Journal of Clinical and Experimental Neuropsychology

ISSN: 1380-3395 (Print) 1744-411X (Online) Journal homepage: https://www.tandfonline.com/loi/ncen20

Is there a sex difference in human laterality? II. An exhaustive survey of visual laterality studies from six neuropsychology journals

Merrill Hiscock , Marlyne Israelian , Roxanne Inch , Carolyn Jacek & Cheryl Hiscock-kalil

Journal of Clinical and Experimental Neuropsychology
1995, Vol. 17, No. 4, pp. 590-610

1380-3395/95/1704-590$6.00

Is There a Sex Difference in Human Laterality? II. An Exhaustive Survey of Visual Laterality Studies from Six Neuropsychology Journals*

Merrill Hiscock[1], Marlyne Israelian[2], Roxanne Inch, Carolyn Jacek[3], and Cheryl Hiscock-Kalil[4]
[1]University of Houston, [2]Emory University, [3]University of Saskatchewan, and [4]Sam Houston State University

ABSTRACT

The contents of six neuropsychology journals (98 volumes, 368 issues) were screened to identify visual half-field (VHF) experiments. Of the 516 experiments identified, 42% provided information about sex differences. Sixty-eight experiments yielded a total of 92 sex differences, 23 of which met stringent criteria for sex differences in laterality. Of the 20 sex differences satisfying stringent criteria and lending themselves to interpretation in terms of the differential lateralization hypothesis, 17 supported the hypothesis of greater hemispheric specialization in males than in females. The 17 confirmatory outcomes represent 7.8% of the informative experiments. When less stringent criteria were invoked, 27 outcomes (12.3% of the informative experiments) were found to be consistent with the differential lateralization hypothesis. Six findings were contrary to the hypothesis. The results, which closely resemble results for auditory laterality studies, are compatible with a population-level sex difference that accounts for 1 to 2% of the variance in laterality.

The existence of a sex difference in hemispheric specialization is a matter of dispute. After noting reports of sex differences in dichotic listening and tachistoscopic studies, McGlone (1980) concluded that asymmetries indicative of left hemisphere dominance for linguistic processing are more marked and more frequent in adult right-handed males than in adult right-handed females. McGlone (1980) also cited sex differences in verbal and nonverbal abilities following unilateral cerebral lesions (e.g., Lansdell & Urbach, 1965; McGlone, 1977, 1978; McGlone & Kertesz, 1973) as evidence that males have more marked lateralization of cerebral functions than do females. However, sex differences in performance on perceptual laterality tasks tend to be sporadic (Bryden, 1982, 1988), as do sex differences in the consequences of unilateral brain lesions (Bornstein, 1984; Kertesz & Sheppard, 1981; Snow & Sheese, 1985). Furthermore, some of the sex differences reported in lesion studies may be attributable to differences between males and females in the strategy used to accomplish nonverbal tasks (Inglis & Lawson, 1982).

As pointed out by Hiscock, Inch, Jacek, Hiscock-Kalil, and Kalil (1994), previous reviews of sex differences in laterality (e.g., Bryden, 1988; McGlone, 1980) have highlighted positive findings selected from an unspecified population of laterality studies. Given the variability of outcomes across experiments, as well as the diversity of stimuli and procedures that have been used, it is unlikely that any definitive conclusion regarding sex differences can be reached on the basis of a small number of experiments selected in an unspecified manner.

The solution to the problem of haphazard

* This work was supported in part by a grant to the first author from the Medical Research Council of Canada. The authors thank Jenine Hawryluk and Paula J. Lyon for their assistance. Reprint requests should be addressed to Merrill Hiscock, Department of Psychology, University of Houston, Houston, TX 77204-5341, USA.
Accepted for publication: December 29, 1994.

sampling entails either sampling randomly from a specified population of experiments, or examining all experiments in the population. In a previous study (Hiscock et al., 1994), we examined all of the dichotic and monaural listening experiments in a population of 352 published experiments. Even though 60% of the experiments provided no information about sex differences, 11 of the informative experiments yielded an unequivocal sex difference in laterality and another 17 experiments provided less direct evidence. Of these 28 outcomes, 21 were consistent with McGlone's (1980) hypothesis of greater lateralization in males. The proportion of confirmatory outcomes differed significantly from chance at $p = .01$. Hiscock et al. (1994) concluded that findings from dichotic and monaural listening studies are compatible with "the concept of a weak population-level sex difference" (p. 433).

Using the same data base as that used by Hiscock et al. (1994) to identify auditory laterality studies, we conducted an exhaustive search of visual laterality studies. Six mainstream neuropsychology journals were surveyed in order to determine (1) the number of visual studies providing information about sex differences; (2) the proportion of studies showing a sex difference according to specified criteria; and (3) the direction of the sex differences reported, that is, whether males and females are equally likely to show the greater asymmetry.

METHOD

Data Sources

The following periodicals were examined: *Brain and Cognition, Brain and Language, Cortex, Developmental Neuropsychology, Journal of Clinical and Experimental Neuropsychology* (previously *Journal of Clinical Neuropsychology*) and *Neuropsychologia*. Each issue, from the inception of the respective journal to December 1987, was included in the survey. Coverage included a total of 98 volumes, which comprised 368 issues. Table 1 shows the yield of experiments from each journal.

Procedure

The sequence of stepwise decisions made for each experiment is summarized in Table 2. This series of tests is identical to that used by Hiscock et al. (1994) except that visual studies were selected in lieu of auditory studies, and the distinction between unilateral and bilateral visual stimulation replaced the distinction between monaural and dichotic listening.

Beginning with the table of contents for each issue of each journal, we identified all papers that might include laterality findings. When there was any doubt about the possibility of laterality data in an article, the article was marked for examination. Each paper so identified was then inspected to determine whether (1) a measure of laterality was included in one or more experiments and (2) a sample of normal children or adults contributed data. Experiments meeting these two criteria were examined further to determine if stimuli were presented (3) in the visual modality and (4) in one visual half-field (VHF) per trial. If the stimuli were not visual, the experiment was not included in the present study. Experiments employing bilateral stimulation (i.e., simultaneous presentation to left and right VHF) were included in the study, but unilateral and bilateral studies were compiled separately.

The next step (5) entailed determining whether adults or children served as subjects; data for adults and children were tabulated separately. The next three steps entailed determining whether (6) the subject's

Table 1. Data Sources.

Source	Total Experiments	Informative Experiments	Percentage
Brain and Cognition	52	28	53.8
Brain and Language	118	56	47.5
Cortex	147	61	41.5
Neuropsychologia	194	71	36.6
Journal of Clinical and Experimental Neuropsychology[1]	4	2	50.0
Developmental Neuropsychology	1	1	100.0
Total	516	219	42.4

Note. [1]Includes all volumes of *Journal of Clinical Neuropsychology*.

Table 2. Sequence of Tests.

Step	Test	Positive Result	Negative Result
1	Laterality study?	Go to 2	Stop
2	Normal subjects?	Go to 3	Stop
3	Visual modality?	Go to 4	Record
4	Unilateral presentation?	Go to 5	Go to 5
5	Adult subjects?	Go to 6	Go to 6
6	Sex of subject specified?	Go to 7	Tabulate
7	Both sexes included?	Go to 8	Tabulate
8	Sex as factor in analysis?	Go to 9	Tabulate
9	Significant sex difference?	Go to 10	Tabulate
10	Category of sex difference?	[Go to Table 3]	

sex was specified, (7) subjects of both sexes were included, and (8) sex of subject was included as a factor in the data analysis (or if separate analyses were performed for females and males). If any of these three questions yielded a negative answer, the experiment was classified as uninformative with respect to sex differences.

The final steps were (9) to determine whether there was a statistically significant sex difference and (10) to categorize the significant sex difference according to the classification scheme depicted in Table 3.

