent production (a repetitive verbal skill on which females generally do better (Petersen, 1976)). If verbal and spatial ability were influenced by estrogen and androgen, respectively, it would be expected that androgynous males would show poorer spatial ability and better verbal ability than the "more masculine" males, while androgynous females would be verbally poorer but spatially stronger than other females. This was not found. Rather, in the two older groups, androgynous subjects of both sexes showed superior spatial abilities compared to both the more masculine and the more feminine subjects. Androgynous males were poorer at fluent production than other males; in females there was no correlation between androgyny and fluent production scores. (No correlations at all were found for the 13-year-olds.)

These results, and those of Turner's-syndrome patients, suggest that while hormones may play some complex role in spatial ability—perhaps there is an optimal androgen-estrogen balance for superior spatial ability—they do not necessarily influence verbal ability. It should be noted, though, that the sex differences in fluent production scores might be explained by the fact that the task was an inherently tedious and repetitive one ("automatizing"), rather than by any considerations of linguistic skill; androgynous males have been shown to be poorer than other males in automatizing tasks, and performance on such tasks has been shown to be related to testosterone levels (Petersen, 1979).

If we identify androgyny with late maturation, assuming androgynous subjects were exactly those who were lagging in sexual maturity, then

[10] There are two obvious objections to Petersen's procedure. One concerns the confounding of androgyny and maturity; this will be discussed later in this section. The other concerns the validity of making inferences about people's hormone levels just from looking at nude photographs of them, as the somatic measures cited are surely affected by many factors other than hormones. Petersen points out the major methodological problems still unsolved in measuring endocrine activity (1979, pp. 195–197) and cites some support from the published literature for her procedure.

Petersen's results are consistent with (if not identical to) those of Waber (1976), discussed in the previous section, in which late maturation correlated with superior spatial ability but did not correlate with verbal ability. However, this identification is at best tenuous; except perhaps for the 16-year-old males, all her subjects in the groups with correlations were presumably fully sexually mature.[11] Moreover, Petersen reanalyzed her data in the manner of Waber and found no correlation between age of maturity and cognitive scores, although she suggests (1976, p. 530) that sample differences may account for this. In any event, it would be useful to know if Petersen's results can be replicated with older subjects.

More important to the subject of this survey, there seem to be no data relating androgyny to nonautomatizing linguistic skills or to lateralization. This is unfortunate. If the standard hypothesis that there is an inverse relationship between spatial and verbal ability is to be maintained, these data, when collected, would have to show androgynous people poorer in verbal ability and more lateralized than more sex-stereotypic people are. It remains to be seen if this is the case; Waber's results suggest that it won't be.

ARE SEX DIFFERENCES IN LINGUISTIC ABILITY INNATE?

Heretofore we have tacitly assumed that if there is a sex difference in linguistic ability then it is innate. In this section we will discuss some evidence that challenges this assumption. The basic socialization hypothesis is that each sex shows superior ability in the skills that society, for one reason or another, chooses to reinforce as appropriate to that sex, and only because of that reinforcement.

Before proceeding, we should make it clear that finding biological correlates for the sex differences—lateralization differences, for example—does not rule out socialization as a cause. It has been suggested, for example, that the "feminine" abilities of kwashiorkor victims stem from their more feminine appearance affecting the social influences on them (reported by Petersen, 1976, p. 525). Even lateralization differences might be explained as an effect of the practice of skills associated with assigned sex roles (Petersen, 1979, p. 208).

[11] It is of course inherent in Petersen's rating scheme that it confounds androgyny and maturity. Strangely, she concedes that this could be a problem when dealing with subjects who are not guaranteed to be fully mature—less than 18 years, she suggests (1976, p. 527)—and yet she then seems to ignore or gloss over the problem, despite the fact that most of her subjects were under 18 and her title is "Physical androgyny and cognitive functioning in *adolescence*" (italics added).

If verbal abilities are determined by sex role, we would expect them to be correlated in an individual with the degree to which he or she perceives, accepts, and plays out that role. Several studies cited by Nash (1979) show that reading is perceived by children as a feminine activity, and that boys who perceive it as more feminine are somewhat poorer readers. Reading ability has also been shown to be inversely related to the degree of masculinity in the self-image of adolescents, while spatial ability was positively correlated (Nash, 1979); in fact, spatial ability in girls who said they would like to have been boys was as high as in boys who said they did not want to be girls.

