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An Investigation of Sex Differences in Visual Recognition and Recall

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Forty college age and 40 high school age males and females were tested on visual recognition and visual recall tasks using pictorial stimuli. TSD analyses showed there was no sex difference in visual recognition memory for either population. Females in both groups remembered more detail in the recall condition, though the sexes did not differ in the overall number of pictures recalled. Females' ability to generate verbal descriptors for pictorial information may explain why females are generally found superior in tests of visual imagery.

Introduction

Sex differences in cognitive processing are now well documented (Maccoby & Jacklin, 1974; McGuinness & Pribram, 1978; Sherman, 1978; Wittig & Petersen, 1979) and generally are found to fall into two major categories: verbal (females superior) and visuo-spatial (males superior). The current issue in much sex difference research is to delineate more precisely which aspects of these abilities are consistently sex-linked and also whether they influence related cognitive skills, such as performance on memory tasks.

In general, female superiority is conceded in tests of verbal recall. Maccoby and Jacklin (1974) review 20 studies on subjects ranging in age from 2½ - 21 years, and report that females are significantly superior in 10 of these experiments, and in no case are males superior. Girls' superiority is particularly marked after 6 - 7 years.

By contrast, where stimuli are nonverbal patterns or pictures the sex differences are more equivocal. Maccoby and Jacklin report no sex differences in 13 experiments investigating memory for pictorial stimuli. Experiments other than those they report have shown sex effects, generally favoring females. Guilford (1967), in a series of studies, reported a consistent superiority for females in recall of pictorial stimuli. Ernest and Paivio (1971) found that college age females had better memory for both words and pictures than males, and that this superiority increased in a test of incidental recall. Imaging ability in females but not males appeared to be in-

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volved in this task. Marks (1973) in a similar study replicated this finding in two out of three experiments.

In a study carried out in our laboratory (McGuinness, Olson, & Chaplin, in press), high imagery words, equated for ratings of "female" versus "male" items, were either printed on cards (words), or drawn (pictures) and presented to 40 students aged 16 - 18 years. We found that females were superior for word memory in all conditions but males were superior in pictorial memory only for the same-sex category.

The influence of imaging ability in visual memory is interesting in the light of a recent review by White, Sheehan, and Ashton (1977) which reveals that in six of the eight studies investigating sex differences, females report significantly more vivid images than males.

With all of the experiments on memory for visual stimuli or on visual imagery, the problem is that the results are confounded by the possibility of verbal strategies or verbal responding. "Visual" material often turns out to be, on inspection, a list of words. Certain pictorial stimuli, like geometric shapes, or line drawings, could easily be coded verbally. Finally, *all* responses in all experiments on memory or imagery tests are verbal responses either spoken or written. The emphasis on verbal aspects, of course, favors females.

If verbalization was made possible, would the sexes perform similarly, or might males be superior? As males are consistently superior in visualization of complex three-dimensional forms (Harris, 1976; McGuinness & Pribram, 1978), could this be part of a general visualizing capacity engaging memory systems?

The obvious paradigm to investigate this issue would be a recognition memory task. A problem arises, however, because pictorial memory tested by recognition alone is notoriously efficient, creating a ceiling effect in all experiments. Subjects have been reported to score between 85% - 95% correct at tests given weeks after the initial stimulus presentation (Haber, 1979). Haber concludes from a number of experiments that pictorial memory is essentially perfect. He also points out that when words are attached to pictures, memory improves substantially.

The following experiment attempted to disentangle verbal and visual memory. This was accomplished by using stimuli which were extremely difficult to code verbally and by degrading the recognition test stimuli to a point where subjects were performing at approximately 70% correct. To test further for the advantages of verbal coding, the recognition memory task was compared with a recall task.

These experiments were designed to determine whether or not sex differences would be found in either the recognition or recall task. No sex differneces were predicted for recognition memory, whereas females were expected to be superior in the recall condition. To insure that all effects of response bias were eliminated, a forced-choice design was employed to

An additional hypothesis was tested in these experiments, based on a study by Brabyn and McGuinness (1979) concerning sex differences in contrast thresholds to sinusoidal gratings: females were more sensitive at threshold to low spatial frequences (.4 - 1.0 cycles/degree) and males to high spatial frequencies (6-10 cycles/degree); no differences were found in the mid-range which is the peak sensitivity range for the human eye. Should these sensory differences influence pattern perception, they could do so by creating a more diffuse or wholistic pattern recognition process in females, and a more discrete or "edge-sensitive" system in males. Also, as low-spatial frequency information requires less foveal vision and may be processed more by the rod system, this could result in a greater awareness of peripheral information in females. Conversely, high spatial frequency sensitivity in males (high acuity) could create a more central (foveal) orientation in males. Data were thus analyzed independently for performance on central and peripheral target positions.