Category A comprises significant main effects for sex of subject, that is, outcomes reflecting a difference between females and males in overall performance. Although Category A outcomes have no direct relevance to the hypothesis of greater lateralization in males, such outcomes may be of interest for other reasons. Category B outcomes consist of either a significant Sex x Visual Field interaction for raw scores or the comparable finding for laterality indices, which is a significant main effect for sex of subject. In either case, the finding would reflect a significant difference between the VHF advantage shown by males and the VHF advantage shown by females. Category B outcomes are directly relevant to the hypothesis of greater lateralization in males. Category C consists of significant Sex x Visual Field x Third Factor interactions in the case of raw scores and Sex x Third Factor interactions when laterality indices are used. Such outcomes may or may not be interpretable with respect to the sex difference hypothesis. Category D outcomes, which entail four-way interactions, and Category E outcomes, which reflect separate analyses for females and males, are unlikely to provide convincing evidence of a sex difference. Nonetheless, our tabulation includes findings that fall into those categories. The $p = .05$ level was set as the criterion for a statistically significant outcome in all instances.

RESULTS

Proportion of Experiments Yielding Information About Sex Differences

Of the 516 experiments (478 with adult subjects; 38 with child subjects) satisfying the inclusion criteria, 219 (42.4%) yielded information about sex differences. There was a higher percentage of informative experiments among studies of children than among studies of adults, 63.2% versus 40.8% $\chi^2(1, N = 219) = 6.32, p < .025$. The percentage of informative experiments for each of the six journals is shown in Table 1.

Table 3. Categories of Sex Differences.

Category	Raw Scores	Laterality Index
A	Main Effect for Sex	Not Applicable
B	Sex x VHF Interaction	Main Effect for Sex
C	Sex x VHF x Other Factor	Sex x Other Factor
D	Sex x VHF x 2 Other Factors	Sex x 2 Other Factors
E	Separate Analyses	Separate Analyses

Table 4. Number of Experiments Yielding Positive and Negative Outcomes for Adults, Children, and Combined Data.

	Unilateral Presentation	Bilateral Presentation[1]	Total
		Experiments with Adults	
Sex Difference	47	14	61
No Sex Difference	94	40	134
		Experiments with Children[2]	
Sex Difference	4	3	7
No Sex Difference	12	5	17
		Adult and Child Experiments Combined	
Sex Difference	51	17	68
No Sex Difference	106	45	151

Note. [1] Experiments were included in the bilateral category if bilateral presentation was used at all in the experiment, i.e., bilateral only, or both bilateral and unilateral presentation in the same design.
[2] Includes 4 experiments with children and adults, 1 of which yielded a significant sex difference.

Frequency of Significant Sex Differences

Frequency data are summarized in Table 4. Of the 219 informative experiments, 68 (31.1%) yielded at least one significant effect or interaction involving the sex factor. The percentage of experiments with positive outcomes did not differ significantly between experiments with adults (31.3%) and experiments with children (29.2%), or between experiments that used unilateral presentation of stimuli (32.1%) and experiments that used bilateral presentation (28.6%).

Categorization of Positive Outcomes

The number of experiments falling into each of the five outcome categories (A, B, C, D, and E) is shown in Table 5. Multiple positive outcomes in some experiments caused the total of positive outcomes (n = 92) to exceed the number of experiments with positive outcomes (n = 68).

Category A outcomes

A total of 28 experiments (20 with unilateral presentation, 8 with bilateral presentation) yielded 29 significant main effects for sex. All but 2 of the experiments involved adults as subjects. Two of the 29 significant outcomes (Natale, Gur, & Gur, 1983, Experiments 1 and 2) reflected a sex difference in the rating of facial emotion: Females gave lower (sadder) ratings than did males. The remaining 27 significant main effects indicated a sex difference in the accuracy of stimulus identification (n = 15) or in reaction time (n = 12). Females outperformed males in 12 of the 15 accuracy measures, but males were faster than females on 10 of the 12 reaction time measures. Both of these proportions were significantly different from chance by the binomial test, $p < .02$ (Siegel, 1956). In one instance, the female superiority for accuracy and the male superiority for speed were significant within the same experiment (Barry, 1981).

Category B outcomes

The 23 Category B outcomes (22 Sex x Visual Field interactions and 1 comparable main effect) are summarized in Appendix A. Sixteen of the outcomes were associated with unilateral presentation of stimuli; 7 were associated with bilateral presentation. Four of the experiments involved children as subjects, and 19 involved adults.

Three findings are difficult to relate to the hypothesis of greater lateralization in males. The Sex x Visual Field interaction reported by Birkett (1981) is based on reaction time for matching pairs of letters irrespective of spatial orientation (upright or inverted) and type of match required (physical or name). It appears that females showed a right visual field advan-

Table 5. Positive Outcomes by Category.

	Number of Experiments[1]					
	Adults		Children		Combined	
Category	Unilateral	Bilateral	Unilateral	Bilateral	Unilateral	Bilateral
A	20	7	1	1	21	8
B	13	6	3	1	16	7
C	21	7	0	1	21	8
D	4	1	0	1	4	2
E	4	1	0	0	4	1
Total	62	22	4	4	66	26

Note. [1]Totals are inflated by experiments with multiple positive outcomes.

tage overall, whereas males showed no asymmetry. Given that some stimulus and task combinations may favour the left hemisphere, whereas other combinations may favour the right hemisphere, the two-way interaction is not readily interpreted. Tankle and Heilman (1982) found that females but not males made fewer errors from the left visual field than from the right visual field when reading mirror-image words. For various reasons, including the absence of a comparable difference between left- and right-handers, it is not clear how the sex difference should be interpreted. The third ambiguous outcome pertains to a sample of 4-year-olds who were administered a letter-matching task that yielded a right visual field advantage in 5- to 8-year-olds (Davidoff & Done, 1984). Among the 4-year-olds, most of whom were unable to name the letters of the alphabet, boys showed a left visual field advantage and girls showed no significant asymmetry. This outcome could reflect either a greater right-hemispheric specialization in boys for the matching of shapes, or more advanced alphabetic knowledge in girls, whose lack of asymmetry might reflect a transition to the right field superiority shown by both boys and girls at 5 years of age.

One other sex difference also entails some interpretive ambiguity. Jones (1979) found a right visual field advantage for males, but not females, on a task requiring subjects to classify faces as either female or male. Even though the finding for males runs counter to the usual left visual field advantage for facial perception, Jones (1979) argued that discrimination of gender is a function which is distinct from facial recognition and which involves primarily the left hemisphere. Consequently, we include this sex difference among the outcomes consistent with the differential lateralization hypothesis.

Exclusion of the Birkett (1981), Tankle and Heilman (1982), and Davidoff and Done (1984) findings leaves 20 sex differences, 17 of which may be construed as favouring the hypothesis of greater lateralization in males. This distribution differs from chance at $p = .001$ by the binomial test. Two of the contrary findings (Duda & Brown, 1984; Lavadas, Umiltà, & Ricci-Bitti, 1980) concern the perception of emotion in faces. In both instances, females responded more rapidly to faces in the left visual field than in the right visual field, but males showed no asymmetry. The third contrary finding (Young, Bion, & Ellis, 1980) reflects a sex difference in the magnitude of the right visual field advantage for pronounceable nonwords. Although there was a robust visual field effect, the asymmetry was somewhat more marked in females than in males.

Category C outcomes

There were 26 significant three-way interactions among sex, visual field, and a third factor, and 3 interactions between sex and another factor in experiments utilizing a laterality index. Of the 29 outcomes, 21 were associated with unilateral presentation of stimuli, 5 were associated with bilateral presentation, and 3 were associated with a combination of unilateral and bilateral presentations. All but one of the experiments (Young & Bion, 1980, Experiment 2) involved adult subjects.