This could be seen as evidence of people acting the sex roles they perceive as theirs or, if they find the sex role too inappropriate to themselves, then to some extent rejecting or ignoring it. A simpler explanation, however, is that subjects "upgrade" their abilities and excuse their inabilities by appropriate sex-role judgments; when the disparity between ability and sex role is too great, they express a desire for a new sex role.

More evidence of the social influence are studies (cited by Nash, 1979) showing that in Germany and England, where reading is considered male-appropriate, boys have higher reading scores than girls. This suggests that female superiority in verbal ability may be primarily a North American phenomenon.[12]

Arguing against socialization are the data of Petersen (1976, 1979), discussed earlier, showing physically androgynous males to have inferior fluent production ability and superior spatial ability to that of more masculine subjects.[13] If socialization were the main factor, then we would expect the more physically masculine males to have an equal or better spatial score than the others (Petersen, 1976), just as we suggested that social pressures may have led to the higher verbal scores of the kwashiorkor victims. A possible counterargument is that the physically androgynous males "compensated" for their androgyny by adopting a "stronger" masculine sex role.

Also arguing against socialization is the age at which the sex differences become apparent. Although Nash (1979) claims that it is at about 11 years of age, just when sex roles start to become important in the child's life, Gullahorn (1979) presents data showing female superiority from the age of 6 months. Girls are faster to acquire language and are more fluent

[12] American science has an unfortunate tendency to equate America with the universe and ignore research in the rest of the world, even research in other English-speaking countries where the language barrier cannot be used as an excuse. A psychological phenomenon found in American high school or college students is assumed to be a human universal.

[13] Do not confound physical masculinity and androgyny in Petersen's studies with the psychological masculinity and androgyny of Nash's.

than boys from an early age. The degree to which maturation differences between the sexes explain this is, of course, unknown.

CONCLUSIONS

In a paper in which as much uncertainty is expressed as this one, there are no neat conclusions. We have seen that there *may* be sex differences in both linguistic ability and functional brain lateralization, and the two *may* be causally related. If the differences do exist, they *may* be related more to handedness than sex and *may* be influenced by hormonal activity, or correlated with age of maturity, or *may* perhaps be mostly induced by social factors.

What new work would be necessary before we could reach some interesting conclusions? For a start, it would be useful to have some tests for verbal ability that unequivocally avoid sex bias (assuming such tests could be agreed upon). Some large and expensive studies could then try to see if females really do have a verbal superiority, even when everything controllable is controlled for. Studies in other societies would of course be necessary too. (The results would probably be no more well accepted than the similar project looking at sex differences in mathematical abilities, cited in the first section, or studies examining racial differences in IQ, especially if differences were found.)

Careful (and preferably cross-cultural) replications of the work of Waber (1976) and Petersen (1976, 1979) and performance of the longitudinal study suggested in the third section are also necessary. This work would be important for two reasons. First, the experiments cited have suggested a dissociation between verbal and spatial ability. If the dissociation could be proved, then explanations that assume verbal and spatial ability to tend to be mutually excluding could be ruled out. Second, Waber's and Petersen's data suggest neat explanations ("It's not sex, its _____"), which, if shown to be true, could open new areas in the study of the biological basis of cognition ("The reason _____ influences verbal behavior is . . .").

Then too, it would be nice to have the Truth About Lateralization. Indirect approaches have yielded ambiguous and contradictory data. Ethical direct approaches such as sodium amytal studies are difficult and slow to provide data for a large-enough sample, but it is probably only through these that the matter can be resolved.

It is important that researchers keep in mind the social implications of sex-difference research. Experiments that could needlessly produce

results open to popular misinterpretation should be avoided. Petersen's work (1976, 1979) is a good example of walking the tightrope that leads to important insights but risks undesired social consequences. For example, a finding that less physically androgynous females had superior verbal ability could have easily been distorted in the popular press as, say, breast size determining a female's verbal abilities (or, worse, her secretarial abilities). Scientific research is not done in a social vacuum.

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