EXPERIMENT 1

Method

Subjects

The subjects were 20 male and 20 female college students, all selected from an introductory course in general psychology. Subject hours were required for this class.

Apparatus

The stimulus material was presented by means of a carousel projector. The subject was positioned in a comfortable chair facing a screen. Subjects were also issued with data collection forms.

Stimulus Material

Part I. Stimuli were slides taken from a set of over 500 color photographs, mounted as 2 x 2 transparencies, of various scenes in Europe and North America. Particular attention was paid to balancing the categorical content using pictures which were predominantly of landscapes, animals, buildings, and vehicles. Approximately half of the photographs contained people. Forty-eight of these photographs were selected as target stimuli. Twenty-four different photographs were selected as distractor stimuli and were carefully paired with 24 of the original 48 slides for similarity of content (mountain scene with mountain scene, etc.). As the slides were extremely complex with a great deal of redundancy within categories and were also matched for categorical content with the distractor series, this made verbal coding nearly impossible.

The test series consisted of the 24 distractor slides paired with 24 of the original slides which had been changed so that now all 48 were blackened to permit only one portion of the visual field to be illuminated. These portions were carefully controlled so that nine regions were represented. The amount of the visual field was reduced in the test series to approximately three degrees of visual angle, reflecting an eight-fold reduction in stimulus information. This manipulation further diminished subject reliance on verbal coding and reduced performance to approximately 70% correct detection in pilot trials.

Part II. An additional 12 intact color slides were employed for Part II.

Procedure

Part I. Subjects were seated facing the screen at three meters distance and told that they would be participating in a visual memory task. First, they would see 48 color slides of various scenes, each presented for 2 seconds; and immediately following this, they would see 24 of these slides again, mixed randomly with 24 slides they had not seen previously. The subject's task was to fill in the form provided by ticking the appropriate boxes: YES (seen it before) or NO (never seen it before). They were told that the response time would be self-paced and that they must guess if they were uncertain. Subjects were also informed that the test slides would be largely obscured and that only a small portion of the field would be visible.

Following this, the 48 stimulus slides were presented in a semi-darkened room at 2-second intervals. Total visual angle was 30 degrees. Next, the test series of 48 slides (24 new, 24 old) was presented at a speed commensurate with the subject's response. Subjects generally responded within 1 or 2 seconds. Room lights were switched on and a rest period of 5 minutes was given.

Part II. Subjects were now given instructions for the second experiment and were told that it was also about memory. However, this time the subject was requested to write descriptions of the slides they saw to the best of their ability on the form provided.

They were told that they would see 12 slides for 2 seconds each and that following this presentation, they should begin to write down their descriptions in any order of recall they chose. They were instructed to keep the description of each slide separate, either by spacing or numbering their answers. Subjects were also informed that there was no time limit on this task. Following this, lights were dimmed, the subjects saw the 12 stimulus slides for 2 seconds each, and were taken into an adjoining room to write their descriptions. Subjects could take an unlimited time on this task, but in practice subjects rarely took longer than 30-40 minutes.

Results

Part I

The data were submitted to a two-way mixed analysis of variance with sex as a between factor, and target position (central or peripheral) as a within factor. The results of this analysis are presented in Table 1. The dependent variable was the percent correct for central and peripheral targets.

TABLE 1

ANOVA Summary Table - Recognition Task College Population

Source of Variance	SS	df	MS	F
Between				
Sex	52	1	52	<1
Error	4377.5	38	115.19	
Within				
Target Position	6	1	6	<1
Sex x Target	173	1	173	2.19
Error	3003	38	79.03	

These results show that the sexes did not differ in their ability to detect the target stimuli, males scoring 66% correct overall and females 64%, nor did peripheral or central target produce differences in detection accuracy. There was no interaction between these factors. An analysis of error scores also revealed no sex differences (Mann-Whitney U Test, $p > .10$).