Four outcomes stem from experiments that also yielded two-way interactions, that is, the Sex x Visual Field x Third Factor interaction was accompanied by a Sex x Visual Field interaction as described in Appendix A. However, in only one instance were the two- and three-way interactions both interpretable with respect to the differential lateralization hypothesis. In that case (Young & Bion, 1980, Experiment 2), only boys showed a left visual field superiority for faces and, as expected, the asymmetry materialized for upright but not inverted faces. Thus, although the three-way interaction seems to strengthen the claim regarding a sex difference in the lateralization of face processing, we excluded the three-way interaction from our tabulation of supportive outcomes so as to avoid inflating the count with partially redundant findings.

The Category C outcomes are described in Appendix B. Of the 29 outcomes, 20 were not readily interpretable in terms of the differential lateralization hypothesis and 1 supportive outcome was excluded because it was redundant with a two-way interaction. The remaining 8 outcomes include 5 that suggest greater lateralization in males and 3 that suggest greater lateralization in females. The distribution is not significantly different from chance, $p = .25$. The outcomes contrary to the differential lateralization hypothesis include a left visual field advantage for females but not males on a face recognition task involving instructions to use emotional imagery (McKeever & Dixon, 1981), and two instances in which females showed a stronger right visual field advantage than males on a verbal task (Healey, Waldstein, & Goodglass, 1985, Experiment 1; McKeever & VanDeventer, 1977).

Category D outcomes

Five experiments yielded six significant interactions among sex, visual field, and two additional factors (Brand, van Bekkum, Stumpel, & Kroeze, 1983; Lambert & Beaumont, 1983, Experiment 1; Pring, 1981, Experiment 1; Seitz & McKeever, 1984; Young & Bion, 1981). Four outcomes were associated with unilateral presentation of stimuli and two were associated with both unilateral and bilateral presentation. Five of the outcomes were associated with studies of adults, and one was associated with a mixed sample of children and adults.

Three of the four-way interactions had been decomposed by the respective authors (Pring, 1981; Seitz & McKeever, 1984) into three-way interactions that are described in Appendix B. Even though these two experiments yielded a total of seven qualifying outcomes – 4 three-way and 3 four-way interactions – none could be interpreted in terms of the differential lateralization hypothesis. The remaining three Category D findings also were judged to be uninterpretable with respect to the hypothesis of greater lateralization in males. Thus, there were no interpretable four-way interactions.

Category E outcomes

As pointed out by Hiscock et al. (1994), the results of separate analyses for males and females must be interpreted cautiously because such results do not establish the existence of a statistically significant sex difference. For instance, even though males show a right visual field advantage that is significant at $p = .05$ and females show no significant asymmetry, the *difference* between males and females may not be statistically significant.

With that caveat in mind, we identified five experiments in which sex differences were suggested by separate analyses for males and females (Davidoff, 1977; Franzon & Hugdahl, 1986; Kail & Siegel, 1978; McGlone & Davidson, 1973; Sasanuma & Kobayashi, 1978). This total does not include any experiment in which the analyses were undertaken to follow up a significant interaction involving the sex factor. All five outcomes were derived from studies of adults, and four of the five were associated with unilateral presentation of stimuli.

Each of the five Category E findings was interpretable in terms of the differential lateralization hypothesis, and each one supported the claim of greater lateralization in males. The proportion of supportive outcomes (5 out of 5) is significantly different from chance by the binomial test at $p = .05$. Four outcomes entailed left visual field superiority for males but not females on tasks that included dot detection, dot enumeration, judgment of line orientation, and naming colours in the presence of Stroop interference. In the fifth experiment (Kail & Siegel, 1978), males showed a right visual field advantage for identifying but not for localizing digits from an array. Females showed no significant asymmetry irrespective of the task.

Composite Data

Accumulating the interpretable outcomes in Categories B, C, D, and E, we find that 27 outcomes are consistent with the differential lateralization hypothesis and 6 are contrary to the hypothesis. This distribution differs significantly from chance by the binomial test, $z = 3.48$, $p < .0005$.

Of the 27 sex differences indicating greater asymmetry in males, 19 were associated with unilateral presentation of stimuli and 8 were associated with bilateral presentation. The respective proportions of positive outcomes, relative to the total number of sex differences from unilateral and bilateral experiments, did not differ significantly, 44.2% versus 50.0%, $\chi^2(1, N = 59) = .01$.

The 27 experiments yielding greater asymmetry in males were categorized as verbal ($n = 9$), nonverbal ($n = 8$), or indeterminate ($n = 10$) on the basis of stimulus and task characteristics. The respective proportions of positive outcomes, relative to the total number of sex differences from verbal, nonverbal, and indeterminate experiments, did not differ significantly, 47.4%, 50.0%, 41.7%, $\chi^2(2, N = 59) = .30$.

DISCUSSION

The most striking aspect of the results is their strong similarity to previous findings regarding sex differences in auditory laterality (Hiscock et al., 1994). Irrespective of modality, the data show that: (1) approximately 40% of studies provide information about sex differences; (2) about one third of the informative studies yield a statistically significant sex difference, and (3) the majority of those significant sex differences are either irrelevant to the differential lateralization hypothesis (e.g., main effects for sex) or difficult to interpret in terms of the hypothesis (e.g., three- and four-way interactions). However, when readily interpretable sex differences are found in either visual or auditory studies, they usually support the hypothesis of greater lateralization in males.

Although the proportion of studies involving children is much smaller in the visual laterality literature than in the corresponding auditory literature, studies of children are significantly more likely than studies of adults – irrespective of modality – to provide information about sex differences. In neither modality is there any obvious difference between children and adults in the incidence or direction of sex differences.

The most stringent criterion for a sex difference in visual laterality is the Category B outcome, that is, a significant Sex x Visual Field interaction or a significant main effect for sex when a laterality index was employed. Even though such outcomes constitute only 23 of the 92 sex differences summarized in Table 5, they provide substantial support for the differential lateralization hypothesis. Of the 20 outcomes that could be interpreted in terms of differential lateralization, 17 suggest greater lateralization in males than in females.

The 3 two-way interactions that run contrary to the differential lateralization hypothesis do not offset the supportive evidence. Any single finding of greater laterality in females than in males could be attributed to sampling error. This explanation is especially plausible in the case of Young et al.'s (1980) Experiment 2, in which the sample was small and the sex difference merely quantitative, that is, males and females differed in the magnitude of asymmetry on a linguistic task that yielded a strong right visual field advantage for both sexes. In fact, each of the 10 male and 10 female subjects showed a right visual field advantage.

The other two contrary findings (Duda & Brown, 1984; Lavadas et al., 1980) involve tasks that require rapid detection of facially expressed emotion. The finding of a left visual field advantage for females but not males may reflect differential strategy or some other factor that is specific to the recognition of emotion in faces. This explanation is supported by sex differences in rated emotion (Natale, Gur, & Gur, 1983), which suggest that females are more sensitive than males to facial emotion cues. Alternatively, one might hypothesize that sex differences in the lateralization of emotion in general are distinct from sex differences in the lateralization of cognitive processes. If only cognitive tasks are considered, then 17 of 18 interpretable Sex x Visual Field interactions – all but the Young et al. (1980) finding – favour the hypothesis of greater lateralization in males.

If there is any notable discrepancy between sex differences in visual and in auditory laterality, it lies in the proportion of interpretable sex differences among three- and four-way interactions. Whereas the auditory literature yielded 10 interpretable outcomes from 21 three- and four-way interactions, the visual literature yielded only 8 interpretable outcomes – excluding 1 that was partially redundant with a two-way interaction – from 35 higher order interactions. Perhaps the lower yield for visual experiments reflects the greater number of stimulus variations that have no clear relationship to hemispheric specialization, for example, size of lettering or lexical category (word vs. pronounceable nonwords). Interactions of such variables with sex and visual field do not lend themselves readily to interpretation in terms of differential lateralization. Among the interpretable higher order interactions, however, the proportion of visual studies that support the differential lateralization hypothesis is similar to the proportion of supportive auditory studies (63% vs. 70%).

Despite the interpretive ambiguity inherent in separate analyses for females and males within a single experiment, the finding that all five separate analyses suggested greater lateralization in males is itself statistically significant. In the auditory literature, five of seven separate analyses suggested greater lateralization in males.

When outcomes are aggregated across categories, 82% of the 33 interpretable sex differences support the hypothesis of greater lateralization in males. This is similar to the 75% support obtained from 28 interpretable outcomes in the auditory laterality literature.

Hiscock et al. (1994) acknowledged the possibility that the sex difference in auditory laterality reflects a factor other than hemispheric specialization. The question may be extended to the sex difference in visual laterality. Under some circumstances, visual half-field asymmetries are influenced by factors such as directional scanning and attentional bias (Bradshaw, Nettleton, & Taylor, 1981; Mondor & Bryden, 1992). However, it seems implausible that a factor of this kind would produce a right visual field advantage for word recognition in males only (e.g., Bradshaw & Gates, 1978, Experiment 3) while producing a left visual field advantage for face recognition in males only (e.g., Rizzolatti & Buchtel, 1977). The similarity of sex differences in visual and auditory modalities also militates against any explanation based on a method-specific artefact. Any factor that produces a sex difference in one modality presumably would have to be present in the other modality as well.

Three hypothetical models were considered by Hiscock et al. (1994) in the light of the auditory evidence: (1) a population-level sex difference that is manifested with certain stimuli or tasks (Bryden, 1982); (2) a population-level sex difference that accounts for little variance and is observed only sporadically (Bryden, 1988; Hiscock & Mackay, 1985); and (3) biased reporting of chance findings, that is, a manifestation of Rosenthal's (1979) "file drawer problem." Hiscock et al. (1994) argued that the auditory laterality results tended to support the second model (a weak sex difference in hemispheric specialization), although the third model (the null hypothesis) could not be ruled out entirely.

The data compiled for the present study strengthen the case for the second model and, accordingly, weaken the case for the third model. If outcomes from both modalities are pooled, then 26 of 30 two-way interactions (87%) and 48 of 61 outcomes from all categories (79%), excluding Category A, support the hypothesis of greater lateralization in males. It may not be possible to reject unequivocally the third model, especially when 60% of experiments are uninformative, but the numbers derived from the combination of auditory and visual data differ quite markedly from the null hypothesis of a 50:50 split between instances of greater male and greater female laterality.

As a first step toward estimating the magnitude of the putative population-level sex difference, we calculated the coefficient of determination, r^2, for each of the Sex x Visual Field interactions that indicated a larger asymmetry for males than for females. Coefficients ranged from .05 to .54. If these 17 outcomes represent approximately the upper 8% of a distribution (the 17 strongest sex differences from 219 informative studies), then r^2 would fall below .05 in the remaining 92% of experiments.

What population-level magnitude is reflected by a sex difference that is detected 8% of the time? Analysis of statistical power (Cohen, 1988) indicates that, assuming a two-tailed *t* test or one-way ANOVA, an alpha level of .05, and a sample size of 30 (the median sample size for the 17 experiments), a true sex difference will be detected 8% of the time if the sex difference accounts for 1% of the variance (i.e., if $r^2 = .01$) In actuality, the power to detect sex differences varies with the experimental design as well as the sample size. Consequently, even if 8% is an accurate estimate for the proportion of confirmatory outcomes, the true effect size of the sex factor may differ somewhat from .01.

The simple model described in the previous paragraph is inadequate in at least two respects. First, it disregards higher order interactions and the results of separate analyses for females and males. Although these outcomes provide a less certain basis for inferences about the underlying population (e.g., because higher order interactions are not possible in all experiments and because, as acknowledged previously, separate analyses may be misleading), their omission causes the number of observed sex differences to be understated. The model also fails to account for sex differences that occur on a chance basis. However, the second factor tends to offset the first. Including higher order interactions and the results of separate analyses adds 10 sex differences that are consistent with stronger lateralization in males, raising the percentage of confirmatory findings to slightly above 12%. But, if 2.5% of the confirmatory findings are attributable to chance (the upper 2.5% of the distribution, based on two-tailed tests with an alpha level of .05), then the remaining percentage of findings at that end of the distribution is approximately 10%, and the estimated effect size for sex falls between .01 and .02. Similar analyses of the auditory laterality data (Hiscock et al., 1994) lead to an estimated effect size of approximately .01.

By the same logic, 2.5% of the significant outcomes at the opposite end of the distribution, that is, instances of greater laterality in females, can also be attributed to chance. The six observed sex differences in that direction constitute 2.7% of the 219 informative experiments and thus their number is remarkably close to the number expected by chance.

The estimated size of the sex effect fits Cohen's (1988) definition of a small effect. However, as Cohen points out, "the *meaning* of any given [effect size] is, in the final analysis, a function of the context in which it is embedded" (p. 535). Rosenthal and Rubin (1982) have shown that weak effects can sometimes be consequential. In the context of hemispheric specialization, a sex difference may be of theoretical interest despite its small magnitude.

Can stimulus or task factors account for the sporadic appearance of sex differences across experiments? Even though Seitz and McKeever (1984) found reversed sex differences for unilateral and bilateral presentation of line drawings, the data in general fail to reveal any difference between experiments with unilateral presentation and those with bilateral presentation. Similarly, the proportion of outcomes that support the differential lateralization hypothesis is similar for verbal experiments, nonverbal experiments, and experiments with both verbal and nonverbal aspects. However, given the abundance of stimulus and task parameters that might influence sex differences, it is impossible to rule out such influences entirely.

The concept of a weak population-level sex difference seems to provide the most satisfactory explanation for the visual laterality data included in our archival study. Although the data do not rule out the hypothesis of no population-level sex difference, they do render the null hypothesis less plausible, especially when the visual data are considered in conjunction with auditory laterality data. As was the case in the previous examination of auditory laterality data (Hiscock et al., 1994), our conclusions are constrained by certain limitations of our analysis, which include its focus on differences between females and males in the magnitude of asymmetry rather than on differences in the distribution of left- and right-sided advantages within each experiment (cf. Bryden, 1983). Moreover, since right-handed North American university students are overrepresented in the studies that we examined, caution must be used in generalizing the results to left-handers and to populations with other ethnic, linguistic, and socioeconomic characteristics.

REFERENCES

Adams, J.O., & Duda, P.D. (1986). Laterality of cross-modal spatial processing. *Cortex, 22*, 539-552.

Barry, C. (1981). Hemispheric asymmetry in lexical access and phonological encoding. *Neuropsychologia, 19*, 473-478.

Bashore, T.R., Nydegger, R.V., & Miller, H. (1982). Left visual field superiority in a letter naming task for both left- and right-handers. *Cortex, 18*, 245-255.

Birkett, P. (1981). Hemispheric asymmetry for classifying upright and inverted letter pairs: Handedness and sex differences. *Neuropsychologia, 19*, 713-717.

Bornstein, R.A. (1984). Unilateral lesions and the revised Wechsler Adult Intelligence Scale: No sex differences. *Journal of Consulting and Clinical Psychology, 52*, 604-608.

Bradshaw, J.L., & Gates, E.A. (1978). Visual field differences in verbal tasks: Effects of task familiarity and sex of subject. *Brain and Language, 5*, 166-187.

Bradshaw, J.L., Nettleton, N.C., & Taylor, M.J. (1981). The use of laterally presented words in research into cerebral asymmetry: Is directional scanning likely to be a source of artifact? *Brain and Language, 14*, 1-14.