In order to insure that neither of these findings was confounded by differences in response bias, the data were submitted to a signal detection analysis. The mean value of d' for males was .884 and for females .778. A Mann-Whitney U Test for non-normal distributions showed these differences to be nonsignificant. Males and females had similar distributions of β Values with males equally biased to caution and risk with females somewhat more biased to risk.

Figure 1 illustrates the distribution of d' values for males and females.

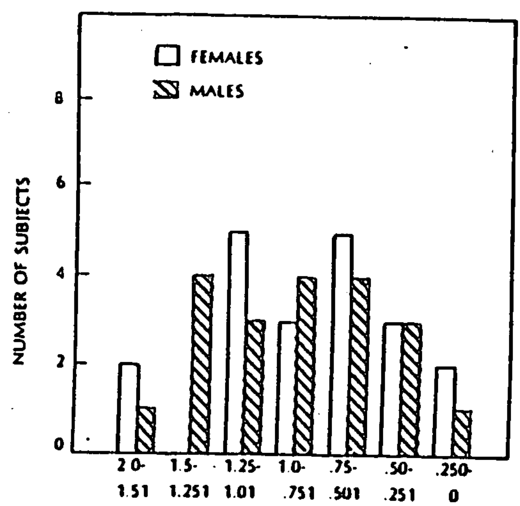

FIGURE 1

d' values for college population.

Part II

The data from the recall section were analyzed in four stages. First, the absolute number of slides remembered was recorded. For males the mean was 8.4 and for females 8.25. These values do not differ statistically (Mann-Whitney U Test, $p > .10$).

The total number of descriptors for each slide was determined before scoring by the two experimenters. Images combining features, such as an unusual garment of an unusual color (a red robe), were scored as one item — though the subject may have presented two separate descriptors. Similar attention was paid to every item in the slide. Subjects' sheets were number coded before analysis so sex could not be determined.

The mean scores for the remaining three analyses are illustrated in Table 2. The appropriate statistical value is indicated beneath each pair of scores. Females are superior in generating the most descriptors overall, especially in the number of persons included in their descriptions. Nonperson descriptors show no sex difference.

TABLE 2
Mean Scores in Recall Task College Population

	Total Slides Recalled	Total Descriptors	People Descriptors	Non-People Descriptors
Males	8.4	23.85	6.1	17.75
Females	8.25	30.45	8.65	21.80
	Mann-Whitney N.S.	$t = 1.95$ $p < .05$ (1-tail)	$t = 2.24$ $p < .025$ (1-tail)	$t = 1.43$ N.S.

EXPERIMENT 2

As Experiment 1 was carried out on a highly selected university population, it could be possible that sex differences in memory might be attenuated. To investigate this possibility, the same experiment was repeated on a high school population.

Method

Subjects

The subjects were 20 male and 20 female students from a local high school solicited through posters and through the school's psychology teacher. The students were between the ages of 13 and 17 and were paid for their participation. The mean age for boys was 15.4 years, and for girls, 15.3 years.

Apparatus and Materials

The same apparatus and materials were used, except that the number of recall slides was reduced to 10.

Procedure

The subjects received identical instructions and the procedure was carried out exactly as in Experiment 1.

Results

Part I

A 2-way (1 within, 1 between) ANOVA was carried out on the scores for total items correct in each category. The summary table is presented in Table 3.

TABLE 3

ANOVA Summary Table - Recognition Task High School Population

Source of Variance	*SS*	*df*	*MS*	*F*
Between				
Sex	11.25	1	11.25	24.45*
Error	17.5	38	.460	
Within				
Target Position	20.00	1	20.00	3.18
Sex x Target	1.8	1	1.80	<1
Error	236.2	38	6.28	

*$p < .01$

The analysis indicates a highly significant effect for sex of subject ($p < .001$), females superior, with no significant effect of target position and no significant interaction.

However, a further analysis revealed that females made more errors than males ($t = 1.773$, $p < .10$) and that the error variance was not normally distributed ($F = 2.276$, $p < .05$). A signal detection analysis was carried out. The frequency distribution for d' is presented in Figure 2.