Brand, N., van Bekkum, I., Stumpel, M., & Kroeze, J.H.A. (1983). Word matching and lexical decisions: A visual half-field study. *Brain and Language, 18*, 199-211.

Bryden, M.P. (1982). *Laterality: Functional asymmetry in the intact brain.* New York: Academic Press.

Bryden, M.P. (1983, August). *Sex-related differences in perceptual asymmetry.* Paper presented at the meeting of the American Psychological Association, Anaheim, CA.

Bryden, M.P. (1988). An overview of the dichotic listening procedure and its relation to cerebral organization. In K. Hugdahl (Ed.), *Handbook of dichotic listening: Theory, methods and research* (pp. 1-43). Chichester: Wiley.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Erlbaum.

Davidoff, J.B. (1977). Hemispheric differences in dot detection. *Cortex, 13*, 434-444.

Davidoff, J.B., & Done, D.J. (1984). A longitudinal study of the development of visual field advantage for letter matching. *Neuropsychologia, 22*, 311-318.

Duda, P.D., & Brown, J. (1984). Lateral asymmetry of positive and negative emotions. *Cortex, 20*, 253-261.

Franzon, M., & Hugdahl, K. (1986). Visual half-field presentations of incongruent color words: Effects of gender and handedness. *Cortex, 22*, 433-445.

Freeman, J.M., & Ellis, H.D. (1984). The effects of stimulus and subject factors on a face matching task. *Neuropsychologia, 22*, 635-638.

Graves, R., Landis, T., & Goodglass, H. (1981). Laterality and sex differences for visual recognition of emotional and non-emotional words. *Neuropsychologia, 19*, 95-102.

Hannay, H.J., & Malone, D.R. (1976). Visual field effects and short-term memory for verbal material. *Neuropsychologia, 14*, 203-209.

Healey, J.M., Waldstein, S., & Goodglass, H. (1985). Sex differences in the lateralization of language discrimination vs. language production. *Neuropsychologia, 23*, 777-789.

Heister, G. (1984). Sex differences and cognitive/motor interference with visual half-field stimulation. *Neuropsychologia, 22*, 205-214.

Hiscock, M., Inch, R., Jacek, C., Hiscock-Kalil, C., & Kalil, K.M. (1994). Is there a sex difference in human laterality? I. An exhaustive survey of auditory laterality studies from six neuropsychology journals. *Journal of Clinical and Experimental Neuropsychology, 16*, 423-435.

Hiscock, M., & Mackay, M. (1985). The sex difference in dichotic listening: Multiple negative findings. *Neuropsychologia, 23*, 441-444.

Inglis, J., & Lawson, J.S. (1982). A meta-analysis of sex differences in the effects of unilateral brain damage on intelligence test results. *Canadian Journal of Psychology, 36*, 670-683.

Jones, B. (1979). Sex and visual field effects on accuracy and decision making when subjects classify male and females faces. *Cortex, 15*, 551-560.

Kail, R.V. Jr., & Siegel, A.W. (1978). Sex and hemispheric differences in the recall of verbal and spatial information. *Cortex, 14*, 557-563.

Kertesz, A., & Sheppard, A. (1981). The epidemiology of aphasic and cognitive impairment in stroke: Age, sex, aphasia type and laterality differences. *Brain, 104*, 117-128.

Ladavas, E., Umiltà, C., & Ricci-Bitti, P.E. (1980). Evidence for sex differences in right-hemisphere dominance for emotions. *Neuropsychologia, 18*, 361-366.

Lambert, A.J., & Beaumont, J.G. (1983). Imageability does not interact with visual field in lateral word recognition with oral report. *Brain and Language, 20*, 115-142.

Lansdell, H., & Urbach, N. (1965). Sex differences in personality measures related to size and side of temporal lobe ablations. *Proceedings of the American Psychological Association*, 113-114.

Lukatela, G., Carello, C., Savic, M., & Turvey, M.T. (1986). Hemispheric asymmetries in phonological processing. *Neuropsychologia, 24*, 341-350.

Marcel, T., Katz, L., & Smith, M. (1974). Laterality and reading proficiency. *Neuropsychologia, 12*, 131-139.

Martin, C.M. (1978). Verbal and spatial encoding of visual stimuli: The effects of sex, hemisphere and yes-no judgements. *Cortex, 14*, 227-233.

McGlone, J. (1977). Sex differences in the cerebral organization of verbal functions in patients with unilateral brain lesions. *Brain, 100*, 775-793.

McGlone, J. (1978). Sex differences in functional brain asymmetry. *Cortex, 14*, 122-128.

McGlone, J. (1980). Sex differences in human brain asymmetry: A critical survey. *Behavioral and Brain Sciences, 3*, 215-264.

McGlone, J., & Davidson, W. (1973). The relation between cerebral speech laterality and spatial ability with special reference to sex and hand preference. *Neuropsychologia, 11*, 105-113.

McGlone, J., & Kertesz, A. (1973). Sex differences in cerebral processing of visuospatial tasks. *Cortex, 9*, 313-320.

McGuinness, D., & Bartell, T.E. (1982). Lateral asymmetry: Hard or simple-minded? *Neuropsychologia, 20*, 629-639.

McKeever, W.F., & Dixon, M.S. (1981). Right-hemisphere superiority for discriminating memorized from nonmemorized faces: Affective imagery, sex, and perceived emotionality effects. *Brain and Language, 12*, 246-260.

McKeever, W.F., & Hoff, A.L. (1982). Familial sinistrality, sex, and laterality differences in naming and lexical decision latencies of right-handers. *Brain and Language, 17*, 225-239.

McKeever, W.F., & Jackson, T.L., Jr. (1979). Cerebral dominance assessed by object- and color-naming latencies: Sex and familial sinistrality effects. *Brain and Language, 7*, 175-190.

McKeever, W.F., Seitz, K.S., Hoff, A.L., Marino, M.F., & Diehl, J.A. (1983). Interacting sex and familial sinistrality characteristics influence both language lateralization and spatial ability in right handers. *Neuropsychologia, 21*, 661-667.

McKeever, W.F., & VanDeventer, A.D. (1977). Visual and auditory language processing asymmetries: Influence of handedness, familial sinistrality, and sex. *Cortex, 13*, 225-241.

Milstein, V., Small, I.F., Malloy, F.W., & Small, J.G. (1979). Influence of sex and handedness on hemispheric functioning. *Cortex, 15*, 439-449.

Mondor, T.A., & Bryden, M.P. (1992). On the relation between visual spatial attention and visual field asymmetries. *Quarterly Journal of Experimental Psychology, 44A*, 529-555.

Natale, M., Gur, R.E., & Gur, R.C. (1983). Hemispheric asymmetries in processing emotional expressions. *Neuropsychologia, 21*, 555-565.

Nichelli, P., Manni, A., & Faglioni, P. (1983). Relationships between speed, accuracy of performance and hemispheric superiorities for visuo-spatial pattern processing in the two sexes. *Neuropsychologia, 21*, 625-632.

Pring, T.R. (1981). The effect of stimulus size and exposure duration on visual field asymmetries. *Cortex, 17*, 227-240.

Rizzolatti, G., & Buchtel, H.A. (1977). Hemispheric superiority in reaction time to faces: A sex difference. *Cortex, 13*, 300-305.

Rosenthal, R. (1979). The "file drawer problem" and tolerance for null results. *Psychological Bulletin, 86*, 638-641.

Rosenthal, R., & Rubin, D.B. (1982). A simple, general purpose display of magnitude of experimental effect. *Journal of Educational Psychology, 74*, 166-169.

Sasanuma, S., & Kobayashi, Y. (1978). Tachistoscopic recognition of line orientation. *Neuropsychologia, 16*, 239-242.

Seitz, K.S., & McKeever, W.F. (1984). Unilateral versus bilateral presentation methods in the reaction time paradigm. *Brain and Cognition, 3*, 413-425.

Siegel, S. (1956). *Nonparametric statistics for the behavioral sciences*. New York: McGraw-Hill.

Snow, W.G., & Sheese, S. (1985). Lateralized brain damage, intelligence, and memory: A failure to

find sex differences. *Journal of Consulting and Clinical Psychology, 53*, 940-941.
Strauss, E. (1983). Perception of emotional words. *Neuropsychologia, 21*, 99-103.
Strauss, E., & Moscovitch, M. (1981). Perception of facial expressions. *Brain and Language, 13*, 308-332.
Sullivan, K.F., & McKeever, W.F. (1985). The roles of stimulus repetition and hemispheric activation in visual half-field asymmetries. *Brain and Cognition, 4*, 413-429.
Tankle, R., & Heilman, K.M. (1982). Mirror-reading in right- and left-handers. *Brain and Language, 17*, 124-132.
Tapley, S.M., & Bryden, M.P. (1983). Handwriting position and hemispheric asymmetry in right-handers. *Neuropsychologia, 21*, 129-138.
Young, A.W., & Bion, P.J. (1979). Hemispheric laterality effects in the enumeration of visually presented collections of dots by children. *Neuropsychologia, 17*, 99-102.
Young, A.W., & Bion, P.J. (1980). Absence of any developmental trend in right hemisphere superiority for face recognition. *Cortex, 16*, 213-221.
Young, A.W., & Bion, P.J. (1981). Accuracy of naming laterally presented known faces by children and adults. *Cortex, 17*, 97-106.
Young, A.W., & Bion, P.J. (1983). The nature of the sex difference in right hemisphere superiority for face recognition. *Cortex, 19*, 215-226.
Young, A.W., Bion, P.J., & Ellis, A.W. (1980). Studies toward a model of laterality effects for picture and word naming. *Brain and Language, 11*, 54-65.
Young, A.W., & Ellis, A.W. (1985). Different methods of lexical access for words presented in the left and right visual hemifields. *Brain and Language, 24*, 326-358.

APPENDIX A

Experiments Yielding a Significant Sex x VHF Interaction or the Equivalent Main Effect when a Laterality Index Was Used as the Dependent Measure.

Experiment	Subjects	Stimuli and Task	Results
Marcel, Katz, & Smith (1974)	Forty 7- and 8-year-old children (10 M and 10 F good readers, 10 M and 10 F poor readers)	5-letter words (unilateral); recognition with oral response	Main effect for sex, $F(1, 36) = 9.60$, $p < .01$, in analysis of number of correct words, and $F(1, 36) = 9.42$, $p < .01$, in analysis of number of correct letters. RVFA greater for boys than for girls (laterality index)
Hannay & Malone (1976)	30 RH adults (15 M, 15 F)	3-letter CVC nonsense words (unilateral); same-different matching task with oral response	Sex x VF interaction, $F(1, 24) = 4.55$, $p < .05$, in analysis of correct responses. RVFA for males but no asymmetry for females
Rizzolatti & Buchtel (1977), Experiment 1	16 RH adults (8 M, 8 F)	Photographs of faces, 100 ms exposure (unilateral); recognition with manual response	Sex x VF interaction, $F(1, 14) = 9.61$, $p < .01$, in analysis of RT. LVFA for males but no asymmetry for females
Rizzolatti & Buchtel (1977), Experiment 2	16 RH adults (8 M, 8 F)	Photographs of faces, 20 ms exposure (unilateral); recognition with manual response	Sex x VF interaction, $F(1, 14) = 16.14$, $p < .005$, in analysis of RT. LVFA for males but no asymmetry for females
Bradshaw & Gates (1978), Experiment 3	24 RH adults (12 M, 12 F)	1-syllable nouns (unilateral); naming response	Sex x VF interaction, $F(1, 22) = 6.1$, $p < .025$, in analysis of errors. RVFA for males but no asymmetry for females
Jones (1979), Experiment 1	24 RH adults (12 M, 12 F)	Photographs of faces (unilateral); classification as male or female with oral response	Sex x VF interaction, $F(1, 22) = 14.03$, $p < .001$, in analysis of accuracy, and $F(1, 22) = 4.60$, $p < .05$, in analysis of decision optimization. RVFA for males but no asymmetry for females
McKeever & Jackson (1979)	20 RH adults (10 M, 10 F)	Drawings of objects (unilateral); naming response	Sex x VF interaction, $F(1, 18) = 14.7$, $p < .005$, in analysis of RT. RVFA greater for males than for females

Milstein, Small, Malloy, & Small (1979)	40 adults (10 RH M, 10 RH F, 10 LH M, 10 LH F)	1-digit by 1-digit multiplication problems (unilateral, with competing stimulus in opposite field); oral response	Sex x VF interaction, $F(1, 43) = 7.17$, $p < .01$, in analysis of correct responses. RVFA for males but no asymmetry for females
Young & Bion (1979)	60 RH children (10 M and 10 F at ages 5, 7, and 11 years)	Sets of 2-6 dots (unilateral); enumeration with oral response	Sex x VF interaction, $F(1, 54) = 7.45$, $p < .01$, in analysis of accuracy. LVFA for boys but no asymmetry for girls
Ladavas, Umiltà, & Ricci-Bitti (1980)	24 RH adults (12 M, 12 F)	Photographs of faces expressing different emotions (unilateral); identification of specified emotion with manual response	Sex x VF interaction, $F(1, 22) = 7.02$, $p < .025$, in analysis of RT. LVFA for females but no asymmetry for males
Young & Bion (1980), Experiment 2	96 RH children (16 M and 16 F at ages 7, 10, and 13 years)	Upright and inverted photographs of faces (bilateral); recognition with pointing response	Sex x VF interaction, $F(1, 84) = 4.83$, $p < .05$, in analysis of accuracy. LVFA for boys but no asymmetry for girls
Young, Bion, & Ellis (1980), Experiment 2	20 RH adults (10 M, 10 F)	Pronounceable CVC nonwords (bilateral); naming response	Sex x VF interaction, $F(1, 16) = 5.26$, $p < .05$, in analysis of accuracy. RVFA greater for females than for males
Birkett (1981)	80 adults (20 RHM, 20 LHM, 20 RHF, 20 LHF)	Pairs of letters in normal or inverted orientation (unilateral); same-different judgment with manual response	Sex x VF interaction, $F(1, 76) = 4.26$, $p < .05$, in analysis of RT data. Apparent RFVA for females but no asymmetry for males
McGuinness & Bartell (1982)	40 RH adults (20 M, 20 F)	Pairs of letters or 3-dimensional shapes presented sequentially in same VF with rotation of the second stimulus (unilateral); same-different judgment with manual response	Sex x VF interaction (F and p not provided) in analysis of RT for different letters within a pair. RVFA for males but no asymmetry for females