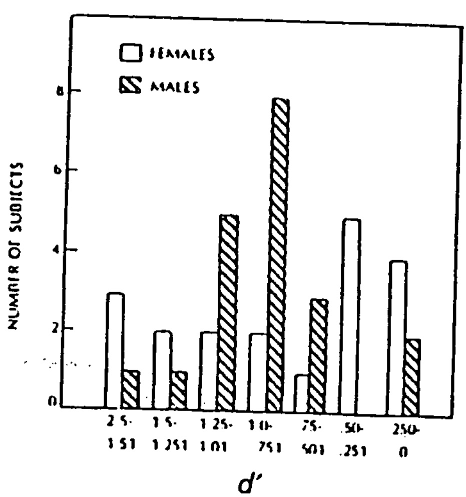

FIGURE 2

d' values for high school population.

This graph reveals that males are a uniform population with a normal distribution, and females are not, appearing more bimodally distributed. Of the 7 best performances, 5 were female, whereas, of the 11 worst performances, 9 were female. An analysis of d' values therefore showed no sex differences (Mann-Whitney $U = 168$ ($n_1 = 20$, $n_2 = 20$) $p > .10$).

Analysis of β scores showed males biased to caution, and females relatively unbiased, as .500 in this study represents a completely unbiased performance. Table 4 indicates a frequency breakdown of subjects falling into the categories Risk, No-Bias, Caution.

TABLE 4
Number of Subjects in Each Category

	RISK Above .550	NO-BIAS .480-.520	CAUTION Below .480
Males	4	3	13
Females	4	13	3

The only possible interpretation of these data is that in this population females and males do not differ in absolute sensitivity for a recognition task, except that a portion of females will tend to outperform males and a portion of females will be inferior to males. In a forced-choice situation high school males are biased to be cautious in their judgments. No effect of age on these values could be determined in a test of correlation ($r = .172$, $p > .10$).

Part II

The mean scores for the recall experiment are presented in Table 5 with the statistical value for the sexes in the bottom row. These subjects saw two slides fewer than the university population and therefore had lower overall recall scores. However, the two populations were nearly identical in their performance in generating descriptors of the slides. Females are again superior, and by the same margin, in the two conditions: total number of descriptors, descriptors of persons.

TABLE 5
Mean Scores in Recall Task High School Population

	Total Slides Recalled	Total Descriptors	People Descriptors	Non-People Descriptors
Males	6.6	22.32	6.16	16.15
Females	6.85	28.00	8.93	18.95
	Mann-Whitney N.S.	$t = 1.75$ $p < .05$ (1-tail)	$t = 2.477$ $p < .025$ (1-tail)	$t = 1.21$ N.S.

Discussion

The results of both studies on recognition memory demonstrate clearly that the sexes do not differ in their ability to recognize pictorial information. However, in an unselected population such as the high school group, females were found to exhibit a bimodal distribution with approximately ¼ showing very superior recognition memory skills, and ⅓ showing decidedly inferior recognition memory. The males in this population showed a uniform distribution with considerably less variance.

The fact that subjects took up to 40 minutes to generate verbal descriptions for 10 slides in the recall task makes it extremely unlikely that verbalization was an effective strategy during the presentation of the 48 slides. Also, as the distractor set of 24 slides contained similar categorical content, verbalization would be made even more inefficient as a result of this manipulation. In fact, subjects in pilot trials reported that a verbal strategy was totally ineffective.

The data on recall memory confirm for both populations that the sexes do not differ in the absolute number of photographs recalled, but differ significantly in the number of descriptors generated for each stimulus. This effect is particularly marked for the number of descriptors relating to persons in the photographs. This result confirms the finding (McGuinness & Symonds, 1977) that females are especially sensitive to detecting people as opposed to objects in a binocular rivalry task.

These results bring into question the consistent sex effect favoring females in reports of visual imagery (White, et al., 1977) where scores are determined by verbal reports of vividness or extensiveness, and suggest that the current measures of visual imagery may be seriously contaminated by verbal fluency.

The prediction that females, because of a low spatial frequency sensitivity, would be more likely to process information globally and process more information from the periphery of the visual field, while males with high spatial frequency sensitivity would attend to more central (foveal) information was not upheld. No differences were found for the sexes, or for the groups as a whole, in preferential responding to either central or peripheral target items. These results continue a series of findings in which, so far, sex differences in visual sensory processing have failed to correlate with any higher order perceptual or cognitive tasks. McGuinness and Brabyn (in preparation) failed to find any relationship between visual acuity, stereopsis and depth perception with performance on the DAT spatial relations sub-test. Although intuitively attractive, the view that sex differences in sensitivity to certain aspects of the visual signal *ought* to be reflected in higher order perceptual tasks has proved exceedingly difficult to demonstrate.

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