Tankle & Heilman (1982), Experiment 2	24 adults (6 RHM, 6 LHM, 6 RHF, 6 LHF)	3-letter words in mirror print or mirror script (unilateral); naming response	Sex x VF interaction, $F(1, 20) = 10.55$, $p < .01$, in analysis of error data. LVFA for females but apparently no asymmetry for males
Nichelli, Manni, & Faglioni (1983)	56 RH adults (28 M, 28 F)	Patterns of 5 dots (unilateral); pattern discrimination with manual response	Sex x VF interaction, $p < .025$, for RT data. LVFA in males but no asymmetry for females
Strauss (1983), Experiment 1	20 RH adults (10 M, 10 F)	4-letter emotional words and pronounceable nonsense words (bilateral); lexical decision task with manual response	Sex x VF interaction, $F(1, 18) = 4.45$, $p = .05$, in analysis of accuracy. RVFA for males but no asymmetry for females
Tapley & Bryden (1983)	24 RH adults (8 M & 8 F noninverted writers, 5 M & 3 F inverted writers)	Pronounceable 3-letter nonsense syllables (unilateral); naming	Sex x VF interaction, $F(1, 20) = 4.60$, $p < .05$, in analysis of number of correct letters. RVFA larger for males than for females
Davidoff & Done (1984), Experiment 3	30 children (15 M, 15 F) at age 4 years	3-letter words and consonant trigrams (unilateral); matching task with manual response	Sex x VF interaction, $F(1, 28) = 5.83$, $p < .05$, in analysis of errors (false negatives). LVFA for boys but no asymmetry for girls
Duda & Brown (1984)	40 RH adults (20 M, 20 F)	Photographs of faces with neutral or emotional expression (bilateral); detection of emotional face with manual response	Sex x VF interaction, $F(1, 38) = 5.03$, $p < .05$, in analysis of RT. LVFA for females but no asymmetry for males
Seitz & McKeever (1984)	50 RH adults (25 M, 25 F)	Line drawings of common objects (bilateral); naming	Sex x VF interaction, $F(1, 46) = 4.4$, $p < .05$, in analysis of RT. RVFA larger for males than for females
Young & Ellis (1985), Experiment 1	24 RH adults (12 M, 12 F)	Highly imageable nouns of 3-6 letters (bilateral); naming with cued order of report	Sex x VF interaction, $F(1, 22) = 7.71$, $p < .05$, in analysis of accuracy. RVFA larger for males than for females

Lukatela, Carello, Savic, & Turvey (1986)	112 Yugoslav adults (56 M undergraduates, 56 F high school seniors)	Phonologically ambiguous and unambiguous letter strings (unilateral); lexical decision task with manual response	Sex x VF interaction, $F(1, 108) = 7.03$, $p < .01$, in analysis of errors for word stimuli. LVFA for females and RVFA for males

Note. Abbreviations: M--male; F--female; RH--right-handed; LH--left-handed; RHM--right-handed male; LHM--left-handed male; RHF--right-handed female; LHF--left-handed female; VF--visual half-field; VFA--visual half-field advantage; RVF--right visual half-field; LVF--left visual half-field; RVFA--right visual half-field advantage; LVFA--left visual half-field advantage; RT--reaction time; CVC--consonant-vowel-consonant; FS--familial sinistrality.

APPENDIX B

Experiments Yielding a Significant Sex x VHF x Third Factor Interaction or the Equivalent Two-Way Interaction when a Laterality Index Was Used as the Dependent Measure.

Experiment	Subjects	Stimuli	Results
McKeever & Van Deventer (1977)	151 adults (31 RHM, 49 RHF, 29 LHM, 42 LHF); each group further divided on basis of FS	1 letter presented in each VF, followed by masking letter at 30 or 130 ms SOA (bilateral); recognition with oral response	Sex x Handedness interaction, $F(1, 143) = 4.29$, $p < .05$, in analysis of accuracy data. RVFA for RHF but no asymmetry for RHM; no sex difference for LHs (laterality index)
Bradshaw & Gates (1978), Experiment 1 [first sex difference]	24 RH adults (12 M, 12 F)	3-letter words and nonword letter strings (unilateral); lexical decision task with manual response	Sex x VF x Trial Block interaction, $F(1, 22) = 22.6$, $p < .001$, in analysis of RT data. RVFA for males in both halves of experiment but RVFA for females in second half only
Bradshaw & Gates (1978), Experiment 1 [second sex difference]	24 RH adults (12 M, 12 F)	3-letter words and nonword letter strings (unilateral); lexical decision task with manual response	Sex x VF x Word interaction, $F(1, 22) = 4.56$, $p < .05$, in analysis of errors. RVFA larger for words than nonwords, with effect stronger in males than in females
C. Martin (1978)	12 RH adults (6 M, 6 F)	Verbal task: 2 letters, the name of one or both rhymed with "ee." visual task: 2 letters, the shape of one or both contained a curve (unilateral); matching with manual yes/no response	Sex x VF x Decision Type interaction, $F(1, 10) = 10.06$, $p < .01$, in analysis of RT data. LVFA for females and RVFA for males when "yes" responses were required. No sex differences for "no" responses

Young & Bion (1980), Experiment 2	96 RH children (16 M and 16 F at ages 7, 10, and 13 years)	Upright and inverted photographs of faces (bilateral); recognition with pointing response	Sex x VF x Orientation interaction, $F(1, 84) = 4.23, p < .05$, in analysis of accuracy. Boys had LVFA for upright but not inverted faces; girls showed no asymmetry for faces in either orientation
Barry (1981)	20 RH adolescents (10 M, 10 F) at ages 16-18 years	4-letter words and pronounceable nonwords (unilateral); lexical decision with manual response	Sex x VF x Word Type interaction, $F(1, 16) = 9.1, p < .01$, in analysis of errors with word stimuli. The difference between homophones and non-homophones was larger in the RVF for females and in the LVF for males
Birkett (1981)	80 adults (20 RHM, 20 LHM, 20 RHF, 20 LHF)	Pairs of letters in normal or inverted orientation (unilateral); same-different judgment with manual response	Sex x VF x Orientation interaction, $F(1, 76) = 8.07, p < .01$, in analysis of RT data. RFVA for females when letters were upright but no asymmetry for males irrespective of letter orientation
Graves, Landis, & Goodglass (1981)	24 RH adults (12 M, 12 F)	4-letter words--emotional and nonemotional--and 4-letter pronounceable nonwords (bilateral); lexical decision task with manual response	Sex x VF x Word Category interaction, $F(1, 22) = 10.18, p = .005$, in analysis of word recognition accuracy. RVFA for males, who also recognized more emotional words than non-emotional words in the LVF; no asymmetry for females, and no interaction between VF and category
McKeever & Dixon (1981)	64 RH adults (32 M, 32 F)	Photographs of 4 faces (unilateral); discrimination of 2 target faces from 2 nontarget faces; prior memorization of target faces with either emotional or neutral imagery instructions; manual response	Sex x VF x Imagery interaction, $F(1, 60) = 4.15, p < .05$, in analysis of RT data. LVFA for females in emotional imagery group, but no asymmetry for females in neutral imagery group or for males in either group
Pring (1981)	16 RH adults (8 M, 8 F)	4-letter nouns and pronounceable nonwords in 3 print sizes (unilateral); lexical	Sex x VF x Print Size interaction, $F(2, 28) = 4.79, p < .025$, in analysis of RT for nonwords. Fastest RT obtained with me-

		decision task with manual response	dium print, except in RVF of females
Strauss & Moscovitch (1981), Experiment 1 [first sex difference]	32 RH adults (16 M, 16 F)	Pairs of photographs of faces with happy, sad, and surprised expressions (unilateral); matching of expressions with manual response	Sex x VF x Hand interaction, $F(1, 6) = 12.78$, $p < .005$, in analysis of RT to faces with different expressions. RVFA for males but no asymmetry for females
Strauss & Moscovitch (1981), Experiment 1 [second sex difference]	32 RH adults (16 M, 16 F)	Pairs of photographs of faces with happy, sad, and surprised expressions (unilateral); matching of expressions with manual response	Sex x VF x Expression interaction, $F(2, 24) = 4.83$, $p < .025$, in analysis of RT to different faces with the same expression. Females had overall LVFA, but males had LVFA only for faces expressing surprise
Strauss & Moscovitch (1981), Experiment 3 [first sex difference]	24 RH adults (12 M, 12 F)	Pairs of photographs of faces with happy, sad, and surprised expressions (unilateral); manual response either to the presence or absence of specified expression	Sex x VF x Expression interaction, $F(1, 8) = 23.62$, $p < .001$, in analysis of RT to specified expressions. Females had overall LVFA, but males had LVFA only when both faces within a pair expressed the same emotion
Strauss & Moscovitch (1981), Experiment 3 [second sex difference]	24 RH adults (12 M, 12 F)	Pairs of photographs of faces with happy, sad, and surprised expressions (unilateral); manual response either to the presence or absence of specified expression	Sex x VF x Hand interaction, $F(1, 8) = 5.96$, $p < .05$, in analysis of RT to the absence of specified expressions. LVFA for males who responded with the right hand
Bashore, Nydegger, & Miller (1982)	36 adults (6 RHM, 6 RHF, 3 LHM, & 6 LHF non-inverted writers; 0 RHM, 3 RHF, 6 LHM, & 6 LHF inverted writers)	Single letters (unilateral); naming	Sex x VF x Trial Block interaction, $F(7, 189) = 2.32$, $p < .05$, in analysis of RT data. LVFA in males large for Block 1, moderate for Blocks 2-4, and absent after Block 4; moderate LVFA in females for all blocks but 3 and 7
McKeever & Hoff (1982)	64 RH adults (16 FS-M, 16 FS+M, 16 FS-F, & 16 FS+F)	Line drawings of common objects (unilateral); naming	Sex x VF x FS interaction, $F(1, 60) = 4.1$, $p < .05$, in analysis of RT data. The RVFA was smaller

			for FS– females and FS+ males than for the other two groups
McKeever, Seitz, Hoff, Marino, & Diehl (1983)	50 RH adults (12 FS-M, 12 FS+M, 15 FS-F, & 11 FS+F)	Line drawings of common objects (unilateral); naming	Sex x VF x FS interaction, $F(1, 46) = 10.58, p < .005$, in analysis of RT data. The RVFA was smaller for FS– females and FS+ males than for the other two groups
Young & Bion (1983), Experiment 1	48 RH adults (24 M, 24 F)	Photographs of female faces presented with 3 ratios of different stimuli to number of trials: 1:12, 1:2, or 2:1 (bilateral); recognition with pointing response	Sex x VF x Condition interaction, $F(2, 92) = 6.58, p < .01$, in analysis of accuracy. LVFA for males when stimuli-to-trials ratio was 1:12 or 1:2, and LVFA for females when ratio was 1:12
Freeman & Ellis (1984), Experiment 2	48 RH adults (24 M, 24 F)	Line drawings of faces with low or medium information content (unilateral); same-different judgment with vocal response	Sex x VF x Information Level interaction, $F(1, 44) = 4.4, p < .05$, in analysis of accuracy. LVFA for males in identifying low information faces but no asymmetry for females
Heister (1984)	32 RH adults (16 M, 16 F)	CVC words and nonwords in vertical orientation (unilateral); lexical decision task with manual response	Sex x VF x Hand interaction, $F(1, 28) = 4.90, p < .05$, in analysis of RT data. RVFA for females irrespective of responding hand and for males who responded with left hand; no apparent asymmetry for males who responded with right hand
Seitz & McKeever (1984) [first sex difference]	100 RH adults (28 FS-M, 21 FS+M, 28 FS-F, & 23 FS+F)	Task 1. line drawings of common objects (unilateral); naming Task 2. line drawings of common objects (bilateral); naming	Sex x VF x Task interaction, $F(1, 92) = 5.9, p < .025$, in analysis of RT for combined unilateral and bilateral tasks. RVFA larger for males than for females with bilateral presentation, and tendency toward opposite sex difference with unilateral presentation
Seitz & McKeever (1984) second sex difference]	50 RH adults (12 FS-M, 12 FS+M, 15 FS-F, & 11 FS+F)	Line drawings of common objects (unilateral); naming	Sex x VF x FS interaction, $F(1, 46) = 10.6, p < .005$, in analysis of RT. The RVFA was smaller for FS– females and FS+ males than for the other two groups

Seitz & McKeever (1984) [third sex difference]	50 RH adults (16 FS-M, 9 FS+M, 13 FS-F, & 12 FS+F)	Line drawings of common objects (bilateral); naming	Sex x VF x FS interaction, $F(1, 46) = 5.1$, $p < .05$, in analysis of RT. The RVFA was larger for FS+ males than for the other three groups
Healey, Waldstein, & Goodglass (1985) Experiment 1	30 RH adults (15 M, 15 F)	4-letter words and pronounceable nonwords (unilateral in Tasks 1 & 3, bilateral in Task 2); lexical decision with manual response in Tasks 1 & 2 (response to cued stimulus in Task 2) and naming response in Task 3	Sex x Task interaction, $F(3,78) = 3.09$, $p < .05$, in analysis of RT data. Comparable RVFA for males and females on the lexical decision tasks, but females showed greater RVFA on the naming task (laterality index)
Healey, Waldstein, & Goodglass (1985), Experiment 2	30 RH adults (15 M, 15 F)	3-, 4-, and 5-letter words and pronounceable nonwords (bilateral in Tasks 1, 2, & 4, unilateral in Task 3); lexical decision with manual response in Tasks 1 & 2 (response to either stimulus in Task 1 and to cued stimulus in Task 2) and naming response in Tasks 3 & 4 (response to cued stimulus in Task 4)	Sex x Task interaction, $F(3,78) = 4.5$, $p < .05$, in analysis of RT data. Males showed greater RVFA than females on Task 1 (lexical decision with no cuing) but females showed greater RVFA on Task 4 (naming with cued bilateral presentation) (laterality index)
Sullivan & McKeever (1985), Experiment 1	48 RH adults (24 M, 24 F)	Line drawings of common objects (unilateral); naming	Sex x VF x FS interaction (details not provided) in analysis of RT data. The RVFA was smaller for FS– females and FS+ males than for the other two groups
Adams & Duda (1986)	80 RH adults (20 M & 20 F assigned to each of two tasks, i.e., tactile-to-visual and visual-to-tactile)	8- and 12-point Vanderplas & Garvin shapes (unilateral); Visual stimulus preceded or followed bimanual tactile stimulation; cross-modal matching with manual response	Sex x VF x Task interaction, $F(1, 76) = 10.44$, $p < .005$, in analysis of accuracy data. Superior performance on visual-to-tactile task, relative to tactile-to-visual task, was manifested in RVF by males and in LVF by females

Lukatela, Carello, Savic, & Turvey (1986) [first sex difference]	112 Yugoslav adults (56 M undergraduates, 56 F high school seniors)	Phonologically ambiguous and unambiguous letter strings (unilateral); lexical decision task with manual response	Sex x VF x Phonology interaction, $F(1, 108) = 5.28$, $p < .025$, in analysis of errors for word stimuli. The difference between unambiguous and ambiguous words was larger in the LVF of males and the RVF of females
Lukatela, Carello, Savic, & Turvey (1986) [second sex difference]	112 Yugoslav adults (56 M undergraduates, 56 F high school seniors)	Phonologically ambiguous and unambiguous letter strings (unilateral); lexical decision task with manual response	Sex x VF x Phonology interaction, $F(1, 108) = 5.02$, $p < .025$, in analysis of RT for pseudoword stimuli. The difference between unambiguous and ambiguous pseudowords was larger in the LVF of males and the RVF of females

Note. Abbreviations: M--male; F--female; RH--right-handed; LH--left-handed; RHM--right-handed male; LHM--left-handed male; RHF--right-handed female; LHF--left-handed female; FS-M--male with no familial sinistrality; FS+M--male with familial sinistrality; FS-F--female with no familial sinistrality; FS+F--female with familial sinistrality; VF--visual half-field; VFA--visual half-field advantage; RVF--right visual half-field; LVF--left visual half-field; RVFA--right visual half-field advantage; LVFA--left visual half-field advantage; RT--reaction time; SOA--stimulus onset asynchrony; CVC--consonant-vowel-consonant; FS--familial sinistrality.